Cross-linguistic evidence for a non-distributive lexical meaning of conjunction †

Enrico Flor, Nina Haslinger, Hilda Koopman, Eva Rosina, Magdalena Roszkowski and Viola Schmitt*

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1 Introduction

- We look at sentences in which conjunctions with individual-denoting (type e) conjuncts combine with predicates containing a measure phrase or a numeral-modified indefinite DP ('C-predicates').
- Conjunctions often have **distributive readings ('D-readings')** as well as **non-distributive readings ('ND-readings')** wrt. certain predicates (1).

(1) a. *Mary and Sue earned exactly 100 euros.*
b. 'Mary earned exactly 100 euros and Sue earned exactly 100 euros.' D-reading
c. 'Mary and Sue earned exactly 100 euros between them.' ND-reading

This ambiguity could be due to a lexical ambiguity of *and*, a covert operator on the conjunction, a covert operator on the predicate or any combination of these.

Two research questions:

(a) Does one of the two readings correspond to the basic lexical meaning of binary conjunction (henceforth 'COORD') cross-linguistically?

(b) How do languages vary wrt. the source of distributivity (i.e. whether the two interpretations are derived at the level of the predicate or the conjunction)?

- Here we try to address these questions by looking at **cross-linguistic form-function correlations**.

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*`enrico.flor@univie.ac.at`, `nina.haslinger@univie.ac.at`, `koopman@ucla.edu`, `eva.rosina@univie.ac.at`, `magdalena.roszkowski@univie.ac.at`, `viola.schmitt@univie.ac.at`

- Our **background assumption** is that if we posit a covert operation to derive the ambiguity in English (1), we should expect this operation to **show up overtly in some other language**. If so, we can argue against a given semantic analysis on the basis of typological gaps. All other things being equal, an analysis of conjunction that works cross-linguistically and allows us to derive typological gaps is to be preferred.

- So far, we have preliminary data from 15 languages (8 of them non-Indo-European) that were collected mostly via the **Terraling** database (Koopman 2016).[1] This data set motivates the following hypotheses:

Main theoretical claims:

(a) Cross-linguistically, the **lexical meaning of COORD is ND**.

(b) Cross-linguistically, one potential source of D-readings and ND-readings is the availability of **predicate-level distributivity operators**.

- Our claims here are limited to what we call **iterative conjunction**, a subclass of conjunctive coordinate structures with the following properties (among others):

(2) Properties of "iterative coordination" – slightly simplified

a. The two conjuncts and the coordinator(s) can form a constituent to the exclusion of any other material.

b. To the extent this can be determined, the two conjuncts must have the same grammatical function.

c. If the language has overt, island-sensitive wh-movement in questions or in relative clauses, the structure should show Coordinate Structure Constraint effects.

d. Coordination of more than two conjuncts is possible.

This excludes some cases of comitative conjunction (e.g. those discussed in McNally (1993)) and conjunctive verbs (e.g. Gil (1991)).

2 Deriving D-readings and ND-readings

2.1 Conjunction-based approaches

Ambiguity theories

- In principle, one could assume that there are two lexical entries for conjunction – as suggested e.g. by Hoeksema (1983, 1988) (and recently defended by Sudo (2015) for NP-conjunctions of type $\langle e, t\rangle$). If so, we don't need any additional operators within the conjunction to derive the ambiguity.

[1] So far, we have data from Akan (Niger-Congo, Kwa), Basa'a (Niger-Congo, Bantu), Cantonese (Sino-Tibetan, Chinese), Chickasaw (Muskogean), Dutch (Indo-European, Germanic), German (Indo-European, Germanic), Greek (Indo-European, Greek), Italian (Indo-European, Italic), Japanese (Japonic), Korean (Koreanic), Nones (Indo-European, Italic), Polish (Indo-European, Balto-Slavic), SerBo-Croatian (Indo-European, Balto-Slavic), Turkish (Turkic) and Wuhu Chinese (Sino-Tibetan, Chinese).

- **D-reading:** Partee and Rooth (1983) a.o.: the meaning of COORD is defined in a unified way as in (3-b) for all types that "end in t", (3-a).

