A plural analysis of distributive conjunctions: Evidence from two cross-linguistic asymmetries*

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draft

Abstract This paper argues that the conjunctive coordinating morpheme COORD, realized as *and* in English, denotes a plurality-forming operation cross-linguistically and across categories. We first present two cross-linguistic generalizations which strongly suggest that the basic meaning of COORD in individual conjunctions (e.g. *Ada and Bea*) is not intersective, as in 'classical' analyses of conjunction, but rather plural-based. We then discuss the consequences of this result for 'distributive' conjunction patterns, which lack the readings usually associated with a plural semantics of conjunction when they occur in subject position. We argue that even these structures involve a 'plural' denotation of COORD because in some languages, they permit cumulative readings – a hallmark of semantic plurality – in non-subject position. Based on an empirical analogy between 'distributive' individual conjunctions and conjunctions of universal quantifiers, we argue that the former also denote quantifiers. Accordingly, the 'plural' denotation of COORD must be generalized to functional types. Since earlier attempts to do so don't extend to our data, we propose an analysis within the Plural Projection framework (Haslinger & Schmitt 2018b, 2019, Schmitt 2018) that derives all our observations. Finally, we discuss the cross-linguistic predictions of our proposal for conjunctions of VPs and embedded clauses and present preliminary data supporting them.

keywords: individual conjunction, quantifier conjunction, plurality, cumulativity, semantic universals

1 Introduction and outline

The denotation of English *and* is a much-debated issue in semantics (see Schmitt to appear for an overview). Much of the discussion focusses on **individual conjunctions** – conjunctions with individual-denoting conjuncts like *Ada and Bea* – since sentences containing such expressions exhibit a particular ambiguity: (1-a) has a **distributive** reading, which is true in scenario (1-b), but false in scenario (1-c). On this reading, the predicate ⟦*earned exactly 100 euros*⟧ must hold of each of the individuals which the individual conjuncts denote. (1-a) further has a **non-distributive** reading, which is true in scenario (1-c), but not in (1-b). Here, the amounts earned by the individuals must add up to exactly 100 euros.

(1) a. *Ada and Bea earned exactly 100 euros.*
b. SCENARIO: Ada earned 100 euros driving a cab. Bea earned 100 euros working at the mall.

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c. SCENARIO: Ada earned 40 euros driving a cab. Bea earned 60 euros working at the mall.

There is no consensus on which reading reflects the lexical meaning of *and* and which is derived via additional operations.[1] **Intersective theories** (Winter 2001 a.o.) essentially assume that the distributive reading is basic: The lexical meaning of *and* in *Ada and Bea* is distributive and can be defined in terms of (classical) sentential conjunction. **Plural theories** (Link 1983 a.o.) take the non-distributive reading to be basic and assume that a plurality-forming operation underlies the lexical meaning of *and* in individual conjunction, focusing on the parallel with definite plurals like *the girls*.

In the remainder of this section, we give a preview of our main points, outlining our empirical contribution to the debate concerning the lexical meaning of *and* and its consequences for the compositional analysis of coordinate structures.

1.1 Background: Testing for non-distributive readings

To be able to paraphrase the different readings, we introduce some basic notions from plural semantics. We assume a set $A \subseteq D_e$ of atomic individuals, a binary operation $+$ on D_e and a function $f : (\mathcal{P}(A) \setminus \{\emptyset\}) \to D_e$ such that: 1) $f(\{x\}) = x$ for any $x \in A$ and 2) f is an isomorphism between the structures $(\mathcal{P}(A) \setminus \{\emptyset\}, \cup)$ and $(D_e, +)$. Hence there is a one-to-one correspondence between plural individuals and nonempty sets of atomic individuals. We will use the notation in (2).

(2) For any $x, y \in D_e$, $S \subseteq D_e$:
   a. $x \leq y \Leftrightarrow x + y = y$ ("x is a part of y")
   b. $x \leq_a y \Leftrightarrow x \leq y \wedge x \in A$ ("x is an atomic part of y")
   c. $\bigplus S = f(\bigcup\{f^{-1}(x) \mid x \in S\})$ (the sum of all individuals in S)

Our examples of non-distributive readings will all involve **cumulative truth conditions**, where some relation **applies cumulatively** to two or more pluralities.[2] Simplifying somewhat, these readings are the result of closing the extension of a relation under 'pointwise sum', as defined in (3-a) for binary relations between individuals: For each set S' of pairs in the original relation, we obtain a pair in the derived relation by taking the sum of all first components of pairs in S' and the sum of all second components of pairs in S'. For the time being, we follow Sternefeld (1998), Beck & Sauerland (2000) a.o. and implement this operation as an object-language operator ** that attaches to binary relations, as exemplified in (3-b,c).

(3) a. For a relation R of type $\langle e, \langle e, t\rangle\rangle$, $[\![**]\!](R)$ is the smallest relation S such that $R \subseteq S$ and for all nonempty $S' \subseteq S$, $\langle \bigplus_{\langle x,y\rangle \in S'} x, \bigplus_{\langle x,y\rangle \in S'} y\rangle \in S$.
   b. $[\![\mathit{like}]\!] = \{\langle a, c\rangle, \langle b, d\rangle, \langle a, e\rangle\}$
   c. $[\![{**}\ \mathit{like}]\!] = \{\langle a, c\rangle, \langle b, d\rangle, \langle a, e\rangle, \langle a + b, c + d\rangle, \langle a, c + e\rangle, \langle a + b, d + e\rangle, \langle a + b, c + d + e\rangle\}$

In (1-a), however, *100 euros* is most naturally interpreted as a measure phrase quantifying over degrees, not as a quantifier over plural individuals. The truth conditions of this cumulative reading thus require a sum operation on degrees, $\bigplus^d$, which is associative and commutative like $\bigplus$, but not idempotent (since 30€ $+^d$ 30€ should equal 60€).[3] (4) states that for any nonempty set of degree-individual pairs in the original relation, the sum of the degree components and the sum of the individual components stand in

[1] See below for the hypothesis that *and* is ambiguous.

[2] While 'cumulative' and 'collective' scenarios are often collapsed (but see Landman 2000 for more discussion), we focus on cumulative scenarios as we do not know which of our claims extend to inherently collective predicates, whose interaction with conjunction differs from cumulative predicates in some languages (see Roszkowski 2019).

[3] However, Dotlačil & Nouwen (2016) argue that an idempotent sum operation is also available for degrees.

the derived relation.

(4) For a relation R of type $\langle d, \langle e, t\rangle\rangle$ (where d is the type of degrees), $[\![**]\!](R)$ is the smallest relation S such that $R \subseteq S$ and for all nonempty $S' \subseteq S$, $\langle +^{d}_{\langle x,y\rangle \in S'} x, +_{\langle x,y\rangle \in S'} y\rangle \in S$.

For many plural sentences, the distributive and the cumulative reading are not logically independent: The sentence in (5-a) with two plural definites is true both in the 'distributive' scenario (5-b) and in 'cumulative' scenarios like (5-c). But if the cumulative reading requires the subject plurality and the object plurality to stand in the relation $[\![$** *like*$]\!]$, and the distributive reading is true iff $[\![$*like the two cats*$]\!]$ holds of each atomic part of the subject plurality, the distributive reading comes out as a special case of the cumulative reading. Therefore, (5-a) does not provide evidence for an ambiguity. Sentences with unmodified numerals like (6) exhibit the same problem, if an 'at least'-reading for the numeral is assumed.

(5) a. *The girls like the two cats.*
b. SCENARIO: Two girls: Ada, Bea. Two cats: Cleo, Dean. Ada likes Cleo and Dean. Bea likes Cleo and Dean.
c. SCENARIO: Two girls: Ada, Bea. Two cats: Cleo, Dean. Ada likes Cleo. Bea likes Dean.

(6) *Ada and Bea earned 100 euros.*

In (1-a), we used a modified numeral to avoid this problem: Neither of the two readings paraphrased in (7) entails the other, so (1-a) shows that the distributive and the cumulative readings of sentences involving conjunction are genuinely distinct.[4]

(7) a. $[\![$** *earn*$]\!]$(100€)($\mathbf{A} + \mathbf{B}$) and there is no $d >$ 100€ such that $[\![$** *earn*$]\!]$(d)($\mathbf{A} + \mathbf{B}$).
b. For each atomic part x of $\mathbf{A} + \mathbf{B}$: $[\![$*earn*$]\!]$(100€)(x) and there is no $d >$ 100€ such that $[\![$*earn*$]\!]$(d)(x).

While we will use the interpretation of predicates containing modified numerals as a diagnostic to distinguish between the readings, our analysis below (like many other accounts of cumulativity) does not extend straightforwardly to such predicates. However, Haslinger & Schmitt (2018a) show how the semantic framework presented here can be extended to such data.

1.2 Cross-linguistic evidence for a plural lexical meaning of COORD

Having distinguished the two relevant readings, we return to the two different semantic analyses of *and*. Since both posit silent operators to derive the non-basic reading, it is hard to disentangle them based on English alone. However, if these additional operators are assumed to be present in the syntax, cross-linguistic data can be brought to bear on this question. An idea that many typologically informed morphosyntactic studies implicitly rely on is that certain meanings universally require more complex syntactic structures than others, and that morphosyntactic marking reveals such asymmetries: If there are languages where the morphosyntactic form realizing meaning A 'properly contains' the form realizing meaning B, but there is no language where the form realizing B properly contains the form realizing A, this suggests that meaning A involves a more complex syntactic structure cross-linguistically. Data from languages where the containment relation is transparent can then inform us about the underlying

[4] Throughout, we represent the denotations of lexical predicates and proper names by boldfaced versions of the respective object-language expressions.

structure in languages that lack a formal markedness asymmetry.[5]

Applied to conjunction, this perspective yields the following predictions: If there is a cross-linguistic markedness asymmetry between the two readings, intersective theories predict the non-distributive reading to correspond to 'more complex' forms, as it requires additional semantic operations. Plural theories, however, predict that, if one of the two readings systematically corresponds to more complex forms, it is the distributive one. By testing these predictions against a cross-linguistic data sample, we can thus evaluate the hypothesis that the lexical meaning of the correlates of *and* – which we call COORD – is the same across languages and, if it is confirmed, identify the basic reading.

The first part of this paper presents two generalizations from our cross-linguistic investigation of this question, which strongly suggest that **the cross-linguistic lexical meaning of COORD is plural** (see Flor et al. 2017, to appear for similar claims based on a smaller data set). When considering sentences like (1-a) above, we essentially found that if there is any semantic effect of additional morphosyntactic marking, this marking may remove a non-distributive reading or make a distributive reading available, but never makes a formerly impossible non-distributive reading available. For example, in SerBoCroatian, the 'unmarked' pattern in (8-a) permits both readings, but the 'marked' pattern in (8-b), where *i* precedes each conjunct, only has the distributive reading. The reverse situation, with a purely distributive 'unmarked' pattern and a 'marked' pattern that permits the non-distributive reading, is unattested.

(8) a. *[A (i) B i C] su zaradili tačno sto evra.*
A (and) B and C AUX.3PL earn.PART.PL.M exactly hundred euros.GEN
'A, B and C earned exactly 100 euros.'

b. *[I A i B i C] su zaradili tačno sto evra.*
'A, B and C earned exactly 100 euros each.'

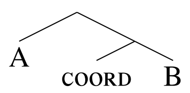
(SerBoCroatian, Jovana Gajić)[6]

1.3 Consequences for the treatment of 'distributive' conjunction patterns

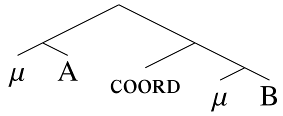
This claim about the cross-linguistic lexical meaning of COORD in individual conjunctions raises a problem: How do we give 'distributive' conjunction patterns like (8-b) a compositional semantics, using a denotation for COORD that permits a non-distributive reading? Closer scrutiny of such distributive patterns reveals three desiderata for an adequate analysis, which call for a revision of existing theories like Szabolcsi 2015 and Mitrović & Sauerland 2016.

Cross-categorial plurality-forming conjunction Following Mitrović & Sauerland 2014, 2016 and Szabolcsi 2015, we attribute the morpho-syntactic differences between the 'simple' and the 'complex' conjunction patterns to the absence/presence of 'conjunction particles' – represented by μ – which are affixed to each individual conjunct, (9). Thus, *i* would correspond to μ in (8-b), but realizes COORD in (8-a).

(9) a.



b.



The markedness pattern sketched above suggests that μ forces a distributive reading of the entire conjunction. Following the basic idea of Mitrović & Sauerland 2016 (but not their implementation), we

[5] See Bobaljik 2012 for a detailed discussion of this reasoning.
[6] `http://test.terraling.com/groups/8/lings/1083`

will argue that μ maps the individual conjunct denotations to quantifiers. The main difference between (9-a) and (9-b) is then that COORD conjoins individuals in (9-a), but higher-type denotations in (9-b). But since we argued that the lexical meaning of COORD in (9) is plural, this requires a cross-categorial semantics for COORD that yields a non-distributive reading for individual conjuncts, and a distributive reading for quantifier conjuncts. Further, this semantics should be expressible in terms of a uniform schema for all types.While plural-based analyses for higher-type conjunctions have been proposed before (Link 1984, Krifka 1990, Heycock & Zamparelli 2005, Schmitt 2013, 2018), these proposals fail to predict a distributivity requirement for (9-b).

'Plurality-like' behavior and cumulativity asymmetries Besides the cross-linguistic pattern, there is another reason to assume that, at least in some languages, the semantics of distributive conjunctions involves pluralities: Haslinger & Schmitt (2018b, 2019) note that some distributive conjunctions 'lose' their distributivity requirement when interpreted in the scope of another plural expression. This scope-related asymmetry is paralleled by English *every* (Schein 1993, Kratzer 2003, Champollion 2010 a.o.), suggesting that it reflects a deeper cross-linguistic pattern. In Polish, for example, the 'distributive' conjunction pattern *i A i B* disallows a cumulative reading relative to plural expressions it c-commands but permits cumulativity w.r.t. syntactically higher plural expressions. Relative to their nuclear scope, Polish *i A i B* conjunctions thus behave as predicted by traditional intersective analyses of quantifier conjunction (cf. von Stechow 1974, Gazdar 1980, Partee & Rooth 1983 a.o.), but for the purposes of semantic composition with higher expressions, they behave like plurals. This asymmetry cannot be attributed to ambiguity since, as we will see, the cumulative reading and the distributivity requirement are simultaneously present if a distributive conjunction is 'sandwiched' between two plural expressions (see also Schein 1993).

We attribute a common source to these asymmetries and the cross-linguistic markedness pattern: Distributive conjunctions contain a semantically plural component. The challenge is to build this component into the meaning of COORD without predicting that all conjunctions always permit cumulative readings.

1.4 The Plural Projection analysis of distributive conjunctions

Following Haslinger & Schmitt 2018b, 2019, we adopt an analysis of distributive conjunctions based on Schmitt's 2018 **Plural Projection** mechanism, which requires three basic assumptions: First, all semantic domains contain pluralities and a cross-categorial sum operation can be defined. Second, semantically plural expressions denote sets of pluralities. This claim extends to conjunctions of any category, which denote sets of pluralities formed from the conjunct denotations. Rather than directly expressing the sum operation, COORD combines such sets of pluralities, returning the set of all pluralities obtained by summing up individual elements of each of the argument sets. Crucially, this denotation for COORD extends to distributive conjunctions which, by hypothesis, introduce pluralities of quantifiers. Together with the type-shift expressed by the μ-particles, this semantics for COORD, although still plural-based, will ensure that such conjunctions cannot cumulate with other plurals in their nuclear scope.

The third core property of the system is a conception of cumulativity which differs drastically from the traditional view that cumulativity is a property of relational expressions. Cumulativity results from a composition rule operating on sets of (potentially higher-type) pluralities. This rule allows the mereological structure of plural expressions to 'project' to the denotations of larger constituents containing them. By applying this rule repeatedly, cumulative truth conditions are derived in a series of local steps, without any covert syntactic operations specific to cumulative sentences.

Haslinger & Schmitt (2019) show how these properties permit us to derive scope-related cumulativity asymmetries in languages like Polish: The conjuncts affixed with μ-particles denote functions that directly combine with a set of pluralities, thus blocking the compositional rule that yields cumulativity. The high type of μ-particles effectively forces the conjunction to 'distribute over' other plurals in its c-command domain. However, since the value obtained by combining such a distributive conjunction with its scope argument is another set of pluralities which can be fed to the cumulative composition rule, we correctly derive cumulative readings w.r.t. syntactically higher plural expressions.

1.5 Cross-linguistic predictions for other types of conjunction

Several natural languages have strategies for individual conjunction that generalize to conjunctions of other semantic categories, like unary predicates or propositions. Since our plural semantics will be cross-categorial, and furthermore predicts that certain hierarchical asymmetries can block the step-wise computation of cumulativity, it makes predictions about the conditions under which cumulative readings of VP and clausal conjunctions are available: We expect cumulative readings of 'unmarked' conjunctions of this type, and (depending on which μ-particle is used) cumulative readings of 'marked' strategies relative to syntactically higher pluralities of individuals. We will conclude the paper by presenting some preliminary data in support of these predictions.

1.6 Structure of the paper

Section 2 presents cross-linguistic evidence for the claim that the lexical meaning of COORD in individual conjunctions is plural-based rather than intersective. In Section 3, we discuss the resulting problem for the analysis of distributive conjunctions and formulate the aforementioned constraints on a solution of this problem. In Section 4, we present the plural semantics from Haslinger & Schmitt (2018b, 2019) and their analysis of distributive conjunctions. Section 5 considers the cross-linguistic predictions of this analysis for other types of conjunctions. Section 6 concludes the paper.

2 Cross-linguistic evidence for a plural denotation of COORD in individual conjunctions

The starting point for our investigation of COORD in individual conjunctions is the ambiguity observed in sentences like (1-a) or (10), where a conjunction in subject position combines with what we call a **C-predicate** – a predicate containing a plural or degree expression. Both examples have a **distributive reading** (**D-reading**) and a **non-distributive reading** (**ND-reading**).

(10) *Ada and Bea ate exactly three bananas.*
   a. D-reading: Ada and Bea each ate exactly three bananas.
   b. ND-reading: Ada and Bea ate exactly three bananas in total.

As mentioned above, analyses that do not appeal to a lexical ambiguity of COORD fall into two classes, which make different assumptions concerning which of the two readings is 'basic'. We briefly introduce both theories (Section 2.1) and outline how their cross-linguistic predictions can be tested (Section 2.2). We then present two generalizations based on our cross-linguistic data sample which, in combination, suggest that the lexical meaning of COORD involves plurality formation: The ND-readings of (1-a) and (10) reflect the basic meaning of conjunction, while the D-readings are derived via additional operations.

2.1 Plural and intersective analyses of COORD

The competing theories differ in the parallels they draw between individual conjunction and other constructions. **Intersective theories** take the equivalence between the D-reading of (1-a) and the sentential conjunction in (11) to reflect the lexical meaning of COORD: In (11), the property [[*earn exactly 100 euros*]] applies to each individual separately, which is exactly what happens under the D-reading of (1-a). Intersective theories thus posit a connection between the denotation of COORD in sentential conjunctions and its denotation in individual conjunctions. The ND-reading of (1-a) – which is not equivalent to (11) – must be obtained via additional operations.

(11) *Ada earned exactly 100 euros and Bea earned exactly 100 euros.*

In contrast, **plural theories** concentrate on the parallel between individual conjunctions and definite plurals: (12) has a reading that is equivalent to the ND-reading of (1-a). They assume that DPs like *the two children* denote sums of individuals and the operation forming such sums underlies the semantics of COORD. In principle, sum individuals could primitively satisfy the property [[*earn exactly 100 euros*]], although we will see below that the actual situation is more complex.

(12) *The two children earned exactly 100 euros.*

Just like (1-a), (12) also has a D-reading, which is true if *each* of the children earned exactly 100 euros. For definite plurals, this reading is traditionally derived via an additional mechanism applying either to the predicate or to the plural-based denotation of the DP. This mechanism could also apply to conjunctions, giving us the D-reading of sentences like (1-a).

