



# Syntactic conditions on cumulative readings of German *jeder* ‘every’ DPs

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## Abstract

English *every*-DPs can have cumulative readings relative to plural DPs, but only under severe syntactic constraints. This paper discusses different potential formulations of these constraints for the German correlate of *every*-DPs, *jed*-DPs. We argue that existing ‘surface-oriented’ hypotheses face empirical problems and propose a new hypothesis, namely that the availability of a cumulative reading relative to another plural X is sensitive to all positions in the derivational chain of X. We then spell out one possible semantic analysis of this pattern and sketch the consequences of this hypothesis for future empirical work.

**Keywords** Cumulativity · Distributivity · Universal quantifiers · Scope · Surface c-command

## 1 Introduction

### 1.1 Background: cumulativity asymmetries with singular universals

Sentences with two or more plural DPs can have **cumulative readings** (Kroch 1974; Langendoen 1978; Scha 2013 [1981]; Krifka 1986 among others): (1c) is true in the ‘cumulative’ scenario (1b), where neither girl fed *two* dogs, but each dog was fed by one of the girls and each girl fed one of the dogs.

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- (1) a. CONTEXT: There are two girls, Ada and Bea, and two dogs, Carl and Dean.  
 b. ‘CUMULATIVE’ SCENARIO: Ada fed Carl. Bea fed Dean.  
 c. (The) two girls fed (the) two dogs. **true in (1b)**

It is well known that English singular universal DPs—*every*-DPs—can partake in such cumulative readings when co-occurring with plural expressions like (*the*) *two dogs*. But unlike ‘standard’ plural DPs, they only do so in a restricted class of syntactic configurations (Schein 1993; Kratzer 2003; Ferreira 2005; Zweig 2008; Champollion 2010). (2c), where the *every*-DP occurs in subject position and the other plural in object position, only has a **distributive reading**: It is true in scenario (2b), where the predicate *fed (the) two dogs* applies to each girl individually, but false in the cumulative scenario (1b). In contrast, (2d), with the *every*-DP in object position and the other plural in subject position, is true in both scenarios.

- (2) a. CONTEXT: There are two girls, Ada and Bea, and two dogs, Carl and Dean.  
 b. ‘DISTRIBUTIVE’ SCENARIO: Ada fed Carl and Dean. Bea fed Carl and Dean.  
 c. **Every girl** in this town fed (the) two dogs. **true in (2b), false in (1b)**  
 d. (The) two girls fed **every dog** in this town. **true in (2b), true in (1b)**

(2c) and (2d) thus form a minimal pair with only the latter permitting a cumulative reading—but what is the syntactic factor underlying this semantic asymmetry? Or rather: Which syntactic relation must hold between the *every*-DP and the other plural expression to license a cumulative reading of the *every*-DP?<sup>1</sup>

## 1.2 The derivational hypothesis

This paper will use survey data on the German determiner *jed*- ‘every’ to motivate a new hypothesis about the syntactic configuration underlying cumulativity asymmetries: the **derivational hypothesis**.

- (3) **Derivational hypothesis (‘D-hypothesis’)**  
 A plural expression  $\alpha$  has a cumulative reading relative to a *jed*-DP only if the *jed*-DP does not c-command any element of  $\alpha$ ’s chain at LF.<sup>2</sup>

<sup>1</sup> We will focus on examples with a single DP headed by *jed*- ‘every’ and one other plural expression. Much of the semantic literature on cumulativity asymmetries concentrates on more complex cases like (i-b) (going back to Schein 1993), where the *every*-DP is sandwiched between two plural expressions. (i-b) is true in scenario (i-a), but false if Carl or Dean was taught only one trick. The *every*-DP is thus distributive relative to *two new tricks*, but cumulates with *Ada and Bea*. Such data show that the contrast in (2) cannot be captured by taking *every* to be ambiguous between two meanings—a (distributive) classical quantifier meaning vs. a standard plural denotation—with a complementary syntactic distribution. The truth conditions of (i-b) raise several issues for semantic theories of cumulativity (see Schein 1993; Kratzer 2003; Ferreira 2005; Zweig 2008; Champollion 2010; Haslinger and Schmitt 2018 among others), which we won’t go into here as our focus is on the syntactic conditions on cumulativity.

- (i) a. SCENARIO: There are two dogs, Carl and Dean. Ada taught Carl tricks 1 and 2. Ada taught Dean trick 3 and Bea taught Dean trick 2.  
 b. Ada and Bea taught every dog two new tricks. **true in (i-a)** (adapted from Schein 1993)



- (5) a. [ ... [ *jed*- NP ] [ ... $\alpha$  ... ] ... ]                   \***cumulative** (see (19a))  
 b. [ ... [  $\alpha$  [ ... *jed*- NP ] ... ] ... ]                   ✓ **cumulative** (see (18a))

The predictions of the D-hypothesis diverge from a simple c-command generalization once movement of the lower DP is involved. Consider first (6a), which is derived from (5a) by moving the plural  $\alpha$  into a position that asymmetrically c-commands the *jed*-DP: Since  $\alpha$  is now part of a chain consisting of its derived position and its trace, and the *jed*-DP still c-commands the trace, the D-hypothesis predicts that this kind of movement cannot make a cumulative reading available. In contrast, movement of the *jed*-DP in a configuration like (5b) does have an impact: If the *jed*-DP moves to a position that asymmetrically c-commands  $\alpha$ , the cumulative reading is blocked even though it is available in the base structure (5b).

- (6) a. [  $\alpha_1$  [ ... [ *jed*- NP ] [ ... $t_1$  ... ] ... ]                   \***cumulative** (see (19b))  
 b. [ *jed*- NP ]<sub>1</sub> [ ... [  $\alpha$  [ ... $t_1$  ... ] ... ]                   \***cumulative** (see (18b))

Importantly, the D-hypothesis does not block the cumulative reading for any *jed*-DP in a derived position: If its landing site is below the base position of the other plural, a cumulative reading is still permitted. Further, since the D-hypothesis applies at LF, syntactic reconstruction may interfere with its effects. For example, applied to the surface structure in (6b), reconstruction yields (5b) as our LF. A cumulative reading would then be available despite the surface configuration. Actual examples corresponding to the schemata in (5) and (6) will be discussed in Sects. 2.2 and 4.

In the remainder of the paper, we will first present two new observations about cumulativity asymmetries in German, which correspond to the abstract schemata above and are correctly accounted for by the D-hypothesis. We will then discuss four other, simpler hypotheses that attribute the contrast to a scope asymmetry, a surface c-command asymmetry, thematic-role hierarchies (see Kratzer 2003 and Chatain 2022 for discussion), although their actual systems are largely structure-based) and the special status of the subject position (see Drozd et al. 2017), respectively. We will argue that, while each of these generalizations captures a part of the data pattern, none of them attains the empirical coverage of the D-hypothesis for the German data. We further argue that while our data do not rule out the ‘mixed thematic/structural’ approach implicit in Kratzer’s (2003) semantic analysis of *every*-DPs, Kratzer’s data are compatible with the D-hypothesis and all else being equal, a purely structural generalization would be more parsimonious.

Assuming that the D-hypothesis is correct, one might wonder why a semantic phenomenon like cumulativity should correlate with a condition on the movement chains of the DPs involved. Our final point (in Sect. 5) will thus be to show that this correlation can in fact be derived from semantic properties of the relevant structures: It suggests that semantic plurality and trace binding interact non-trivially (this claim also follows from Chatain’s (2022) discussion of cumulativity asymmetries in English).

Along the way, we address potential questions for future experimental work.

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Footnote 4 continued

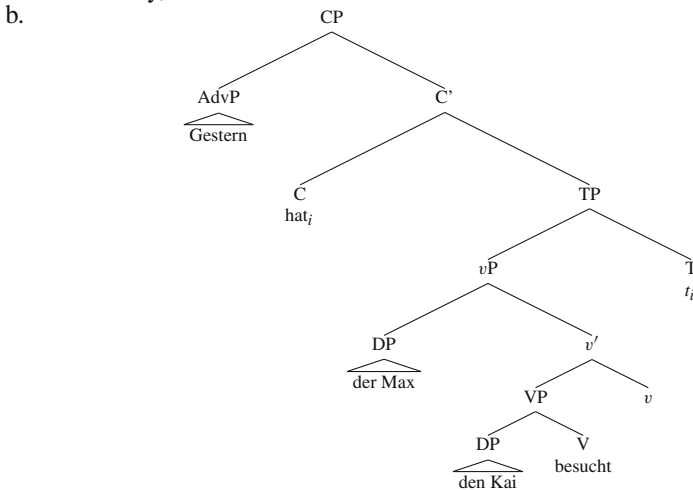
chains. But crucially, these LFs will not involve movement of a plural quantifier across another, unlike the LFs in (6); the predictions of the D-hypothesis are therefore not affected by this technical change.

### 1.3 Background assumptions about German clause structure

In order to disentangle structural from thematic asymmetries and isolate potential effects of movement on cumulativity, we will focus on two types of constructions: embedded infinitives with an (overt) subject and constructions involving so-called scrambling, i.e., movement within the German ‘Mittelfeld’.<sup>5</sup> Before we motivate our use of these constructions, we briefly outline which basic syntactic assumptions are crucial for our claims.

We start with some basic assumptions about German clause structure. Like most of the literature (den Besten 1989 among others), we identify the V2-position, i.e., the position of the auxiliary in (7a), with C. (We do not use a more fine-grained left periphery as this does not matter for our purposes.) We furthermore assume that subjects asymmetrically c-command objects, but it is irrelevant for us whether they are introduced by different heads, i.e. whether *v* and V should be distinguished in German. We also remain agnostic as to whether subjects in German must move to the specifier of T. Omitting this potential movement and also any movement of the clause-initial adverb, our simplified structure for (7a) is (7b).

- (7) a. Gestern hat der Max den Kai besucht.  
*yesterday AUX.3SG the.NOM Max[NOM] the.ACC Kai[ACC] visit.PTCP*  
 ‘Yesterday, Max visited Kai.’



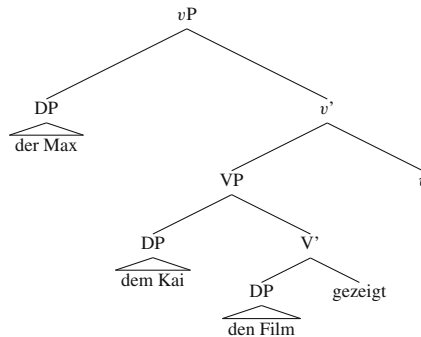
For double-object constructions such as (8a), we assume a structural asymmetry between the base positions of the two objects, following Frey (1993), Lechner (1998), and others in taking the base position of the indirect object (*dem Kai*) to c-command that of the direct object (*den Film*).<sup>6</sup> Again, what is crucial for us is the c-command

<sup>5</sup> ‘Mittelfeld’ refers to the sequence of positions between the position of finite verbs in V2 clauses and the position of final verbs in V-final clauses.

<sup>6</sup> Frey (1993) and Lechner (1998) adopt this c-command asymmetry partly to account for the different scope options for sentences with different orderings of the two objects. As we note below, it is unclear to us how robust (on an inter-speaker level) such scope generalizations are. Others (e.g., Grewendorf 1988)

asymmetry; the particular implementation does not bear on our points. We here assume that the *vP* in double-object constructions is represented as in (8b).

- (8) a. Gestern hat der Max dem Kai den  
*yesterday* AUX.3SG *the*.NOM *Max*[NOM] *the*.DAT *Kai*[DAT] *the*.ACC  
 Film gezeigt.  
*movie*[ACC] *show*.PTCP  
 ‘Yesterday, Max showed Kai the movie.’  
 b.



We now turn to the configurations of interest and start with scrambling. In the broadest sense, it refers to a reordering of the arguments following the C-position. In (9) for example, the order of the subject and the object has been reversed relative to (7).

- (9) Gestern hat den Kai der Max besucht.  
*yesterday* AUX.3SG *the*.ACC *Kai*[ACC] *the*.NOM *Max*[NOM] *visit*.PTCP  
 ‘Yesterday, Max visited Kai.’

Only two assumptions about scrambling will be crucial for us:<sup>7</sup> First, that it affects the c-command relation between the arguments, as suggested by the contrast in (10) (see, e.g., Webelhuth 1989 for similar examples): The subject pronoun cannot be bound by the quantifier in object position in (10a), which involves no scrambling, but this binding is possible in (10b) where the object has been scrambled across the subject.

While asymmetric c-command relations between the scrambled arguments are relevant for our purposes, the exact position of the scrambled element is not. For (10b), we simply assume that the scrambled phrase is adjoined to *vP* as in (10c).<sup>8</sup>

- (10) a. \*Gestern haben seine<sub>i</sub> Eltern [jeden Schüler]<sub>i</sub>  
*yesterday* AUX.3PL *his*.NOM *parents*[NOM] *every*.ACC *student*[ACC]  
 besucht.  
*visit*.PTCP

Footnote 6 continued

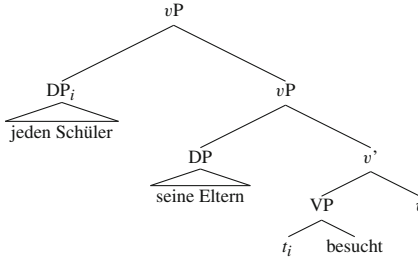
take the surface order in (8a) to be the result of scrambling of the indirect object across the direct one. While we here take the former position, the crucial point for us is that one object c-commands the other—an assumption corroborated by the binding facts mentioned below. Moreover, the double-object data in Sect. 4 are puzzling irrespective of which of the two objects has the higher base position.

<sup>7</sup> We thus ignore the issue which factors drive scrambling (see, e.g., Struckmeier 2014 for an overview).

<sup>8</sup> For the moment, we ignore LF-relevant parts of the structure, like indices created by movement.

- b. Gestern haben [jeden Schüler]<sub>i</sub> seine<sub>i</sub> Eltern  
*yesterday* AUX.3PM *every*.ACC *student*[ACC] *his*.NOM *parents*[NOM]  
 besucht  
*visit*.PTCP  
 ‘Yesterday, every student was visited by his parents.’

c.



(10c) also incorporates the second assumption that will be crucial for us, namely that scrambling is an instance of movement (see Webelhuth 1989 among many others), rather than base generation (see, e.g., Fanselow 2001). This is supported by the observation that scrambled material can (at least sometimes) reconstruct (see Frey 1993; Lechner 1998 among many others), as shown in (11), where the anaphor contained in the scrambled direct object can be bound only if that object reconstructs below the subject.<sup>9</sup>

- (11) ... weil [dieses Bild von sich<sub>i</sub>] [der Hans]<sub>i</sub> seinen  
 ... *because this*.ACC *picture*[ACC] *of* REFL *the*.NOM *Hans*[NOM] *his*.DAT  
 Freunden schenken wollte  
*friends*.DAT *give*.INF *want*.PST.3SG  
 ‘since Hans wanted to give this picture of himself to his friends’  
 (Lechner 1998, 297)

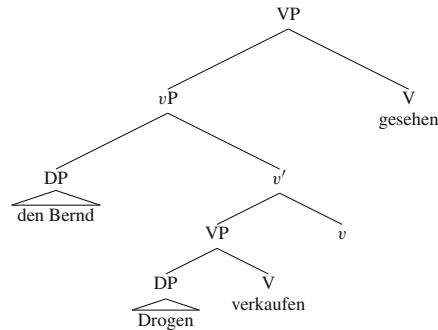
The second type of construction we will look at are embedded infinitives with an overt subject, as in (12a). It is irrelevant for our purposes how big the embedded structure is, i.e., whether it is a full CP or only a vP. We here use the latter type of structure for the sake of simplicity, as illustrated in (12b).