(3) a. The set TC of t-conjoinable types is the smallest set of semantic types such that $t \in TC$ and if $b \in TC$, then for all a, $\langle ab \rangle \in TC$. (cf. Partee and 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: $[\![\text{COORD}_{\langle ab \rangle}]\!] = \lambda P_{\langle ab \rangle}.\lambda Q_{\langle ab \rangle}.\lambda x_a.[\![\text{COORD}_b]\!](P(x))(Q(x))$ (cf. Partee and Rooth (1983))
c. $[\![[[\uparrow \text{M}_e]\ \text{COORD}_{\langle\langle et \rangle t \rangle}\ [\uparrow \text{S}_e]]\ \text{P}]\!] = [\![\text{P}]\!]([\![\text{M}]\!]) \wedge [\![\text{P}]\!]([\![\text{S}]\!])$

- For e-conjunctions we thus need the operation in (4-a) that shifts the denotations of the conjuncts to a t-conjoinable type. As a result, we derive the D-reading of e-conjunctions like (1-a) as in (3-c).

(4) a. $[\![\uparrow]\!] = \lambda x_e.\lambda P_{\langle et \rangle}.P(x)$ (cf. Montague (1973))
b. $[\![\text{COORD}_{\langle\langle et \rangle t \rangle}]\!] = \lambda \mathbf{P}_{\langle\langle et \rangle t \rangle}.\lambda \mathbf{Q}_{\langle\langle et \rangle t \rangle}.\lambda R_{\langle et \rangle}.\mathbf{P}(R) \wedge \mathbf{Q}(R)$

- **ND-reading:** COORD expresses an operation analogous to that which forms pluralities from individuals ('$\oplus$'), (5).

(5) $[\![\text{COORD}_{ND}]\!] = \lambda x_e.\lambda y_e.x \oplus y$

- Under this approach, it would be a lexical accident that English has only one lexical item *and* for both readings (Winter 2001).

D-theories

- The lexical meaning of COORD is roughly reducible to the operation '$\wedge$' from classical propositional logic (e.g. Gazdar (1980), Partee and Rooth (1983), Keenan and Faltz (1985), Winter (2001), Champollion (2015)). There is no special lexical entry for the ND-reading.

- How can we derive the ND-reading (1-c)? Winter (2001) posits two operators, MIN (7-a), and $\exists$ (7-b), which attach to the conjunction (we slightly adapt his proposal for our purposes). Basically, we quantify existentially over those pluralities[2] consisting exclusively of individuals the conjuncts' denotations identify (7-d) – which yields the ND-reading for (1-a).

(7) a. $[\![\text{MIN}]\!] = \lambda \mathcal{P}_{\langle\langle et \rangle t \rangle}.\lambda x_e.\exists Q_{\langle et \rangle}.[\mathcal{P}(Q) \wedge \forall Q'_{\langle et \rangle}[Q' \subseteq Q \wedge \mathcal{P}(Q') \rightarrow Q' = Q] \wedge x = \bigoplus Q]$
b. $[\![\exists]\!] = \lambda P_{\langle et \rangle}.\lambda Q_{\langle et \rangle}.\exists x_e[P(x) \wedge Q(x)]$
c. [[$\exists$ [MIN [[$\uparrow$ Mary] $\text{COORD}_{\langle\langle et \rangle t \rangle}$ [$\uparrow$ Sue]]]] [earned 100 euros]]
d. $[\![\exists\ [\text{MIN}\ [[\uparrow \text{M}]\ \text{COORD}_{\langle\langle et \rangle t \rangle}[\uparrow \text{S}]]]]\!] = \lambda Q_{\langle et \rangle}.\exists x_e[x = m \oplus s \wedge Q(x)] = \lambda Q_{\langle et \rangle}.Q(m \oplus s)$

[2] We assume a set $A \subseteq D_e$ of atomic individuals, a binary operation $\oplus$ on D_e and a function $f : (\mathcal{P}(A) \setminus \{\emptyset\}) \rightarrow D_e$ such that: 1) $f(\{a\}) = a$ for any $a \in A$ and 2) f is an isomorphism between the structures $(\mathcal{P}(A) \setminus \{\emptyset\}, \cup)$ and $(D_e, \oplus)$. Hence there is a one-to-one correspondence between plural individuals and nonempty sets of atomic individuals. We will use the notions in (6), following much of the literature.

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

ND-theories

- COORD lexically denotes the plurality-forming operation $\oplus$ and D-readings can be derived from this meaning (e.g. Link (1983), Krifka (1990), Schmitt (2017))
- With this type of analysis, additional operations – e.g. a **distributivity operator** (8)– are required to derive the D-reading.