2.1.1 Intersective theories

Intersective theories (Gazdar 1980, Partee & Rooth 1983, Winter 2001, Champollion 2016b a.o.) generally derive the cross-categorial meaning for COORD from its semantic contribution in type t conjunctions and identify the latter with the truth-functional connective $\wedge$ from classical propositional logic. For so-called t-conjoinable types, defined in (13-a), the denotation of COORD is recursively derived from $\wedge$, as in (13-b).[7]

(13) a. The set TC of t-conjoinable types is the smallest set of types such that $t \in TC$ and if $b \in TC$, then for all a, $\langle a, b\rangle \in TC$. (cf. Partee & Rooth 1983)
b. $[\![\text{COORD}_t]\!] = \lambda p_t.\lambda q_t.p \wedge q$, and for every type $b \in TC$ and every type a:
$[\![\text{COORD}_{\langle a,b\rangle}]\!] = \lambda P_{\langle a,b\rangle}.\lambda Q_{\langle a,b\rangle}.\lambda x_a.[\![\text{COORD}_b]\!](P(x))(Q(x))$ (cf. Partee & Rooth 1983)

Since type e is not t-conjoinable, the conjuncts in individual conjunction must be shifted to generalized quantifiers, (14), which can then be conjoined via the COORD operation in (13), as shown in (15-a). Since in (15-a) the quantifiers, corresponding to the individual conjuncts, apply to the property R separately, we obtain a D-reading for individual conjunctions (15-b).

(14) a. $[\![\uparrow]\!] = \lambda x_e.\lambda P_{\langle e,t\rangle}.P(x)$ (cf. Montague 1973)
b. $[\![\uparrow Ada]\!] = \lambda P_{\langle e,t\rangle}.P(\mathbf{Ada})$

(15) a. $[\![\text{COORD}_{\langle\langle e,t\rangle,t\rangle}]\!] = \lambda \mathcal{P}_{\langle\langle e,t\rangle,t\rangle}.\lambda \mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}.\lambda R_{\langle e,t\rangle}.\mathcal{P}(R) \wedge \mathcal{Q}(R)$

[7] The analysis in Keenan & Faltz (1985) is an exception: Here, the meet operation is defined primitively for each type.

b. *Ada and Bea ate exactly three bananas.*
$[\![[[\uparrow Ada_e]\ \textsc{coord}_{\langle\langle e,t\rangle,t\rangle}\ [\uparrow Bea_e]]\ [\textit{earned exactly 100 euros}]]\!]$
$= [\![[\uparrow Ada_e]\ \textsc{coord}_{\langle\langle e,t\rangle,t\rangle}\ [\uparrow Bea_e]]\!]([\![\textit{earned exactly 100 euros}]\!])$
$= (\lambda R_{\langle e,t\rangle}.R(\mathbf{Ada}) \wedge R(\mathbf{Bea}))([\![\textit{earned exactly 100 euros}]\!])$
$= [\![\textit{earned exactly 100 euros}]\!](\mathbf{Ada}) \wedge [\![\textit{earned exactly 100 euros}]\!](\mathbf{Bea})$

Winter (2001) derives the ND-reading by applying two additional operators to the conjunction, MIN and $\exists$ in (16-a,b) (we slightly adapt his proposal for our purposes). $[\![\textsc{min}]\!]$ extracts the minimal sets from a quantifier extension and, if these sets are non-empty, forms the corresponding pluralities. Its output is fed to $\exists$, resulting in existential quantification over those pluralities consisting exclusively of individuals identified by the conjunct denotations. If these operators are realized as silent elements in the syntax, the structure of a conjunction with an ND-reading is that in (16-c). Since the conjunction denotes an existential quantifier over sums, (16-d), this captures the intuition underlying plural theories of conjunction – the link between individual conjunctions and pluralities.

(16) a. $[\![\textsc{min}]\!] = \lambda\mathcal{P}_{\langle\langle e,t\rangle,t\rangle}.\lambda x_e.\exists Q_{\langle e,t\rangle}[\mathcal{P}(Q) \wedge \forall Q'_{\langle e,t\rangle}[Q' \subseteq Q \wedge \mathcal{P}(Q') \rightarrow Q' = Q] \wedge x = +Q]$
b. $[\![\exists]\!] = \lambda P_{\langle e,t\rangle}.\lambda Q_{\langle e,t\rangle}.\exists x_e[P(x) \wedge Q(x)]$
c. $[[\exists\ [\textsc{min}\ [[\uparrow Ada]\ \textsc{coord}_{\langle\langle e,t\rangle,t\rangle}\ [\uparrow Bea]]]]\ [\textit{earned 100 euros}]]$
d. $[\![\exists\ [\textsc{min}\ [[\uparrow\ Ada]\ \textsc{coord}_{\langle\langle e,t\rangle,t\rangle}\ [\uparrow\ Bea]]]]\!] = \lambda Q_{\langle e,t\rangle}.\exists x_e[x = \mathbf{A}+\mathbf{B} \wedge Q(x)] = \lambda Q_{\langle e,t\rangle}.Q(\mathbf{A}+\mathbf{B})$

Importantly, the goal of deriving the ND-reading from an intersective lexical meaning of COORD does not require the coordinate structure itself to be ambiguous. It could also be achieved by a predicate-level operator like $\textsc{nd}_{pred}$ in (17), which derives a 'non-distributive version' of the predicate that yields the ND-reading when combined with an intersective quantifier conjunction. $\textsc{nd}_{pred}$ maps a unary predicate to a higher-type denotation which takes a quantifier argument and extracts the minimal pluralities from the quantifier denotation by means of $\exists$ and MIN.

(17) $[\![\textsc{nd}_{pred}]\!] = \lambda R_{\langle e,t\rangle}.\lambda Q_{\langle\langle e,t\rangle,t\rangle}.[\![\exists]\!]([\![\textsc{min}]\!](Q))(R)$

In sum, intersective theories take the intersective meaning of conjunctions to be basic and take advantage of the fact that pluralities of individuals can be extracted from a quantifier denotation.

2.1.2 Plural theories

In contrast, plural theories assume that COORD in individual conjunctions directly forms pluralities (Link 1983, Krifka 1990, Schwarzschild 1996 a.o.): COORD denotes the sum operation +, so that the entire coordinate structure denotes a plurality consisting exclusively of the individuals denoted by the conjuncts.

(18) a. $[\![\textsc{coord}_{ND}]\!] = \lambda x_e.\lambda y_e.x + y$
b. $[\![Ada\ \textsc{coord}_{ND}\ Bea]\!] = \mathbf{Ada} + \mathbf{Bea}$

If predicates like *earn exactly 100 euros* can have pluralities in their extension, the ND-reading of sentences like (1-a) and (10) follows straightforwardly, but the D-reading requires additional work. This point extends to plural definites, for which a plural-based basic meaning is more broadly accepted. The D-reading of plural definites is derived by means of a **distributivity operator** which effectively applies the respective predicate to each atom of a plurality (Link 1987; see Champollion 2016a for discussion). This operator can either be assumed to modify the DP, in which case its denotation is as given in (19-a), or the VP-predicate, in which case it looks like (19-b).

(19) a. $[\![\text{D}_{DP}]\!] = \lambda x_e.\lambda P_{\langle e,t\rangle}.\forall y \leq_a x.P(y) = 1$
b. $[\![\text{D}_{pred}]\!] = \lambda P_{\langle e,t\rangle}.\lambda x_e.\forall y \leq_a x.P(y) = 1$

Either way, plural theories reduce the apparent generalized-quantifier interpretation of conjunctions in sentences like (1-a) to the combination of a plural lexical meaning and a D-operator.

2.2 Testing the cross-linguistic predictions of both types of theories

Both classes of theories take one reading to require additional operations and hence make predictions about the morpho-syntactic 'complexity' of the two readings. Thus, a cross-linguistic look at the morphosyntactic markedness relations between forms expressing the two readings allows us to test whether either of the hypotheses in (20) is correct.

(20) a. **H1** The cross-linguistic lexical meaning of COORD is intersective.
b. **H2** The cross-linguistic lexical meaning of COORD is plural-based.

This was one of the objectives of our cross-linguistic study of conjunction via the Terraling database (`http://test.terraling.com/`). We now discuss its empirical focus and then give a brief description of the database and our survey.

2.2.1 What type of minimal pairs do we have to consider?

In order to draw conclusions about the 'basic' or 'derived' nature of the two readings, we need to consider morphosyntactically complex realizations of conjunction. A language with two formally unrelated coordinators, where one permits a ND-reading and the other is purely distributive, would be uninformative: This pattern is compatible with any theory deriving one reading from the other, because in realizational theories of morphology, an element of a complex structure can block overt realization of another element (Distributed Morphology; see e.g. Bobaljik 2012) or, alternatively, a single marker can spell out a complex structure (Nanosyntax; see e.g. Caha 2009, 2013). Therefore, we do not expect the structural containment relations posited by the two theories to show up transparently in every language, even if they hold universally. To test the predictions of the two theories, we must concentrate on languages that make the containment relation transparent. Accordingly, we considered minimal pairs of 'less marked' structures C1 and 'more marked' structures C2 such that C2 contains all the markers in C1 plus at least one additional marker, i.e. C2 properly contains C1 morpho-syntactically (see Flor et al. to appear for more discussion).

One complicating factor is that both classes of theories allow for different assumptions about the 'location' of additional operators: The D/ND ambiguity of English sentences containing a conjunction and a C-predicate could reflect an ambiguity of the conjunction itself, or of the C-predicate. Thus, in languages that mark the D/ND distinction overtly, we might find a markedness asymmetry at the conjunction level, an asymmetry at the predicate level or both. We therefore considered two types of markedness asymmetries. The first type, schematized in (21), involves minimal pairs where C2 contains additional material β relative to C1 which appears *outside* the coordinate structure, while the realization of the coordinate structure itself is the same. (For now, it is irrelevant where β is located within the VP and whether it corresponds to one or more markers).

(21) [A COORD B] [P] vs. [A COORD B] [β P]

The second type of asymmetry concerns additional material *inside* the coordination: Here, C2 contains additional markers α that form a constituent with the coordinate structure, as schematized in (22) (again, the exact position of α is irrelevant and it may correspond to multiple markers).

(22) [A COORD B] [P] VS. [α A COORD B] [P] or [α A COORD α B] [P]

2.2.2 Our Terraling survey

In addition to some data from the literature, our conclusions are based on an ongoing study carried out via the Terraling database. Terraling is an open-ended, open-source database where language experts (mostly native speaker linguists) answer metalinguistic questions in a 'yes/no/does-not-apply' format, and can provide examples (cf. Koopman t.a.). Our Terraling group – the first one dedicated to formal semantics – currently contains partial data sets from 24 languages from 9 major language families (available via `http://test.terraling.com/groups/8`). Data about the interpretation of individual conjunctions are available for 21 languages. In our questionnaire we asked consultants whether particular forms were available in their language, but importantly we also asked whether these different forms can express the D-reading, the ND-reading or both (see Flor et al. to appear). More precisely, consultants were asked to construct sentences with C-predicates for different coordination patterns/strategies in their language. They then had to test for the presence of D- and ND-readings by judging whether these sentences adequately describe scenarios that distinguish between the two readings. The C-predicates were supposed to contain modified numerals whenever possible, to ensure that the two readings are logically independent. Since we suspected that there might be subject/object asymmetries concerning the availability of cumulative readings (see Section 3), we only considered sentences with the conjunction in subject position. Further, we excluded both lexically collective and lexically distributive predicates (like *meet* or *be blond*, respectively). Finally, we limited our survey to structures that show the 'symmetric' syntactic behavior characteristic of coordination, excluding comitatives, which have different semantic properties in some languages (McNally 1993, Roszkowski 2019): Consultants were encouraged to apply tests for 'genuine' coordination, e.g. whether the given structure permits more than two coordinates and whether it shows symmetry wrt. grammatical functions or Coordinate Structure Constraint effects.

2.3 Two cross-linguistic generalizations and their theoretical consequences

Our data set yields two generalizations that are directly relevant to our research question and that, taken together, favor a plural-based lexical meaning for conjunction.

2.3.1 Generalization 1: Markers external to the coordinate structure

We first consider minimal pairs of the form (23) that differ wrt. the presence or absence of a certain marker *outside* the coordinate structure (i.e. within the VP).

(23) [A COORD B] [P] VS. [A COORD B] [β P]

As we saw above, intersective theories can derive an ND-reading from a (distributive) generalized-quantifier interpretation of conjunction using predicate-level operators, while plural theories use such operators to derive the D-reading from a plural-based meaning of conjunction. At first sight, languages like English, where sentences with a conjunction and a C-predicate are ambiguous, appear to provide evidence for both classes of operators: We find VP-level markers that disambiguate the sentence towards a D-reading (*each*), but also modifiers that enforce an ND-reading (like *in total* or *between them*).

However, the generalization **G1** emerges once we consider languages where one of the readings *requires* a certain predicate-level marker:

G1 There are some conjunction strategies where a D-reading requires certain VP-level markers. There are no conjunction strategies where a ND-reading requires certain VP-level markers.

This means that some languages have minimal pairs of structures C1 and C2, where C1 is restricted to an ND-reading and C2 (with extra marking within the VP) has a D-reading. For English *and*-conjunctions, no such minimal pairs exist since sentences like (10) above are ambiguous. But in Basa'a, for instance, the 'unmarked' structure in (24-a) only has the ND-reading (it is true in the 'cumulative' scenario (25-a), but false in the 'distributive' scenario (25-b)), while the D-reading can be expressed by adding the modifier híkií mut ('each person') *outside* the coordinate structure ((24-b) is true in scenario (25-b) and false in (25-a)). So this conjunction strategy in Basa'a requires extra marking to express the D-reading.

(24) a. [*A*, *B* ni *C*] bá-bí-kosná dikóó dísámal
A B COORD C 2.SM-PST2-receive 13.thousands 13.six
'A, B and C received six thousand francs.' (ND only)

b. [*A*, *B* ni *C*] bá-bí-kosná dikóó dísámal, híkií mut
A B COORD C 2.SM-PST2-receive 13.thousand 13.six each 1.person
'A, B and C received six thousand francs each.' (D only)

(Basa'a, Paul Roger Bassong)[8]

(25) a. SCENARIO: A earned 3000 francs. B earned 2000 francs. C earned 1000 francs.
b. SCENARIO: A earned 6000 francs. B earned 6000 francs. C earned 6000 francs.

Importantly, the inverse situation is unattested in our data: We found no language with a conjunction strategy for which the ND-reading is made available by adding an external marker, and unavailable without this marker. Thus there is a two-way split between conjunction patterns that disallow the D-reading and those permitting this reading without any special marker (like English *A and B*).

G1 shows that at least for some forms of conjunction, one reading is derived from the other at the predicate level, not at the conjunction level: The predicate-internal markers are formal correlates of two different readings of C-predicates, not of two readings of conjunction. Further, **G1** suggests that the D-reading can be derived from the structure underlying the ND-reading by adding a predicate-level distributivity operator, like D_{pred} in (19-b) above.[9] But predicate-level operators are never used to derive the ND-reading of such sentences from the structure underlying the D-reading. We take this asymmetry to reflect a universal property of C-predicates: The basic readings of such predicates are cumulative; the D-reading can be derived by attaching a distributivity operator. This would explain why additional markers are never *necessary* for the ND-reading.

The cross-linguistic variation concerning the obligatoriness of extra markers for the D-reading can be captured by assuming that languages like English, where C-predicates are ambiguous, permit a null realization of the distributivity operator D_{pred}. Sentences like (26) are ambiguous between a structure containing the covert distributivity operator (26-a) and a structure without this operator (26-b). While (26-a) yields the D-reading, (26-b) gives us the 'default' cumulative reading. (There might be additional structures, depending on whether the conjunction is ambiguous as well – see below.)

[8] `http://test.terraling.com/groups/8/examples/16284`; `http://test.terraling.com/groups/8/examples/16285`

[9] The 'standard' analysis of cumulativity (Section 1.1) relies on a cumulation operator ** that syntactically attaches to relation-denoting expressions (see Beck & Sauerland 2000 for motivation). It therefore predicts that there could be languages which require an overt realization of ** to express the cumulative reading. The fact that this pattern was unattested in our study therefore challenges this assumption. Our proposal in Section 4 avoids this problem, since it builds cumulativity into the composition rules.

(26) *Ada and Bea earned 100 euros.*

a. [[*Ada* COORD *Bea*] [D$_{pred}$ [*earned 100 euros*]]]

b. [[*Ada* COORD *Bea*] [*earned 100 euros*]]

In contrast, languages like Basa'a lack this null element, so without an overt distributivity marker, only the default cumulative reading is available.

Interestingly, we did not find conjunction strategies that completely disallow the D-reading, in the sense that no overt or covert operator added to the predicate would make this reading available. This suggests that all languages in our sample have some way of deriving both readings at the predicate level. We therefore speculate that predicate-level distributivity operators are universally available, although not all languages require them to be overt. This is compatible with (although not a consequence of) **G1**, which suggests that the unmarked interpretation of C-predicates is cumulative.

If predicate-level distributivity operators are available cross-linguistically, conjunction patterns should fall into the two semantic subclasses in (27). Conjunctions with a 'plural' meaning should permit a cumulative or a distributive interpretation, depending on whether D$_{pred}$ is present. Conjunctions with an 'intersective' meaning should lack the cumulative reading even in the absence of D$_{pred}$.

(27)

conjunction meaning	reading without D$_{\text{pred}}$	reading with D$_{\text{pred}}$
plural-based	**cumulative**	**distributive**
intersective	**distributive**	(**distributive**)

Indeed, both 'distributive' conjunction patterns, which lack the cumulative reading in the configuration discussed here, and conjunction patterns that permit both readings are attested. To address our initial question about the lexical meaning of COORD, we must thus look at formal containment relations between different conjunction patterns within a language, controlling for the possibility of predicate-level distributivity operators.[10]

2.3.2 Generalization 2: Markers internal to the coordinate structure

Our second generalization, stated in **G2** below, relates more directly to the question what the basic lexical meaning of COORD is. It concerns minimal pairs of conjunction patterns C1 and C2 where C2 contains additional markers *inside* the coordinate structure, as sketched in (28).

(28) [A COORD B] [P] vs. [α A COORD B] [P] or [α A COORD α B] [P]

G2 For any pair of conjunction strategies for proper names, where one strategy can be obtained from the other by adding extra markers (e.g. μ-particles or repetition of the coordinator):
a) If the marked form permits a ND-reading relative to a certain C-predicate, so does the unmarked

[10]Dowty (1987) gives an independent argument that C-predicates in English are ambiguous: (i-a) is true in scenario (i-b), so an individual conjunction in subject position can combine with a conjunction of a distributive and a non-distributive predicate. If (non-)distributivity were exclusively determined by the interpretation of the individual conjunction, we would expect the same interpretation for both predicates. But if C-predicates in English are ambiguous between a D-reading and an ND-reading, such examples are unsurprising since (i-a) can be assigned the structure in (i-c). Note that, if C-predicates in English are ambiguous between a D-reading and an ND-reading, no separate ambiguity of *and* is required.

(i) a. *This place is so expensive! Ada and Bea had exactly one glass of wine and paid 16 euros.* (adapted from Dowty 1987)

b. SCENARIO: Ada and Bea had exactly one glass of wine each. The wine was 8 euros per glass.

c. [[*Ada and Bea*] [[D$_{pred}$ *had exactly one glass of wine*] *and* [*paid 16 euros*]]]

form.
b) If the unmarked form permits a D-reading relative to a certain C-predicate, so does the marked form.

G2 describes two typological gaps. First, we did not find any language where additional markers within the coordinate structure *add* a ND-reading. Second, we never find additional markers within the coordinate structure that remove the D-reading of an ambiguous conjunction. This constitutes yet another morphosyntactic markedness asymmetry between the two readings since the inverse patterns are attested: There are languages where the unmarked structure is ambiguous, but the marked structure only permits a D-reading, i.e. the additional marker removes the ND-reading. This pattern is illustrated by the SerBoCroatian data in (29), repeated from (8) above. While (29-a) is ambiguous and hence true in both scenarios in (30), (29-b), with every conjunct modified by the marker *i*, only has the D-reading: It is true in scenario (30-a), but false in (30-b).

(29) a. [*A (i) B i C*] *su zaradili tačno sto evra*.
'A, B and C earned exactly 100 euros.'
b. [*I A i B i C*] *su zaradili tačno sto evra*.
'A, B and C earned exactly 100 euros each.'