<sup>9</sup> Scrambling has been argued to display different reconstruction properties depending on whether A- or A'-movement is involved (see Frey 1993). While we won't say much about the A/A' distinction (but see Sect. 6), we will adopt Wurmbrand's (2010) more general take on reconstruction asymmetries, which relates the availability of reconstruction to information-structural properties rather than the A/A' distinction (see also Wurmbrand 2008): Even 'short' scrambling of a direct object  $\alpha$  across an indirect object as in (i) allows reconstruction if  $\alpha$  is a topic, i.e. (i) permits binding of the pronoun by the universal quantifier.

- (i) weil sie [EIN Bild von seinem<sub>i</sub> Auftritt]<sub>j</sub> [JEDem\ Kandidaten]<sub>i</sub>  
*because she*.NOM *one*.ACC *picture*[ACC] *of* *his*.DAT *appearance*[DAT] *every*.DAT *candidate*.DAT  
 t<sub>j</sub> zeigte  
*show*.PST.3SG  
 ‘since she showed one picture of his appearance to every candidate’ (Wurmbrand 2010, 19)

- (12) a. Gestern hat der Hans den Bernd  
*yesterday AUX.3SG the.NOM Hans[NOM] the.ACC Bernd[ACC]*  
 Drogen verkaufen gesehen.  
*drugs[ACC] sell.INF see.PTCP*  
 ‘Yesterday, Hans saw Bernd sell drugs.’

b.



What is crucial for us is that the embedded subject receives its ‘standard’ thematic role from the embedded verb, rather than receiving a special thematic role from the matrix verb (regardless of the accusative case assignment by the matrix verb). This is supported by the observation that the embedded *vP* may be an idiom with a fixed subject, as shown in (13a), which permits the idiomatic reading of *alle Stricke reißen*. If the embedded subject stood in a thematic relation with the matrix verb, this would be unexpected; further, the acceptability of expletives in the subject position of the embedded infinitive, illustrated by (13b), would be unexplained.

- (13) a. Leider hat der Hans alle Stricke reißen  
*unfortunately AUX.3SG the.NOM Hans[NOM] all.ACC ropes[ACC] tear.INF*  
 gesehen.  
*see.PTCP*  
 Literal: ‘Unfortunately, Hans saw all the ropes tear.’  
 Idiomatic: ‘Unfortunately, Hans saw everything fail/worst come to worst.’
- b. Der Hans hat es draußen regnen gesehen.  
*the.NOM Hans[NOM] AUX.3SG EXPL outside rain.INF see.PTCP*  
 ‘Hans saw it rain outside.’

## 2 Cumulativity asymmetries in German: two new observations

At first sight, German DPs with *jed-* ‘every’ exhibit the same basic asymmetry as English *every*-DPs: (14a), the translation of (2c), only has a distributive reading, whereas (14b), which is parallel to (2d), also permits a cumulative construal.

- (14) a. Jedes Mädchen in dieser Stadt hat (die)  
*every.NOM girl[NOM] in this.DAT town[DAT] AUX.3SG (the[ACC])*  
 zwei Hunde gefüttert.  
*two[ACC] dogs[ACC] feed.PTCP*



- ‘Every girl in this town fed (the) two dogs.’ **true in (2b), false in (1b)**
- b. (Die) zwei Mädchen haben jeden Hund in  
 (the[NOM]) two[NOM] girls[NOM] AUX.3PL every.ACC dog[ACC] in  
 dieser Stadt gefüttert.  
 this.DAT town.DAT feed.PTCP  
 ‘(The) two girls fed every dog in this town.’ **true in (2b), true in (1b)**

As in English, such simple examples won’t help us to disentangle the different factors that could underlie the asymmetry—structural relations like c-command, semantic scope, thematic roles and grammatical functions. Our informal survey thus uses more complex configurations to tease these factors apart: As indicated above, it involved structural asymmetries between two arguments in different clauses that both bear AGENT roles, double object configurations, and various scrambling configurations.

We used an online questionnaire<sup>10</sup> that was completed by 30 native speakers of German.<sup>11</sup> We presented German sentences containing a DP headed by *jed-* ‘every’ and a numeral-modified plural indefinite, together with a short text describing a cumulative scenario. Speakers had to judge how adequately the sentence describes the scenario on a 5-point scale from 1 (‘not at all adequate’) to 5 (‘completely adequate’).<sup>12</sup> As fillers, we used sentences with a *jed-* (‘every’) DP and a singular indefinite, and cumulative sentences with two numeral-modified plural indefinites.

This was not a controlled experiment, but an informal ‘pretest’ for further research. Still, the results indicate interesting questions to pursue in experimental research, discussed below and in Sect. 6. A further qualification is that not all participants accepted the cumulative reading, even in syntactic configurations that should uncontroversially permit it. As graded acceptability judgments do not tell us if a reading was unavailable for grammatical reasons or simply dispreferred, we leave the conditions on this variation to future study and concentrate on the aggregated data.

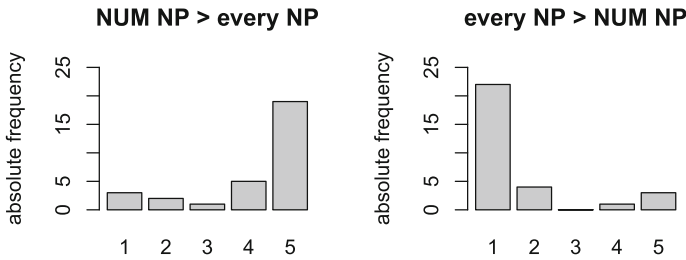
## 2.1 Embedded subjects under perception verbs

The first test configuration targeted cumulativity asymmetries between a main-clause subject and an argument in the embedded clause. We intended to disentangle structural effects from effects of thematic roles or grammatical functions: We considered infini-

<sup>10</sup> The questionnaire is accessible at <https://sites.google.com/view/the-typology-of-cumulativity/questionnaires>. We used two versions, which involved the same structural configurations, but different lexical predicates for some items.

<sup>11</sup> As these included speakers of different dialects and ages, participants had to state their region and age. Since it was not obvious to us whether these parameters had any effect, we will not discuss them here.

<sup>12</sup> A reviewer correctly points out that speakers coming from the German/Austrian school system are used to 1 being the best and 5 the worst grade and that this might have affected our results. We are fairly confident that it didn’t: First, the judgments on the infinitival embedding cases (Sect. 2.1) were very clear. Had the participants reversed the intended mapping of numbers to acceptability values, the results would be surprising in light of all previous work and also our own judgments: It would mean that they accept cumulative readings for a *jed-*DP matrix subject relative to a plural subject of an embedded clause, but reject such readings for the inverse situation. Second, while the answers of some participants deviated strongly from the majority on several items, no participant consistently exhibited the inverse of the general patterns described below, as far as we can see.



**Fig. 1** Survey data on cumulative readings of *jed-* in embedded subject vs. matrix subject position (1 = ‘not at all adequate’ in the scenario; 5 = ‘completely adequate’ in the scenario). *Left*: *jed*-DP in embedded subject position and plural indefinite in matrix subject position, as in (15a). *Right*: Plural indefinite in embedded subject position and *jed*-DP in matrix subject position, as in (15b)

tival embedding configurations with AGENT roles for both the matrix subject and the embedded subject. The relevant point of variation was whether the *jed*-DP occurred in matrix subject position, with the plural indefinite in embedded subject position, or vice versa.

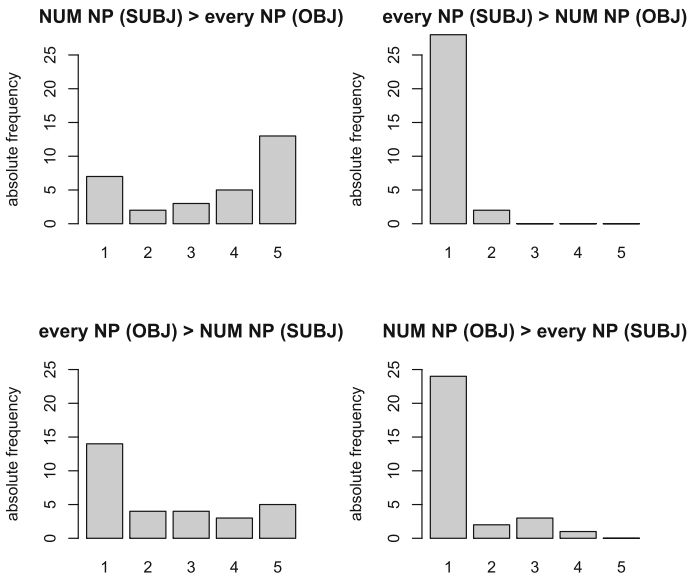
In (15a), the *jed*-DP subject of the infinitive is c-commanded by the higher plural indefinite *zwei Detektive* in matrix subject position. This contrasts with (15b), where the *jed*-DP in matrix subject position c-commands the plural indefinite *zwei von diesen Kriminellen*.

- (15) a. Gestern haben zwei Detektive jeden von diesen  
*yesterday* AUX.3PL *two*[NOM] *detectives*[NOM] *every*.ACC *of these*.DAT  
 Kriminellen Drogen verkaufen gesehen.  
*criminals*[DAT] *drugs*[ACC] *sell*.INF *see*.PTCP  
 ‘Yesterday, two detectives saw each of these criminals sell drugs.’  
**NUM NP (matrix) > every NP (embedded) ✓ cumulative**
- b. Gestern hat jeder Detektiv zwei von diesen  
*yesterday* AUX.3SG *every*.NOM *detective*[NOM] *two*[ACC] *of these*.DAT  
 Kriminellen Drogen verkaufen gesehen.  
*criminals*[DAT] *drugs*[ACC] *sell*.INF *see*.PTCP  
 ‘Yesterday, every detective saw two of these criminals sell drugs.’  
**every NP (matrix) > NUM NP (embedded) \*cumulative**

As shown in Fig. 1, most participants accessed a cumulative reading for the *jed*-DP in (15a), but rejected this reading for (15b). Assuming that the thematic role and the grammatical function of the *jed*-DP is identical in both cases (but see Sect. 3 for more discussion), this suggests that cumulativity asymmetries cannot be based solely on the thematic role of the *jed*-DP or its grammatical function. Rather, the contrast indicates that the distinguishing property is structural.

These data fall out from the D-hypothesis: In (15a), the *jed*-DP subject of the embedded clause does not c-command any element of the chain of the matrix subject, *zwei Detektive* (‘two detectives’). This parallels the schematic structure in (4a) above, repeated in (16a), for which the D-hypothesis correctly predicts a cumulative reading.





**Fig. 2** Survey data on cumulative readings of *jed-* in subject vs. direct object position, with asymmetric predicates (*erschließen* ‘shoot’ and *gewinnen* ‘win’). 1 = ‘not at all adequate’ in the scenario; 5 = ‘completely adequate’ in the scenario. *Top left*: Plural indefinite subject and *jed*-DP object; unmarked word order, as in (18a). *Bottom left*: Plural indefinite subject and *jed*-DP object; object scrambled over subject, as in (18b). *Top right*: *jed*-DP subject and plural indefinite object; unmarked word order, as in (19a). *Bottom right*: *jed*-DP subject and plural indefinite object; object scrambled over subject, as in (19b)

accessed the cumulative reading for a non-scrambled *jed*-DP in direct object position (18a). We further observed that scrambling of the *jed*-DP object across the subject affects the availability of the cumulative reading: In cumulative scenarios, (18b) is rejected more often than (18a), although we find more inter-speaker variation than in the infinitival embedding case. The results are given in the first column of Fig. 2.

- (18) a. Gestern haben zwei Jäger jeden Hirsch in  
*yesterday* AUX.3PL *two*[NOM] *hunters*[NOM] *every*.ACC *stag*[ACC] *in*  
*diesem* Wald erschossen.  
*this*.DAT *forest*[DAT] *shoot*.PTCP  
 ‘Yesterday, two hunters shot every stag in this forest.’  
**NUM NP (SUBJ) > every NP (OBJ)**  
 ✓ cumulative [with some variation, see Figure 2]
- b. Gestern haben jeden Hirsch in diesem Wald  
*yesterday* AUX.3PL *every*.ACC *stag*[ACC] *in this*.DAT *forest*[DAT]  
*zwei* Jäger erschossen.  
*two*[NOM] *hunters*[NOM] *shoot*.PTCP  
 ‘Yesterday, every stag in this forest was shot by two hunters.’  
**every NP (OBJ) > NUM NP (SUBJ)**  
 ??cumulative [with some variation, see Figure 2]

Now consider sentences with the *jed*-DP in subject position and a plural indefinite as the direct object. The base-generated order, corresponding to the schematic structure (5a) above, is given in (19a). In (19b), the object is scrambled above the subject, resulting in a structure that corresponds to (6a). As the second column in Fig. 2 shows, both types of sentences were rejected in cumulative scenarios by almost all speakers, with no discernible effect of scrambling.

- (19) a. Gestern hat jeder Jäger in diesem Ort  
*yesterday* AUX.3SG *every*.NOM *hunter*[NOM] *in this*.DAT *town*[DAT]  
 fünf Hirsche erschossen.  
*five*[ACC] *stags*[ACC] *shoot*.PTCP  
 ‘Yesterday, every hunter in this village shot five stags.’  
**every NP (SUBJ) > NUM NP (OBJ)** \*cumulative
- b. Gestern hat fünf Hirsche jeder Jäger in  
*yesterday* AUX.3SG *five*[ACC] *stags*[ACC] *every*.NOM *hunter*[NOM] *in*  
*diesem Ort* erschossen.  
*this*.DAT *town*[DAT] *shoot*.PTCP  
 ‘Yesterday, five stags were shot by every hunter in this village.’  
**NUM NP (OBJ) > every NP (SUBJ)** \*cumulative

At first sight, these data are perplexing: While (18) suggests that movement affects the availability of cumulative readings—or in other words, that the c-command relation between the *jed*-DP and the indefinite plural matters for cumulativity—(19) suggests it doesn’t. Recall, however, that the D-hypothesis appeals not only to the c-command relation between a *jed*-DP and a plural DP  $\alpha$ , but also to the c-command relation between the *jed*-DP and the other elements of  $\alpha$ ’s chain. Consequently, if  $\alpha$  moves,  $\alpha$ ’s base position will still matter.