(8) $[\![\text{D}_{conj}]\!] = \lambda x_e.\lambda P_{\langle et\rangle}.\forall y \leq_{AT} x.P(y) = 1$

(9) $[\![[\text{D}_{conj}$ [Mary COORD$_e$ Sue]] earned 100 euros$]\!] = [\lambda P_{\langle et\rangle}.\forall y \leq_{AT} m \oplus s.P(y) = 1]$ $([\![\text{earned 100 euros}]\!]) = 1$ iff $\forall y \leq_{AT} m \oplus s.[\![\text{earned 100 euros}]\!](y) = 1$

2.2 Predicate-based approaches

- If the coordinated subject can denote a plurality (regardless of whether this interpretation is derived or not), D-readings and ND-readings can also be derived using operators that attach to the C-predicate.
- Some mechanism of this kind is needed, even in English:

(10) *Mary and Sue [$_{VP1}$ met in the bar] and [$_{VP2}$ had exactly one glass of wine].*
(adapted from Dowty (1987))

(10) is ambiguous and can be true if Mary and Sue drank exactly one glass each.

If non-distributivity were determined by the conjunction alone, we would need the distributive lexical meaning for this reading – but the non-distributive meaning is needed to license the collective predicate in VP1. So we need to account for this ambiguity at the predicate level. Note that this removes any language-internal motivation for an ambiguity at the conjunction level.

- Much of the literature assumes a **D-operator** that attaches to the predicate and yields a D-reading (11) (cf. a.o. Link (1987), Roberts (1987) for discussion).

(11) a. $[\![\text{D}_{pred}]\!] = \lambda P_{\langle et\rangle}.\lambda x_e.\forall y \leq_{AT} x.P(y) = 1$
b. $[\![[\text{D}_{pred}$ [earned 100 euros]]$]\!] = [\lambda x_e.\forall y \leq_{AT} x.[\![\text{earned 100 euros}]\!](y) = 1]$

- Note that it is not immediately obvious that the D-reading is the derived one. Under a theory that distinguishes between pluralities and atomic 'groups' (Link 1984, Landman 1989), one could redefine D_{pred} as follows:

(12) $[\![\text{D}_{pred}]\!] = [\lambda P_{\langle et\rangle}.\lambda x_e.{}^*P(x)]$, where ${}^*P$ is the closure of P under sum.[3]

Unlike the definition in (11-a), this (independently motivated) operation is reversible if P contains only atomic individuals. We could then define an '**ND-operator**' that reverses its effect.

[3] That is, ${}^*P$ is the smallest set such that

(13) a. $P \subseteq {}^*P$
b. and for any nonempty $S \subseteq {}^*P$, $\oplus S \in {}^*P$.

- This raises two **questions**:
  - Is the D-reading of C-predicates really the derived one?
  - Do we need a conjunction-based mechanism for deriving D-readings and ND-readings in addition to the predicate-level one?

  These questions are hard to answer on the basis of English data. But maybe we can find relevant arguments by looking at the way (non-)distributivity is formally marked in other languages that have iterative *e*-conjunctions.

3 Scope and methodology of our survey

- We will look at two kinds of 'paradigms' within a language:
  - paradigms involving different ways of expressing the coordinate structure itself. The coordinate structure may contain extra morphemes in addition to COORD (α) (14).

    (14) [A COORD B] [P] vs. [α A COORD B] [P]

    (15) a. Polish [A *i* B] vs. [*i* A *i* B]
    b. German [A *und* B] vs. [A *und auch* B]
    c. Turkish [A *ve* B] vs. [A *dA (ve)* B *dA*]

  - paradigms where the coordinate structure itself is held constant and variation concerns additional markers (β) occurring *outside* the coordinate structure (16).[4]

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

    (17) a. English [earned 100 euros] vs. [earned 100 euros *each*]
    b. English [earned 100 euros] vs. [earned 100 euros *between them*]
    c. Basa'a [ɓá-bí-kosná dikóó dísámal] 'received 6000 [francs]' vs. [ɓá-bí-kosná dikóó dísámal, *híkií mut*] 'received 6000 [francs] each'

- We are interested in the question whether α and β can be analyzed as overt counterparts of the various D- and ND-operators surveyed in Section 2. We assume that morphosyntactic considerations matter for semantic theory – in particular, if some semantic operator is assumed to exist cross-linguistically, we would expect overt realizations in some languages.

- If so, we can argue on the basis of typological gaps: if the operations required by some semantic theory are *not* found overtly, that could count as evidence against the theory.

- Here we report preliminary results of our Terraling study 'Conjunction and disjunction' which we are currently extending to more languages.