(30) a. A earned 100 euros, B earned 100 euros, C earned 100 euros.
b. A earned 30 euros, B earned 30 euros, C earned 40 euros.

The fact that additional markers can block the ND-reading suggests that the D-reading requires additional syntactic structure. Hence, one might also expect to find conjunction strategies that are *restricted* to a ND-reading, but can acquire a D-reading if additional markers within the conjunction are added. Whether this is verified depends on one's exact interpretation of 'restricted to a ND-reading': Some languages have conjunction strategies that disallow a D-reading in the absence of a predicate-level distributivity marker. However, additional markers within the conjunction make the D-reading available even without this distributivity marker. For instance, this pattern is found in Turkish (data due to Sozen Ozkan, `http://test.terraling.com/groups/8/lings/1088`), where sentences with a conjunction containing the coordinator *ve* and a C-predicate can acquire a D-reading in two ways: First, one can add the distributivity marker *-er* 'each' to the predicate. Second, the conjuncts can be modified by the additive particle *dA*, which makes the D-reading available even without *-er*. Importantly, the D-reading is unavailable if distributivity is marked neither within the conjunction nor at the predicate level. The conjunction strategies in such languages are not completely 'restricted to an ND-reading' since they are compatible with predicate-level distributivity operators. What is restricted to an ND-reading is the combination of an unmarked conjunction and an unmarked predicate.

2.3.3 Consequences of Generalization 2

G2 has the following impact on our initial question regarding the lexical meaning of COORD: Given our earlier division of conjunction strategies into two semantic subclasses, it shows that the 'unmarked' conjunction in (29-a) has a plural-based interpretation, while the 'marked' conjunction in (29-b) has an intersective interpretation. The same markedness pattern is found in other languages, such as Hungarian or Turkish. This is in line with the predictions of plural theories, which assume that conjunctions lacking additional morphemes on top of COORD should denote pluralities. To get an intersective interpretation for the conjunction, additional material has to be added, as in (29).

(31) **Plural analysis**

a. [A COORD B] D or ND (depending on presence/absence of D_{pred})
b. [D_{DP} [A COORD B]] D only

On an intersective theory, we can also derive a plural interpretation for conjunction patterns like English *A, B and C* or SerBoCroatian *A, B i C*. Again, this interpretation of conjunction will yield a D-reading or an ND-reading for the entire sentence, depending on how the predicate is interpreted, (32-b). However, this plural-based interpretation has to be derived from the intersective interpretation by means of the additional operators ∃ and MIN. We would therefore expect to find languages in which one or both of these operators must be overtly realized. Such languages would have an additional marker adding the ND-reading to a conjunction that otherwise lacks it – a situation unattested in our sample.[11]

(32) **Intersective analysis**
a. [A COORD B] D only
b. [∃ [MIN [A COORD B]]] D or ND (depending on presence/absence of D_{pred})

In summary, if our sample reflects real typological gaps, they follow from the plural analysis (under certain morphosyntactic assumptions). Further, under the intersective analysis, D-only conjunction patterns that are marked relative to an ambiguous conjunction pattern are unexpected, even though they occur in several languages. Our evidence therefore supports hypothesis **H2**:

H2 The cross-linguistic lexical meaning of COORD is plural-based.

2.4 Interim summary

The semantic behavior of individual conjunctions is double-edged: Sometimes the truth conditions of sentences with an individual conjunction are reducible to those of a corresponding sentential conjunction. Based on this analogy, many analyses of conjunction take the lexical meaning of COORD to be intersective, deriving the ND-reading via an additional operation. Other accounts take the plural-like behavior of individual conjunctions to indicate a plural-based lexical meaning. We addressed this issue by investigating which of the two readings of individual conjunctions is associated with a more complex structure, using the morphosyntactic realizations of conjunction as a diagnostic. Concentrating on minimal pairs of two conjunction patterns, one of which 'properly contains' the other, we tried to test the predictions of both approaches in a cross-linguistic survey, which currently covers 37 conjunction strategies in 21 languages. The results strongly suggest that the basic interpretation of conjunction is plural-based and the structures underlying the D-reading contain additional operators.

3 Distributive conjunctions: The analytical challenge

As we saw, several languages have distributive conjunction patterns which involve extra markers on top of a formal realization of COORD that is compatible with a ND-reading. This pattern is illustrated by SerBoCroatian *i A i B* in (29-b) and Hungarian *A is (és) B is* (33) (see Szabolcsi 2015 for the latter). Since the reverse situation is unattested, we concluded that COORD universally has a plural lexical meaning.

(33) [*A is (és) B is*] *100 kilót nyomott.*
A too COORD B too 100 kg weighed
'A and B each weighed 100 kg.' Hungarian (adapted from Szabolcsi 2015:181, (45))

[11] The predictions of intersective theories would change D_{pred} should turn out to not be universally available. But then they would still predict that additional marking can *remove* the D-interpretation – a pattern that is also unattested.

Since the predicates in (29-b) and (33) permit a cumulative reading if an 'unmarked' conjunction pattern is used, the distributivity requirement must be due to the semantics of the 'marked' conjunctions. However, we argued that all conjunctive coordinations, including those in (29-b) and (33), contain an operator COORD with a uniformly *plural-based* lexical meaning. In this section, we spell out the requirements a compositional analysis of this distributivity requirement must satisfy given the results of Section 2. To avoid confusion, we will use the term '**D-conjunctions**' for 'marked' conjunction patterns like those in (29-b) and (33), which are limited to D-readings when occurring in the subject position of C-predicates.

We first introduce our assumptions about the syntactic structure of D-conjunctions, following Mitrović & Sauerland (2014, 2016) and Szabolcsi (2015). We then argue against a semantic assumption common to all these approaches, namely that D-conjunctions ultimately denote distributive generalized quantifiers. We reject this claim because in certain contexts even D-conjunctions behave like plural expressions. We will then develop an analogy between the role of COORD in (29-b) and (33) and its behavior in conjunctions of universal quantifiers. Based on this analogy, we hypothesize that the particles are type-shifters mapping individuals to generalized quantifiers, and that the distributivity requirement of D-conjunctions follows from their high type (see also Mitrović & Sauerland 2016). This raises a compositionality problem: If the conjuncts denote quantifiers, how do they compose with a plural meaning of COORD? We conclude that a notion of sum for quantifiers is needed, but existing attempts to formalize such an operation make incorrect predictions for sentences like (29-b) and (33). Thus, a new, 'hybrid' semantics for COORD is called for.

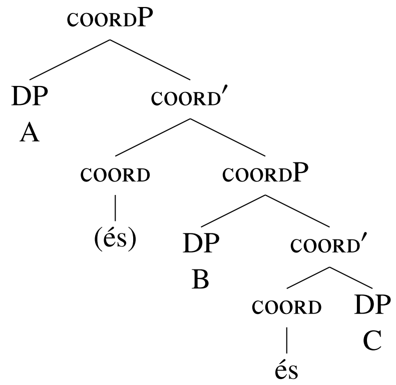
3.1 The structure of distributive conjunctions

Mitrović & Sauerland 2014 and Szabolcsi 2015 base their syntactic proposals on languages like Hungarian where (unlike in SerBoCroatian) the additional markers in D-conjunctions are not homophonous with the default realization of COORD. In 'unmarked' conjunctions like (34), which exhibit the same ambiguity as English *and*-conjunctions, COORD is realized as *és*. The 'marked' pattern from (33-b) above, which is restricted to a D-reading, may also contain *és*, but also has an extra marker *is* that may follow each conjunct. We call these extra elements **conjunction particles** or (following Mitrović & Sauerland 2014) **μ-particles**.

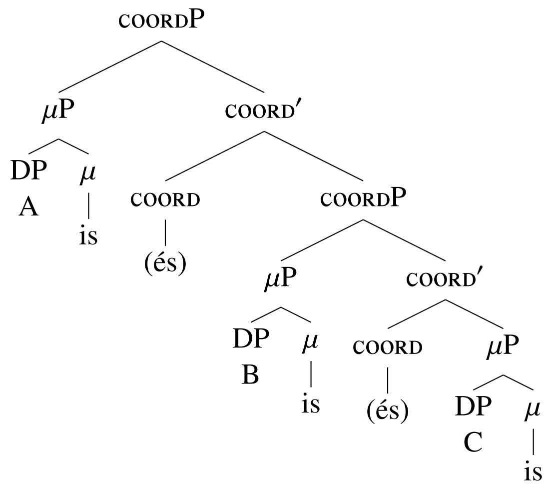
(34) *A és B 100 kilót nyomott.*
A COORD B 100 kg weighed
'A and B weighed 100 kg.' Hungarian (Szabolcsi 2015:180, (44))

Like Mitrović & Sauerland (2014) and Szabolcsi (2015), we assume that the μ-particles combine with the individual conjuncts in the syntax, and that there are no other relevant structural differences between the marked and the unmarked patterns. Following the previous literature, we treat COORD and μ as heads rather than modifiers: For Hungarian, this yields the structure in (35-a) for unmarked *és* conjunctions and the one in (35-b) for the marked pattern including *is*.

(35) a.



b.



Since μ-particles appearing on each conjunct are quite common cross-linguistically, Mitrović & Sauerland (2014) and Szabolcsi (2015) submit that the structure in (35) is not limited to Hungarian, but also underlies the SerBoCroatian pattern that seems to involve repetition of the coordinator. Within current realizational theories of morphology, there are two ways of deriving this pattern from the structure in (35-b). First, one could assume that *i* is the default realization of both COORD and μ, but that COORD receives a null realization in the context of μ-particles.[12] The difference between the Hungarian and SerBoCroatian patterns would thus reduce to two lexical coincidences: SerBoCroatian *requires* a null spell-out of COORD in the presence of μ, and the 'elsewhere' realization of COORD is homophonous with μ. However, this account seems stipulative in light of the cross-linguistic situation: The lack of an overt coordinator in the presence of μ-particles is also attested in unrelated languages such as Japanese, where the D-conjunction pattern *A-mo B-mo* does not contain the coordinator *-to* found in non-distributive conjunctions. Theories like Nanosyntax permit a more principled approach, since they allow single vocabulary items to realize a complex syntactic structure: A lexical entry relating a complex treelet T to a certain morphological form matches any subtree of T. We can therefore posit a single vocabulary item *i* that matches a treelet containing both COORD and μ if μ is present, but matches only COORD otherwise (see Caha (2009:ch. 2) for a discussion of the relevant spell-out mechanism).[13]

(36) gives a tentative lexical entry for *i*. For non-final conjuncts, (36) matches a complex structure containing a COORDP plus the μP in its specifier; for the final conjunct, it simply matches the μP. (Since (36) does not contain a DP node, the conjunct DPs have to be spelled out before (36) can apply.)

[12]Hungarian shows that the presence of μ-particles can affect the spell-out of COORD: According to Szabolcsi (2015), *és* is only optional in conjunctions with the conjunction particle *is*. The idea that the exponent *i* in Slavic languages has two distinct syntactic roles receives independent support from Southeastern Macedonian data discussed by Mitrović & Sauerland (2014), where *i* overtly appears in both positions in the 'marked' conjunction pattern *i A i i B*.

[13]The exact formulation of this lexical entry raises some technical issues, which we gloss over here.

(36) $i \leftrightarrow$
$$\begin{array}{ccc} & \text{COORDP} & \\ \mu\text{P} & & \text{COORD}' \\ | & & | \\ \mu & & \text{COORD} \end{array}$$

(37)
a. $[_{\text{COORD}P1}\ [_{\mu\text{P1}}\ \text{DP}_1\ \mu\ ]\ [_{\text{COORD}'}\ \text{COORD}\ [_{\text{COORD}P2}\ [_{\mu\text{P2}}\ \text{DP}_2\ \mu\ ]\ [_{\text{COORD}'}\ \text{COORD}\ [_{\mu\text{P3}}\ \text{DP}_3\ \mu\ ]\ ]\ ]]]$
b. (36) matches μP_3, given that DP_3 has already been spelled out
$\Rightarrow [_{\text{COORD}P1}\ [_{\mu\text{P1}}\ \text{DP}_1\ \mu\ ]\ [_{\text{COORD}'}\ \text{COORD}\ [_{\text{COORD}P2}\ [_{\mu\text{P2}}\ \text{DP}_2\ \mu\ ]\ [_{\text{COORD}'}\ \text{COORD}\ [i\ \text{DP}_3\ ]\ ]\ ]]]$
(spell-out of μP_3)
c. (36) matches COORDP_2, given that DP_2 and μP_3 have already been spelled out
$\Rightarrow [_{\text{COORD}P1}\ [_{\mu\text{P1}}\ \text{DP}_1\ \mu\ ]\ [_{\text{COORD}'}\ \text{COORD}\ [i\ \text{DP}_2\ i\ \text{DP}_3]\ ]\ ]$ (spell-out of COORDP_2)
d. (36) matches COORDP_1, given that DP_1 and COORDP_2 have already been spelled out
$\Rightarrow [i\ \text{DP}_1\ i\ \text{DP}_2\ i\ \text{DP}_3]$

There are several unresolved issues with this approach, but the important point is that the expressive power of realizational morphosyntactic theories allows us to assign a unified syntactic structure to D-conjunctions, regardless of whether they contain a separate exponent of COORD.[14] Such theories are also powerful enough to accommodate the German pattern in (38), which lacks a transparent containment relation between the D-conjunction and the 'standard' plurality-denoting conjunction (inserting *und* into (38-a) yields ungrammaticality).

(38) German
a. *sowohl A als auch B als auch C*
as-well A as also B as also C
'A as well as B as well as C' (purely distributive)
b. *A, B und C*
A B and C
'A, B and C' (ambiguous)

While the precise structure of (38-a) requires further work, abstract morphological theories will allow us to assign a structure containing COORD even to cases like (38-a) where there is no morphosyntactic evidence for its presence. We will assume that *sowohl* and *als auch* modify the conjunct they immediately precede and that they have some syntactic feature that conditions a zero spell-out of COORD.

To conclude, we assign a unified syntactic structure to conjunctions involving μ-particles, which contains a binary coordinator in addition to the particles. While recent analyses of μ-particles (Mitrović & Sauerland 2014, 2016, Szabolcsi 2015) share this assumption, our semantics for COORD and μ will differ substantially from these approaches. This deviation is motivated empirically in the next section.

3.2 'Plurality-like' behavior of distributive conjunctions and cumulativity asymmetries

In Section 2, we argued that COORD denotes a plurality-forming operation. We also saw that certain μ-particles systematically remove the ND-reading. How is this possible if particle conjunctions still have plural-based meanings?

Mitrović & Sauerland (2016) account for this pattern without going beyond the established analyses of conjunction. They take COORD to be ambiguous between an intersective and a plural-based lexical

[14] We don't know if there are any non-distributive conjunction patterns with markers that syntactically behave like μ-particles. An apparent example is the marker *-to* in Japanese, which can appear after each conjunct (*A-to B-to*) or just after the non-final conjuncts (*A-to B*), but Tatsumi & Fujiwara (2018) argue that the second occurrence of *-to* in the former case is not a μ-particle.

meaning: The latter may appear in 'unmarked' conjunction patterns with a ND-reading, but cannot appear in structures with μ-particles, since the particles shift the conjuncts to quantifiers, which cannot be parts of pluralities. To interpret conjunctions containing μ-particles, we therefore need the intersective lexical entry for COORD, which expresses the classical quantifier-conjunction in (39), forcing a D-reading of the sentence.

(39) $[\![\text{COORD}_{\langle\langle e,t\rangle,t\rangle}]\!] = \lambda\mathcal{P}_{\langle\langle e,t\rangle,t\rangle}.\lambda\mathcal{Q}_{\langle\langle e,t\rangle,t\rangle}.\lambda R_{\langle e,t\rangle}.\mathcal{P}(R) \wedge \mathcal{Q}(R)$

On this account, the fact that in languages like Hungarian COORD has the same exponent in conjunctions with and without μ-particles is a lexical accident. Mitrović & Sauerland's 2016 data set does not provide strong support for this putative lexical ambiguity of COORD, raising the question whether we can do without it: Having only one (possibly cross-categorial) lexical meaning would be more parsimonious.

But there is also a stronger argument against the ambiguity hypothesis: In some languages, the very same conjunction patterns that are purely distributive relative to structurally lower plurals permit cumulativity relative to structurally higher plurals. Given that cumulativity is a hallmark of semantic plurality, this suggests that D-conjunctions can be plural expressions.

The Polish data in (40) illustrate this pattern. (40-a), where the D-conjunction occurs in subject position, lacks a cumulative reading relative to the plural definite object. A quantifier analysis of COORD as in (39) would predict (40-c) to lack a cumulative reading too – regardless of whether the plural definite is interpreted 'in the scope' of the conjunction. But surprisingly, the cumulative reading is available. That is, Polish *i A i B* conjunctions behave like 'ordinary' plural expressions in (40-c), but not in (40-a). The same asymmetry is found for D-conjunctions in German (*sowohl A als auch B*, Haslinger & Schmitt 2019), Hungarian (*A is és B is*, Dóra Kata Takács, p.c., also discussed in Haslinger & Schmitt 2019)) Japanese (*A-mo B-mo*, Kazuko Yatsushiro, p.c.)) and Turkish (*A dA ve B dA*, Umut Ovat, p.c).

(40) Polish[15]

a. ***I Sabina i Magda** dostatecznie wcześnie zadzwoniły do tych dwóch restauracji.*
I Sabina I Magda enough early called to these two restaurants
'Both Sabina and Magda called these two restaurants early enough.'

b. SCENARIO: Sabina called 'Express Restaurant'. Magda called 'Star Restaurant'. (40-a) **false**

c. *Na szczęście dwie organizatorki dostatecznie wcześnie poinformowały **i Adama i Piotra**.*
on the-luck two organizers enough early informed I Adam I Piotr
'Fortunately, the two organizers informed both Adam and Piotr early enough.'

d. SCENARIO: Sabina called Adam. Magda called Piotr. (40-c) **true**

This cross-linguistic pattern is hard to reconcile with Mitrović & Sauerland's 2016 assumption that μ-particles force us to interpret the entire coordinate structure as an intersective quantifier conjunction.

But couldn't we claim that (40-c) (as opposed to (40-a)) involves a different lexical entry for μ which does not shift its argument to a quantifier, thus allowing the conjunction to be interpreted as a simple plural individual? This ambiguity view of μ-particles would capture the pattern in (40) without going beyond the established analyses of conjunction. It is falsified, however, by what we call **Schein sentences** (discussed by Schein 1993 for English *every*-DPs, see also Kratzer 2003, Ferreira 2005, Zweig 2008, Champollion 2010, Haslinger & Schmitt 2018b): In (41-a), a German D-conjunction is 'sandwiched' between two plural expressions. Haslinger & Schmitt (2019) note that this sentence *simultaneously* exhibits the distributivity requirement relative to lower plurals and the lack of such a requirement relative to higher plurals: (41-a) is true in scenario (41-b), which requires a cumulative reading of the

[15] Thanks to Marcin Wągiel (p.c.) for confirming the judgments.

D-conjunction relative to the *und*-conjunction in subject position, since neither of the girls taught *both* Carl and Dean two tricks.[16] So, the *sowohl ... als auch* conjunction (41-a) shows the same kind of 'exceptional' cumulative reading we observed in (40-b) above. But importantly, the fact that (41-a) is false in scenario (41-c) demonstrates that a cumulative reading relative to the syntactically lower plural 'two tricks' is unavailable, just as in (40-a) above. (The behavior of D-conjunctions thus resembles the pattern discussed in the literature on *every*-DPs.)

(41) a. *Die Ada und die Bea haben sowohl dem Carl als auch dem Dean zwei neue Tricks beigebracht.*
The Ada and the Bea have PRT the Carl PRT also the Dean two new tricks taught
'Ada and Bea taught both Carl and Dean two new tricks.' (Haslinger & Schmitt 2019)

b. SCENARIO: Ada taught Carl tricks 1 and 2. Ada taught Dean trick 3 and Bea taught Dean trick 2. (41-a) **true**

c. SCENARIO: Ada taught Carl trick 1. Bea taught Dean trick 2. (41-a) **false**

At least in the languages discussed here, the behavior of D-conjunctions is therefore two-faced: They lack a ND-reading relative to syntactically lower plurals, but behave like ordinary plural expressions relative to higher plurals.