Here is how the data follow from the D-hypothesis: Example (18a) corresponds to the schema in (5b) above, repeated in (20a): The *jed*-DP does not c-command the plural indefinite, which forms a chain by itself. Accordingly, the D-hypothesis correctly predicts the cumulative reading to be available.

- (20) a. [ ...[  $\alpha$  [ ...[*jed*- NP] ... ] ] ... ]
- b. [ Gestern haben [ [ **zwei Jäger** ] [ [ **jeden**  
*yesterday* AUX.3PL [ [ *two*[NOM] *hunters*[NOM] ] [ [ *every*.ACC  
**Hirsch in diesem Wald** ] erschossen ] ] ]  
*stag*[ACC] *in this*.DAT *forest*[DAT] ] *shoot*.PTCP ] ] ]

Next, consider (18b): The *jed*- DP has moved to a position c-commanding the subject, yielding a surface structure that corresponds to our schema (21a) (= (6b)). As our hypothesis makes reference to LF c-command relations, we must now take into account the possibility that a scrambled phrase may syntactically reconstruct. If reconstruction is available, the surface structure in (18b) is corresponds to two distinct LFs: Without reconstruction, the LF is (in the relevant respects) identical to the surface structure in (21a). As the *jed*-DP c-commands the plural indefinite in this structure, a cumulative interpretation is blocked. But if the *jed*- DP reconstructs, we obtain the LF schematized

in (20a), where the *jed*-DP does not c-command any element of the indefinite plural's chain, so nothing stands in the way of a cumulative reading.

- (21) a. [ [*jed*-NP]<sub>1</sub> [ ... [  $\alpha$  [ ...t<sub>1</sub> ... ] ] ... ] ]  
 b. [ Gestern haben [ [ **jeden Hirsch in diesem Wald** ] ]<sub>1</sub> [ [*yesterday* AUX.3PL [ [ *every*.ACC *stag*[ACC] *in this*.DAT *forest*[DAT] ] ] ]<sub>1</sub> [ [ **zwei Jäger** ] [ t<sub>1</sub> erschossen ] ] ] ]  
 [ *two*[NOM] *hunters*[NOM] ] [ t<sub>1</sub> *shoot*.PTCP ] ] ] ]

In order to derive a prediction about (18b) from the D-hypothesis, we thus need a hypothesis about when scrambled phrases reconstruct. We adopt Wurmbrand's (2008) view that reconstruction is possible, but only if the scrambled phrase has the prosodic and pragmatic properties of a contrastive topic in the sense of Büring (1997)—with the proviso that this constraint might be subject to dialectal variation.<sup>13</sup>

Relating this to our results, we note that a parse with a scrambled contrastive topic would require a highly marked prosody (see Büring 1997 among others) and the contexts we provided neither forced nor blocked such a parse—our written questionnaire did not control for the prosody participants assigned to the sentences. We thus cannot be sure if they interpreted the scrambled *jed*-DP as a contrastive topic, but suspect that while most participants did not parse the *jed*-DP as a contrastive topic, a minority might have done so. This would account for the fact that (18b) received high ratings from some speakers, but still considerably less often than (18a): If (21a) is the preferred LF and the reconstructed structure in (20a) is dispreferred, e.g. for information-structural reasons, the D-hypothesis predicts that (18b) should lack a cumulative reading for most speakers. Moreover, the structural possibility of reconstruction might also explain why the contrast between (18a) and (18b) is not more clear-cut: If a minority of our participants interpreted the scrambled object as a contrastive topic, thus licensing reconstruction, the D-hypothesis predicts the cumulative reading to be available for them. This reasoning makes a testable prediction that we cannot address here: The contrast between (18a) and (18b) should become more distinct if the prosody is controlled in a way that blocks a contrastive topic interpretation.

In contrast, reconstruction cannot rescue the cumulative reading for the examples in (19). In both (19a) and (19b), the *jed*-DP c-commands the base position of the plural indefinite, so the necessary condition for a cumulative reading cannot be met regardless of the LF: The two possible LFs for (19b) correspond to the schemata in (5a) and (6a), repeated in (22a) and (23a), respectively. In both cases, one element of the chain of the plural indefinite is c-commanded by the *jed*-DP; thus, the D-hypothesis correctly predicts that neither LF makes the cumulative reading available.

<sup>13</sup> A more common claim, which dates back at least to Frey (1993), is that scrambling structures are generally ambiguous between a surface-scope reading and a reconstructed reading, independently of their information structure. This disagreement in the literature might reflect dialectal variation or the fact that, while much of the literature controls for potential effects of prosody by indicating the main stress, the information-structural conditions licensing the stress pattern at hand are often not controlled for. For example, several works including Frey (1993) use *verum focus* to impose a 'flat' prosody on the postverbal material, but do not give discourse contexts that would license the use of *verum focus*. In fact, it is hard to provide such a context without disambiguating the sentence towards one of the two scope options.







account for a cumulative reading of *every*-DPs regardless of the syntactic configuration. As alluded to above, there are different semantic analyses that are compatible with a structural approach to cumulativity asymmetries, and each of them deviates in some way from the assumptions about LF syntax that lead to a type mismatch: Event-based approaches (Ferreira, 2005; Chatain, 2020, 2022) analyze lexical verbs as denoting unary predicates of events regardless of their arity, and *every*-DPs as operators on such predicates (possibly mediated by a thematic-role operator); Champollion (2010) analyzes *every*-DPs not as quantifiers, but as simple type *e* plurals that must stand in a certain syntactic relation to a cumulation or distributivity operator; and Haslinger and Schmitt (2018) interpret predicates as sets of pluralities (as opposed to simple relations between individuals) and provide a cross-categorial schema to interpret *every*-DPs as operators on such sets. Finally, in Sect. 5 we will present a version of Haslinger and Schmitt's (2018) approach on which plural quantifiers must combine with a predicate mapping individuals to sets of pluralities, which must be derived by abstraction over an index. While the abstraction rule may be linked to QR, this analysis crucially differs from the standard QR-based treatment in that the derived predicates may return sets of pluralities of any type. There is no requirement for an *every*-DP to combine with the counterpart of a type  $\langle e, t \rangle$  predicate, and hence no requirement for it to move across the subject. The upshot is that in all of these theories, quantifiers in object position combine with their nuclear scope in exactly the same way as quantifiers in subject position, removing the need for obligatory QR across the subject.

So if there is no obligatory QR of one DP across another, what about the option that such QR is available, but dispreferred in German? If so, examples with a *jed*-DP in object position, like (18a), would be assigned an additional, dispreferred LF that lacks the cumulative reading. As long as the preferred LF permits a cumulative reading, this possibility would be compatible with our data, although we see do not see strong evidence for it. Conversely, even if a plural object in a sentence like (19a) is optionally permitted to QR across a *jed*-DP in subject position, the D-hypothesis would not license a cumulative reading of the object, as the trace of the plural object would still be c-commanded by the *jed*-DP.<sup>15</sup>

In summary, our discussion of the scrambling data in light of the D-hypothesis relies on the view that overt movement and reconstruction, not QR, is the crucial scope mechanism in the German Mittelfeld (following Frey 1993; Beck 1996; Buring 1997; Wurmbrand 2008 and others): *jed*-DPs in object position do not undergo obligatory QR across the subject for type reasons. This fits well with the fact that none of the existing semantic analyses of cumulativity asymmetries imposes a type requirement that would motivate this QR. That being said, we leave open whether QR is available as an optional, but dispreferred mechanism in addition to reconstruction, as our data have no bearing on this issue.

### 2.2.3 Data with (near-)symmetric predicates and PP objects

Having discussed the predictions of the D-hypothesis for scrambling data and its interaction with different assumptions about scope in German, we now turn to the

<sup>15</sup> Chatain (2022, Sect. 3.3) makes an analogous point about QR and cumulativity asymmetries in English. See Sect. 6.

second set of monotransitive sentences in our questionnaire. They involved predicates with PP-objects (the adjective *verwandt* ‘related’ and the verb *treffen* ‘meet’, the transitive versions of which take a PP headed by *mit* ‘with’) and were intended to show whether semantically symmetric/near-symmetric transitive predicates, each of which also has an intransitive collective variant, display cumulativity asymmetries.

(26) gives two sentences from our questionnaire with such predicates. The results for these cases were much less clear than those for asymmetric predicates: The majority of participants rejected the cumulative reading, irrespective of whether the *jed-* DP occurred in subject position and whether scrambling had occurred. Due to this high rejection rate, there were no clear contrasts between scrambled and non-scrambled sentences, and between sentences with a high and a low base position of the *jed-* DP.

- (26) a. Interessanterweise sind zwei Wiener  
*interestingly* COP.3PL *two*[NOM] *Viennese*[NOM]  
 Bekannte von mir mit jedem Einwohner  
*acquaintances*[NOM] of *me*.DAT with *every*.DAT *inhabitant*[DAT]  
 dieses Dorfes verwandt.  
*this*.GEN *village*.GEN *related*  
 ‘Interestingly, two Viennese acquaintances of mine are related to every inhabitant of this village.’
- b. Interessanterweise sind mit jedem Einwohner dieses  
*interestingly* COP.3PL with *every*.DAT *inhabitant*[DAT] *this*.GEN  
 Dorfes zwei Wiener Bekannte von mir  
*village*.GEN *two*[NOM] *Viennese*[NOM] *acquaintances*[NOM] of *me*.DAT  
 verwandt.  
*related*  
 ‘Interestingly, for every inhabitant of this village, two Viennese acquaintances of mine are related to them.’

#### 2.2.4 Pragmatic constraints on cumulativity as a potential confound

We suspect that the reason for this low acceptability of the cumulative reading is not a theoretically significant contrast between symmetric and asymmetric predicates, but a methodological issue with our questionnaire: The availability of cumulative readings depends in part on contextual factors—even in configurations where the semantic prerequisites for a cumulative reading are uncontroversially met, such as sentences with two plural definites. More specifically, Haslinger (2022) argues that a cumulative reading is available only if the contextually given ‘issue’ (roughly, the question under discussion, QUD) does not distinguish between cumulative and distributive scenarios. Further, Poortman (2016) shows (using cumulative predicate conjunction in Dutch) that the acceptance rate for a cumulative reading increases if the distributive reading is implausible or ‘atypical’ for reasons of non-linguistic world knowledge.

We believe that the contexts we provided for the symmetric predicates, unlike those for the asymmetric predicates, were not sufficiently biased towards the cumulative

reading in either of these respects. For illustration, translations of our contexts for (18a) and (26a) are given in (27a) and (28a), respectively:

- (27) a. CONTEXT: The animal rights activist Hans is shocked to find that the five stags living in the forest behind his house have all disappeared. He assumes right away that the three hunters in the village, Karl, Franz and Sepp, are responsible. Indeed, it turns out that Karl shot two stags and Franz shot the other three. Sepp did not participate in the hunt. Hans tells his wife: It is very sad ...
- b. Gestern haben zwei Jäger jeden Hirsch in  
*yesterday AUX.3PL two[NOM] hunters[NOM] every.ACC stag[ACC] in*  
 diesem Wald erschossen.  
*this.DAT forest[DAT] shot.PTCP*  
 ‘Yesterday, two hunters shot every stag in this forest.’
- (28) a. CONTEXT: Hans just spent his vacation in a small alpine village inhabited by two large families: the Huber family and the Schandl family. The Hubers are not related to the Schandls, but every inhabitant of the village belongs to one of these two families. When Hans gets back to Vienna, he notes that his neighbor in Vienna is related to the Huber family. Another one of Hans’ acquaintances in Vienna is related to the Schandl family. Talking about his vacation, he notes:
- b. Interessanterweise sind zwei Wiener  
*interestingly COP.3PL two[NOM] Viennese[NOM]*  
 Bekannte von mir mit jedem Einwohner  
*acquaintances[NOM] of me.DAT with every.DAT inhabitant[DAT]*  
 dieses Dorfes verwandt.  
*this.GEN village.GEN related*  
 ‘Interestingly, two Viennese acquaintances of mine are related to every inhabitant of this village.’

The context in (27a) seems to implicitly set up a QUD like: ‘How many of the stags got killed and which of the hunters participated in killing them?’ A distributive reading (on which the stags get shot twice—German *erschießen*, unlike English *shoot*, entails that the victim is killed) does not seem to be available, but even if it were, it would have the same status with respect to the implicit QUD as the cumulative reading. So both of the contextual factors mentioned above favor a cumulative reading.

In contrast, (28b) has a plausible distributive reading (each of the acquaintances is related to both families in the village). Further, while the context does not set up an obvious QUD, a natural question answered by (28b) in this context seems to be: ‘Which relations are there between the two families from the village and your other acquaintances?’ Such a general question would be answered differently in a cumulative and a distributive scenario; the generalization proposed by Haslinger (2022) then

predicts low acceptability for the cumulative reading, for reasons unrelated to the *jed*-DP.

These pragmatic considerations suggest there is a plausible non-syntactic explanation for the contrast between our results for symmetric and asymmetric predicates, which makes testable predictions: The acceptability of a cumulative reading for sentences like (26a) should improve with a QUD that does not distinguish between cumulative and distributive scenarios, and the acceptability of a cumulative reading for sentences with asymmetric predicates should decrease once the distributive reading is plausible and the QUD biased towards a distributive reading. We hope to test these predictions in future work.

### 2.3 Interim summary

In this section, we gave empirical motivation for the following claim about the distribution of cumulative readings of German *jed*- ('every'):

(29) **Derivational hypothesis ('D-hypothesis')**

A plural expression  $\alpha$  has a cumulative reading relative to a *jed*-DP only if the *jed*-DP does not *c*-command any element of  $\alpha$ 's chain at LF.

In Sect. 2.1, we argued that the availability of such readings depends on structural relations like *c*-command, rather than a simple thematic-role or subject-object asymmetry (but see Sect. 3.4 for a more nuanced discussion). The motivating data come from infinitival embedding: Even if the matrix subject and the infinitival subject are both agents, a *jed*-DP in embedded subject position can receive a cumulative reading relative to the matrix subject, but not vice versa.

Section 2.2 explored the interaction between cumulative readings of *jed*-DPs and scrambling of the object across the subject. For asymmetric predicates, a *jed*-DP in object position receives a cumulative reading relative to a plural subject, but the acceptance rate for this reading decreases if the *jed*-DP is scrambled across the subject. Further, a *jed*-DP in subject position does not get a cumulative reading relative to the object regardless of the surface word order. This motivates the idea that the semantic mechanism underlying cumulative readings of *jed*-DPs is sensitive not just to the LF positions of the other plurals, but also to their base positions. The results from a second data set with symmetric predicates were less clear, as the acceptance rate for cumulative readings in these cases was low in all syntactic configurations. We suggested that this might be due to general pragmatic constraints on cumulativity, which were not unambiguously met in the contexts the questionnaire provided.