- Terraling is an open-ended, public database where language experts (mostly native speaker linguists) answer metalinguistic questions in a 'yes/no/does-not-apply' format, and also have the option of providing glossed examples (cf. Koopman (2016)).

- Our study is the first to use Terraling for formal semantics. Therefore, we asked consultants whether particular forms were available in their language, but importantly we also asked whether these different forms can express D- and ND-readings. The focus was on two issues:

[4] Neither of the schemata in (14) and (16) is supposed to represent linear order facts or the number of occurrences of α/β. Nor do we assume that COORD must be phonologically realized.

– whether the language has conjunction patterns/strategies that are ambiguous wrt. (non-)distributivity
– and whether the language has additional markers that enforce one of the two readings.

- We asked our consultants to construct sentences with C-predicates (which contain a numeral-modified indefinite plural or a measure phrase) for different coordination patterns/strategies in their language.[5] They then had to judge whether these sentences adequately describe certain scenarios that distinguish between the two readings.

- We asked consultants to use examples in which the coordinate structure occurs in subject position, as there may be subject/object asymmetries wrt. cumulativity (Schein 1993, Kratzer 2000).

- **Metalinguistic surveys vs. traditional fieldwork:** Since this method relies on the consultants' ability to understand linguistic terminology and construct relevant examples in their language, it is possible to elicit data on many diverse languages using a single questionnaire.

- However, this leaves a significant part of the linguistic analysis to the consultant (e.g. determining the subject of a sentence or the status of a structure as conjunctive coordination), leaving the researcher with little control over the specific tests used.

- As the "properties" (yes/no questions) encoded on Terraling are the same for all consultants on a given project, it is relatively hard to ask follow-up questions relating to a specific example. While consultants can provide comments and glossed examples, it is difficult to ask consultants to provide additional comments on a subset of their examples.

4 Predicate-level markers

Cross-linguistic hypothesis

- We first look at additional marking *outside* of the coordinate structure, i.e. β in (18).

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

- Many languages have markers that disambiguate C-predicates towards a D-reading (e.g. English *each*) or towards an ND-reading (e.g. English *together*).

- Further, some languages have additional marking on the predicate that is needed for a D-interpretation, i.e. the structure without the marker has only an ND-reading, but the marker makes the D-reading available. According to our consultants this is found in Basa'a (19), Turkish and Modern Greek (subject to speaker variation). In (19) *híkií mut* 'each person' is required for a D-reading.

(19) a. *[A, B ni C] ɓá-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)

[5] We explicitly instructed our consultants to avoid sentences with inherently distributive predicates – such as *John, Mary and Sue left* – since such predicates won't let us distinguish the D-reading and the ND-reading truth-conditionally. Therefore, our claims might not generalize to inherently distributive predicates.

b. *[A, B ni C] ɓá-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 [Equatorial Bantu], adapted from examples by Paul Roger Bassong[6])

- We did not find any examples where a predicate-level marker is required, in the same sense, for an ND-interpretation of a C-predicate – even though we explicitly asked for such data.

> **Generalization (I)**:
> There are iterative conjunction patterns that require one or more predicate-level markers for a **distributive** interpretation of C-predicates. This means that the D-reading of sentences with a C-predicate is available with the markers, but unavailable if the markers are omitted.
> There are no iterative conjunction patterns that require predicate-level markers for a **non-distributive** interpretation of C-predicates.

In a nutshell: **If one of the two readings *has* to be marked on the predicate, it is the D-reading.**

Theoretical consequences

- Generalization **(I)** is expected if **predicate-level D-operators** exist cross-linguistically.
- We hypothesize that distributivity markers generally realize an operator like D_{pred}. Languages differ as to whether this operator is always spelled out in the case of C-predicates:

(20) a. overt spell-out of D_{pred} required: e.g. Basa'a
b. overt spell-out of D_{pred} optional: e.g. English

- In a language of type (20-b), (21-a) must have a structure like (21-c), while (21-b) can correspond to either of the two structures in (21-c) and (21-d).