We now have two independent empirical arguments for the conclusion that conjunctive coordinations universally involve a plurality-forming operator: Section 2 showed that in some languages, D-conjunctions transparently contain conjunction patterns with a plural semantics, while the reverse pattern is unattested. This suggests that the basic meaning of conjunction is plural-based and D-conjunctions involve additional operators that interact with plurality formation. Furthermore, we just saw that in some languages, the seemingly 'purely distributive' D-conjunctions permit a cumulative reading relative to structurally higher plural expressions. This challenges an assumption shared by all recent analyses of μ-particles – that D-conjunctions ultimately have the denotation derived by intersective analyses. Instead of taking their distributivity requirement to be incompatible with a plural denotation, we therefore need a system that allows D-conjunctions to have both properties at the same time.

3.3 Particle conjunctions and universal quantifiers

Before we address the role of COORD and of cumulativity in such a system, we informally outline our view of μ-particles, which is a new take on Mitrović & Sauerland's 2016 idea that μ-particles impose a distributivity requirement because they shift the conjuncts to quantifiers. Importantly, we reject Mitrović & Sauerland's assumption that this shift necessitates a lexically intersective meaning for COORD.

We just discussed the 'two-faced' behavior of D-conjunctions in languages like Polish, which are restricted to a distributive interpretation relative to syntactically lower plurals, but not relative to higher plurals. The same asymmetry has been observed for another type of expression, singular universal quantifiers like English *every* DPs English (Schein 1993, Kratzer 2003, Ferreira 2005, Zweig 2008, Champollion 2010) or German *jed-* DPs (Haslinger & Schmitt 2018b): (42-a) with a *jed-* DP in subject position lacks a cumulative reading – it is false in scenario (42-c). But (42-b), with a *jed-* DP in object position, has a cumulative reading for many speakers – it is true in (42-c).

(42) a. *Jedes Mädchen in diesem Ort hat die zwei Hunde gefüttert.*
every girl in this town has the two dogs fed

[16] As the authors cited above show, the truth conditions of (41-a) cannot be captured in terms of a single cumulative relation between the girls and the dogs. See Section 4.4.2.

'Every girl in this town fed the two dogs.'

b. *Die zwei Mädchen haben jeden Hund in diesem Ort gefüttert.*
the two girls have every dog in this town fed
'The two girls fed every dog in this town.'

c. SCENARIO: Two girls, Ada and Bea. Two dogs, Carl and Dean. Ada fed Carl and Bea fed Dean. (42-a) **false**, (42-b) **true**

Consider now what happens when we conjoin two *jed-* DPs using the coordinator *und* 'and'. In individual conjunctions, *und* permits ND-readings, so given the results of Section 2, we can conclude that it has a plural-based semantics. Conjunctions of two *jed-* DPs in object position provide independent support for a plural-based analysis, as they permit cumulative readings relative to a higher plural: (43-a) can be true in the 'cumulative' scenario in (43-b). Importantly, scenario (43-b) does not entail that the two girls cumulatively fed all the dogs, since Bea did not feed any dog. This shows that *und* does not impose a distributivity requirement here: It is not the case that each of its conjuncts has to cumulate separately with the subject plurality – rather, it seems to sum up the pluralities contributed by the two *jed-* DPs, creating a single 'flat' plurality containing both cats and dogs.

(43) a. *Die zwei Mädchen haben jeden Hund und jede Katze in diesem Ort gefüttert.*
the two girls have every dog and every cat in this town fed
'The two girls fed every dog and every cat in this town.'

b. SCENARIO: Two girls, Ada and Bea. Two dogs, Carl and Dean. Three cats, Eve, Fay and Gal. Ada fed Carl, Dean and Eve. Bea fed Fay and Gal. (43-a) **true**

Accordingly, *und* can have a plurality-forming semantics even when it conjoins universal quantifiers. Further, when *und* conjoins individual-denoting expressions, the resulting conjunction permits cumulative readings regardless of its syntactic position. Given this background, it might appear surprising that when an *und*-conjunction of universal quantifiers combines with a syntactically lower plural, a cumulative reading of the conjunction is ruled out just as categorically as a cumulative reading of the individual quantifiers: (44-a) is false in scenario (44-b), and hence cannot express a cumulative relation between the two conjuncts of the quantifier conjunction and the two dogs.

(44) a. *Jeder Bub und jedes Mädchen hat die zwei Hunde gefüttert.*
every boy and every girl has the two dogs fed
'Every boy and every girl fed the two dogs.'

b. SCENARIO: Two girls, Ada and Bea. Two dogs, Carl and Dean. Two boys, Eric and Fritz. Ada and Bea both fed Carl. Eric and Fritz both fed Dean. (44-a) **false**

(45) summarizes the German facts: When COORD conjoins proper names PN_1 and PN_2, the resulting conjunction permits a cumulative reading relative to a plural DP, regardless of its syntactic position relative to that DP. When it conjoins quantificational DPs headed by *jed-* 'every', the distributivity requirement associated with this determiner appears to 'spread' to the conjunction: While the configuration in (45-c) permits a cumulative interpretation of the DP conjunction, (45-d) does not, as it lacks a reading where the two quantifiers stand in a cumulative relation to the sum individual introduced by the lower plural.

(45) a. [[NUM NP] [$\cdots$ [$\cdots$ [PN_1 COORD PN_2] $\cdots$]]] COORD **distributive/cumulative**
b. [[PN_1 COORD PN_2] [$\cdots$ [$\cdots$ [NUM NP] $\cdots$]]] COORD **distributive/cumulative**
c. [[NUM NP] [$\cdots$ [$\cdots$ [[*jed-* NP_1] COORD [*jed-* NP_2]] $\cdots$]]] COORD **distributive/cumulative**
d. [[[*jed-* NP_1] COORD [*jed-* NP_2]] [$\cdots$ [$\cdots$ [NUM NP] $\cdots$]]] COORD **distributive**/***cumulative**

We therefore face the challenge of giving a unified semantics for COORD that accounts for (45). Since

COORD conjoins individuals in (45-a,b) and quantifiers in (45-c,d), this semantics has to take the form of a cross-categorial schema. Importantly, we cannot explain the contrast in (45-c,d) by appealing to a lexical ambiguity of COORD: If the conjunction is 'sandwiched' between two plural expressions, we observe cumulativity relative to the higher plural (45-c) and distributivity relative to the lower plural (45-d) at the same time. We thus need a single meaning for COORD that lets us derive both the distributivity requirement in (45-d) and the availability of a cumulative reading in (45-c).

Crucially, this asymmetric behavior of conjunctions of *every* DPs is mirrored by D-conjunctions with μ-particles. In both cases, cumulative readings of the conjunction are subject to a scope-related asymmetry, although COORD itself does not exhibit any such asymmetry when it conjoins individual-denoting expressions. Accordingly, a semantics that predicts the pattern in (45-c,d) will naturally generalize to the asymmetric behavior of certain D-conjunctions, summarized in (46) – assuming that the μ-particles shift the conjuncts to a meaning closely related to singular universal quantifiers.

(46) a. [[NUM NP] [$\cdots$ [$\cdots$ [[μ PN$_1$] COORD [μ PN$_2$]] $\cdots$]]] COORD **distributive/cumulative**
b. [[[μ PN$_1$] COORD [μ PN$_2$]] [$\cdots$ [$\cdots$ [NUM NP] $\cdots$]]] COORD **distributive/*cumulative**

In sum, the availability of ND-readings relative to higher plurals is actually compatible with the idea that μ-particles shift their argument to a quantifier type: The asymmetric behavior of D-conjunctions is mirrored by expressions that are uncontroversially quantifiers – DPs headed by singular universal determiners. Given this analogy, we now turn to the semantic contribution of COORD in quantifier conjunctions.

3.4 Generalizing existing plural theories of conjunction

In Section 3.2, we concluded that the classical intersective meaning for quantifier conjunction fails to account for cumulative readings. We will now see that simply extending existing plural-based analyses of COORD to quantifiers won't solve our puzzle either.

The literature contains several attempts to define a cross-categorial sum operation, motivated by cumulative readings of higher-type expressions like predicate conjunctions (Link 1984, Krifka 1990) or conjunctions of embedded clauses (Schmitt 2013, 2018). These approaches fall into two classes. The first one (Link 1984, Krifka 1990, Heycock & Zamparelli 2005 a.o.) takes the sum operation on the individual domain D_e to be the basic meaning of COORD, from which the plural-based conjunction operation for higher types 'starting' in e is derived. The second approach (Schmitt 2013, 2018) 'enriches' every semantic domain by adding pluralities of the respective type – i.e., we don't just have pluralities of type e, but also pluralities of predicates, propositions and crucially quantifiers. Such pluralities correspond to non-empty subsets of 'atomic' domain elements. This approach provides a primitive notion of sum for each type, which is identified with the meaning of COORD.

Neither proposal captures the behavior of COORD in quantifier conjunctions. Consider first the 'e-based' approach that recursively derives the cross-categorial meaning of COORD from the sum operation on D_e. The most general version, Krifka (1990), extends to all e-conjoinable types, a notion defined in (47).

(47) The set EC of e-conjoinable types is the smallest set such that $e \in EC$ and for all $a_1, \ldots, a_n \in EC$, $\langle a_1, \ldots, \langle a_n, t\rangle\rangle \in EC$.

Krifka's analysis is motivated by cumulative sentences in which a conjunction of a functional type – like the VP conjunction in (48) – combines directly with a conjunction of the corresponding argument type. Intuitively, (48) is true iff $[\![$*Ada and Bea*$]\!]$ is the sum of two subpluralities x_1 and x_2 such that x_1 smoked and x_2 drank. More generally, the sum of two one-place predicates $P, Q \in D_{\langle e,t\rangle}$ is a predicate true of exactly those pluralities that can be split into a P-part and a Q-part. Generalizing this paraphrase, Krifka (1990) defines the sum operation in (49-a) for arbitrary e-conjoinable types. The predicate conjunction in our example then receives the denotation in (49-b).

(48) *Ada and Bea smoked and drank.*

(49) a. For any X, Y of type $\langle a_1, \ldots, \langle a_n, t\rangle\rangle$, where $a_1, \ldots, a_n$ are e-conjoinable:
$X \oplus_{\langle a_1,\ldots,\langle a_n,t\rangle\rangle} Y = \lambda z_1, \ldots, z_n.\exists x_1, y_1, \ldots, x_n, y_n$
$[x_1 \oplus_{a_1} y_1 = z_1 \wedge \cdots \wedge x_n \oplus_{a_n} y_n = z_n \wedge X(x_1)\ldots(x_n) \wedge Y(y_1)\ldots(y_n)]$
b. $[\![smoked]\!] \oplus_{\langle e,t\rangle} [\![drank]\!] = \lambda z_e.\exists x_e, y_e[x \oplus_e y = z \wedge [\![smoked]\!](x) \wedge [\![drank]\!](y)]$
c. For any type $a \in EC$: $[\![\textsc{coord}_a]\!] = \lambda x_a.\lambda y_a.x \oplus_a y$

Since $\langle\langle e,t\rangle, t\rangle$ is an e-conjoinable type, conjunctions of quantifiers, like *every boy and every girl*, can be interpreted via two applications of the recursive definition in (49-a), as illustrated in (50).

(50) $[\![[every\ boy]\ [\textsc{coord}\ [every\ girl]]]\!] = [\![every\ boy]\!] \oplus_{\langle\langle e,t\rangle,t\rangle} [\![every\ girl]\!]$
$= \lambda Z_{\langle e,t\rangle}.\exists X_{\langle e,t\rangle}, Y_{\langle e,t\rangle}[[\![every\ boy]\!](X) \wedge [\![every\ girl]\!](Y) \wedge Z = X \oplus_{\langle e,t\rangle} Y]$
$= \lambda Z_{\langle e,t\rangle}.\exists X_{\langle e,t\rangle}, Y_{\langle e,t\rangle}[[\![every\ boy]\!](X) \wedge [\![every\ girl]\!](Y) \wedge Z = (\lambda z_e.\exists x_e, y_e.X(x) \wedge Y(y) \wedge z = x \oplus_e y)]$
$= \lambda Z_{\langle e,t\rangle}.\exists X_{\langle e,t\rangle}, Y_{\langle e,t\rangle}[[\![boy]\!] \subseteq X \wedge [\![girl]\!] \subseteq Y \wedge Z = (\lambda z_e.\exists x_e, y_e.X(x) \wedge Y(y) \wedge z = x \oplus_e y)]$

However, this predicts incorrect truth conditions for sentences like (51-a), where the quantifier conjunction combines with a predicate conjunction.

(51) a. *Every boy and every girl smoked and drank.*
b. Scenario: Every boy smoked. Some boys did not drink. Every girl drank. Some girls did not smoke.

In scenario (51-b), the quantifier meaning in (50) holds of the predicate $[\![smoked]\!] \oplus_{\langle e,t\rangle} [\![drank]\!]$, which is true of all sum individuals that consist of a smoking part and a drinking part. Given the scenario, every sum of a boy and a girl has this property. However, (51-a) is false in this scenario and intuitively requires both predicates to hold of every individual boy or girl. Similarly, if we apply the schema in (49) to quantifiers derived by lifting individuals to type $\langle\langle e,t\rangle, t\rangle$ (our rendering of D-conjunctions) we get the denotation in (52). Again, $[\![smoked]\!] \oplus_{\langle e,t\rangle} [\![drank]\!]$ satisfies the condition in (52) even if Ada smoked, but did not drink, and Bea drank, but did not smoke.

(52) $(\lambda P_{\langle e,t\rangle}.P(\mathbf{Ada})) \oplus_{\langle\langle e,t\rangle,t\rangle} (\lambda P_{\langle e,t\rangle}.P(\mathbf{Bea}))$
$= \lambda Z_{\langle e,t\rangle}.\exists X_{\langle e,t\rangle}, Y_{\langle e,t\rangle}[X(\mathbf{Ada}) \wedge Y(\mathbf{Bea}) \wedge Z = (\lambda z_e.\exists x_e, y_e.X(x) \wedge Y(y) \wedge z = x \oplus_e y)]$

The 'e-based' approach therefore does not derive the cumulativity asymmetry associated with universal quantifiers and D-conjunctions. It furthermore has several additional weak points[17]: First, since neither t nor $\langle s,t\rangle$ is an e-conjoinable type, cumulative readings of embedded clausal conjunctions (Schmitt 2013) remain unexplained. Second, the analysis only works for examples in which the plural expressions 'participating' in cumulativity stand in a function-argument configuration. It won't derive a cumulative reading if the predicate conjunction is separated from the other plurals by one or more intervening nodes, as in (53), which intuitively involves cumulation between the two ambassadors and the two predicates $[\![$*talk to Putin*$]\!]$ and $[\![$*build a hotel in Tbilisi*$]\!]$. But if we apply (49) to the predicate conjunction, the

[17] We only address problems of immediate relevance for our purposes. Krifka (1990) and Champollion (2016b) raise additional issues.

predicates cannot 'cumulate' with the two ambassadors, since the semantic argument of the predicate conjunction is Trump, an atomic individual.

(53) a. The Georgian ambassador called this morning, the Russian one at noon.
They think that Trump should talk to Putin and build a hotel in Tbilisi, but neither addressed the Caucasus conflict! **true** in (53-b)

b. Scenario: The Georgian ambassador thinks Trump should build a hotel in Tbilisi. The Russian ambassador thinks Trump should talk to Putin. adapted from Schmitt (2018)

For Schmitt (2013, 2018), these issues motivate a new cross-categorial notion of sum. Rather than denoting a simple predicate that applies to plural individuals, a predicate conjunction like *smoked and drank* denotes a sum with two atomic parts – $[\![smoked]\!]$ and $[\![drank]\!]$. More generally, each semantic domain contains pluralities, which stand in a one-to-one correspondence to nonempty sets of the 'atomic' domain elements. For type $\langle e, t\rangle$, these atomic elements are all the characteristic functions of subsets of D_e. Importantly, any nonempty set of such functions has a sum that is in $D_{\langle e,t\rangle}$.

For every type, we then define an operator $+$ that maps each nonempty subset of the domain to its sum. Schmitt (2013) identifies the lexical meaning of coord with this operation. Conjunctions of predicates or other derived types are thus assigned denotations that make the individual conjunct denotations accessible: Even if the individuals who both drank and smoked happen to be the same individuals who are both linguists and philosophers, the conjunctions $[\![$*drank* [coord *smoked*]$]\!]$ and $[\![$*linguist* [coord *philosopher*]$]\!]$ are generally not coextensional, since $[\![drank]\!]$ is an atomic part of the former, but not the latter.

(54) $[\![\text{COORD}_{\langle e,t\rangle}]\!]([\![drank]\!])([\![smoked]\!]) = [\![drank]\!] + [\![smoked]\!] \in D_{\langle e,t\rangle}$

Equipped with this enriched ontology, we can interpret cumulative sentences involving conjunctions of derived types, like (48): For the necessary cumulative relations, Schmitt (2013) extends the cumulation operator ** to relations of arbitrary types, while Schmitt (2018) replaces this operator with a special composition rule for plural expressions (an approach we will adopt below). Regardless of the composition mechanism, (48) is predicted to be true iff the atomic parts of the subject plurality – Ada and Bea – cumulatively satisfy the atomic parts of the predicate conjunction, $[\![smoked]\!]$ and $[\![drank]\!]$. Hence, we derive the following truth conditions:

(55) $\forall x \leq_a \textbf{Ada}+\textbf{Bea}.\exists P \leq_a \textbf{smoked}+\textbf{drank}.P(x) \wedge \forall P \leq_a \textbf{smoked}+\textbf{drank}.\exists x \leq_a \textbf{Ada}+\textbf{Bea}.P(x)$

While this analysis extends to data like (53) and also covers clausal conjunctions, its predictions for conjunctions of universal quantifiers do not improve substantially on the '*e*-based' approach. (51-a) is predicted to involve a cumulative relation between a plurality of two universal quantifiers and a plurality of two predicates: Each quantifier applies to at least one of the predicates **smoked** and **drank** and each predicate is in the extension of at least one quantifier. This condition is satisfied in scenarios like (51-b) and thus does not capture the truth conditions.

(56) a. $[\![every\ boy\ and\ every\ girl]\!] = \text{COORD}_{\langle\langle e,t\rangle,t\rangle}([\![every\ boy]\!])([\![every\ girl]\!]) = [\![every\ boy]\!]+[\![every\ girl]\!]$

b. $\forall Q \leq_a [\![every\ boy]\!] + [\![every\ girl]\!].\exists P \leq_a \textbf{smoked} + \textbf{drank}.Q(P) \wedge \forall P \leq_a \textbf{smoked} + \textbf{drank}.\exists Q \leq_a [\![every\ boy]\!] + [\![every\ girl]\!].Q(P)$

More generally, the analysis fails to capture the correlation between quantifier type and distributivity, because quantifier conjunctions combine with (possibly plural) denotations of type $\langle e, t\rangle$ in the same way that predicate conjunctions combine with (possibly plural) individuals.[18]

Summing up, Link (1984), Krifka (1990) and Schmitt (2013, 2018) show that predicate conjunctions and clausal conjunctions permit cumulative readings. This motivates a notion of sum for higher types, which provides a cross-categorial semantics for COORD. But if expressions like *every girl* have their usual generalized-quantifier denotations, this approach fails to explain why conjunctions of such quantifiers lack cumulative readings relative to lower plurals.

We thus need a 'hybrid' analysis of quantifier conjunctions that assigns them plural denotations, but forces them to 'distribute over' pluralities introduced by syntactically lower expressions. The availability of cumulative readings for quantifier conjunctions, and for D-conjunctions of individuals, suggests that Schmitt's 2013 idea to introduce higher-type pluralities is on the right track – but it must be combined with a new approach to quantifiers that captures their special status with respect to distributivity.

3.5 Interim summary

In the preceding paragraphs we presented the puzzle raised by D-conjunctions ('marked' distributive conjunction patterns) and derived several constraints on any adequate analysis: First, the distributive effect must be tied to the semantic contribution of the μ-particles. Following ideas by Mitrović & Sauerland 2016, we assumed that these particles 'lift' the individual conjunct denotations to quantifiers. Second, the meaning of COORD in D-conjunctions must be plural-based. This assumption is motivated both by the cross-linguistic pattern presented in Section 2 and by the observation that several languages have D-conjunctions with a 'plurality-like' behavior, which permit cumulative construals when occurring in the scope of another plural. In combination, these two points motivate a plural-based meaning for COORD that extends to higher-type arguments such as quantifiers. However, existing attempts to formulate such a meaning don't deliver the 'two-faced' behavior of D-conjunctions, which are underlyingly plural-like, but must be interpreted distributively w.r.t. their nuclear scope.