## 3 Four alternative hypotheses about the semantic asymmetry

Up to this point, we motivated our novel D-hypothesis. The existing literature on English *every* implicitly entertains several simpler hypotheses about the nature of the cumulativity asymmetry, although most of the syntactic configurations that could distinguish between them have not been investigated in detail empirically. While we



ify what we mean by ‘scope’: The availability of a cumulative reading for an *every*-DP relative to another plural  $\alpha$  in a syntactic configuration  $C$  would be linked to the scope relation that would hold between  $\alpha$  and the *every*-DP in  $C$  on a *distributive* reading. In a framework that assumes a structural relation (such as LF c-command) underlying scope, this boils down to the claim that the same structural relation underlies cumulativity asymmetries. But an empirical correlation between scope relations on a distributive reading and the availability of a cumulative reading would be expressible in non-LF-based frameworks as well.

For some of the existing works just cited, it is not obvious whether the intended structural relation is semantic scope or surface c-command, as syntactic configurations in which scope and surface c-command might diverge are not discussed in detail. For example, Champollion (2010) argues that the constraints on cumulativity asymmetries are structural and phrases them in terms of a c-command condition, but does not commit to a syntactic level of LF distinct from surface structure (or discuss data that might dissociate c-command from scope).<sup>17</sup> Similarly, Haslinger and Schmitt (2018) call their analysis of cumulativity asymmetries surface-compositional, but do not address any data that could distinguish between scope asymmetries and surface c-command asymmetries.

Given the observation that scrambled phrases in German may, at least under certain conditions, undergo scope reconstruction (Sect. 2.2.1), we will first discuss the predictions of a generalization based on scope and then discuss the predictions of surface c-command separately—despite the fact that some of the existing work on cumulativity asymmetries cannot easily be categorized along those lines.

(33) **Scope hypothesis (‘S-hypothesis’)**: An *every*-DP can have a cumulative reading relative to another plural  $\alpha$  iff  $\alpha$  would be able to outscope the *every*-DP on a distributive reading.

( $\approx$  Within LF-based approaches to scope: An *every*-DP can have a cumulative reading only relative to plural expressions that c-command it at LF.)

According to (33), cumulativity asymmetries reflect the **relative scope** of the *every*-DP and the other plural expression. How does this claim differ from the D-hypothesis if we adopt the assumptions underlying the latter, especially that scope reduces to LF c-command? Both hypotheses would then appeal to c-command relations at LF. But while the S-hypothesis only considers the position where  $\alpha$  is interpreted in relation to the position of the *every*-DP (other elements of  $\alpha$ ’s chain at LF are irrelevant), the D-hypothesis considers the positions of all elements of  $\alpha$ ’s chain at LF.

How does the S-hypothesis fare if we apply it to our German data in Sect. 2? First, as mentioned above, it derives the contrast between matrix and embedded subjects, i.e., (30), under the assumption that in such configurations scope of the embedded subject over the matrix subject is dispreferred.<sup>18</sup>

<sup>17</sup> Champollion (2010) adopts Trace Conversion (Fox, 2002), a rule that is usually thought of as applying at LF, but his data could be captured even if it applied to the surface representation.

<sup>18</sup> Testing the S-hypothesis directly for such cases would require a more complex set-up than our questionnaire: Not only would we have to test the availability of inverse scope readings, we would also have to control for inter-speaker variation regarding scope inversion, and for other factors that might affect scope,

Concerning the scrambling data from Sect. 2.2.1, the following picture emerges: Scrambling has been argued to not only affect surface c-command, but also scope (see Frey 1993; Beck 1996; Büring 1997; Lechner 1998; Heck 2001; Pafel 2005; Wurmbrand 2008 for discussion). Most syntacticians agree that German sentences where the arguments appear in their base positions—with the subject preceding the object and no topicalization—disallow scope inversion (but see Pafel 2005; Frey 1993; Heck 2001 for dissenting views). The S-hypothesis thus correctly predicts our results regarding (31a): As the *jed*-DP is an object in its base position, it does not outscope  $\alpha$ , the so cumulative construal should be available.

Most syntacticians also agree that sentences where the object is scrambled over the subject permit scope reconstruction.<sup>19</sup> But as mentioned in Sect. 2.2.1, we adopt Wurmbrand's (2008) view that reconstruction in German scrambling structures is restricted to contrastive topics. If supplemented with this restriction, the S-hypothesis is compatible with the mostly negative judgments for (31b): The *jed*-DP will outscope  $\alpha$  (blocking the cumulative reading) unless it is construed as a contrastive topic.

What about our results for those cases where the *jed*-DP is a subject? For (32a), where both the subject and the object occur in their base positions, scope inversion is disallowed, so the *jed*-DP takes scope over  $\alpha$ . The S-hypothesis thus correctly predicts the cumulative reading to be unavailable. Yet, (32b), where the object has been scrambled across the *jed*-DP subject, also lacks a cumulative reading. The S-hypothesis could only account for this if it assumed that scrambled direct objects in cumulative sentences obligatorily reconstruct. But under this assumption, it no longer correctly accounts for (31b): Here, it had to assume that scope reconstruction of the object is dispreferred. The S-hypothesis thus captures the effect of scrambling in (31b), where the *jed*-DP is the object, but cannot explain the fact that scrambling has no effect in (32b), where the *jed*-DP is the subject.

### 3.2 Surface c-command (C-hypothesis)

Our second candidate hypothesis, (34), is not explicitly distinguished from the S-hypothesis in the literature,<sup>20</sup> but since it makes potentially distinct predictions, we address it separately.

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Footnote 18 continued

like the choice of the second plural DP (as different DPs have been argued to have different scope options; see, e.g., Beghelli and Stowell 1997) or prosody (see, e.g., Büring 1997).

<sup>19</sup> The picture in the literature is, in fact, surprisingly diverse. As mentioned in footnote 13, this might be due to dialectal variation and/or the influence of intonation and context on reconstruction. Another complication is that scope reconstruction has been claimed to be less restricted than binding reconstruction, suggesting that both syntactic and semantic reconstruction are available (Frey 1993; Lechner 1998). Moreover, positions about the 'base' or 'default' argument order in German diverge: We here assume that configurations where the subject precedes the object reflect the base-generated order. But the latter is sometimes taken to depend on lexical properties of the verb (Frey 1993) or to coincide with the least marked order relative to various ranked constraints involving animacy and agentivity (Heck 2001).

<sup>20</sup> As stated in Sect. 3.1, although Champollion's (2010) proposal is presented as a c-command generalization, it is unclear if it should count as an instance of the S-hypothesis or the C-hypothesis.

- (34) **Surface c-command hypothesis ('C-hypothesis')**: An *every*-DP can have a cumulative reading only relative to plural expressions that c-command it at surface structure.

According to (34), a cumulative reading of an *every*-DP relative to a plural DP  $\alpha$  is possible only if  $\alpha$  is syntactically 'higher' at the surface structure than the *every*-DP. As it lacks reference to the level of LF, the C-hypothesis differs both from our LF-based gloss of the S-hypothesis and from the D-hypothesis; the difference from the latter is that it only considers  $\alpha$ 's surface position, not the entire chain.

The C-hypothesis clearly makes the correct predictions for the matrix vs. embedded subject cases from Sect. 2.1, i.e. (30): In (30a), the matrix subject *jed*-DP c-commands the plural indefinite at surface structure, so the cumulative reading is predicted to be blocked, whereas the reverse holds of (30b).

As for our scrambling data, the C-hypothesis is compatible with the structures without movement: In (31a) the *jed*-DP object is c-commanded by the plural DP in subject position, so the cumulative reading is correctly predicted to be available, while in (32a), the *jed*-DP subject c-commands the plural object, so this reading is correctly predicted to be blocked. But just like the S-hypothesis, the C-hypothesis fails to account for the structures where the object has moved across the subject (although the two hypotheses differ in which problems they encounter): In (31b), the *jed*-DP object has moved across the subject, so according to the C-hypothesis, the cumulative reading should be blocked. While this is roughly on the right track, the C-hypothesis cannot account for the contrast between this example and (32a), where judgments were also negative, but much more clear-cut. It is (32b), however, that is the most unexpected case for the C-hypothesis: As the plural DP has been scrambled across the *jed*-DP subject, it c-commands the latter at surface structure. Accordingly, the cumulative reading is clearly—and falsely—predicted to be available.

### 3.3 Thematic roles (T-hypothesis)

So far, we focused on structural relations between the *every*-DP and the other plural DP, but it is not obvious that cumulativity asymmetries should be described in terms of c-command or other structural relations at all. In particular, Kratzer's (2003) description of the facts concerning English *every* suggests that the possibility of cumulating an *every*-DP with another plural might be determined by the thematic role of the other plural. This raises two questions: First, could our data be captured by a generalization based purely on thematic roles? Second, how does the actual semantic system implemented in Kratzer (2003) relate to the D-hypothesis and the S-hypothesis?

As for the first question, if we assumed that thematic roles are ranked on a hierarchy that determines their relative propensity for cumulative readings, we could posit a generalization of the following kind:

- (35) **Thematic hypothesis ('T-hypothesis')**: A cumulative reading for an *every*-DP relative to another plural is unavailable if the other plural has a thematic role that ranks lower than the thematic role of the *every*-DP.



The T-hypothesis would correctly account for the basic subject-object asymmetry in (2) if the thematic-role hierarchy ranks AGENTS higher than THEMES. Kratzer (2003) discusses data suggesting that an *every*-DP may have a cumulative reading as long as the other plural argument is not a THEME, even if there is no AGENT in the sentence. This generalization would be a variant of the T-hypothesis in which THEMES are ranked below everything else. The scrambling data presented in Sect. 2 above, however, pose a problem for any generalization that relies exclusively on thematic roles. Consider the contrast in (36) (= (18)) again. First, the low acceptability of a cumulative reading in (36b) suggests that AGENTS should rank below THEMES contrary to Kratzer's description, and second, whatever the ranking of the two arguments in (36b) is, any variant of the T-hypothesis falsely predicts it to be on a par with (36a).

- (36) a. Gestern haben zwei Jäger jeden Hirsch in  
*yesterday* AUX.3PL *two*[NOM] *hunters*[NOM] *every*.ACC *stag*[ACC] *in*  
*diesem* Wald erschossen.  
*this*.DAT *forest*[DAT] *shoot*.PTCP  
 'Yesterday, two hunters shot every stag in this forest.'  
**NUM NP (SUBJ) > every NP (OBJ)**  
 ✓ **cumulative [with some variation]**
- b. Gestern haben jeden Hirsch in diesem Wald  
*yesterday* AUX.3PL *every*.ACC *stag*[ACC] *in this*.DAT *forest*[DAT]  
*zwei* Jäger erschossen.  
*two*[NOM] *hunters*[NOM] *shoot*.PTCP  
 'Yesterday, every stag in this forest was shot by two hunters.'  
**every NP (OBJ) > NUM NP (SUBJ)**  
 ??**cumulative [with some variation]**

The infinitival embedding data in Sect. 2.1, repeated in (37), are also problematic for at least some variants of the T-hypothesis: The subjects of the embedded-clause verb *verkaufen* 'sell' are AGENTS; under the plausible assumption that the matrix subjects are AGENTS as well, a cumulative reading should be equally acceptable in (37a) and (37b), contrary to fact. To reconcile such data with the T-hypothesis, one would have to assume either that the matrix subject in (37) has a distinct thematic role that outranks AGENT, or that main-clause arguments outrank embedded-clause arguments regardless of their thematic role. While such moves would make the T-hypothesis compatible with the data in (37), this compatibility is only superficial, as scrambling also has an effect in examples like (37a): In our judgment, the scrambled variant (38) cannot easily get a cumulative reading. Thus, even a variant of the T-hypothesis that is adapted to the contrast in (37) would not capture the whole pattern.

- (37) a. Gestern haben zwei Detektive jeden von diesen  
*yesterday* AUX.3PL *two*[NOM] *detectives*[NOM] *every*.ACC *of these*.DAT  
*Kriminellen* Drogen verkaufen gesehen.  
*criminals*[DAT] *drugs*[ACC] *sell*.INF *see*.PTCP  
 'Yesterday, two detectives saw each of these criminals sell drugs.'  
**NUM NP (matrix) > every NP (embedded)** ✓ **cumulative**

- b. Gestern hat jeder Detektiv zwei von diesen  
*yesterday* AUX.3PL *every*.NOM *detective*[NOM] *two*[ACC] *of these*.DAT  
 Kriminellen Drogen verkaufen gesehen.  
*criminals*[DAT] *drugs*[ACC] *sell*.INF *see*.PTCP  
 ‘Yesterday, every detective saw two of these criminals sell drugs.’  
**every NP (matrix) > NUM NP (embedded) \*cumulative**

- (38) Gestern haben jeden von diesen Kriminellen zwei  
*yesterday* AUX.3PL *every*.ACC *of these*.DAT *criminals*[DAT] *two*[NOM]  
 Detektive Drogen verkaufen gesehen.  
*detectives*[NOM] *drugs*[ACC] *sell*.INF *see*.PTCP  
 ‘Yesterday, each of these criminals was seen selling drugs by two detectives.’  
**every NP (embedded) > NUM NP (matrix) \*cumulative**

While the T-hypothesis in (35) fails to capture the structural factors constraining cumulative readings of *every*-DPs, we cannot necessarily discount any influence of thematic roles on these asymmetries: Whereas the generalization explicitly stated in Kratzer (2003) appears to be a variant of the T-hypothesis—an *every*-DP may have a cumulative reading relative to another plural unless that other plural is a theme<sup>21</sup>—the compositional semantic system Kratzer (2003) sketches is not really an implementation of the T-hypothesis and actually extends in a natural way to effects of scrambling on cumulativity. If (36b) has the LF in (39) and the trace  $t_1$  is interpreted as a variable ranging over plural individuals, an event-based semantics of the type Kratzer assumes would correctly derive a distributive reading: In her system, an *every*-DP combines with a relation  $R$  between events and individuals, returning a predicate of events. Informally, this predicate is true of an event iff it can be partitioned into subevents such that every atomic individual in the NP-extension stands in relation  $R$  to one of the subevents, and each subevent stands in relation  $R$  to at least one such atomic individual. So in (39),  $vP_2$  would denote a relation that holds between an individual  $x$  and an event iff that event was a shooting of  $x$  by two hunters. The predicate denoted by  $vP_3$  is then true of an event  $e$  only if for every stag  $x$ ,  $e$  has a subevent in which  $x$  is shot by two hunters—the wide scope of the *every*-DP forces a distributive construal in spite of the thematic-role asymmetry. So, although Kratzer (2003) does not explicitly discuss this issue, her compositional system incorporates both thematic-role asymmetries and structural factors influencing cumulativity.