(21) a. *Mary and Sue each earned 100 euros.*
b. *Mary and Sue earned 100 euros.*
c. [[Mary COORD Sue] [D_{pred} [earned 100 euros]]]
d. [[Mary COORD Sue] [earned 100 euros]]

- In languages of type (20-a), D_{pred} is overt whenever it is present and hence and are unambiguous. If a sentence with a C-predicate lacks an overt D-marker, its structure corresponds to (21-b), which makes it unambiguously non-distributive.
- If the ambiguity were due to **predicate-level ND-operators**, the present pattern would be unexpected. First, we would expect there to be languages in which overt realization of the ND-operator is obligatory. Second, it would be unclear why the D-reading *has* to be marked in some languages, as it would be the 'basic' reading of ambiguous predicates.
- Under a theory in which languages (or individual predicates) differ as to which reading is basic, we would expect no asymmetry in either direction – unless there are functional, non-grammatical reasons for the apparent typological gap, a possibility that we cannot exclude at this point.

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

- If the typological gap described in **(I)** is real, the simplest grammatical explanation would be that the ND-reading of C-predicates is the basic one cross-linguistically.

5 Conjunction-level markers

Cross-linguistic hypothesis

- Now we consider markedness relations within the coordinate structure itself. We asked for conjunction patterns that allow both for D-readings and for ND-readings (possibly depending on the predicate) and for conjunction patterns that lack one of these readings.
- Some languages were uninformative for this question because they either lacked iterative type-*e* conjunction (Chickasaw) or the consultants provided only a single, ambiguous, conjunction pattern (corresponding semantically to English *A and B*).
- In languages with more than one pattern, we found several possibilities:

  (a) **The markers within the coordination are formally unrelated**, as in German *A und B* (ambiguous) vs. *sowohl A als auch B* 'A as well as B' (purely distributive at least in the syntactic context considered here).

  (b) **There is a markedness relation, but it does not affect distributivity**, as in English *A, B and C* vs. *A and B and C* or Japanese *A-to B* vs. *A-to B-to* (cf. Szabolcsi 2015 on the latter).

  (c) **A purely distributive pattern is marked relative to an ambiguous one**. This pattern has been described in the literature (e.g. Szabolcsi (2015) on Hungarian) and occurs in several languages in our data set:

(22) D-only conjunction patterns that are marked relative to an ambiguous pattern

a. Polish, SerBo-Croatian [A *i* B] vs. [*i* A *i* B]
b. SerBo-Croatian [A, B *i* C] vs. [A, B *ali i* C]
c. Turkish [A *ve* B] vs. [A *dA (ve)* B *dA*]
d. Modern Greek [A, B *ce* C] vs. [A, B *ala ce* C] (speaker variation)
e. Dutch [A, B *en* C] vs. [A, B *en ook* C] (speaker variation)

(23) 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.' (ambiguous)

b. *[I A i B i C] su zaradili tačno sto evra.*
and A and B and C AUX.3PL earn.PART.PL.M exactly hundred euros.GEN
'A, B and C earned exactly 100 euros each.' (distributive only)
(SerBo-Croatian, adapted from examples by Jovana Gajić[7])

(24) a. *O Janis, i Maria ce o Kostas cerdisan ekato evro akrivos*
the John.NOM the Maria.NOM COORD the Kostas.NOM won a hundred euros exactly

[7] `http://test.terraling.com/groups/8/examples/16182`, `http://test.terraling.com/groups/8/examples/16177`

'John, Maria and Kostas won exactly a hundred euros.' (non-distributive interpretation available)

b. *O Janis, o Kostas ala ce i Maria kerdisan*
the John.NOM the Kostas.NOM but COORD the Maria.NOM won
ekato euro
a hundred euros
'John, Kostas and Maria won a hundred euros.' (non-distributive interpretation unavailable for some speakers)
(Modern Greek, examples by Nikolaos Angelopoulos[8])

- Interestingly, we did not find cases where a conjunction pattern that has an ND-reading is marked relative to a conjunction pattern that is limited to the D-reading.
- We explicitly asked consultants for examples of conjunction patterns that lack a D-reading (for C-predicates), and did not find any clear examples. While we did not explicitly ask for ambiguous patterns that are marked relative to a D-only pattern, none of the ambiguous patterns provided by our consultants fit this description.
- We conjecture that these two observations reflect a typological gap:

Generalization (II):
For any pair of iterative coordination patterns within a language that have a conjunctive meaning and apply to proper names, where one pattern can be obtained from the other by adding "additional markers":
(a) If the **marked** pattern permits a **ND** interpretation, so does the **unmarked** pattern.
(b) If the **unmarked** pattern allows for a **D** interpretation, so does the **marked** pattern.

In a nutshell: **Additional marking within a conjunction may enforce distributivity, but not non-distributivity.**

Theoretical consequences

- If the typological gap in **(II)** is real, it supports a **ND-theory of conjunction**. The ND-theory predicts that we have to add additional operators within the conjunction to derive conjunction patterns that lack the ND-reading, like D_{conj} (25-a).