4 Distributive conjunction patterns: A Plural Projection account

In this section, we will show how the data pattern just presented follows from the Plural Projection analysis of D-conjunctions developed by Haslinger & Schmitt (2019).

The Plural Projection framework is based on the idea, motivated and worked out in Schmitt 2018, that semantic plurality 'projects' up in the syntactic tree in a way that resembles the computation of focus alternatives (Rooth 1985) or Kratzer & Shimoyama's 2002 alternative-based treatment of indefinites. Any constituent containing a semantically plural subexpression will itself be semantically plural, unless this 'projection' process is blocked by one of a small set of intervening operators. Thus, if (57-a) is semantically plural, so are all the expressions in (57-b-e).

(57) a. *Ada and Bea*
  b. *Ada and Bea drank*
  c. *saw Ada and Bea drink*
  d. *Cleo saw Ada and Bea drink*
  e. *believe that Cleo saw Ada and Bea drink*

[18] This correlation extends to other conjunctions of genuine quantifiers (excluding numerals and indefinites): They generally lack a reading with a cumulative relation between the individual quantifiers and structurally lower plurals (see also Champollion 2016b).

In Section 3.4, we briefly addressed a prerequisite for this mechanism, namely that **plurality formation is generalized to all semantic categories**: Any semantic domain contains pluralities that stand in a one-to-one correspondence to non-singleton sets of atomic domain elements. Unlike earlier accounts, the current system therefore assumes pluralities of functions, like predicate denotations or propositions (see Schmitt 2018, Haslinger & Schmitt 2018b, 2019 for motivation). Hence, (57-a-c) will involve pluralities of individuals, propositions and predicate denotations, respectively.

This property makes the system more permissive than previous theories when it comes to the analysis of distributive operators. Recall the assumption from Section 2 that distributivity is due to additional operators applying to the basic predicate meaning, which require the predicate to hold of each relevant part of a plurality. Since the output of such operators is of *t*-conjoinable type, the notion of an operator that is distributive and simultaneously maps its argument to a plurality does not make sense under more traditional views of semantic plurality. However, a system with pluralities of propositions and predicates leads us to *expect* the existence of such operators. Further, since distributivity operators are always functions taking a higher-type argument, the possibility of forming a sum of such operators does not arise within previous theories. But in a system with higher-type pluralities, we again expect such sums to feature in the semantics.

More concretely, the enriched plural ontology will allow us to capture the notion of pluralities of several distributive operators, each of which maps its argument to a plural denotation. This notion is exactly what we need to derive the hybrid behavior of D-conjunctions – they behave like distributive operators when viewed from 'below' and like plural expressions when viewed from 'above'. We derive this sensitivity to the syntactic position of other plurals from a second important trait of the Plural Projection framework: The plural expressions participating in a cumulative interpretation are interpreted *in situ*, without any covert syntactic operations specific to cumulative sentences (of the kind discussed inBeck & Sauerland 2000).

4.1 Informal preview

The 'projection' behavior exemplified by (57) is implemented by a special composition rule. Our starting point is the idea that if a function combines with an argument plurality, or a function plurality combines with an argument, we obtain a plurality of values. In the former case, the function applies to each atomic part of the argument and the resulting values are summed up. In the latter case, each atomic part of the function applies to the argument and the resulting values are summed up. As shown in (58), where **+** indicates plurality formation, the mereological structure introduced by the embedded plural expression is 'preserved' in the denotation of the node dominating it.

(58)
$$\begin{array}{cc} \multicolumn{2}{c}{f(a)+f(b)} \\ f & a+b \end{array} \qquad\qquad \begin{array}{cc} \multicolumn{2}{c}{f(a)+g(a)} \\ f+g & a \end{array}$$

In order to generalize this idea, however, we need a slightly more complex system since whenever both the functor and the argument denote pluralities, a single plurality of values would be insufficient: Cumulative truth conditions are compatible with many possible ways of matching up the functor-parts and the argument-parts. Thus, plural expressions will be assumed to denote sets of pluralities – **plural sets** – rather than single pluralities. Haslinger & Schmitt (2018b, 2019) assign a special type to these plural sets, so that they can be targeted by specific compositional rules: Plural sets form the input for the compositional rule that yields the 'projection' in (58) and also encodes cumulativity. This rule combines a set of function pluralities and a set of argument pluralities as follows: It returns the set of all value pluralities obtained by applying atomic function parts to atomic argument parts in such a way that all the parts of some plurality in the function set are 'covered', and all the parts of some plurality in the argument set are 'covered'. This effect is schematized in (59). As in (58), the denotation of the mother node preserves the part structure introduced by the plural expressions it dominates. (The 'projection' behavior in (58) is what the rule schematized in (59) does whenever one of the two plural sets is a singleton containing a non-plural denotation.)

(59)
$$\begin{array}{c} \{f(a)+g(b), f(b)+g(a), f(a)+g(a)+g(b), f(b)+g(a)+g(b), f(a)+f(b)+g(a), f(a)+f(b)+g(b), \\ f(a)+f(b)+g(a)+g(b)\} \\ \diagup \quad \diagdown \\ \{f+g\} \qquad \{a+b\} \end{array}$$

This operation is repeated at any syntactic node that dominates at least one plural expression: In cumulative sentences, the rule applies at each node intervening between the plural expressions that participate in cumulativity. Sentences will thus denote plural sets of propositions, which count as true if at least one plurality in the set consists exclusively of true propositions.

Following Haslinger & Schmitt 2018b, 2019, our meaning for COORD operates on plural sets and considers different ways of picking one element from each of the sets – like the projection rule. But here, the selected elements are summed up: Given plural sets S_1 and S_2 of the same type, we obtain the set of all sums of an element from S_1 and an element of S_2, as shown in (60). If the elements of the set are themselves plural sets, this 'element-wise sum' operation will apply recursively.

(60) $[\![\text{COORD}]\!]\ (\{\mathbf{a{+}b}, \mathbf{c}\})(\{\mathbf{d{+}e}, \mathbf{f}\}) = \{\mathbf{a{+}b{+}d{+}e}, \mathbf{c{+}d{+}e}, \mathbf{a{+}b{+}f}, \mathbf{c{+}f}\}$

Crucially, this meaning for conjunction is cross-categorial, i.e. it performs the same operation irrespective of the semantic type of the conjuncts: All of the conjunctions in (61) denote singleton plural sets containing the sum of the conjunct denotations. Hence, as opposed to the '*e*-based' accounts (Link 1984, Krifka 1990), the parts corresponding to the individual conjunct denotations remain accessible at later stages of the composition. We thus avoid their problematic prediction that cumulative readings of higher-type conjunctions require them to be in a functor-argument relation with another plural.

(61) a. *Ada and Bea* $\approx \{\mathbf{Ada}_e + \mathbf{Bea}_e\}$
b. *smoke and drink* $\approx \{\mathbf{smoke}_{\langle e,t\rangle} + \mathbf{drink}_{\langle e,t\rangle}\}$
c. *every cat and every dog* $\approx \{[\![\textit{every cat}]\!] + [\![\textit{every dog}]\!]\}$

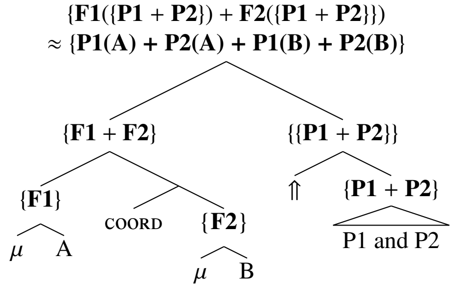
But why should the high type of D-conjunctions make a difference, when we just argued that we can form pluralities from all kinds of functional denotations? While the default compositional mechanism for plural sets is the projection rule sketched above, our assumption that plural sets differ from their elements in semantic type allows us to define functions that require a plural set as their argument. The lexical meaning of COORD is such a function, but Haslinger & Schmitt (2018b, 2019) propose that quantifiers like *every* and μ-particles also fall into this class. Following Mitrović & Sauerland (2016), they assume that μ-particles encode a version of the 'Montague lift' from individuals to quantifiers, but quantifiers are analyzed as functions that require a *plural set* of predicates, rather than a single predicate. Simplifying slightly, μ-particles combine an individual with a set of predicate pluralities and return the plural set obtained by applying each of the predicate pluralities 'pointwise' to the individual. When conjunction applies to conjuncts affixed with μ-particles, it will do its standard job, forming a singleton plural set containing the sum of the higher-type functions the conjuncts denote.

(62) sketches an abstract example. The higher-type functions expressed by the μ-affixed conjuncts are represented by **F1** and **F2**. Crucially, since each of these functions needs to combine with a plural set rather than a simple predicate, our plural composition rule will not allow the plural set of quantifiers to combine directly with the meaning of the predicate conjunction. We first have to lift that meaning, a plural set of predicates, to a singleton set of yet higher type. The fact that the quantifier conjunction

combines with a singleton, higher-type plural set ultimately gives us the distributive effect we were after: Each of **A** and **B** is forced to combine with both parts of the predicate plurality **P1**+**P2**, which would not be the case if we had directly cumulated $\{$**P1**+**P2**$\}$ with the individual-type plural set $\{$**A**+**B**$\}$.

(62) a. [[[μ *A*] [COORD [μ *B*]]] [*P1* COORD *P2*]]

b.



(62) also illustrates a second core feature of this analysis: The result of combining a D-conjunction with its nuclear scope via the projection rule is yet another plural set. **F1** and **F2** each apply to the plural set {**P1** + **P2**}, yielding two plural sets of propositions – {**P1(A) + P2(A)**} for **F1**, and {**P1(B) + P2(B)**} for **F2**. The compositional system then forces us to combine these two plural sets by means of the 'recursive sum' operation. Disregarding some technical details (see Section 4.3), we obtain the singleton plural set indicated at the root node of (62-b). Importantly, while this set encodes the D-reading in the sense that the parts of the propositional plurality combine each of the individuals **A** and **B** with both **P1** and **P2**, it is still a plural denotation since it contains a propositional plurality with accessible atomic parts. This plurality can now participate in a cumulative relation with plural expressions occurring higher in the structure. This property is at the core of our account of the 'two-faced' behavior of D-conjunctions: Our mechanisms for conjunction and cumulativity conspire to derive the type of 'hybrid' analysis of conjunction we appealed to in Section 3.4.

4.2 Background: Plural Projection (Schmitt 2018, Haslinger & Schmitt 2018b, 2019)

We now introduce the Plural Projection system more formally. For a more detailed discussion including independent motivation for the system's individual components see Haslinger & Schmitt 2019.

4.2.1 Ontology

As mentioned above, in addition to introducing a cross-categorial notion of plurality, we will assume that semantically plural expressions generally denote sets of such pluralities – **plural sets**. Since the compositional system should not treat the denotations of plural expressions like *Ada and Bea* on a par with non-plural unary predicates like $[\![girl]\!]$, we distinguish between 'ordinary' characteristic functions and plural sets in the type system: For any semantic type a, there is a corresponding type a^* for plural sets with elements of type a (63).

(63) The set T of **semantic types** is the smallest set such that $e \in T, t \in T$, for any $a, b \in T$, $\langle a, b\rangle \in T$, and for any $a \in T$, $a^* \in T$.

We add these additional domains of pluralities and plural sets to our ontology: For each type a, we have an atomic domain A_a and a full domain D_a, which contains the elements of the atomic domain plus arbitrary sums formed from them. The atomic domains for primitive types are stipulated in the standard way, (64-a). The atomic domains of higher types – which now include both regular functional types like $\langle e, t\rangle$ and plural (= starred) types like e^* – are defined recursively on the basis of the *full* domains of lower types, (64-b,c) The domains for functional types $\langle a, b\rangle$ are derived in the usual way in (64-b) (*modulo* the enrichment of the domains and co-domains of the relevant functions). The domain for a starred type of the form a^*, on the other hand – a new feature of the current system – is isomorphic to, but disjoint from, the power set of D_a (and therefore distinct from the functional domain $D_{\langle a,t\rangle}$).

(64) For each type a, there is an **atomic domain** A_a and a **full domain** D_a with the following properties:
  a. $A_e = A$, the set of individuals; $A_t = \{0, 1\}^W$, where W is the set of possible worlds.
  b. For any types a, b: $A_{\langle a,b\rangle} = D_b^{D_a}$, the set of partial functions from D_a to D_b.
  c. For any type a, A_{a^*} is a set that is disjoint from $\mathcal{P}(D_a)$ and on which the operations $\cup$, $\cap$ and $\setminus$ are defined. Further, there is a function $pl_a^* : \mathcal{P}(D_a) \to A_{a^*}$ that is an isomorphism wrt. $\cup$, $\cap$ and $\setminus$.

The full domain D_a for each type a is derived from the atomic domain as follows: The sum operation $+$, specified in (65-a), maps any nonempty set of denotations of the same type to its unique sum. More precisely, the nonempty subsets of A_a stand in a one-to-one correspondence with the elements of D_a. The disjointness condition in (65-b) prevents the pluralities in D_a from being equated with elements of the next higher functional domain ($D_{\langle a,t\rangle}$), since they will be targeted by different composition rules.[19]

(65) a. For each type a:
    (i) D_a is a set such that $A_a \subseteq D_a$ and there is an operation $+_a : \mathcal{P}(D_a)\setminus\{\emptyset\} \to D_a$.
    (ii) There is a function $pl_a : \mathcal{P}(A_a)\setminus\{\emptyset\} \to D_a$ such that: $pl_a(\{x\}) = x$ for each $x \in A_a$ and pl_a is an isomorphism from $(\mathcal{P}(A_a)\setminus\{\emptyset\}, \bigcup)$ to $(D_a, +)$.
  b. For any type $b \neq a$, D_a and D_b are disjoint.

For the sake of readability, we introduce some notational conventions:

(66) a. We use ‘starred’ variables like x^*, P^* etc. for types of the form a^*.
  b. We sometimes omit type subscripts on cross-categorial operations like $+_a$ or pl_a.
  c. For variables $x, x_1, \ldots, x_n$ of any type, we write $[x_1, \ldots, x_n]$ for the plural set $pl^*(\{x_1, \ldots, x_n\})$ with elements $x_1, \ldots, x_n$, and $[x \mid \phi]$ for the plural set $pl^*(\lambda x.\phi)$. Informally, square brackets replace set brackets whenever we are dealing with plural sets.
  d. For any type b and $x, y \in D_b$:
    (i) $x +_b y =_{\text{def}} +_b(\{x, y\})$ (binary sum operation)
    (ii) $x \leq y \Leftrightarrow_{\text{def}} x +_b y = y$ (parthood)
    (iii) $x \leq_a y \Leftrightarrow_{\text{def}} x \leq y \wedge x \in A_b$ (atomic parthood)

(67) illustrates the effects of these definitions: (67-a) gives some elements of the (standard) atomic domain for type $\langle e, t\rangle$. (67-b) illustrates the full domain, which now also contains sums of predicate denotations. Some elements of the atomic domain for type $\langle e, t\rangle^*$, which has the structure of the power set of $D_{\langle e,t\rangle}$, are listed in (67-c).

(67) a. $A_{\langle e,t\rangle} = \{\mathbf{smoke}_{\langle e,t\rangle}, \mathbf{dance}_{\langle e,t\rangle}, (\lambda x.\mathbf{smoke}_{\langle e,t\rangle}(x) \vee \mathbf{dance}_{\langle e,t\rangle}(x)), \ldots\}$
  b. $D_{\langle e,t\rangle} = \{\mathbf{smoke}_{\langle e,t\rangle}, \mathbf{dance}_{\langle e,t\rangle}, (\lambda x.\mathbf{smoke}_{\langle e,t\rangle}(x) \vee \mathbf{dance}_{\langle e,t\rangle}(x)),$
  $\mathbf{smoke}_{\langle e,t\rangle} + \mathbf{dance}_{\langle e,t\rangle}, \mathbf{smoke}_{\langle e,t\rangle} + (\lambda x.\mathbf{smoke}_{\langle e,t\rangle}(x) \vee \mathbf{dance}_{\langle e,t\rangle}(x)),$
  $\mathbf{dance}_{\langle e,t\rangle} + (\lambda x.\mathbf{smoke}_{\langle e,t\rangle}(x) \vee \mathbf{dance}_{\langle e,t\rangle}(x)), \ldots\}$
  c. $A_{\langle e,t\rangle^*} = \{[\mathbf{smoke}_{\langle e,t\rangle}], [\mathbf{dance}_{\langle e,t\rangle}], [\lambda x.\mathbf{smoke}_{\langle e,t\rangle}(x) \vee \mathbf{dance}_{\langle e,t\rangle}(x)], [\mathbf{smoke}_{\langle e,t\rangle}, \mathbf{dance}_{\langle e,t\rangle}], \ldots$

[19]The disjointness condition cannot hold for the empty set, which is an element of any domain of functions or plural sets. This is a general problem for type-driven interpretation and not specific to our framework.

$[\mathbf{smoke}_{\langle e,t\rangle} + \mathbf{dance}_{\langle e,t\rangle}], \ldots [\mathbf{smoke}_{\langle e,t\rangle}, \mathbf{smoke}_{\langle e,t\rangle} + \mathbf{dance}_{\langle e,t\rangle}], \ldots \}$

Semantics of plurals and conjunction The starting point for our analysis of COORD, following earlier plural-based analyses of conjunction, is that the denotations of conjunctions should resemble the denotations of 'standard' plural expressions like plural definites and indefinites. In our system, the latter uniformly have type e^*. While a definite plural like *the girls* denotes a singleton set containing the sum of all girls, a plural indefinite like *two pets* denotes the set of all sums of two pets.[20] (For the DP-internal composition, see Haslinger & Schmitt 2018b, 2019.)

(68) a. $[\![$*the girls*$]\!] = [\![$*the* [PL *girl*]$]\!] = [\mathbf{A} + \mathbf{B}]$
b. $[\![$*two pets*$]\!] = [\![$*two* [PL *pet*]$]\!] = [\mathbf{C} + \mathbf{D}, \mathbf{C} + \mathbf{E}, \mathbf{D} + \mathbf{E}]$

However, unlike earlier theories, we take COORD to have the same effect cross-categorially, so conjunctions of higher-type conjuncts also denote plural sets. Furthermore, COORD will denote an operation $\bigoplus$ (**'recursive sum'**) on plural sets, which is more complex than standard plurality formation. For arguments of non-plural type, $\bigoplus$ coincides with our ordinary sum operation, (69-a). But if the arguments are plural sets, it forms the set of all pluralities obtained by selecting an element from each of the argument sets and summing up the selected elements, as stated in (69-b).

(69) For any type a, the operation $\bigoplus_a : \mathcal{P}(D_a)\backslash\{\emptyset\} \to D_a$ is defined as follows:
For any nonempty $S \subseteq D_a$:
a. If a is a non-plural type (i.e. a is not of the form b^*): $\bigoplus_a S = +_a S$.
b. If $a = b^*$ for some type b: $\bigoplus_a S = [\, \bigoplus_b(\{f(X^*) \mid X^* \in S\}) \mid f$ is a function from S to $D_b \wedge \forall X^* \in S : f(X^*) \in pl^{*-1}(X^*)]$

(70) Notational convention: For any type a and any $x, y \in D_a$: $x \oplus_a y = \bigoplus_a(\{x, y\})$.

Importantly, the lexical entry for conjunction performs the operation defined in (69), but requires its arguments to be plural sets. Conjuncts that are not of a 'starred' type therefore have to be shifted to plural sets before they combine with conjunction.

(71) $[\![\textsc{coord}_{\langle a^*,\langle a^*,a^*\rangle\rangle}]\!] = \lambda x_{a^*}.\lambda y_{a^*}.x \oplus_{a^*} y$ for any type a

(72) illustrates the effect of COORD. In (72-a), it combines with two plural sets; one of them contains singular girls, the other proper pluralities of pets. We end up with the set of all sums consisting of a girl and two pets. More generally, if at least one conjunct is an indefinite, the whole conjunction will, semantically speaking, be indefinite, denoting a non-singleton plural set. If both arguments are singletons, as in (72-b) or (72-c), we obtain another singleton (corresponding to the denotation of a definite). (72-b) and (72-c) furthermore illustrate that the operation has the same effect irrespective of the type of its arguments.