- (39) [<sub>TP</sub> gestern [<sub>vP<sub>3</sub></sub> [<sub>DP</sub> jeden Hirsch in diesem Wald ] ] [<sub>vP<sub>2</sub></sub> 1  
 [<sub>TP</sub> yesterday [<sub>vP<sub>3</sub></sub> [<sub>DP</sub> every.ACC stag[ACC] in this.DAT forest[DAT] ] ] [<sub>vP<sub>2</sub></sub> 1  
 [<sub>vP<sub>1</sub></sub> zwei Jäger [<sub>VP</sub>  $t_1$  erschossen ] ] ] ] haben ]  
 [<sub>vP<sub>1</sub></sub> two[NOM] hunters[NOM] [<sub>VP</sub>  $t_1$  shoot.PTCP ] ] ] ] AUX.3PL ]

The ‘mixed’ structural/thematic theory implicit in Kratzer (2003) would rely on thematic-role asymmetries for arguments in their base positions, but still correctly predict that movement of an *every*-DP can block a cumulative construal: The effect of move-

<sup>21</sup> We thank a reviewer for alerting us to the details of Kratzer’s generalization in its current form. Like the reviewer, we are unsure if Kratzer intends all plural non-theme arguments to pattern the same way.



implicit in Kratzer (2003), but not by the T-hypothesis in (35), irrespective of which thematic-role hierarchy is used.

- (41) a. The Fijians and the Peruvians won every game.  
           ✓ **cumulative** (Zweig 2008)  
       b. Every game was won by the Fijians and the Peruvians.  
           \***cumulative** (Zweig 2008)

In sum, passivization in English appears to interact with cumulativity asymmetries in the same way as German scrambling. Its behavior is thus problematic for the T-hypothesis and the C-hypothesis, but compatible with the D-hypothesis and with a mixed structural/thematic theory. As all the data we have presented can be accounted for equally well with and without reference to thematic roles, the purely structural D-hypothesis strikes us as more parsimonious than the mixed theory.<sup>23</sup>

### 3.4 Grammatical functions (GF-hypothesis)

There is another potential view of cumulativity asymmetries that lacks any direct reference to c-command or scope: Drozd et al. (2017) tie the lack of a cumulative construal for the *every*-DP in English sentences like (42) (= (2c)) to the fact that the *every*-DP is a subject in (42).<sup>24</sup>

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

The relevant distinction would thus be one between subjects and non-subjects, not between structurally higher and structurally lower arguments. More generally, the pattern in (2) could reflect a grammatical-function hierarchy as assumed in Lexical Functional Grammar (LFG) and other systems that do not unify grammatical-function asymmetries with constituent-structure asymmetries (see, e.g., Dalrymple 2001 for a discussion of the syntax-semantics interface in such theories). (43) gives an abstract generalization of this kind.

- (43) **Grammatical function hypothesis ('GF-hypothesis')**: An *every*-DP cannot have a cumulative reading relative to another plural if the grammatical function of the other DP ranks lower than that of the *every*-DP.

Although not expressed in LFG terms, Drozd et al.'s (2017) generalization can be viewed as a special case of (43) with a hierarchy that ranks subjects above all other arguments, and leaves the other grammatical functions unordered with respect to one another. Yet, it is also worth considering what a more fine-grained implementation of (43), with distinctions among different classes of non-subjects, would predict.

As the GF-hypothesis restricts its scope to syntactic processes that affect grammatical functions, it does not capture the general data pattern, namely, that cumulativity

<sup>23</sup> That being said, a closer investigation of predicates with 'atypical' thematic-role structures, like the near-symmetric predicates addressed in Sect. 2.2.3, might yield empirical results relevant to this issue.

<sup>24</sup> Drozd et al. (2017) attempt to link distributivity to singular agreement, so the relevant factor for them is that the subject triggers verb agreement. See footnote 26.

interacts with processes that reverse syntactic asymmetries, regardless of whether these asymmetries are traditionally thought of in grammatical-function terms or purely structural terms. In particular, while the GF-hypothesis correctly predicts the effect of the English passive in (41) (as the *every*-DP is a subject in (41b), but not in (41a)), it fails to derive the scrambling data, regardless of the particular hierarchy assumed: Scrambling does not change the grammatical function, so it should not affect the ranking (43) refers to; accordingly, the configurations in (44a) (= (5b)) and (44b) (= (6b)) are falsely predicted to be on a par.<sup>25</sup>

- (44) a. [ ...[  $\alpha$  [ ...[*jed*- NP] ... ] ] ... ] ✓ **cumulative** (see (18a))
- b. [ [*jed*- NP]<sub>1</sub> [ ...[  $\alpha$  [ ...t<sub>1</sub> ... ] ] ... ] ] \***cumulative** (see (18b))

At first sight, the GF-hypothesis also faces a problem with the embedded-subject data from Sect. 2.1, schematized in (45):<sup>26</sup> Given our assumption that the accusative DPs in these sentences are subjects, the cumulativity asymmetry is not captured. Yet, proponents of the GF-hypothesis could argue that nothing but considerations of simplicity precludes introducing a new grammatical function for ECM subjects.<sup>27</sup>

- (45) a. [S<sub>1</sub> ...[  $\alpha_{\text{agent, subject}}$  [ ...[S<sub>2</sub> ...[*jed*- NP]<sub>agent, subject</sub> ... ] ... ]]] ✓ **cumulative** (see (15a))
- b. [S<sub>1</sub> ...[ [*jed*- NP]<sub>agent, subject</sub> [ ...[S<sub>2</sub> ... $\alpha_{\text{agent, subject}}$  ... ] ... ]]] \***cumulative** (see (15b))

Summing up, while the GF-hypothesis accounts for the basic subject/object asymmetries, it leaves any effect of German scrambling on cumulativity (and the apparent analogy between scrambling and the English passive) unexplained. Further, while the infinitival embedding data can be incorporated into a GF-approach, the resulting theory seems less parsimonious than an approach based on LF constituency.<sup>28</sup>

#### 4 An open problem: scrambling in double-object configurations

Before we provide a semantic implementation of the D-hypothesis, we briefly present another set of results from our questionnaire, which concerned double-object constructions. This pattern is much more perplexing than any of the data considered

<sup>25</sup> If subjects outrank all other arguments, the GF-hypothesis also makes a problematic prediction for passive sentences: Cumulative readings should be available if the *every*-DP is in the *by*-phrase and another plural is in subject position; i.e., (40b) should permit a cumulative reading more easily than (40a).

<sup>26</sup> The problem would vanish if we supplemented the GF-hypothesis with Drozd et al.'s (2017) proposal that distributivity is tied to singular agreement: We could distinguish between finite-clause subjects, which trigger agreement, and infinitive subjects, which do not. Yet, the semantic implementation is unclear, as  $\phi$ -feature agreement on the verb is usually considered semantically inactive.

<sup>27</sup> Systems using grammatical-function hierarchies might need to be supplemented with a distinction between main-clause and embedded-clause arguments for independent reasons: For instance, as discussed by Baker (2001), frameworks that do not encode grammatical-function asymmetries in the constituent structure independently need such a provision for clausal embedding to capture phenomena like semantic binding and NPI licensing.

<sup>28</sup> See Baker 2001 for an analogous conceptual argument concerning binding.

so far: Without additional assumptions, the results are unexpected under any of the hypotheses, including our new D-hypothesis.

The basic structure we assume for double-object constructions is schematically repeated in (46) (see Sect. 1.3). The double-object part of our questionnaire was meant to address two questions, i) to what extent cumulative construals of *jed*-DPs in one of the object positions are available at all in such constructions (see Schein 1993; Chatain 2022 for English) and ii) whether scrambling of one object over the other affects the availability of a cumulative construal.

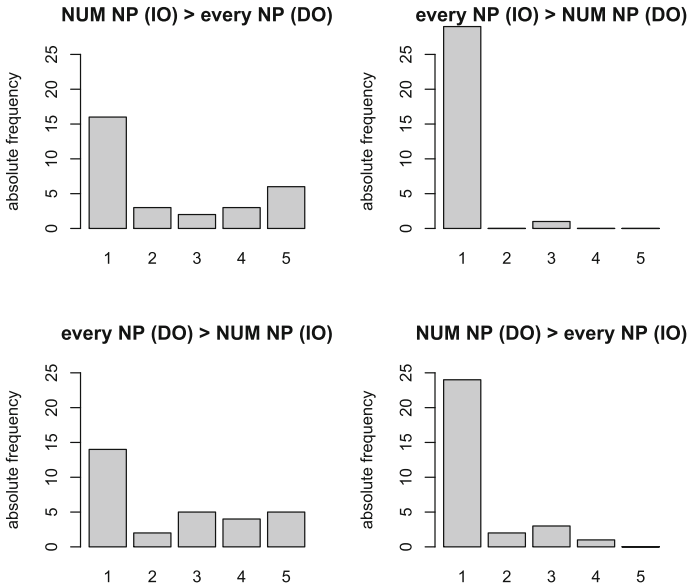
- (46) [<sub>vP</sub> SUBJECT [<sub>VP</sub> INDIRECT OBJECT (IO) [<sub>v'</sub> DIRECT OBJECT (DO) V ]]]

The D-hypothesis predicts high acceptability for the cumulative reading only if the *jed*-DP is the direct object (assuming that the base position of direct objects is lower) and no scrambling has taken place. Our data do not clearly support this prediction, mainly because the acceptance rate for cumulative readings in double object constructions was generally quite low.

Figure 3 presents the results for the verbs *zuweisen* ‘assign’ and *zeigen* ‘show’, which exhibit a clear semantic asymmetry between the two objects. (Again, we also tested two near-symmetric predicates, *vergleichen* ‘compare’ and *vorstellen* ‘introduce’, for which the data pattern was similar.) We manipulated both the base position of the *jed*-DP (direct vs. indirect object) and the surface word order (scrambled vs. non-scrambled). Consider first (47), where the *jed*-DP is the indirect object and the indefinite plural is the direct object. In (47a), the *jed*-DP appears in its base position, c-commanding the direct object, while in (47b), the direct object is scrambled across the *jed*-DP. As shown by the second column in Fig. 3, for both of these sentences, almost everybody rejected the cumulative reading.

- (47) a. Heute habe ich jedem Kind zwei Aufgaben von  
*today* AUX.ISG I.NOM *every*.DAT *child*[DAT] *two*[ACC] *tasks*[ACC] *from*  
 dieser Liste zugewiesen.  
*this*.DAT *list*[DAT] *assign*.PTCP  
 ‘Today, I assigned every child two tasks from this list.’  
**every NP (IO) > NUM NP (DO)**
- b. Heute habe ich zwei Aufgaben von dieser Liste  
*today* AUX.ISG I.NOM *two*[ACC] *tasks*[ACC] *from this*.DAT *list*[DAT]  
 jedem Kind zugewiesen.  
*every*.DAT *child*[DAT] *assign*.PTCP  
 ‘Today, I assigned two tasks from this list to every child.’  
**NUM NP (DO) > every NP (IO)**

This is expected given the D-hypothesis, as the *jed*-DP c-commands the base position of the plural indefinite in both sentences in (47). Moreover, as the *jed*-DP occurs in its base position in both examples, we cannot escape this c-command relation via reconstruction, which is what sets this example apart from structures with a scrambled *jed*-DP as in (48) (= (6b)).



**Fig. 3** Survey data on cumulative readings of *jed-* in indirect object vs. direct object position, with asymmetric predicates (*zuweisen* ‘assign’ and *zeigen* ‘show’). 1 = ‘not at all adequate’ in the scenario; 5 = ‘completely adequate’ in the scenario. *Top left*: Plural indefinite IO and *jed*-DP DO; unmarked word order, as in (49a). *Bottom left*: Plural indefinite IO and *jed*-DP DO; DO scrambled over IO, as in (49b). *Top right*: *jed*-DP IO and plural indefinite DO; unmarked word order, as in (47a). *Bottom right*: *jed*-DP IO and plural indefinite DO; DO scrambled over IO, as in (47b)

(48) [[*jed-* NP]<sub>1</sub> [ ... [  $\alpha$  [ ...t<sub>1</sub> ... ] ] ... ] ]

So far, so good. But now consider the second set of examples, where the *jed-* DP is the direct object and the plural indefinite the indirect object. (49a) reflects the basic word order, while (49b) involves scrambling of the *jed-* DP. Again, most of our consultants rejected the cumulative scenario for both types of sentences, although a notable minority found them acceptable. This is shown in the first column of Fig. 3.

- (49) a. Heute habe ich zwei Kindern jede Aufgabe auf  
*today AUX.1SG I.NOM two[DAT] children.DAT every.ACC task[ACC] on*  
*dieser Liste zugewiesen.*  
*this.DAT list[DAT] assign.PTCP*  
 ‘Today, I assigned two children every task on this list.’  
**NUM NP (IO) > every NP (DO)**
- b. Heute habe ich jede Aufgabe auf dieser Liste  
*today AUX.1SG I.NOM every.ACC task[ACC] on this.DAT list[DAT]*  
*zwei Kindern zugewiesen.*  
*two[DAT] children.DAT assign.PTCP*  
 ‘Today, I assigned every task on this list to two children.’  
**every NP (DO) > NUM NP (IO)**

How do the predictions of the D-hypothesis match these results? It falsely predicts that the cumulative reading should be acceptable in (49a): No position in which the *jed*-DP can be construed c-commands any element of the indefinite's chain. In (49b), the *jed*-DP could potentially reconstruct into a position where it does not c-command any element of that chain, but we would expect the reconstructed reading to be dispreferred, in analogy to the judgments for structures like (48). Yet, the data in Fig. 3 do not show a clear contrast between the structures in (49a) and (49b).

Before we turn to potential explanations for these unexpected results, let us emphasize that they are unexpected under *any* of the generalizations discussed in Sect. 3, for different reasons. Let us first consider the C-hypothesis: While it correctly predicts no cumulative reading for (47a) and (49b) (because the *jed*-DP c-commands the indefinite plural in both cases), it falsely predicts that reading to be highly acceptable in (47b) and (49a) (because in these examples, the indefinite plural c-commands the *jed*-DP). The T-hypothesis from (35), on the other hand, correctly predicts the cumulative reading to be unavailable in (47a) and (47b) if the RECIPIENT-role is taken to rank higher than the THEME-role. However, if so, it is again unclear why the cumulative reading is not highly acceptable in (49a) and (49b), where the indefinite plural is a RECIPIENT and the *jed*-DP a THEME.<sup>29</sup> Likewise, the GF-hypothesis would predict that the cumulative reading should only be blocked if the grammatical function of the *jed*-DP is ranked higher than that of the indefinite plural. Accordingly, if we assume that indirect objects are ranked higher than direct objects, we would predict the correct results for (47a) and (47b), but still face a problem with (49a) and (49b) (and vice versa if we assumed that direct objects are ranked higher than indirect objects). So, in summary, none of the alternative hypotheses accounts for the pattern.

Returning to the D-hypothesis, how could we explain the low acceptance rate for the cumulative reading in double object configurations? Our options depend on how we interpret the results: Fig. 3 shows that the cumulative readings for sentences where the *every*-DP is the direct object were accepted more often than those where it is the indirect object. (Put differently, there was much more variation in the former case than in the latter.<sup>30</sup>) The question is how to treat this admittedly small difference: Should we ignore it and assume that cumulative readings are generally blocked in double object configurations? Or should we take it as suggesting that cumulative readings are available in principle for sentences where the *jed*-DP is the direct object and look for other factors that might explain the high rejection rate? Clearly, this issue can only be decided by a more controlled experiment, so we must leave a definitive answer to future research. We merely sketch some potential accounts of the results under the D-hypothesis, given the two different interpretations of the data.