(25)	a.	[A COORD B]	D or ND (depending on D_{pred})	
	b.	[D_{conj} [A COORD B]]	D only	**ND-analysis**

- The precise predictions depend on whether predicate-level D-operators exist cross-linguistically.[9] If so, a conjunction denoting a plurality should always allow both readings wrt. C-predicates. This predicts the attested situation in (25), where a D-only conjunction pattern is overtly marked relative to an ambiguous pattern.

[8] `http://test.terraling.com/groups/8/examples/16097`, `http://test.terraling.com/groups/8/examples/16119`. The situation is a bit more complex here as our consultant reports that *ala* removes the non-distributive interpretation for measure phrases, but says that there is no marker with this function for regular numeral-modified indefinites. More research on this issue is needed.

[9] Flor et al. (2017) spell out the parameter settings that have an effect on these predictions and lay out the morpho-syntactic assumptions required to derive them without predicting a transparent markedness relation in every language.

- Under a **D-theory of conjunction**, we would expect ambiguous conjunction patterns to be marked relative to D-only patterns in some languages. This pattern is unattested.

(26)	a.	[A COORD B]	D only	
	b.	[∃ [MIN [A COORD B]]]	D or ND (depending on D_{pred})	**D-analysis**

- Even if there turn out to be languages lacking D-operators on the predicate, the D-analysis of conjunction would make a wrong prediction: There should be ND-only conjunction patterns that are marked relative to a D-only conjunction pattern – another unattested situation ruled out by **(II)**.

- If the **ambiguity theory** of conjunction were correct, we would not expect an asymmetry in overt marking – unless there is an independent functional explanation for the markedness patterns found.

- **A morphosyntactic issue:** Some languages have different conjunction patterns with no transparent markedness relation between them (27). Such languages are uninformative for the choice between D-theories and ND-theories. But they show that D-only conjunction patterns – which we argued involve additional operators relative to ambiguous patterns – do not always transparently contain ambiguous patterns.

(27) Japanese
  a. A-*to* B*(-to)* – D-reading and ND-reading available (cf. Szabolcsi 2015)
  b. A-*mo* B-*mo* – only D-reading available (Yasutada Sudo, p.c.)

- We seem to need a more abstract morphosyntactic theory in which the additional operations involved in D-only patterns can either condition a null realization of the coordinator (cf. Bobaljik 2012 a.o.) or directly realize a larger morphosyntactic structure (cf. Caha 2013 a.o.). But this opens up the possibility of deriving surface counterexamples to our generalizations even under an ND-theory (cf. Flor et al. 2017).

- **A semantic issue:** The markers in (22) do not always appear peripherally in the conjunction, as we would expect if they were direct realizations of D_{conj}. One approach to this would be that their actual function is to indicate the presence of D_{conj} higher in the structure (cf. Szabolcsi (2015) for a recent discussion). But it would be more attractive to replace D_{conj} with unary operators attaching to each conjunct, so that these markers can be interpreted directly and compositionally.

- Compositional approaches to conjunction particles exist (cf. Mitrović and Sauerland (2014, 2016), Szabolcsi (2015)), but they do not assume that the basic meaning of COORD is ND.

- The approach of Szabolcsi (2015) can be adapted relatively easily (see Appendix A.1), but requires a syntactic dependency between the particles and the distributivity operator that was not needed in the original paper. The type-shifting approach of Mitrović and Sauerland (2014, 2016) would require strong additional assumptions about the way non-distributive conjunction combines with quantifiers (see Appendix A.2).

6 Conclusion and Outlook

- We considered several ways of deriving D-readings and ND-readings for sentences with conjunction and C-predicates. Using a preliminary sample of 15 languages, we presented some potential cross-linguistic predictions of these theories.

- We made two central empirical claims: First, we find obligatory overt D-markers on the predicate, but no obligatory overt ND-markers **(I)**. This suggests that the ND-reading of C-predicates is the basic one and that predicate-level D-operators occur cross-linguistically.
- Second, there are D-only conjunction patterns that are marked relative to a conjunction pattern that is ambiguous wrt. distributivity, but we did not find the reverse situation **(II)**. This suggests that some languages have a separate mechanism for deriving D-readings at the level of the conjunction, and the ND-interpretation of conjunction is the basic one.
- **Questions for further research:**
  - Do **(I)** and **(II)** remain valid once we consider more languages?
  - Do we find the same (non-)distributivity asymmetries for conjunctions in non-subject position?
  - Is there any counterpart of these asymmetries for non-sentential conjunctions, particularly ND-readings of predicate conjunction (Link 1984, Krifka 1990)?