(72) a. $[\![$*a girl and two pets*$]\!] = [\![$*a girl*$]\!] \oplus [\![$*two pets*$]\!]$
$= [\mathbf{A}, \mathbf{B}] \oplus [\mathbf{C} + \mathbf{D}, \mathbf{C} + \mathbf{E}, \mathbf{D} + \mathbf{E}]$
$= [\mathbf{A} + \mathbf{C} + \mathbf{D}, \mathbf{A} + \mathbf{C} + \mathbf{E}, \mathbf{A} + \mathbf{D} + \mathbf{E}, \mathbf{B} + \mathbf{C} + \mathbf{D}, \mathbf{B} + \mathbf{C} + \mathbf{E}, \mathbf{B} + \mathbf{D} + \mathbf{E}]$
b. $[\![$*smoke and drink*$]\!] = [\mathbf{smoke}_{\langle e,t\rangle}] \oplus [\mathbf{drink}_{\langle e,t\rangle}] = [\mathbf{smoke}_{\langle e,t\rangle} + \mathbf{drink}_{\langle e,t\rangle}]$
c. $[\![$*Ada fed Carl and Bea fed Dean*$]\!] = [\textbf{Ada fed Carl}_t] \oplus [\textbf{Bea fed Dean}_t] = [\textbf{Ada fed Carl}_t + \textbf{Bea fed Dean}_t]$

[20] This is essentially a generalization of Kratzer & Shimoyama's 2002 alternative semantics for indefinites.

Together with the projection rule introduced right below, this lexical meaning of COORD will give us the right results for unmarked conjunctions of individual-denoting expressions. Being cross-categorial, it also makes certain predictions for unmarked conjunctions of other types, which we address in Section 5.

4.2.2 Cumulative composition: The projection rule

Another important difference between the present proposal and existing accounts of cumulative readings of conjunction concerns semantic composition in cumulative sentences. Our richer ontology with plural sets and higher-type pluralities gives us a new, surface-compositional way of deriving cumulative readings.[21] This feature was originally motivated by certain independent problems for the predicate-based analysis sketched in Section 1.1 (Schmitt 2018), but Haslinger & Schmitt (2018b, 2019) show that it also provides a new approach to the cumulativity asymmetries with *every* DPs and, crucially, distributive conjunctions.

In particular, cumulativity is no longer the result of operators targeting predicate denotations and deriving a 'cumulative version' of the predicate, which then combines with its arguments via regular functional application. Rather, we use our rich ontology to formulate a cumulative version of the functional application rule. This rule – **Cumulative Composition (CC)** – applies whenever a plural set of a functional type, i.e., an element of $D_{\langle a,b\rangle^*}$, combines with a plural set of the corresponding argument type – an element of D_{a^*}. Its output is a plural set of type b^* whose elements intuitively correspond to different ways of matching up parts of a plurality from the function set with parts of a plurality from the argument set. This expansion of the notion of cumulativity to arbitrary function-argument configurations gives us a new analysis of sentences where the plurals participating in a cumulative interpretation are 'separated' by intervening non-plural expressions. By applying CC at every branching node dominating a plural expression, the mereological structure introduced by that expression is 'passed up' in the tree, reducing non-local cases of cumulativity to a series of local steps.

To formalize the rule, we introduce the notion of a **cover**, (73-a), which is a binary relation R between the atomic parts of a function plurality P and the atomic parts of an argument plurality x such that each atomic part of P is the first element of a pair in R and each atomic part of x is the second element of a pair in R. This is illustrated in (73-b).

(73) a. Let $P \in D_a, x \in D_b$. A relation $R \subseteq A_a \times A_b$ is a **cover** of (P, x) iff $+(\{P' \mid \exists x' : (P', x') \in R\}) = P$ and $+(\{x' \mid \exists P' : (P', x') \in R\}) = x$.

b. $P = \textbf{drink} + \textbf{smoke}$, $x = \textbf{A} + \textbf{B} + \textbf{C}$
Covers: $\{\langle \textbf{drink}, \textbf{A}\rangle, \langle \textbf{drink}, \textbf{B}\rangle, \langle \textbf{smoke}, \textbf{C}\rangle\}, \{\langle \textbf{drink}, \textbf{A}\rangle, \langle \textbf{smoke}, \textbf{B}\rangle, \langle \textbf{smoke}, \textbf{C}\rangle\}$,
$\{\langle \textbf{drink}, \textbf{A}\rangle, \langle \textbf{drink}, \textbf{B}\rangle, \langle \textbf{drink}, \textbf{C}\rangle, \langle \textbf{smoke}, \textbf{C}\rangle\}, \ldots$
Not a cover: $\{\langle \textbf{drink}, \textbf{A}\rangle, \langle \textbf{drink}, \textbf{B}\rangle, \langle \textbf{drink}, \textbf{C}\rangle\}$
Not a cover: $\{\langle \textbf{drink}, \textbf{A}\rangle, \langle \textbf{smoke}, \textbf{C}\rangle\}$

We then define CC as follows: For any cover of some plurality in the functor set and some plurality in the argument set, we perform functional application for all pairs in the cover and sum up the results. We then collect all the value pluralities corresponding to different covers into one plural set (74).

(74) Cumulative Composition (CC)

a. For any $P^* \in D_{\langle a,b\rangle^*}$ and $x^* \in D_{a^*}$:
$C(P^*, x^*) = [\ \bigoplus(\{P'(x') \mid (P', x') \in R\}) \mid \exists P \in pl^{*-1}(P^*), x \in pl^{*-1}(x^*) : R \text{ is a cover of } (P, x)]$

[21] Unlike earlier surface-compositional approaches to cumulativity, we don't need to assume any inherent connection between cumulativity and events (see Schein 1993, Kratzer 2003, Ferreira 2005, Zweig 2008 for event-based approaches and Champollion 2010, Haslinger & Schmitt 2019 for critical discussion).

b. For any meaningful expressions ϕ of type $\langle a, b\rangle^*$ and ψ of type a^*, $[\phi\ \psi]$ is a meaningful expression of type b^*, and $[\![\phi\ \psi]\!] = C([\![\phi]\!], [\![\psi]\!])$.

For simple plural sentences like (75-a), (74) reproduces the effects of the predicate-based analysis sketched in Section 1.1. But the locus of cumulativity is neither the lexicon nor an operator, but the compositional system itself: A lexical predicate like *fed* primitively denotes a relation between atomic individuals. This is mapped to a singleton plural set by a type-shift $\Uparrow$, defined in (76). The cumulative reading of (75-a) then results from two applications of CC at the nodes marked C in (75-b).

(75) a. *Ada and Bea fed two pets.*
b. $[_C$ [*Ada and Bea*] $[_C$ [$\Uparrow$ *fed*] [*two pets*]]]

(76) For any type a: $[\![\Uparrow_a]\!] = \lambda x_a.[x]$

(77) provides the semantic composition for (75-a). The DP denotations are given in (77-a). For the VP, composition proceeds as follows: There are no proper pluralities in **[fed]**, so each plurality in the object plural set corresponds to exactly one cover, and CC reduces to applying **fed** to each atomic part of the pluralities of pets (77-b). This illustrates the 'projection' behavior of semantic plurality: $[\![$*fed two pets*$]\!]$ preserves the part structure introduced by $[\![$*two pets*$]\!]$ since the parts of the predicate sums correspond to the parts of the pet-pluralities. Next, CC applies to this predicate set and the set containing the sum of the two girls, resulting in the plural set of propositions in (77-c).

(77) a. $[\![$*Ada and Bea*$]\!] = [\mathbf{A} + \mathbf{B}]$; $[\![$*two pets*$]\!] = [\mathbf{C} + \mathbf{D}, \mathbf{C} + \mathbf{E}, \mathbf{D} + \mathbf{E}]$
b. $[\![$*fed two pets*$]\!] = C([\mathbf{fed}], [\![$*two pets*$]\!])$
$= C([\mathbf{fed}], [\mathbf{C} + \mathbf{D}, \mathbf{C} + \mathbf{E}, \mathbf{D} + \mathbf{E}])$
$= [\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D}), \mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{E}), \mathbf{fed}(\mathbf{D}) + \mathbf{fed}(\mathbf{E})]$
c. $[\![$(77-a)$]\!] = C([\![$*fed two pets*$]\!], [\![$*the two girls*$]\!])$
$= C([\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D}), \mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{E}), \mathbf{fed}(\mathbf{D}) + \mathbf{fed}(\mathbf{E})], [\mathbf{A} + \mathbf{B}])$
$= [\mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{B}), \mathbf{fed}(\mathbf{C})(\mathbf{B}) + \mathbf{fed}(\mathbf{D})(\mathbf{A}), \mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{B}), \ldots,$
$\mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{E})(\mathbf{B}), \mathbf{fed}(\mathbf{C})(\mathbf{B}) + \mathbf{fed}(\mathbf{E})(\mathbf{A}) \ldots]$

This system derives type t^* denotations for sentences containing pluralities – plural sets of propositions. These are mapped to truth conditions by the definition in (78):

(78) For any plural set p^* of type t^* and any $w \in W$:
a. p^* is **true** in w iff there is at least one $p \in p^*$ such that for all $q \leq_a p$, $q(w) = 1$.
b. p^* is **false** in w iff for all $p \in p^*$, there is at least one $q \leq_a p$ such that $q(w) = 0$.

For (75-a), we derive the same truth conditions as the traditional predicate-based analysis, although the compositional mechanism is radically different. But two main features set our mechanism apart from earlier proposals: First, expressions denoting pluralities of individuals (or other primitives) no longer have any special status concerning cumulativity – since all semantic domains contain pluralities, the constraints on cumulative readings should in principle be the same for all of them. This is illustrated by (79) (= (53)). We saw in Section 3.4 that earlier plural-based analyses like Krifka 1990 derive cumulative readings for VP-conjunctions, but crucially only if the conjunction and the plural it 'cumulates with' stand in a functor-argument relation. There is no such constraint in the present system, since CC applies at each 'intervening' node between the conjunction and other plural expressions, as shown schematically in (80). (For the actual derivation, our CC-rule needs to be expanded to intensional constructions, as in Schmitt 2019.) (80) also shows that unlike existing plural-based analyses of conjunction, the present system preserves the mereological structure introduced by a conjunction throughout the derivation. Thus, when the plural subject of the matrix clause combines with the matrix VP, it still has access to parts of the matrix VP's denotation that correspond to the conjuncts of the embedded predicate conjunction.

(79) *[$_{S2}$ The agencies think [$_{S1}$ that Trump should [$_{VP}$ talk to Putin and build a hotel in Tbilisi]]]*

(80) a. ⟦*VP*⟧ = **[talk to Putin + build a hotel in Tbilisi]**
b. ⟦*should VP*⟧ = **[should talk to Putin + should build a hotel in Tbilisi]**
c. ⟦*S1*⟧ = **[Trump should talk to Putin + Trump should build a hotel in Tbilisi]**
d. ⟦*think S1*⟧ = **[think(Trump should talk to Putin)+think(Trump should build a hotel in Tbilisi)]**
e. ⟦*the agencies*⟧ = **[a1 + a2]**
f. ⟦*S2*⟧ = **[think(Trump should talk to Putin)(a1)+think(Trump should build a hotel in Tbilisi)(a2), think(Trump should talk to Putin)(a2)+think(Trump should build a hotel in Tbilisi)(a1), . . .]**

The second distinctive property of our analysis is that we derive cumulativity directly from the independently motivated syntactic LF, without having to resort to syntactically derived cumulative relations (as in Beck & Sauerland 2000). This will allow us to account straightforwardly for the asymmetrical behavior of distributive conjunctions observed in Section 3.3.

4.3 Quantifier conjunctions and Plural Projection (Haslinger & Schmitt 2019)

In the present system, once a plural expression enters the semantic derivation, the default is that each node dominating it will be interpreted using CC. But CC is not *required* to apply all the way up: There could be elements that block the effects of CC, combining with a plural set via ordinary functional application. In fact, we have already encountered one such element – our denotation for COORD, which requires two plural sets as its arguments. We will now exploit this possibility to handle the asymmetrical behavior of quantifier conjunctions and D-conjunctions.

Note that, if *every* has the classical generalized quantifier denotation, our current system predicts that sentences like (81-a) should permit a cumulative reading of the quantifier conjunction even if each individual quantifier is distributive: The conjunction would denote a plural set of generalized quantifiers, **[**⟦*every boy*⟧ + ⟦*every girl*⟧**]**, which could combine with **[smoke + drink]** via CC. Since (81-c) is a legitimate cover of these two plural sets, the output of CC would contain the propositional plurality in (81-d), wrongly predicting (81-a) to be true in scenario (81-b).

(81) a. *Every boy and every girl smoked and drank.*
b. SCENARIO: Every boy smoked. Some boys did not drink. Every girl drank. Some girls did not smoke.
c. $\{\langle [\![\textit{every boy}]\!]_{\langle\langle e,t\rangle,t\rangle}, \textbf{smoke}\rangle, \langle [\![\textit{every girl}]\!]_{\langle\langle e,t\rangle,t\rangle}, \textbf{drink}\rangle\}$
d. ⟦*every boy*⟧(**smoke**) + ⟦*every girl*⟧(**drink**)

The key assumption needed to block this undesirable prediction is that quantificational DPs, including *every* DPs, denote functions that take a plural set as their argument. This will block CC from directly combining a quantifier conjunction with a plural set of predicates, making the derivation in (81) unavailable. We will first illustrate this proposal with quantifier conjunctions and then consider the analogous case of D-conjunctions.

Haslinger & Schmitt (2018b, 2019) provide a Plural Projection analysis of *every* that is tailored around its asymmetrical behavior with respect to cumulativity (see Section 3.3). The proposal has two main components: First, the nuclear scope of an *every* DP is a plural set of predicates, rather than a simple predicate. Second, the result of combining the meaning of an *every* DP with its nuclear scope is not a truth value or proposition, but yet another plural set. The individual elements of this set are computed in a way that encodes the D-reading, but it is still a plural denotation that can form the input for the CC rule. We will start by giving a suitable lexical meaning for *every* and then derive the behavior of quantifier conjunctions from the interaction of this meaning, the CC-rule and our semantics for COORD.

We first define the auxiliary operation $\mathcal{D}$, (82-a), which takes a predicate plurality and an argument of matching type and returns the sum of all the values obtained by applying atomic parts of the predicate plurality to the argument, as illustrated in (82-b). The result of combining *every* DP with a plural set of predicates can then be described as follows: We consider different ways of assigning an element of this plural set to every atomic individual from the NP denotation – here, every atomic girl. For each such assignment, we use $\mathcal{D}$ to combine each individual with its corresponding predicate plurality and then sum up the results across all individuals. Finally, the sums thus obtained are collected into one plural set. A more formal definition is given in (82-c) (see Haslinger & Schmitt 2019 for the DP-internal semantics) and illustrated with an example in (82-d). The plural set combined with the *every* DP in (82-d) – **[smoke + drink, dance]**, corresponding roughly to the VP disjunction [*smoke and drink*] *or dance* – contains two elements, so that in total there are four ways of assigning predicate pluralities to the two girls **A** and **B**. Our sentence denotation is therefore the plural set in (82-d). Since the propositional pluralities are based on the output of the $\mathcal{D}$ operator rather than the covers usually considered by CC, the plural set in (82-d) only counts as true if each girl satisfies one of the predicate pluralities **smoke + drink** and **dance**. Thus, (82-d) is true in scenario (82-e), but not in scenario (82-f).

(82) a. For any $P_{\langle a,b\rangle}, x_a$: $\mathcal{D}(P, x) = +(\{Q(x) \mid Q \leq_a P\})$
b. $\mathcal{D}(\mathbf{smoke} + \mathbf{drink}, \mathbf{A}) = \mathbf{smoke}(\mathbf{A}) + \mathbf{drink}(\mathbf{A})$
c. $[\![\textit{every girl}]\!] = \lambda R^*_{\langle e,a\rangle^*}.[+(\{\mathcal{D}(f(x), x) \mid \mathbf{girl}(x)\})|\ f$ is a function from $\mathbf{girl}$ to $pl^{*-1}(R^*)]$
d. For $\mathbf{girl} = \{\mathbf{A} + \mathbf{B}\}$:
$[\![\textit{every girl}]\!]([\mathbf{smoke}{+}\mathbf{drink}, \mathbf{dance}]) = [\mathbf{smoke}(\mathbf{A}){+}\mathbf{drink}(\mathbf{A}){+}\mathbf{smoke}(\mathbf{B}){+}\mathbf{drink}(\mathbf{B}), \mathbf{smoke}(\mathbf{A}){+} \mathbf{drink}(\mathbf{A}) + \mathbf{dance}(\mathbf{B}), \mathbf{dance}(\mathbf{A}) + \mathbf{smoke}(\mathbf{B}) + \mathbf{drink}(\mathbf{B}), \mathbf{dance}(\mathbf{A}) + \mathbf{dance}(\mathbf{B})]$
e. SCENARIO: Ada smoked and drank. Bea danced. (82-d) **true**
f. SCENARIO: Ada smoked, but did not drink. Bea danced. (82-d) **false**

On this analysis, *every* DPs denote operators that map a plural set of some type $\langle e, a\rangle^*$ to a plural set of type a^*. The result of combining these operators with their argument is a plural denotation which nonetheless encodes distributivity. The availability of such denotations is what allows us to capture the cumulativity asymmetries associated with *every* DPs.

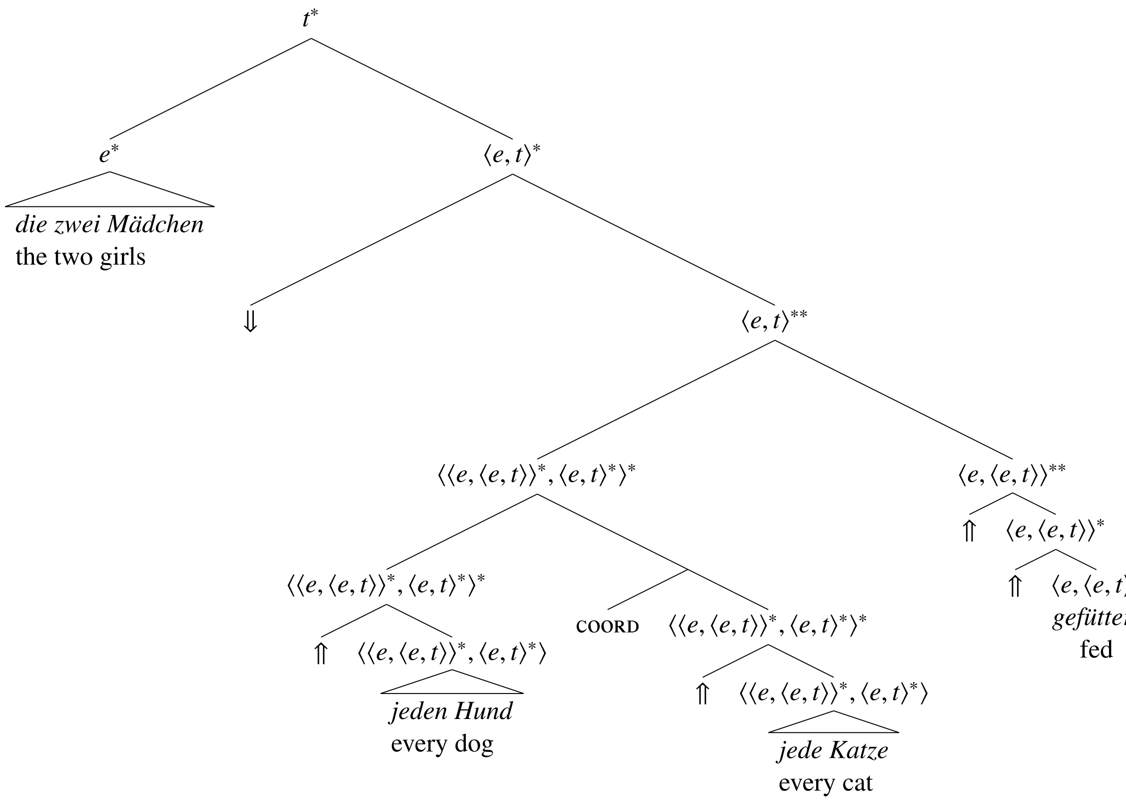
Our next step is to extend the analysis to conjunctions of *every* DPs – using the German examples in (83), repeated from Section 3.3 – since our analysis of D-conjunctions will be modeled on such constructions.