<sup>29</sup> Obviously, if we made the reverse assumption, that THEME is ranked higher than RECIPIENT, the predictions would still not match the observed pattern—in fact, they would be worse as there is a slight difference in judgments between (47) and (49), and a ranking of THEMES above RECIPIENTS would predict a difference in the opposite direction. Note further that a mixed approach that appeals both to thematic roles and to structural factors, as implemented in Kratzer (2003), would make the same predictions and therefore face the same problems as the D-hypothesis here (see Sect. 3.3).

<sup>30</sup> Our own judgment is that the cumulative reading is available in (49a) (and, for the first author, (49b)) although our judgments align with the majority of our participants for the infinitival embedding data and the subject-object scrambling data.



The first option is that there is something amiss with our syntactic assumptions about double-object constructions. That is, we could explore the option that the structure often assumed for English double-object constructions—with the indirect object asymmetrically c-commanding the direct object—is not the base-generated structure in German. While binding data suggest the surface (and LF) c-command relation to be the same as in English, this could result from a more complex derivation with a different underlying merge order. For example, we could assume that the indirect object obligatorily moves across the direct object. If reconstruction were blocked, we would expect the cumulative reading to generally be unavailable in double object constructions (which means that we would have to interpret our results as showing that cumulativity is generally blocked).<sup>31</sup> However, we are not aware of any independent support for this movement step, so if anything, we would have to take the data on cumulativity in double-object constructions as indicating a problem with the standard analysis of ditransitives rather than supporting a particular alternative analysis.<sup>32</sup>

The second option would be to argue that cumulative readings are not blocked *per se* in double object constructions and the qualitative pattern is the same as in the subject-object scrambling data set from Sect. 2.2. If so, the low acceptance rate for cumulative construals could be an artifact of our choice of examples in the questionnaire, rather than reflecting anything structural about double-object constructions. As mentioned above, our questionnaire did not control for the QUDs made salient by the contexts. The contexts we gave for the double-object sentences might thus be less likely to invoke a QUD answered by the cumulative reading. Although we did not attempt to fix the QUD anywhere in the questionnaire, we think that our simple subject/object sentences differed from the double-object sentences in one aspect that would fit well with this type of explanation: Due to our choice of the lexical predicates *erschließen* ‘shoot’ and *gewinnen* ‘win’, the simple subject/object sentences make a *distributive* construal very implausible, so that the cumulative construal does not compete with an equally plausible option. In contrast, the double-object sentences involved predicates with a much more plausible distributive construal (e.g., while it would be weird to assume that a given deer is shot by two hunters, it is less weird to assume that a given chore was assigned to two kids). Thus, the contrast expected under the D-hypothesis between, e.g., (47a) and (49a) might be blurred by a general preference for the distributive construal whenever it is compatible with general world knowledge. If so, the underlying qualitative pattern might actually match the predictions of the D-hypothesis, once this general preference is factored out.<sup>33</sup> In order to establish such

<sup>31</sup> If we permitted reconstruction, *jed*-DPs in indirect object position should permit the cumulative reading more easily than *jed*-DPs in direct object position, which is clearly wrong.

<sup>32</sup> The editor raises the question whether we could assume an optional covert shift of the direct object (across the indirect object) to account for the fact that (49a) is not as acceptable as expected under the D-hypothesis. We are not sure if this assumption can be independently semantically motivated: It would predict that under distributive construals of the sentence, the reading where the direct object scopes over the indirect object should be preferred (as we would have to assume that structures where the object shift has taken place are preferred over those without it so as to account for the high rejection rate of the cumulative construal in (49a)). This does not match our judgments, but more empirical research would be needed.

<sup>33</sup> This would require the assumption that the distributive construal is the more prominent one (for most speakers). While Dotlačil (2010) argues that the cumulative reading is more prominent, some of the findings reported in Maldonado (2018) suggest the opposite, at least for some types of examples. However, these

a claim, a controlled experiment with a wider range of mono- and ditransitive verbs would be needed. We leave this issue to future work.

## 5 A semantic implementation of the D-hypothesis

In the preceding sections, we motivated the hypothesis repeated in (50) to account for the distribution of cumulative readings of *jed*-DPs and argued that it is empirically superior to simpler alternative generalizations.<sup>34</sup>

### (50) Derivational hypothesis ('D-hypothesis')

A plural expression  $\alpha$  has a cumulative reading relative to a *jed*-DP only if the *jed*-DP does not c-command any element of  $\alpha$ 's chain at LF.

In the following, we will argue that the D-hypothesis is not an arbitrary interface condition, but falls out from certain semantic accounts of cumulativity asymmetries given one assumption: That traces can range over pluralities. It therefore reveals an interesting semantic property of traces.

There are two different types of semantic analyses of cumulativity asymmetries that can derive the data if semantically plural traces are permitted: The event-based approach (Schein, 1993; Kratzer, 2003; Ferreira, 2005; Zweig, 2008; Chatain, 2020, 2022) and the so-called plural projection account of Haslinger and Schmitt (2018, 2020). An analysis capable of deriving the effects of the D-hypothesis within an event-based framework has been worked out by Chatain (2022)<sup>35</sup>, who proposes a generalization analogous to the D-hypothesis for the interaction of cumulativity asymmetries and covert QR. Although Chatain does not claim that overt movement of an *every*-DP can block a previously available cumulative reading, we think his formal system could be expanded directly to our scrambling data. A different variant of the event-based analysis of cumulativity asymmetries, based on a weaker semantics for the thematic-role predicates, is developed in Chatain (2020). Unlike Chatain (2022), this system predicts that movement of a plural definite across an *every*-DP is not interpretable at all without reconstruction. However, this does not affect the basic predictions: Moving a plural definite cannot make any new readings available due to the obligatory reconstruction; in contrast, an *every*-DP is interpretable in a derived position and movement of an *every*-DP across a plural definite should block the cumulative reading.<sup>36</sup>

Footnote 33 continued

authors do not consider data with *every*-DPs, and it is unclear to what extent their generalizations extend to sentences with such elements.

<sup>34</sup> Or more parsimonious, when compared to the mixed thematic/structural account discussed in Sect. 3.3.

<sup>35</sup> While Chatain (2022) presents his work as based on a thematic-role hierarchy (e.g., AGENT > RECIPIENT > THEME), his actual semantic implementation of the asymmetry relies on the assumption that this hierarchy is encoded in the syntactic base structure, i.e. that the base position of an AGENT argument c-commands that of RECIPIENTS and THEMES etc., which is why we take it to be an implementation of a structural hypothesis rather than the T-hypothesis.

<sup>36</sup> Chatain (2020) actually argues that scrambling of a DP with *každyj* 'every' in Russian does not block cumulative readings, but it seems to us that both of his formal analyses in Chatain (2020) and Chatain (2022)

In this section, we will very informally present an implementation of the D-hypothesis that is analogous to Chatain (2022), but couched within the plural projection framework. We think this framework fits the empirical claims of this paper better, as we argued that there is no decisive evidence that cumulativity asymmetries are influenced by thematic roles. Unlike event-based approaches, the analysis we will present will not make reference to thematic roles in the derivation of cumulativity asymmetries, and is therefore compatible with not representing them at LF at all.

While the two accounts differ in their basic assumptions concerning the ontology and the way cumulativity is encoded in the grammar, they share two crucial properties: First, *every*-DPs in object position can be interpreted without having to move across the subject. While our account below will involve some LF movement to ensure that every plural quantifier binds an index, this is mainly to simplify the semantic rules and not equivalent to a standard QR-based system, as quantifiers in object position are not forced to move across the base position of the subject. Second, once *every*-DPs have combined with their nuclear scope, the result will itself have a denotation with a ‘plural structure’—a predicate of plural eventualities for Chatain (2022) and a set of pluralities of predicates in our system. ‘Seen from above’, *every*-DPs thus have the properties of a plurality-denoting expression and permit cumulative readings with respect to syntactically higher material.

## 5.1 Informal sketch of the plural projection treatment of *jed*-DPs

We first give a rough outline of the plural projection system (see Haslinger and Schmitt 2018 for motivation and technical details) in Sect. 5.1.1<sup>37</sup> and sketch the basic idea behind its treatment of *every*-DPs in Sect. 5.1.2. But since the system in Haslinger and Schmitt (2018) is variable-free, it requires certain technical changes to permit *jed*- and other plural quantifiers to bind traces: We will show how variables ranging over plural individuals can be integrated into the system in Sect. 5.2.1 and then give an informal account of how plural quantifiers like *jed*-DPs bind them that captures the effects of the D-hypothesis.

### 5.1.1 The core ideas behind plural projection

The plural projection system is based on two core ideas: First, there are pluralities of any semantic type. A plurality is an object corresponding to a non-empty set of atoms of the domain, and the claim is that we need such objects not only in ‘primitive’ domains (such as those of individuals or events), but also in functional domains. For example, just as the domain of individuals contains pluralities of individuals, as sketched in (51a), the domain of one-place predicates of individuals contains pluralities of such

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Footnote 36 continued

actually predict this blocking property unless the DP reconstructs, in line with our claims about German. See Sect. 6.3 for more discussion.

<sup>37</sup> We will not motivate this system further here for reasons of space, but see our manuscript “Asymmetrically distributive items and plural projection” at <https://semanticsarchive.net/Archive/WZjMDE4Z/> for a detailed introduction.

predicates, as sketched in (51b). (Here and hereafter we use ‘+’ to indicate plurality formation.)

- (51) a.  $D_e = \{\mathbf{Ada}, \mathbf{Bea}, \mathbf{Carl}, \mathbf{Ada+Bea}, \mathbf{Bea+Carl}, \mathbf{Ada+Bea+Carl}, \dots\}$   
 b.  $D_{\langle e,t \rangle} = \{\lambda x.\mathbf{smoke}(x), \lambda x.\mathbf{drink}(x), \lambda x.\mathbf{smoke}(x) + \lambda x.\mathbf{drink}(x), \dots\}$

The second core assumption of the system builds on this notion of cross-categorical plurality: The part structure of the denotation of a plural expression ‘projects’ to the denotations of dominating nodes by means of a special composition principle that subsumes functional application for non-plural denotations as a special case. Cumulativity is encoded in this composition principle. In order to implement this rule, we will assume that plural expressions that would usually be taken to be of type  $a$  actually denote sets of pluralities; i.e., for the purposes of this paper, they have denotations of type  $\langle a, t \rangle$ .<sup>38</sup> We will refer to these sets of pluralities as ‘plural sets’. So the possible denotations for regular plural DPs are not just plural individuals from  $D_e$ , but plural sets containing plural individuals from  $D_e$ ; the possible denotations for VPs containing a plural subexpression are not just predicates from  $D_{\langle e,t \rangle}$ , but plural sets containing pluralities of predicates from  $D_{\langle e,t \rangle}$ .

For example, a definite plural DP like *the two dogs* denotes a singleton plural set containing the plurality of all dogs, as in (52) (if Ivo and Joe are the only dogs).

- (52)  $\llbracket \text{the two dogs} \rrbracket = \{\mathbf{Ivo} + \mathbf{Joe}\}$

What does it mean for the part structure of (52) to ‘project’? The denotation of a dominating node, like the VP in (53a), will inherit the structure of the plural set in (52), unless some intervening element blocks this process. That is, when  $\llbracket \text{the two dogs} \rrbracket$ —a plural set with elements of type  $e$ —combines with the predicate  $\llbracket \text{fed} \rrbracket$  of type  $\langle e, \langle e, t \rangle \rangle$ , the result will be a set containing a plurality of type  $\langle e, t \rangle$  predicates, which can be split into parts corresponding one-to-one to parts of  $\mathbf{Ivo} + \mathbf{Joe}$ . Once this plural set of predicates combines with the subject, we obtain a plural set of propositions. Again, this plural set reflects the part-structure of (52), as (53c) shows.

- (53) a. Ada fed the two dogs.  
 b.  $\llbracket \text{fed the two dogs} \rrbracket = \{\lambda y.\mathbf{fed}(\mathbf{Ivo})(y) + \lambda y.\mathbf{fed}(\mathbf{Joe})(y)\}$   
 c.  $\llbracket \text{Ada fed the two dogs} \rrbracket = \{\mathbf{fed}(\mathbf{Ivo})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Ada})\}$

This projection behavior is the result of a composition rule, ‘Cumulative composition’ (‘CC’), which applies whenever we need to combine two plural sets. In examples like (53a), which contain only one plurality-denoting expression, the rule has an essentially distributive effect very similar to what is known as ‘Hamblin functional application’ in the various uses of Hamblin-style alternative semantics (e.g., the application to focus semantics by Rooth (1985), or the treatment of indefinites by Kratzer and Shimoyama (2002)).<sup>39</sup> The interesting effect of this rule—namely, that it encodes

<sup>38</sup> The type system assumed in Haslinger and Schmitt (2018) distinguishes between ‘plural sets’ with elements of type  $a$  and regular predicate denotations of type  $\langle a, t \rangle$ . We omit this distinction here.

<sup>39</sup> This requires that semantically non-plural expressions like *fed* or *Ada* can denote ‘trivial’ plural sets, i.e.  $\{\mathbf{fed}\}$  and  $\{\mathbf{Ada}\}$ .

cumulativity—only becomes visible once we consider structures with more than one plurality-denoting expression.

(54) illustrates the workings of the rule schematically. (We omit an actual definition.) If one sister denotes a plural set containing function pluralities ( $\{f + g\}$  in (54)) and the other a plural set containing argument pluralities ( $\{a + b\}$  in (54)), the rule will yield the following set: It will contain all sums of values 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’, as also shown in (54). ( $f(a) + g(b)$ , for example, is in the set denoted by the mother node since it is a plurality of values that ‘covers’ all the atomic parts of the function plurality  $f + g$  (both  $f$  and  $g$  are used at least once) and all the atomic parts of the argument plurality  $a + b$ . In contrast,  $f(a) + f(b)$  is not in the set, because it does not ‘cover’ all parts of the function plurality  $f + g$ .) As in (53), the pluralities in this resulting set can be split into parts that correspond to parts of the pluralities introduced by the denotations of the daughter nodes.

$$(54) \quad \{f(a) + g(b), f(b) + g(a), f(a) + g(a) + g(b), f(b) + g(a) + g(b), f(a) + f(b) + g(a), f(a) + f(b) + g(b), f(a) + f(b) + g(a) + g(b)\}$$

$\swarrow \quad \searrow$   
 $\{f + g\} \quad \{a + b\}$

Let us apply this rule to the concrete example in (55), which contains two plural DPs and has cumulative truth conditions. The denotation of the VP *fed the two dogs*, which we already computed in (53b), is repeated in (55b) below. (55c) outlines the crucial step: We combine the plural set of predicates in (55b) with the plural set of individuals denoted by *the two girls*, (55c). The outcome is a set of propositional pluralities that each ‘cover’ all of the atomic function parts (i.e., both  $\lambda y.\mathbf{fed(Ivo)}(y)$  and  $\lambda y.\mathbf{fed(Joe)}(y)$  are used at least once) and all of the atomic argument parts (i.e., both **Ada** and **Bea** are used at least once).