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A Issues for the analysis of conjunction particles

- We have argued that the basic reading of iterative conjunction is ND and that a D-reading can be derived by means of additional morphology α inside the coordinate structure.

- But it is unclear how to interpret α semantically: So far, we talked about a unary operator D_1 that modified the entire conjunction, but in several languages **conjunction particles** – markers that appear on each conjunct (28)– enforce a distributive reading.

  (28) A-μ COORD B-μ

- Mitrović and Sauerland (2014) and Szabolcsi (2015) each provide a distributive semantics for (28), but do not assume a ND meaning of COORD. Can these accounts be adapted to accommodate our theoretical claims?

A.1 Szabolcsi (2015)

- If we want to adapt the analysis in Szabolcsi (2015) to type e conjunction, we must assume a structure like (29-a) for (28). The conjuncts must be shifted to quantifiers (by $\uparrow$).

  (29) a. $[_X\ OP_\cap\ [_Y\ [[\uparrow \text{Mary}]\ \mu]\ [\text{COORD}\ [[\uparrow \text{Sue}]\ \mu]]]]$
  b. $[\![Y]\!] = \langle [\![\uparrow \text{M}]\!], [\![\uparrow \text{S}]\!] \rangle = \langle \lambda P.P([\![\text{M}]\!]), \lambda P.P([\![\text{S}]\!]) \rangle$ (ignoring postsuppositions)
  c. $[\![X]\!] = [\![\uparrow \text{M}]\!] \cap [\![\uparrow \text{S}]\!] = \lambda P_{\langle et \rangle}.P([\![\text{M}]\!]) \wedge P([\![\text{S}]\!])$ (ignoring postsuppositions)

- μ introduces a postsupposition requiring that the conjunct's denotation is asymmetrically entailed by $[\![\text{X}]\!]$.

- COORD forms a pair from the conjunct denotations (29-b), and the silent operator $OP_\cap$ intersects the pair, yielding the D-reading (29-c).

- How should the simpler structure (30) be analyzed in this framework?[10] (30) cannot contain $OP_\cap$ because it has an ND-reading. So at least we have to say something additional about the way 'pairs' of conjunct denotations combine with predicates.

  (30) [A [COORD B]]

- One way of doing this is to generalize the notion of pluralities to types ending in t, as proposed for independent reasons by Schmitt (2017).

  (31) Cross-categorial plurality
  For any semantic domain D_a there is a set $AT_a \subseteq D_a$ of atomic elements of that domain, a binary operation $\oplus$ on D_a and a function $f_a : (\mathcal{P}(AT_a) \setminus \{\emptyset\}) \rightarrow D_a$ such that:
  a. $f_a(\{X\}) = X$ for any $X \in AT_a$
  b. and f_a is an isomorphism between the structures $(\mathcal{P}(AT_a) \setminus \{\emptyset\}, \cup)$ and $(D_a, \oplus)$.

- This allows us to say that COORD denotes the operation $\oplus$ cross-categorially. While (30) will denote the individual sum $[\![\text{A}]\!] \oplus [\![\text{B}]\!]$, the argument of $OP_\cap$ in structures like (29-a) will be a sum of two (or more) quantifiers. This means we have to generalize $OP_\cap$ (32).

[10] Adding an additional operator on top of (29-a) which yields the ND-reading is incompatible with (**A**).

(32) $[\![OP_\cap]\!] = \lambda\mathcal{P}_{\langle\langle et\rangle t\rangle}.\bigcap\{\mathcal{Q} : \mathcal{Q} \leq_{AT} \mathcal{P}\}$

- Y from (29-a) above thus has the denotation in (33) – which has the atomic parts $[\![\uparrow \text{M}]\!]$ and $[\![\uparrow \text{S}]\!]$. Hence, we also derive the meaning in (29-c) for (29-a) above, but our assumptions about the semantic contributions of the individual operators differ from those made by Szabolcsi (2015).