(83) a. *Die zwei Mädchen haben jeden Hund und jede Katze gefüttert.*
'The two girls fed every dog and every cat.'
b. *Jeder Bub und jedes Mädchen hat die zwei Hunde gefüttert.*
'Every boy and every girl fed the two dogs.'

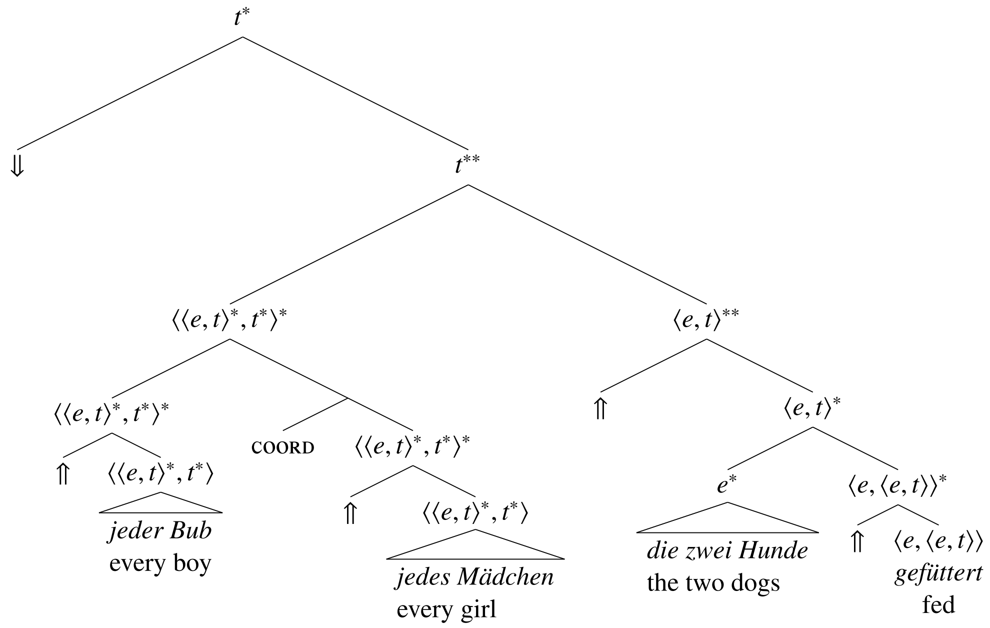
The respective LFs are sketched in (84-a,b). They include several instances of the type-shifting operations $\Uparrow$ and $\Downarrow$, which mediate between singleton plural sets and their elements.[22]

[22]For our purposes, it is irrelevant whether these shifts are encoded in the syntax.

(84) a.



b.



We start with (84-b). Due to our generalized notion of plurality, the denotations of *every* DPs – distributive operators of type $\langle\langle e,a\rangle^*, a^*\rangle$ – can be atomic parts of a plurality. Such pluralities allow us to integrate quantifier conjunctions into a plural analysis of conjunctions. However, as our lexical entry for COORD requires plural sets as its arguments, the two distributive operators must first be shifted to singleton plural sets via $\Uparrow$ (see (76)). This gives us the denotation in (85) for the quantifier conjunction.

(85) $[\![\textit{every boy and every girl}]\!] = [[\![\textit{every boy}]\!]] \oplus [[\![\textit{every girl}]\!]] = [[\![\textit{every boy}]\!] + [\![\textit{every girl}]\!]]$
$= [\lambda R^*_{\langle e,a\rangle^*}.[\boldsymbol{+}(\{\mathcal{D}(f(x),x) \mid \mathbf{girl}(x)\})\mid f \text{ is a function from } \mathbf{girl} \text{ to } pl^{*-1}(R^*)]$
$+ \lambda R^*_{\langle e,a\rangle^*}.[\boldsymbol{+}(\{\mathcal{D}(f(x),x) \mid \mathbf{boy}(x)\})\mid f \text{ is a function from } \mathbf{boy} \text{ to } pl^{*-1}(R^*)]]$

Next, we combine this conjunction with its nuclear scope, which receives the meaning in (86) via the CC-mechanism:

(86) $[\![\textit{fed the two dogs}]\!] = \mathbf{[fed(C) + fed(D)]}$

But we now face a type mismatch. Since (85) is a plural set, it cannot combine with (86) via regular functional application. But neither can we directly apply CC: Distributive operators – including the two parts of the plurality in (85) – require a plural set as their argument. So the whole set in (86) would be a suitable argument for each atomic part of the function plurality in (85), but the CC-rule applies atomic parts of the pluralities in the function set to *atomic parts of the pluralities in the argument set*. The atomic parts of the predicate plurality in (86) are ordinary non-plural predicates and therefore cannot form the input for any part of the function plurality in (85).

The type mismatch is resolved by again appealing to the shift $\Uparrow$: Applying it to the set in (86) yields a denotation of yet higher type, a plural set of plural sets, (87). This set can combine with (85) via CC.

(87) $[\![\Uparrow \textit{fed the two dogs}]\!] = \mathbf{[[fed(C) + fed(D)]]}$

Ignoring the internal structure of the two plural sets in (85) and (87) for the moment, this is how the CC-rule applies to them: (87) is a singleton containing an atomic element of $D_{\langle e,t\rangle^*}$, so it lacks any relevant part structure. (85) is also a singleton, but its element has two parts – the distributive operators expressed by *every boy* and *every girl*. So there is a unique cover, given in (88):

(88) $\{\langle [\![\textit{every boy}]\!], [\![\textit{fed the two dogs}]\!]\rangle, \langle [\![\textit{every girl}]\!], [\![\textit{fed the two dogs}]\!]\rangle\}$

The fact that this is the only cover already goes part of the way towards deriving the distributivity requirement of (84-b). CC now performs functional application for each pair in the cover, sums up the results by means of the recursive sum operation $\oplus$ and puts this sum into a plural set. If **A** and **B** are the only girls and **E** and **F** the only boys, the results of composing the individual pairs in the cover (88) are the two plural sets sketched in (89-a) and (89-b).

(89) a. $[\![\textit{every girl}]\!]([\![\textit{fed the two dogs}]\!]) = \mathbf{[fed(C)(A) + fed(D)(A) + fed(C)(B) + fed(D)(B)]}$
b. $[\![\textit{every boy}]\!]([\![\textit{fed the two dogs}]\!]) = \mathbf{[fed(C)(E) + fed(D)(E) + fed(C)(F) + fed(D)(F)]}$

Next, CC instructs us to form a set containing the recursive sum of (89-a) and (89-b). As discussed above, when $\oplus$ applies to plural sets, it returns all the pluralities formed by selecting an element from each of the sets and summing them up. Since we are dealing with singleton sets, there is only one such plurality and we obtain the denotation in (90), a singleton plural set of plural sets. This type is too high to be mapped to a truth value, so we introduce an operator that can apply whenever a singleton plural set contains another plural set and reduces this complex denotation to a simple plural set, (91).

(90) $\mathbf{[[fed(C)(A) + fed(D)(A) + fed(C)(B) + fed(D)(B)] \oplus [fed(C)(E) + fed(D)(E) + fed(C)(F) + fed(D)(F)]]}$
$= \mathbf{[[fed(C)(A) + fed(D)(A) + fed(C)(B) + fed(D)(B) + fed(C)(E) + fed(D)(E) + fed(C)(F) + fed(D)(F)]]}$

(91) a. $[\![\Downarrow]\!] = \lambda p^*_{a^{**}} : |pl^{*-1}(p^*)| = 1.\iota x.x \in pl^{*-1}(p^*)$
b. $[\![\Downarrow]\!](\mathbf{[[x]]}) = \mathbf{[x]}$

Ultimately, (84-b) ends up denoting a singleton plural set containing a sum of propositions. This sum encodes distributivity, since for every individual boy or girl and each of the two dogs, it contains the proposition that the respective boy or girl fed the dog, and (92) counts as true only if each of the individual propositions in the sum is true.

(92) $[\![\Downarrow]\!]((90)) = [\mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{A}) + \mathbf{fed}(\mathbf{C})(\mathbf{B}) + \mathbf{fed}(\mathbf{D})(\mathbf{B}) + \mathbf{fed}(\mathbf{C})(\mathbf{E}) + \mathbf{fed}(\mathbf{D})(\mathbf{E}) + \mathbf{fed}(\mathbf{C})(\mathbf{F}) + \mathbf{fed}(\mathbf{D})(\mathbf{F})]$

In (84-a), where the quantifier conjunction occurs in object position, its syntactic sister is the non-plural predicate *fed*. Since each atomic part of the quantifier plurality in (93) must combine with a plural set, we have to shift $[\![fed]\!]$ via $\Uparrow$ twice before the CC rule applies. The result is **[[fed]]**, a singleton with a non-plural element, so the only available cover is the one in (94). If **C** and **D** are the dogs and **E** and **F** the cats, the results of functional application for the pairs in this cover are given in (95). Therefore, CC again returns a singleton higher-type plural set, (96-a), which can then be shifted to (96-b) via $\Downarrow$.

(93) $[\![\textit{every dog and every cat}]\!] = [[\![\textit{every dog}]\!] + [\![\textit{every cat}]\!]]$

(94) $\{\langle[\![\textit{every dog}]\!], [\mathbf{fed}]\rangle, \langle[\![\textit{every cat}]\!], [\mathbf{fed}]\rangle\}$

(95) a. $[\![\textit{every dog}]\!]([\mathbf{fed}]) = [\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})]$
b. $[\![\textit{every cat}]\!]([\mathbf{fed}]) = [\mathbf{fed}(\mathbf{E}) + \mathbf{fed}(\mathbf{F})]$

(96) a. $[[\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})] \oplus [\mathbf{fed}(\mathbf{E}) + \mathbf{fed}(\mathbf{F})]]$
$= [[\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D}) + \mathbf{fed}(\mathbf{E}) + \mathbf{fed}(\mathbf{F})]]$
b. $[\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D}) + \mathbf{fed}(\mathbf{E}) + \mathbf{fed}(\mathbf{F})]$

The predicate *fed every dog and every cat* thus ends up denoting a plural set of unary predicates of individuals. We can now take advantage of the fact that our system permits distributive operators that return plural denotations. The subject in (84-a) is a plural definite, of type e^*. The meaning in (96-b) has exactly the right type to combine with this subject via the CC-rule. This time, the rule applies non-trivially, as there are various covers matching up the two girls – **A** and **B** – with the parts of the predicate plurality. We end up with the plural set of propositions in (97), which corresponds to a 'fully cumulative' reading: The sentence is true iff each of the two girls fed at least one dog or cat and each dog or cat was fed by at least one girl.

(97) $[\mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{A}) + \mathbf{fed}(\mathbf{E})(\mathbf{B}) + \mathbf{fed}(\mathbf{F})(\mathbf{B}),$
$\mathbf{fed}(\mathbf{C})(\mathbf{A}){+}\mathbf{fed}(\mathbf{D})(\mathbf{A}){+}\mathbf{fed}(\mathbf{E})(\mathbf{A}){+}\mathbf{fed}(\mathbf{F})(\mathbf{B}), \mathbf{fed}(\mathbf{C})(\mathbf{B}){+}\mathbf{fed}(\mathbf{D})(\mathbf{A}){+}\mathbf{fed}(\mathbf{E})(\mathbf{A}){+}\mathbf{fed}(\mathbf{F})(\mathbf{B}), \ldots]$

Summing up, the Plural Projection theory accounts for the asymmetrical behavior of quantifier conjunctions that permit cumulative readings relative to structurally higher, but not structurally lower plural expressions. To capture this data pattern, we needed to address two problems: First, given the availability of quantifier pluralities and the plural-based lexical meaning for conjunction, how do we block the conjuncts of a quantifier conjunction from cumulating with conjuncts of a predicate conjunction, thus licensing unattested cumulative readings relative to lower plurals? Second, if (some) quantifiers are distributive operators, how can we even make sense of the idea that the result of combining these operators with their nuclear scope is a plural denotation that participates in cumulativity?

Regarding the first problem, we took the nuclear scope argument of quantifiers like *every* DPs to be a plural set of predicates rather than a simple predicate; therefore, any attempt to directly apply the CC rule to a quantifier conjunction and a predicate conjunction yields a type mismatch. When we used an independently motivated type-shift to resolve the mismatch, the result amounted to combining each conjunct separately with the plural set of predicates. Thus, the interaction of the CC-rule and the type system derives a 'distributive effect' although the meaning of conjunction itself is plural-based.

The second problem was addressed by introducing higher-type pluralities and assuming that quantifiers, like other distributive operators, can return a higher-type plural set – which can 'cumulate' with structurally higher plural expressions – rather than a simple property or proposition. The D-reading is encoded in the mereological structure of this plural set. Thus, while the analysis in Mitrović & Sauerland (2016) crucially relies on the idea that a plural-related meaning for conjunction is incompatible with conjuncts of quantifier type, our account integrates distributive quantification and semantic plurality into a single compositional mechanism. Distributivity simply amounts to a slightly different way of computing a plural denotation.

4.4 Extending the analysis to D-conjunctions

We can now derive the connection between quantifier type and distributivity (Section 3) while maintaining the conclusion of Section 2 that the meaning of COORD is uniformly plural-based. The parallels between quantifier conjunctions and D-conjunctions motivated in Section 3 led us to argue that the latter also denote quantifier pluralities. We now put the pieces together and extend our account of quantifier conjunctions to D-conjunctions.

4.4.1 D-conjunctions and cumulativity asymmetries

While we maintain that μ-particles shift individual-denoting conjuncts to quantifiers, we will not identify this shift with the traditional 'Montague lift', since quantifiers in our system must interrupt the CC-mechanism. To model the distributive effect of quantifiers like *every*, we assumed that they require a plural set of some type $\langle e, a\rangle^*$ as their argument, mapping it to another plural set of type a^*. (98) gives a lexical entry for the abstract morpheme μ with a similar effect.

(98) Conjunction particles
$[\![\mu_{\langle e^*,\langle\langle e,a\rangle^*,a^*\rangle\rangle}]\!] = \lambda x^*_{e^*}.\lambda P^*_{\langle e,a\rangle^*}.C(P^*, x^*)$

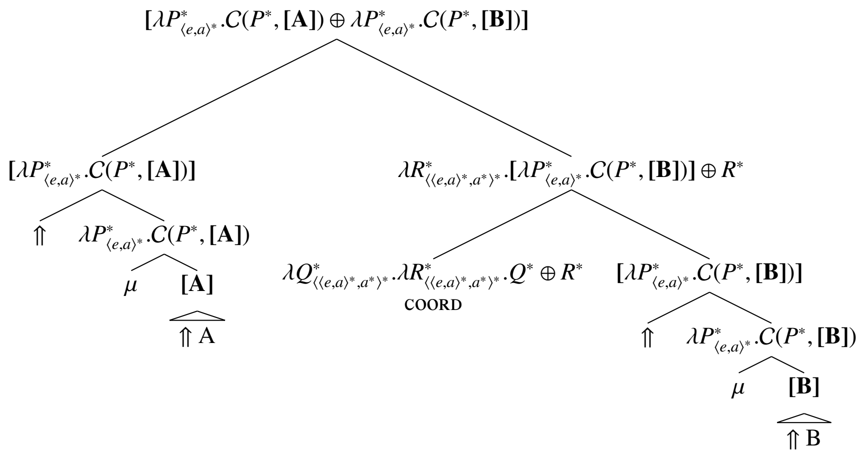
(98) is slightly more general than the examples in this paper would require: It permits the conjuncts affixed with μ-particles to denote 'non-trivial' plural sets of individuals. This is motivated by the properties of D-conjunctions with plural conjuncts, like German *sowohl die Mädchen als auch die Buben* 'the girls as well as the boys' (Haslinger & Schmitt 2019), but we won't go into the details of such examples here and concentrate on deriving the distributivity requirement of D-conjunctions from (98).

The basic contrast we are interested in is schematized in (99), where A, B, C and D are singular proper names. We must derive that (99-a) with the D-conjunction in subject position is restricted to a distributive interpretation, while (99-b) permits a cumulative reading since the D-conjunction is c-commanded by a plural expression, the unmarked conjunction.

(99) a. [[[μ A] [COORD [μ B]]] [*fed* [C [COORD D]]]] **distributive/*cumulative**
b. [[A [COORD B]] [*fed* [[μ C] [COORD [μ D]]]]] **distributive/cumulative**

We start with an illustration of the internal semantics of D-conjunctions. The full LF is given in (100):

(100)



This structure is interpreted as follows. Before they combine with the μ-particles, the individuals **A** and **B** must be shifted to singleton plural sets:

(101) a. $[\![\mu\ [\Uparrow A]]\!] = [\![\mu]\!]([\mathbf{A}]) = \lambda P^*_{\langle e,a\rangle^*}.C(P^*,[\mathbf{A}])$
b. $[\![\mu\ [\Uparrow B]]\!] = \lambda P^*_{\langle e,a\rangle^*}.C(P^*,[\mathbf{B}])$

μ maps each conjunct to a function that requires a plural set of predicates. As with *every* DPs, we apply $\Uparrow$ to each of these modified conjuncts so that they can combine with COORD. The entire conjunction then denotes a plural set containing a sum of two quantifiers, (102).

(102) $[\![\text{COORD}]\!]([\lambda P^*_{\langle e,a\rangle^*}.C(P^*,[\mathbf{B}])])([\lambda P^*_{\langle e,a\rangle^*}.C(P^*,[\mathbf{A}])])$
$= [\lambda P^*_{\langle e,a\rangle^*}.C(P^*,[\mathbf{A}]) + \lambda P^*_{\langle e,a\rangle^*}.C(P^*,[\mathbf{B}])]$

Given the high type of the conjunction, the cumulativity asymmetry from (99) falls out in the same way as the analogous pattern for quantifier conjunctions. In (99-a) the D-conjunction occurs in subject position, with a plural in object position. Our mechanism yields the denotation in (103) for the predicate conjunction – a plural set of type $\langle e,t\rangle^*$. While this is an adequate argument for the individual quantifiers in the sum in (102), it cannot directly combine with (102) via CC. As in Section 4.3, we therefore apply $\Uparrow$ to the predicate and obtain the singleton plural set in (104).

(103) $[\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})]$

(104) $[\![\Uparrow]\!]((103)) = [[\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})]]$

The only cover of the two plural sets in (102) and (104) is the one in (105), which relates each quantifier to the entire VP denotation. Performing functional application for both pairs in the cover yields the plural sets in (106), which are then summed up via the recursive sum operation. The ultimate output of CC is given in (107-a). Since the type of (107-a) is too high to give us truth conditions, we apply $\Downarrow$ to get a plural set of propositions (107-b).

(105) $\{\langle \lambda P^*_{\langle e,a\rangle^*}.C(P^*,[\mathbf{A}]), [\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})]\rangle, \langle \lambda P^*_{\langle e,a\rangle^*}.C(P^*,[\mathbf{B}]), [\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})]\rangle\}$

(106) a. $C([\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})],[\mathbf{A}]) = [\mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{A})]$
b. $C([\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})],[\mathbf{B}]) = [\mathbf{fed}(\mathbf{C})(\mathbf{B}) + \mathbf{fed}(\mathbf{D})(\mathbf{B})]$

(107) a. $[[\mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{A}) + \mathbf{fed}(\mathbf{C})(\mathbf{B}) + \mathbf{fed}(\mathbf{D})(\mathbf{B})]]$

b. $[\mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{A}) + \mathbf{fed}(\mathbf{C})(\mathbf{B}) + \mathbf{fed}(\mathbf{D})(\mathbf{B})]$

As in the case of quantifier conjunctions, the propositional plurality in (107-b) encodes the D-reading: (107-b) is only true if each of **A** and **B** fed both **C** and **D**.

In (99-b), the D-conjunction occurs in object position and is c-commanded by a plural. We must first combine the denotation of the D-conjunction, (108), with the predicate **fed**: We apply $\Uparrow$ twice, mapping the predicate to the higher-type plural set **[[fed]]**. This set composes with (108) via CC, yielding a plural set of plural sets of predicates (109-a), which is reduced to a simple plural set of predicates (109-b).