- (55) a. The two girls fed the two dogs.
- b.  $\llbracket \text{fed the two dogs} \rrbracket = \text{CC}(\llbracket \text{fed} \rrbracket)(\llbracket \text{the two dogs} \rrbracket)$   
 $= \{\lambda y.\mathbf{fed(Ivo)}(y) + \lambda y.\mathbf{fed(Joe)}(y)\}$
- c.  $\llbracket \text{The two girls fed the two dogs} \rrbracket$   
 $= \text{CC}(\{\lambda y.\mathbf{fed(Ivo)}(y) + \lambda y.\mathbf{fed(Joe)}(y)\})(\{\mathbf{Ada} + \mathbf{Bea}\})$   
 $= \{\mathbf{fed(Ivo)}(\mathbf{Ada}) + \mathbf{fed(Joe)}(\mathbf{Bea}), \mathbf{fed(Joe)}(\mathbf{Ada}) + \mathbf{fed(Ivo)}(\mathbf{Bea}),$   
 $\mathbf{fed(Ivo)}(\mathbf{Ada}) + \mathbf{fed(Joe)}(\mathbf{Ada}) + \mathbf{fed(Joe)}(\mathbf{Bea}), \dots,$   
 $\mathbf{fed(Ivo)}(\mathbf{Ada}) + \mathbf{fed(Joe)}(\mathbf{Ada}) + \mathbf{fed(Ivo)}(\mathbf{Bea}) + \mathbf{fed(Joe)}(\mathbf{Bea})\}$

The root nodes in (53) and (55) denote plural sets of propositions. Such a set counts as true if it contains at least one propositional plurality such that all its atomic parts are true. So (55c) would count as true, for example, if both *Ada fed Ivo* and *Bea fed Joe* were true (because then each atomic part of the propositional plurality  $\mathbf{fed(Ivo)}(\mathbf{Ada}) + \mathbf{fed(Joe)}(\mathbf{Bea})$  would be true). This captures the weak truth-conditions of (55a): the sentence is correctly predicted true as long as each of the girls fed at least one of the dogs and each of the dogs was fed by at least one of the girls.

### 5.1.2 *jed*-DPs within the plural projection system

Given this sketch, we would expect that the parts of a plurality can ‘project’ indefinitely—as soon as a plural expression  $X$  enters the derivation, every node dominating  $X$  should denote a plurality that reflects the part-structure of  $X$ ’s denotation. Yet, the system also opens up the possibility that certain elements interact in a non-trivial way with the projection mechanism, by directly taking plural sets as their arguments and thus blocking application of the cumulative composition rule. Haslinger and Schmitt (2018) argue that this is exactly what the denotations of English *every*-DPs and German *jed*-DPs do. We omit the DP-internal semantics here, but give a rough sketch of how this captures cumulativity asymmetries on the basis of English examples, without giving the full lexical entries. (See Haslinger and Schmitt (2018) for a full implementation.)

As just mentioned, an *every*-DP takes the plural set denoted by its nuclear scope as its argument. For (56a) ( $\approx$  (2c)), this means that the argument is the plural set in (56b), which contains only one plurality of predicates (‘projected’ from the definite plural object). When  $\llbracket$ every girl $\rrbracket$  applies, it returns a plural set that is derived as follows: First, we consider mappings from the atomic individuals in the restrictor set—i.e., **Ada** and **Bea**, if these are the only girls—to elements of the scope set. As our scope set in (56b) only has one element, each individual girl is mapped to the same predicate plurality, as sketched in (56c). We then combine each individual with the atomic parts of the predicate plurality it is mapped to and sum up the results, which yields the plurality in (56d). Then these resulting pluralities for all mappings from individuals to predicate pluralities are put into a plural set, so that the overall result of combining  $\llbracket$ every girl $\rrbracket$  with its scope is a new plural set—in our example, the singleton plural set of propositions in (56e). A plural set of propositions is true only if it contains a plurality consisting only of true propositions and for (56e), this is the case only in distributive scenarios (where Ada fed both dogs and Bea fed both dogs).

- (56)
- a. **Every girl** fed the two dogs.
  - b.  $\{\lambda x. \mathbf{fed(Ivo)}(x) + \lambda x. \mathbf{fed(Joe)}(x)\}$
  - c. **Ada**  $\mapsto \lambda x. \mathbf{fed(Ivo)}(x) + \lambda x. \mathbf{fed(Joe)}(x)$ ,  
**Bea**  $\mapsto \lambda x. \mathbf{fed(Ivo)}(x) + \lambda x. \mathbf{fed(Joe)}(x)$
  - d.  $\mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Joe)(Ada)} + \mathbf{fed(Ivo)(Bea)} + \mathbf{fed(Joe)(Bea)}$
  - e.  $\{\mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Joe)(Ada)} + \mathbf{fed(Ivo)(Bea)} + \mathbf{fed(Joe)(Bea)}\}$

This semantics has two crucial features. First, it captures the distributive effect of *every*-DPs with respect to their scope: Each atomic individual from the restrictor has to satisfy all the predicates in one of the predicate pluralities from the nuclear scope. Second, it encodes a certain scope asymmetry, since the output of combining an *every*-DP with its nuclear scope is crucially a plural set, which syntactically higher plural expressions can cumulate with. This has no immediate consequences for (56a) ( $\approx$  (2d)), as the sentence contains no plural expressions that outscope the *every*-DP, but it will have an interesting effect in (57b), where the *every*-DP is lower than the plural indefinite.

In (57a), we again combine the *every*-DP with the plural set in its scope; now this is the ‘trivial’ plural set **{fed}**. The lexical semantics of *every* as described in the previous paragraphs requires that each of the atoms in its restrictor, i.e., each dog, is mapped to the only element of this set, as in (57b). Since **fed** is not a plurality, it is applied separately to **Ivo** and **Joe**, the results are summed up and we form a plural set with this sum—a plurality of predicates—as its only element, (57c). Since the subject *the two girls* is not among the exceptional items that block the plural projection mechanism, the plural set in (57c) now forms the input for the Cumulative Composition rule. In particular, it is combined with the denotation of the subject, the plural set **{Ada + Bea}**, which yields the plural set of propositions indicated in (57d). Given the truth definition for such plural sets, (57d) will be mapped to true if at least one of the propositional pluralities in the set is such that all of its atomic parts are true. This is the case in cumulative scenarios where e.g. Ada fed Ivo and Bea fed Joe.

- (57) a. The two girls fed **every dog**.
- b. **Ivo**  $\mapsto \lambda x.\lambda y.\mathbf{fed}(x)(y)$ , **Joe**  $\mapsto \lambda x.\lambda y.\mathbf{fed}(x)(y)$
- c.  $\{\lambda x.\mathbf{fed}(\mathbf{Ivo})(x) + \lambda x.\mathbf{fed}(\mathbf{Joe})(x)\}$
- d.  $\{\mathbf{fed}(\mathbf{Ivo})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Bea}), \mathbf{fed}(\mathbf{Joe})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Ivo})(\mathbf{Bea}),$   
        $\mathbf{fed}(\mathbf{Ivo})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Bea}), \dots,$   
        $\mathbf{fed}(\mathbf{Ivo})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Ivo})(\mathbf{Bea}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Bea})\}$

In sum, the proposed meaning for *every*-DPs (and *jed*-DPs) makes the following prediction: We get a distributive construal for pluralities in the scope of *every*-DPs (since such pluralities project to pluralities of predicates, and each such predicate plurality is matched with an atomic individual from the restrictor). And we permit cumulative construals of *every*-DPs in relation to plural DP that are syntactically higher at LF, because the result of combining an *every*-DP with its scope is a plurality of predicates that can form the input to the cumulative composition rule.

In terms of our distinction between structural, thematic and grammatical-function asymmetries in Sect. 3, the semantics just sketched clearly falls into the structural class: The contrast between (57) and (56) is driven by the relative order in which the definite and the *every*-DP combine with their sisters, i.e. the LF constituent structure. Thus, the crucial asymmetries determining cumulativity for structures without movement are c-command asymmetries at LF. Thematic roles do not matter in the derivations; the system is compatible with not representing them in the syntax at all.

We now extend the system to structures with movement, as these will distinguish the D-hypothesis from the S-hypothesis. We will make some technical changes to our assumptions about LF syntax and the semantics of plural quantifiers like *every*, but these changes do not affect the basic workings of the analysis.

## 5.2 Plural projection and traces

### 5.2.1 Plural variables

Recall that according to the D-hypothesis, a cumulative construal is blocked not just in configuration (58a), but also in (58b), where the other plural *X* has moved across







With these modified assumptions, we will go through the semantic derivation of (65) step by step. We start with node *B* under an assignment *g* such that  $g(1) = \mathbf{Ivo} + \mathbf{Joe}$  (so  $\llbracket t_1 \rrbracket^g = \{\mathbf{Ivo} + \mathbf{Joe}\}$  as above) and  $g(2) = \mathbf{Ada}$  (so  $\llbracket t_2 \rrbracket^g = \{\mathbf{Ada}\}$ ). Via the CC-rule, this derives the plural set of propositions in (67).

$$(67) \quad \llbracket \llbracket_B t_2 \llbracket_A t_1 \text{ fütterte} \rrbracket \rrbracket \rrbracket^g = \{\mathbf{fed}(\mathbf{Ivo})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Ada})\}$$

While (67) encodes the inference that Ada fed both dogs, since  $g(2)$  is a singular individual, it is crucial to note that the system does not impose any particular restrictions on the trace left by the *jed*-DP—it may have a plural value:<sup>40</sup> Under an assignment  $g'$  with  $g'(1) = \mathbf{Ivo} + \mathbf{Joe}$  and  $g'(2) = \mathbf{Ada} + \mathbf{Bea}$ , node *B* would denote the plural set in (68) (= (57d)), which encodes cumulativity.

$$(68) \quad \llbracket \llbracket_B t_2 \llbracket_A t_1 \text{ fütterte} \rrbracket \rrbracket \rrbracket^{g'} = \{\mathbf{fed}(\mathbf{Ivo})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Bea}), \mathbf{fed}(\mathbf{Ivo})(\mathbf{Bea}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Ada}), \dots\}$$

Now consider the node *C* in (65). This is where the index 2 on the trace of the *jed*-DP should be abstracted over. We will assume a standard implementation of the abstraction rule (see, e.g., Heim and Kratzer 1998), where the result of abstraction is a function from individuals to whichever type the sister of the binder index has. In our system, this sister, labeled *B*, denotes a plural set of propositions. So the node *C* ends up denoting a function that maps an individual to the plural set *B* would denote under an assignment that maps index 2 to that individual. When applied to **Ada** under the assignment *g*, this function returns the plural set in (67); but when applied to **Ada + Bea** under the same assignment, it returns the plural set we would get if **Ada + Bea** were assigned to index 2, i.e. the set in (68).

How do we adapt the semantics of *jed*- to let it combine with this function? Above we said that a *jed*-DP yields a set of pluralities, each of which is created by composing each atomic individual from the restrictor with a predicate plurality in the nuclear scope and summing up the results. As the *jed*-DP now combines with a predicate mapping individuals to plural sets, we need a slight technical change: The scope predicate ( $\llbracket C \rrbracket^g$  in (65)) is applied to each atomic individual in the restrictor, so we obtain a plural set for each such individual. (69) illustrates this step (assuming that Ada and Bea are the only girls).

$$(69) \quad \llbracket C \rrbracket^g(\mathbf{Ada}) = \{\mathbf{fed}(\mathbf{Ivo})(\mathbf{Ada}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Ada})\}, \llbracket C \rrbracket^g(\mathbf{Bea}) = \{\mathbf{fed}(\mathbf{Ivo})(\mathbf{Bea}) + \mathbf{fed}(\mathbf{Joe})(\mathbf{Bea})\}$$

The *jed*-DP then returns the set of all pluralities obtained by selecting an element from each of these plural sets and summing them up. As each of the sets in (69) has only one element, we obtain the singleton set in (70). This is analogous to our earlier analysis in two ways: First, the unbound trace in the scope of the *jed*-DP can range over pluralities and thus behaves like the definite plural in (56). Second, the distributive effect of the *jed*-DP is unaffected by the abstraction over the trace of the *jed*-DP, as is the fact that it returns a plural set.

<sup>40</sup> Accordingly, our treatment of traces of *every/jed*-DPs differs from that of Champollion (2010), who assumes that these traces can only range over atomic individuals.

$$(70) \quad \llbracket D \rrbracket^g = \{\mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Joe)(Ada)} + \mathbf{fed(Ivo)(Bea)} + \mathbf{fed(Joe)(Bea)}\}$$

What remains to be shown is that (65) as a whole does not get a cumulative reading despite the higher position of the indefinite. To interpret the node *E* in (65), we must abstract over the index 1, creating another predicate mapping individuals to plural sets. Its value when applied to **Ivo** + **Joe** is the set in (70); when applied to an assignment *g''* that maps 1 to **Ivo** + **Karl**, it would return the set in (71b):

$$(71) \quad \begin{aligned} \text{a. } & \llbracket E \rrbracket^g(\mathbf{Ivo} + \mathbf{Joe}) = \{\mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Joe)(Ada)} + \mathbf{fed(Ivo)(Bea)} + \\ & \mathbf{fed(Joe)(Bea)}\} \\ \text{b. } & \llbracket E \rrbracket^g(\mathbf{Ivo} + \mathbf{Karl}) = \{\mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Karl)(Ada)} + \mathbf{fed(Ivo)(Bea)} + \\ & \mathbf{fed(Karl)(Bea)}\} \end{aligned}$$

The denotation of the plural indefinite *two dogs* takes the plural sets returned by its scope predicate for different argument pluralities of two dogs and forms the union of all these sets. In a scenario with dogs Ivo, Joe and Karl, the sentence in (65) then denotes the plural set in (72). Crucially, the cumulative reading is blocked, as each element of the set encodes a distributive scenario relative to a plurality of two dogs.

$$(72) \quad \{\mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Joe)(Ada)} + \mathbf{fed(Ivo)(Bea)} + \mathbf{fed(Joe)(Bea)}, \\ \mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Karl)(Ada)} + \mathbf{fed(Ivo)(Bea)} + \mathbf{fed(Karl)(Bea)}, \\ \mathbf{fed(Joe)(Ada)} + \mathbf{fed(Karl)(Ada)} + \mathbf{fed(Joe)(Bea)} + \mathbf{fed(Karl)(Bea)}\}$$