(33) $[\![Y]\!] = [\![\uparrow \text{M}]\!] \oplus [\![\uparrow \text{S}]\!]$

- **Two problems:**
  - Under our assumptions, structures lacking μ cannot contain $OP_\cap$. Otherwise we would predict that any language should allow for D-readings of conjunction regardless of the presence of D_2 – a prediction falsified by languages like Basa'a in (19). Unlike Szabolcsi, we therefore need to posit a syntactic agreement mechanism that ties the occurrence of $OP_\cap$ to that of μ.
  - Without additional assumptions about quantifier pluralities, $OP_\cap$ seems obligatory whenever COORD conjoins expressions of quantifier type. This predicts that quantifier conjunctions should be limited to D-readings – but prima facie this is falsified by well-known examples like (34-a), which has the ND-reading in (34-b).

(34) a. *Two girls and five boys earned exactly 100 euros.*
b. 'A plurality consisting of two girls and five boys earned exactly 100 euros in total.'

A.2 Mitrović and Sauerland (2014)

- Mitrović and Sauerland assume that μ expresses a type-shift, and put part of the semantic workload on silent morphemes $\Uparrow_{\langle e\langle et\rangle\rangle}$ which each conjunct combines with first (35-a). $\Uparrow_{\langle e\langle et\rangle\rangle}$ maps any individual x to the singleton $\{x\}$, whereas μ shifts expressions from $\langle et\rangle$ to $\langle\langle et\rangle t\rangle$ (35-b).

(35) a. $[_X$ [[Mary $\Uparrow_{\langle e\langle et\rangle\rangle}$] μ] [COORD [[Sue $\Uparrow_{\langle e\langle et\rangle\rangle}$] μ]]]
b. $[\![\mu]\!] = \lambda P_{\langle et\rangle}.\lambda Q_{\langle et\rangle}.P \subseteq Q$

- For the meaning of COORD, Mitrović and Sauerland (2014) assume the D-analysis, so that X in (35-a) has the same denotation as (29-c) above. This raises the question how to accommodate a ND-meaning for (30).

- We need a meaning for COORD that gives us the ND-reading and also combines with quantifiers. For this purpose, we use a simplified version of the proposal by Schmitt (2017). Working with the ontology and the denotation for COORD introduced in section A.1, we add a compositional rule '$\bullet$' of pointwise application which applies in two kinds of situations:

(36) Pointwise functional application for pluralities
a. If an argument plurality $a \oplus b$ combines with a (non-plural) function f that itself does not take pluralities as its argument, the result will be the plurality of values $f(a) \oplus f(b)$.
b. If a function plurality $f \oplus g$ combines with a (non-plural) argument, the result is again a plurality of values $f(a) \oplus g(a)$.

- Assuming that sentential pluralities are true iff all of their atomic parts are true, this analysis, partially spelled out in (37-a), correctly derives the D-reading for (35-a). The unmarked pattern in (30) can simply denote a plurality of individuals ($m \oplus s$).

(37) a. $[\![[[[[\text{Mary} \Uparrow_{\langle e\langle et\rangle\rangle}]\ \mu]\ [\textsc{coord}\ [[\text{Sue} \Uparrow_{\langle e\langle et\rangle\rangle}]\ \mu]]]\ [\text{earned 100 euros}]]]\!] =$
$(\lambda P_{\langle et\rangle}.\{m\} \subseteq P \oplus \lambda P_{\langle et\rangle}.\{s\} \subseteq P) \bullet [\![\text{earned 1000 euros}]\!] =$
$= (\{m\} \subseteq [\![\text{earned 1000 euros}]\!]) \oplus (\{s\} \subseteq [\![\text{earned 1000 euros}]\!])$

b. $[\![[[\text{Mary}\ \textsc{coord}\ \text{Sue}]\ [\text{earned 100 euros}]]]\!] = [\![\text{earned 100 euros}]\!]\ (m \oplus s)$

- **Some problems:** If $\bullet$ could apply in (37-b), we would derive a D-reading for (37-b) regardless of whether the predicate contains a D-operator. This could be addressed by stipulating that C-predicates primitively take pluralities as their argument and combine with them by regular functional application.

- But this is implausible as Schmitt (2017) proposes cross-categorial plurality, among other things, to account for ND-readings in examples like (38).

(38) *Mary and Sue sang and danced.*
can be *true* if Mary sang and Sue danced

The ND-reading of (38) cannot be derived from the $\bullet$ rule in its present form. But if we expanded our composition rule to directly derive cumulative readings (Schmitt 2017), it would also generate an unattested ND-reading for quantifier conjunctions like (35-a).

- In addition, as in section A.1, the present proposal falsely predicts only D-readings for conjunctions in which the conjuncts are of type $\langle\langle et\rangle t\rangle$.