(108) $[\lambda P^*_{\langle e,a\rangle^*}.C(P^*, [\mathbf{C}]) + \lambda P^*_{\langle e,a\rangle^*}.C(P^*, [\mathbf{D}])]$

(109) a. $[C([\mathbf{fed}], [\mathbf{C}]) \oplus C([\mathbf{fed}], [\mathbf{D}])]$
$= [[\mathbf{fed}(\mathbf{C})] \oplus [\mathbf{fed}(\mathbf{D})]]$
$= [[\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})]]$

b. $[\![\Downarrow]\!]([[\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})]]) = [\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})]$

(109) highlights a crucial trait of the system: When D-conjunctions combine with their syntactic sisters via the CC-rule, the result is a plural set that preserves the part-whole structure intuitively associated with the conjunction. The way this plural set is computed reflects the distributivity requirement of the conjunction, but it is not precluded from combining with a higher plural – like the conjunction in the subject position of (99-b) – via CC, as illustrated in (110). We thus correctly predict cumulativity asymmetries for D-conjunctions: (110) is mapped to true in 'cumulative' scenarios, e.g., if **A** fed **C** and **B** fed **D**.

(110) $C([\mathbf{fed}(\mathbf{C}) + \mathbf{fed}(\mathbf{D})], [\mathbf{A} + \mathbf{B}])$
$= [\mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{B}), \mathbf{fed}(\mathbf{C})(\mathbf{B}) + \mathbf{fed}(\mathbf{D})(\mathbf{A}), \mathbf{fed}(\mathbf{C})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{A}) + \mathbf{fed}(\mathbf{D})(\mathbf{B}), \dots]$

4.4.2 D-conjunctions in Schein sentences

It should be evident that our semantics also accounts for the 'two-faced' behavior of D-conjunctions in Schein sentences like (111): We predict D-conjunctions to (a) be obligatorily distributive relative to lower plurals and (b) be able to cumulate with higher plurals. However, Schein sentences present a particular complication: While the lowest plural is scopally dependent on the D-conjunction, its part structure must be accessible, in some sense, for the plural subject (see Schein 1993, Kratzer 2003, Ferreira 2005, Champollion 2010, Haslinger & Schmitt 2018b, 2019). As scenario (111-b) shows, all the sentence requires to be true is that each dog was taught two tricks, each of these two tricks was taught to it by *at least one* of the two girls, and each of the girls participated in the teaching. Importantly, a simple cumulative relation between the girls and the dogs would not capture this reading, since a dog might have learned his two tricks from different girls. Rather, we need to take the mereological structure introduced by *two tricks* into account to get the truth conditions right.

(111) a. Scenario: Ada taught Carl tricks 1 and 2. Ada taught Dean trick 3 and Bea taught Dean trick 2.

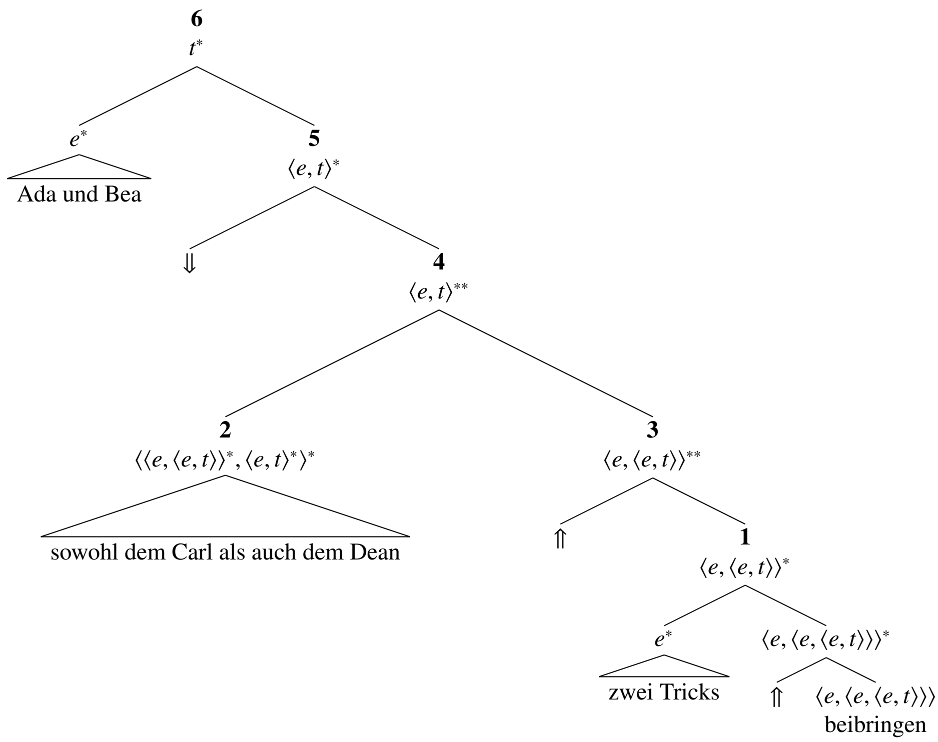
b. *Die Ada und die Bea haben sowohl dem Carl als auch dem Dean zwei neue Tricks beigebracht.*
'Ada and Bea taught both Carl and Dean two new tricks'

Thus, we intuitively want the plural subject to be in a cumulative relation with an element of the plural set indicated in (112).

(112) **[teach C T1 + teach C T2 + teach D T2+ teach D T3, teach C T1 + teach C T2 + teach D T1+ teach D T3, . . .]**

Because combining pluralities of quantifiers with plurals in their scope preserves the part-whole structure associated with the quantifier conjunction – and this structure in turn reflects the part-whole structure of scopally dependent pluralities – our system can deal with such data: (111-b) is assigned the LF in (113), which in turn is interpreted as in (114). As shown in (114-e), the result of combining the D-conjunction with its scope is a plural set of predicates with the structure in (112). The plural set of propositions we eventually arrive at in (114-f) is mapped to true iff Carl was taught two tricks, Dean was taught two tricks and Ada and Bea cumulatively did the teaching – which are the correct truth-conditions.

(113)



(114) a. $[\![\mathbf{1}]\!] = C([\![\textit{beibringen}]\!], [\![\textit{zwei Tricks}]\!]) = C(\mathbf{[teach]}, \mathbf{[t1 + t2, t2 + t3, t1 + t3]}) =$ $\mathbf{[teach(t1) + teach(t2), teach(t2) + teach(t3), teach(t2) + teach(t3)]}$

b. $[\![\mathbf{2}]\!] = [\lambda P^*_{\langle e,t\rangle^*}.C(P^*, \mathbf{[Carl]}) \oplus \lambda P^*_{\langle e,t\rangle^*}.C(P^*, \mathbf{[Dean]})]$

c. $[\![\mathbf{3}]\!] = [\![\Uparrow]\!]([\![\mathbf{1}]\!]) = \mathbf{[[teach(t1) + teach(t2), teach(t2) + teach(t3), teach(t2) + teach(t3)]]}$

d. $[\![\mathbf{4}]\!] = C([\![\mathit{2}]\!], [\![\mathit{3}]\!])$

(i) $= [C(\mathbf{[teach(t1) + teach(t2), teach(t1) + teach(t3), teach(t2) + teach(t3)], [Carl]}) \oplus$ $C(\mathbf{[teach(t1) + teach(t2), teach(t1) + teach(t3), teach(t2) + teach(t3)], [Dean]})]$

(ii) $= \mathbf{[[teach(t1)(C) + teach(t2)(C), teach(t1)(C) + teach(t3)(C), teach(t2)(C) + teach(t3)(C)]} \oplus$ $\mathbf{[teach(t1)(D) + teach(t2)(D), teach(t1)(D) + teach(t3)(D), teach(t2)(D) + teach(t3)(D)]]}$

(iii) $= \mathbf{[[teach(t1)(C) + teach(t2)(C) + teach(t1)(D) + teach(t2)(D),}$ $\mathbf{teach(t2)(C) + teach(t3)(C) + teach(t1)(D) + teach(t2)(D),}$ $\mathbf{teach(t1)(C) + teach(t2)(C) + teach(t2)(D) + teach(t3)(D), \ldots]]}$

e. $[\![\mathbf{5}]\!] = [\![\Downarrow]\!]([\![\mathbf{4}]\!])$
$= \mathbf{[teach(t1)(C) + teach(t2)(C) + teach(t1)(D) + teach(t2)(D),}$
$\mathbf{teach(t2)(C) + teach(t3)(C) + teach(t1)(D) + teach(t2)(D),}$
$\mathbf{teach(t1)(C) + teach(t2)(C) + teach(t2)(D) + teach(t3)(D), \ldots]}$

f. $[\![6]\!] = C([\![5]\!], [\![\textit{Ada und Bea}]\!]) = C([\![5]\!], \mathbf{[Ada + Bea]})$
$= \mathbf{[teach(t1)(C)(A) + teach(t2)(C)(A) + teach(t1)(D)(B) + teach(t2)(D)(B),}$
$\mathbf{teach(t2)(C)(A) + teach(t3)(C)(A) + teach(t1)(D)(B) + teach(t2)(D)(A),}$
$\mathbf{teach(t1)(C)(A) + teach(t2)(C)(A) + teach(t2)(D)(B) + teach(t3)(D)(A), \ldots]}$

4.5 Interim summary

We provided an analysis of D-conjunctions which follows Haslinger & Schmitt 2019 and encodes the insights from the previous sections, namely that the denotation of COORD is uniformly plural-based, that the distributivity requirement of D-conjunctions is due to the μ-particles, and that the plural core of D-conjunctions becomes visible whenever such a conjunction is c-commanded by another plural expression. The analysis employs the Plural Projection framework, which posits pluralities and plural sets for any semantic domain and furthermore encodes cumulativity by a compositional rule. The availability of 'higher-order' pluralities allowed us to formulate a new cross-categorial semantics for COORD, which combines plural sets of arbitrary type by summing up their elements in a 'point-wise' way. This generalization enabled us to tackle the 'two-faced' behavior of quantifier conjunctions and D-conjunctions: They denote plural sets containing pluralities with 'special' parts, namely, functions that block the cumulative composition rule. The μ-particles in D-conjunctions are responsible for mapping the individuals to such functions. As a result, when such a conjunction combines with its scope argument, each conjunct applies to the entire plural set denoted by that argument, giving us distributivity relative to lower plural expressions. Since the result of this compositional step is another plural set, it is available for further applications of the cumulative composition rule, which derives the availability of cumulative readings relative to higher plurals.

5 Predictions for other types of conjunction

In many languages, the formal strategies for conjunction 'spread' to semantic categories other than individuals (or quantifiers), like unary predicates (VP denotations) or propositions (denotations of embedded clauses).[23] This concerns the morphosyntactic realization of COORD, but also, in some languages, the strategies involving μ-particles.[24]

Since our semantics for COORD is cross-categorial and there is no principled reason why our semantics for μ-particles shouldn't be, we make two cross-linguistic predictions for languages that employ formally identical strategies for individual conjunction and predicate conjunction, or for individual and propositional conjunction. We will now briefly address their status in light of our current data set.

5.1 'Unmarked' conjunctions of predicates and propositions

First, given that our lexical entry for COORD is plural-based *and* cross-categorial, we would expect that if languages employ the same form for COORD for predicate-denoting VPs, then 'unmarked' conjunctions of such VPs should also permit cumulativity with respect to other plural expressions in the sentence.

As mentioned in Section 3.4, English and German, which both employ the same coordinator throughout, permit cumulative construals of VP-conjunctions – in fact this was one of the motivations for cross-

[23] See below and Schmitt to appear for discussion of the generalizations in Haspelmath 2013.

[24] We therefore disagree with Mitrović & Sauerland's 2016 assumption that μ-particles are inherently connected to individual conjunction. In the same vein, Szabolcsi (2015) points out that in several languages (e.g. Hungarian and Russian), the μ-particles found in individual-type D-conjunctions can also appear in conjunctions of root clauses.

categorial plural-based analyses of COORD: (115) can be true if half of the children danced and the other half smoked.[25]

(115) *The ten children smoked and danced.*

Our current sample regarding VP-conjunction (`http://test.terraling.com/groups/8/properties/679`) contains data from 13 languages from 5 major language families. No language in this sample prohibits cumulative readings of VP-conjunction relative to a plural subject. While some languages lack VP-conjunction altogether or use different coordinators, 11 languages (from the Indo-European, Uralic, Semitic and Austronesian families) use the same formal realization of COORD in individual and VP-conjunction. (116) gives an example from Polish: The sentence can be true in a scenario where woman 1 smoked, woman 2 danced and woman 3 sang.

(116) *Te trzy kobiety wczoraj paliły (i) tańczyły i piły.*
these three women yesterday smoke.PAST.PL (and) dance.PAST.PL and drink.PAST.PL
'These three women were smoking (and) dancing and drinking yesterday.' [26]

This preliminary result is thus compatible with our predictions, but the Plural Projection mechanism makes further cross-linguistic predictions that have not been tested in detail. For instance, since it treats propositional conjunctions as pluralities, it predicts that if COORD is realized in the same way in 'unmarked' conjunctions of embedded clauses and of individual-denoting expressions, cumulative readings of embedded clausal conjunctions should be available. Schmitt (2013, 2018, 2019) shows that this is correct for English and German: The sentence S in (117) is true in a scenario where one agency claimed that **p** and the other claimed that **q**.[27]

(117) *The agency from Paris called and the one from Berlin. [$_S$ [$_A$ The agencies] claimed [$_B$ [that Macron was considering his resignation]$_p$ and [(that) Merkel hired 10 new bodyguards]$_q$]], but neither had anything to say about the Brexit negotiations.* (Schmitt 2018)

While we are currently extending our TerraLing survey to such examples, we so far only have data from one non-Germanic language: SerBoCroatian, which allows for a cumulative interpretation of 'unmarked' conjunctions of embedded clauses: (118) is true in a scenario where Maja believes that Lea studies French and Ina believes that Sofija regularly goes swimming.

(118) *Maja i Ina veruju da Lea studira francuski*
Maja.NOM and Ina.NOM believe.PRES-3PL that Lea.NOM studies.PRES-3SG French
i da Sofija redovno pliva.
and that Sofija.NOM regularly swims.PRES-3SG
Maja and Ina believe that Lea studies French and that Sofija regularly goes swimming. (Jovana Gajić[28])

This is again in line with our expectations, but we clearly need a broader cross-linguistic data set to see whether our prediction is borne out.

[25] Our examples here are also within the scope of '*e*-based' analyses like Krifka's 1990, as the predicate conjunction and the argument conjunction are in a functor-argument relation. We argued above that the '*e*-based' approach is not general enough for English and German; our goal here is to provide additional data that are compatible with the predictions of our proposal.

[26] `http://test.terraling.com/groups/8/examples/22329`

[27] See Schmitt 2018, 2019 for arguments that such cases are not reducible to 'collective' attitudes.

[28] `http://test.terraling.com/groups/8/lings/1083`

5.2 D-conjunctions of predicates and propositions

A possibly even more interesting prediction of our proposal concerns languages where a 'marked' strategy for D-conjunctions of individual-denoting expressions extends to VP-conjunctions and conjunctions of embedded clauses (i.e. both the realization of COORD *and* of the μ-particles are the same across categories). In such languages, if the 'marked' D-conjunction strategy for individuals exhibits cumulativity asymmetries (see Section 3.2), we expect analogous behavior for 'marked' conjunctions of other types.

More specifically, assuming a default configuration where subjects asymmetrically c-command the VP, we predict that the 'marked' structure should never be limited to a D-reading relative to a plural subject – because the subject is syntactically higher and we expect cumulativity asymmetries to follow the same schema across categories. Again, our very preliminary data set (9 languages from 3 major language families, `http://test.terraling.com/groups/8/properties/682`) suggests that this prediction might be on the right track. The D-conjunction strategy *i A i B* from Polish (see Section 3.2), when occurring in a VP-conjunction as in (119), loses its distributivity requirement: The sentence in (119) has exactly the same truth-conditions as the sentence with the 'unmarked' conjunction in (116) above. The same extends to the 'marked' patterns *sowohl A als auch B* in German and *nii A, B kui (ka) C* in Estonian (see `http://test.terraling.com/groups/8/properties/682`). This ties in with our predictions.

(119) *Te trzy kobiety wczoraj i paliły i tańczyły i piły.*
'These three women were smoking, dancing and drinking yesterday.'[29]

As for clausal conjunctions, for languages of the aforementioned type, we expect D-conjunctions of embedded clauses to have cumulative readings relative to plural expressions in the matrix clause – a hypothesis to be tested in future work, as we still lack informative data.

Accordingly, our very preliminary results support the cross-linguistic predictions of our cross-categorial system. Sparse as the data are, it is worth pointing out that these facts are neither predicted nor derived by any other analysis of COORD and μ-particles.

6 Conclusion and Outlook

This paper made three major points. First, on the basis of a cross-linguistic survey, we argued that the lexical meaning of COORD (i.e. 'basic' conjunctive morphology) in individual conjunction is plural-based, rather than intersective, thus making a new contribution to an ongoing debate in semantics. Essentially, our data showed that 'more marking' on a conjunction can never block the D-reading, but may block the cumulative reading, suggesting that the D-reading is the derived one.

Our second claim concerned the properties of conjunction patterns that impose a distributivity requirement in subject position, so-called D-conjunctions. Our first claim, that the lexical meaning of COORD is plural-based, raises the analytical problem how we can derive this requirement. A closer look at the interpretation of D-conjunctions in different syntactic configurations revealed that in some languages, their semantics must have a 'plural core', since they permit cumulative interpretations relative to structurally higher plurals. This behavior is shared by quantifier conjunctions in several languages, which led us assume (following Mitrović & Sauerland (2016)) that the 'extra markers' – the μ-particles – shift the individual conjuncts to quantifier type. However, we depart from their work – and other recent work on μ-particles – in that we do not assume an intersective interpretation for the resulting quantifier conjunctions: Our other observations showed that even D-conjunctions and quantifier conjunctions should denote pluralities.

[29] `http://test.terraling.com/groups/8/examples/22314`

Our solution of this puzzle – how can we have a plural expression which, at the same time, imposes a distributivity requirement relative to syntactically lower plural expressions? – comprises our third claim: We adapted the Plural Projection mechanism (Schmitt 2018, Haslinger & Schmitt 2018b), and in particular Haslinger & Schmitt's 2019 treatment of distributive conjunctions. In this system, all semantic domains contain pluralities and cumulativity is encoded in the compositional mechanism. Crucially, the system makes a cross-categorial, plural-based lexical meaning for COORD available, allowing us to form pluralities of distributive operators. Because these operators require a plural set as their argument, they essentially block the cumulative composition mechanism when they combine with their nuclear scope. But since combining a conjunction of distributive operators with its scope yields another 'higher-type' plurality, we correctly predict cumulative readings relative to syntactically higher plurals.

As a final point, we presented some preliminary evidence supporting the prediction of our system that the 'plural-based' meaning of COORD and the 'asymmetric' effect of μ-particles should be observable cross-categorially.

We already mentioned some open questions and possibilities for future research (see in particular Section 5). At this point, we only want to highlight an issue which we haven't addressed in this paper, but which has played a major role in previous work on μ-particles (in particular Mitrović & Sauerland 2014, 2016, Szabolcsi 2015) and motivated certain analytical choices in this literature: Cross-linguistically, μ-particles tend to occur also in other syntactic and semantic contexts and tend to have a very limited set of semantic functions. For instance, in several languages, conjunction particles are formally identical to an additive particle. This is the case for Hungarian *is* which does not only occur in D-conjunctions but also in contexts like (120), where it clearly has an additive function (Szabolcsi 2015).

(120) *Mari is 100 kilót nyomott*
Mary too 100 kilos weighed
'Mary, too, weighed 100 kilograms.' (Szabolcsi 2015:(47))

While our analysis involves a close connection between universal quantifiers and μ-particles – which seems to be another cross-linguistic correlation, as the elements used to build up the former often appear in the function of the latter (see e.g. Mitrović & Sauerland 2014, Szabolcsi 2015 for Japanese *mo*) – we don't have anything to say about the connection between μ-particles and additivity. Accordingly, the question how the observations reported in this paper can be reconciled with existing results on other 'guises' of μ-particles must be left to future research.

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