Let us highlight why this result reflects the relative scope of the *jed*-DP and the indefinite's trace, rather than a general correlation between trace binding and distributivity. In the LF in (66) no scrambling has occurred. While each predicate binds a trace, the trace of 'two girls' is not in the scope of the *jed*-DP. For this configuration, our system predicts a cumulative reading. Consider first node *A'* in (66), which denotes a plural set of intransitive predicates, depending on the value of index 2. As the *jed*-DP ranges over atomic individuals, the relevant values of the index will be **Ivo** and **Joe** (if Ivo and Joe are the only dogs). (73a) gives the plural sets denoted by *A'* for these values of the index. The function created by abstraction at node *B'* maps Ivo and Joe to their respective plural sets in (73a); the contribution of the *jed*-DP is to form a set of pluralities created by selecting an element from each of these sets and summing them up, which boils down to the single plurality in (73b).

$$(73) \quad \begin{aligned} \text{a. } & \text{For } g(2) = \mathbf{Ivo} : \llbracket A' \rrbracket^g = \{\mathbf{fed(Ivo)}\}; \text{ for } g'(2) = \mathbf{Joe} : \llbracket A' \rrbracket^{g'} = \\ & \{\mathbf{fed(Joe)}\} \\ \text{b. } & \llbracket C \rrbracket^g = \{\mathbf{fed(Ivo)+fed(Joe)}\} \end{aligned}$$

Node *D'* is then interpreted by combining the plural set in (73b) with the denotation of the indefinite's trace via the cumulative composition rule. Under an assignment *g* where *g*(1) = **Ada** + **Bea**, this yields the plural set in (74), which encodes a cumulative feeding relation between Ada and Bea and the dogs.

$$(74) \quad \llbracket D' \rrbracket^g = \{\mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Joe)(Bea)}, \mathbf{fed(Joe)(Ada)} + \mathbf{fed(Ivo)(Bea)}, \\ \mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Joe)(Ada)} + \mathbf{fed(Joe)(Bea)}, \dots, \\ \mathbf{fed(Ivo)(Ada)} + \mathbf{fed(Joe)(Ada)} + \mathbf{fed(Ivo)(Bea)} + \mathbf{fed(Joe)(Bea)}\}$$



- (78) a.  $\llbracket B'' \rrbracket^g = \{\mathbf{fed(Ivo)(Ada) + fed(Joe)(Bea)}, \mathbf{fed(Joe)(Ada) + fed(Ivo)(Bea)}, \mathbf{fed(Ivo)(Ada) + fed(Joe)(Ada) + fed(Joe)(Bea)}, \dots, \mathbf{fed(Ivo)(Ada) + fed(Joe)(Ada) + fed(Ivo)(Bea) + fed(Joe)(Bea)}\}$   
 b.  $\llbracket B'' \rrbracket^{g'} = \{\mathbf{fed(Ivo)(Ada) + fed(Ivo)(Bea)}\}$   
 c.  $\llbracket B'' \rrbracket^{g''} = \{\mathbf{fed(Joe)(Ada) + fed(Joe)(Bea)}\}$

Abstracting over index 2, node  $C''$  denotes a function from (possibly plural) individuals to sets of the kind sketched in (78); *two girls* then returns the union of the plural sets this function yields when applied to different sums of two girls. Under the assignment  $g$  that maps index 1 to a plurality, the set returned by *two girls* would encode a cumulative construal. But under the assignments  $g'$  and  $g''$ , which map 1 to a singular dog, it encodes the requirement that there were two girls who each fed that dog, as in (79).

- (79) a.  $\llbracket D'' \rrbracket^{g'} = \{\mathbf{fed(Ivo)(Ada) + fed(Ivo)(Bea)}, \mathbf{fed(Ivo)(Ada) + fed(Ivo)(Clara)}, \mathbf{fed(Ivo)(Bea) + fed(Ivo)(Clara)}\}$   
 b.  $\llbracket D'' \rrbracket^{g''} = \{\mathbf{fed(Joe)(Ada) + fed(Joe)(Bea)}, \mathbf{fed(Joe)(Ada) + fed(Joe)(Clara)}, \mathbf{fed(Joe)(Bea) + fed(Joe)(Clara)}\}$

Abstracting over index 1, we then get a function that maps the plurality  $\mathbf{Ivo + Joe}$  to  $\llbracket D'' \rrbracket^g$ , a plural set encoding a cumulative condition, while  $\mathbf{Ivo}$  is mapped to (79a) and  $\mathbf{Joe}$  is mapped to (79b). The crucial step of this derivation comes when we apply the meaning of the *jed*-DP, which combines with a function from individuals to plural sets, but only considers the values of this function for *atomic* individuals. So, the ‘cumulative’ plural set assigned to  $\mathbf{Ivo + Joe}$  is ignored and the plural set returned by the *jed*-DP is computed only on the basis of (79a) and (79b). This is what ultimately gives rise to a distributive construal: We take the set of all sums of a plurality from (79a) (which encodes that two girls fed Ivo) and an element of (79b) (which encodes that two girls fed Joe). The resulting set, sketched in (80), consists of propositional pluralities that are true only if Ivo and Joe were each fed by two of the girls.

- (80)  $\llbracket F'' \rrbracket^g = \{\mathbf{fed(Ivo)(Ada) + fed(Ivo)(Bea) + fed(Joe)(Ada) + fed(Joe)(Bea)}, \mathbf{fed(Ivo)(Ada) + fed(Ivo)(Bea) + fed(Joe)(Bea) + fed(Joe)(Clara)}, \mathbf{fed(Ivo)(Ada) + fed(Ivo)(Clara) + fed(Joe)(Bea) + fed(Joe)(Clara)}, \dots\}$

### 5.2.3 Interim summary

We showed that the D-hypothesis is not a stipulative interface condition, but can actually be derived from certain semantic analyses of cumulativity (see also Chatain 2022). This system we used extends Haslinger and Schmitt (2018), but unlike their variable-free mechanism, it relies on the assumption that every plural quantifier binds an index. Nevertheless, it preserves their main intuition—that plural quantifiers perform operations on sets of pluralities that return another such set, which may then form the input for the cumulation rule.

Crucially, we assumed that traces ranging over pluralities have the same kind of semantics as plural definites or plural pronouns. So if the cumulativity asymmetry of

*every* relative to definites and pronouns is encoded in its lexical semantics, we immediately expect it to extend to unbound traces in the scope of the *every*-DP, in line with the D-hypothesis. This basic idea is not specific to the plural projection semantics, as it can also be encoded in event-based theories such as Chatain (2022). However, our particular implementation seems to be the most direct semantic reflection of our empirical discussion of the syntactic facts above: The only factors that are clearly shown by our data to impact cumulativity asymmetries are the structural position of the elements involved and movement processes; that is, we did not see any unambiguous evidence for an interaction of cumulativity asymmetries and thematic roles. The semantic account we just gave preserves this intuition, because it is sensitive to the positions of elements and their traces, but does not appeal to thematic roles.

## 6 Conclusion and outlook

### 6.1 Broader consequences of the D-hypothesis

Our main aim was to establish an empirical generalization about the distribution of cumulative readings of *jed*- ('every') DPs in German that goes beyond a mere subject-object asymmetry and also covers the interaction of the phenomenon with movement and embedding. Both the scrambling data and the embedding behavior are in line with an account on which the availability of the cumulative reading is influenced by structural asymmetries at the syntactic level that forms the input to semantics. The data we presented do not rule out an additional influence of thematic-role or grammatical-function hierarchies on cumulativity, but neither do they provide evidence for it. We thus took a purely structural approach to cumulativity asymmetries to be more parsimonious.

The variant of the structural approach we ultimately argued for, however—our D-hypothesis—is less closely tied to surface-syntactic asymmetries than a simple scope or c-command generalization: Based on the observation that scrambling a *jed*-DP object across a plural subject removes the cumulative reading for some speakers, we argued that a *jed*-DP cannot receive a cumulative reading relative to another plural  $\alpha$  if it c-commands any element of  $\alpha$ 's chain at LF. On the theoretical side, this provides a new argument for a view of the syntax/semantics interface on which movement dependencies like scrambling are represented at LF, even if the moved DP does not reconstruct. As we saw in Sect. 5, this representation of traces does not have to take the form of a full DP with lexical content (i.e., we do not require 'Trace Conversion' in the sense of Fox 2002); it is enough to represent the trace of a scrambled plural DP as a variable ranging over pluralities. On the empirical side, predictions concerning whether a cumulative reading of an *every*-DP is available in a given syntactic configuration become more complex and more closely tied to structural assumptions about the base positions of the *every*-DP and the other plural.

Besides the issue of diagnosing covert structure, the D-hypothesis also has broader theoretical consequences. First, our account of the effect of scrambling on cumulativity relies on the availability of plural individuals as possible values of variables in natural language (as does the work of Chatain (2020, 2022) within an event-based theory).

While we take the view that variables may range over pluralities to be the default position, the most obvious arguments in its favor involve lexically collective predicates; it is thus an interesting consequence of the scrambling data that plural values for variables are also needed to account for data not involving collectivity.

Second, if one takes it for granted that at least some traces are semantically interpreted as variables, the D-hypothesis has the consequence that cumulativity asymmetries provide a new way of diagnosing the presence of such traces: If a plural expression *c*-commands an expression like an *every*- or *jed*-DP, but a cumulative reading of that plural is categorically blocked, this might indicate that the plural has moved across the *every*-DP from a lower base position. Cumulativity asymmetries could thus inform the syntactic analysis of particular constructions in the same way as reconstruction effects, by providing semantic evidence for filler-gap dependencies. For instance, if an *every*-DP in a certain adjunct position does not permit a cumulative reading relative to the subject despite being structurally lower, that would provide an argument that the subject has moved across the adjunct from its base position.

Third, the observed effects of clausal embedding and of certain instances of movement on cumulativity asymmetries strengthen the parallel with standard cases of scope asymmetries. The traditional description of cumulative readings as ‘scopeless’ or ‘semantically symmetric’ (see, e.g., Scha 2013 [1981]; Sher 1990)<sup>41</sup> is already called into question by the basic subject-object asymmetries observed by Schein (1993), Kratzer (2003) and others: If the cumulative reading of *every*-DPs in object position involved a semantic mechanism that treats subjects and objects symmetrically, it would be unclear why *every*-DPs in subject position cannot receive a cumulative reading by the same mechanism. The observation that both scope-taking in distributive sentences and cumulativity are affected by movement provides further reason to doubt that there is a good empirical basis for the sharp distinction usually made between cumulative plural predication and ‘ordinary’ quantification or scope-taking, especially when these data are put together with other effects of syntactic movement on cumulative readings, like the distribution of ‘weak’ readings of modified-numeral indefinites (Haslinger and Schmitt, 2020).<sup>42</sup> Clearly, further work is needed to develop a uniform approach to these phenomena and to determine how far-reaching the empirical analogies with ordinary scope-taking are.

<sup>41</sup> This description is motivated by the truth-conditions of sentences like (i) (= (1c)), which are ‘symmetric’ in the sense that the sentence is true as long as i) every one of the two girls fed at least one of the two dogs and ii) every one of the two dogs was fed by at least one of the two girls.

(i) (The) two girls fed (the) two dogs.

<sup>42</sup> A reviewer suggests our data would be compatible with a conception of cumulativity as scopeless if cumulativity is taken to result from the absence of scope-taking *operations*, rather than the absence of semantic asymmetries, and if movement generally counts as a scope-taking operation. The idea seems to be that *every/jed*- has a simple plural denotation and its scopal behavior results from the way movement chains are interpreted. Such a system would face the problem that scrambling of a plural definite or indefinite object across the subject does not block cumulative readings; i.e., if scrambling were generally linked to distributive scope-taking, the asymmetries should not be restricted to *every/jed*-DPs. Further, one would have to stipulate that *every/jed*-DPs in subject position undergo an obligatory scope-taking operation, while other plural subjects do not. So while we agree with the reviewer’s comment in principle, the fact that the potential distinction between scopeless cumulativity and distributive scope-taking gives rise to such problems suggests to us that it is an artificial distinction.

## 6.2 Open empirical questions in German

We conclude by addressing the most obvious empirical gaps in our data. Two such issues were already discussed in Sects. 2.2.3 and 4: the surprisingly low acceptance rates for cumulative readings with near-symmetric predicates and with ditransitive predicates, regardless of the syntactic configuration. The question is if we would find a pattern similar to the asymmetric monotransitive scrambling data from Sect. 2.2 if certain aspects of our questionnaire items were more controlled. In addition to providing contexts that make a particular QUD salient, we should also control for how easily distributive construals are available for these predicates. If the effects of scrambling for the near-symmetric and ditransitive predicates were masked by a general processing preference for a distributive construal, one could try to neutralize this preference via a more complex task instead of truth-value/acceptability judgments. For example, one could test the availability of each construal separately via a picture selection task in which participants can choose between a scenario that makes the sentence true on the relevant construal and one that makes it false on either reading, and also have the option of rejecting both scenarios. (See Lohiniva and Panizza 2016 for a discussion of such tasks.) An experiment using such a choice task might help determine which of the effects reported here are due to genuine grammatical constraints.<sup>43</sup>

Another issue our study did not address is whether other types of movement in German have analogous effects on cumulative construals of *jed*-DPs. In particular, it would be interesting to see if A- and A'-movement interact with cumulativity in the same way: It would be conceivable that the D-hypothesis holds for A'-chains, but not for A-chains. German scrambling does not provide an optimal test case for this potential distinction, since its status as A'-movement is controversial (cf., e.g., Webelhuth 1989; Frey 1993; Müller and Sternefeld 1994 for discussion); in fact, 'scrambling' is sometimes taken to be a cover term for a heterogeneous set of A- and A'-movement processes (see, e.g., Frey 1993; Wurmbrand 2010). It would thus be instructive to compare the effects of scrambling on cumulativity with those of passivization, a clear case of A-movement (if analyzed as movement at all), and with those of a clear case of A'-movement like topicalization, i.e. movement to Spec,CP. As our D-hypothesis is sensitive to the LF positions of plurals rather than their surface positions, it does not necessarily predict that topicalization will affect cumulative readings to the same extent as A'-scrambling, since topicalization has been claimed to permit reconstruction more easily than scrambling does (Höhle 1991; Beck 1996; Buring 1997; Heck 2001; Papfel 2005 among others). We would thus expect topicalization to have some effect on the availability of a cumulative reading for an *every*-DP in object position, but this effect should be less pronounced compared to scrambling. Another open question is whether higher and lower landing sites for scrambling, which can be differentiated by inserting adverbials (see, e.g., Frey and Pittner 1998; Frey 2000) and have been

<sup>43</sup> There would be a potential confound: As our data in Sect. 3 suggest reconstruction of scrambled phrases was a salient option for at least some participants, a task designed to reveal dispreferred readings might obscure any effects of scrambling on cumulativity. Working out the effect of different tasks on speakers' choice between distributive and cumulative construals of *every*-DPs is an interesting task for future experimental research.





- (82) a. Every girl in this town fed two dogs.  
 b. [two dogs] [1 [[every girl in this town] [fed t<sub>1</sub>]]]

Existing observations on other languages seem more problematic for the D-hypothesis. First, Chatain (2020) reports that while Russian DPs with *každyj* ‘every’ exhibit cumulativity asymmetries, scrambling does not affect the availability of a cumulative reading, regardless of which DP has the lower base position. As Russian scrambling is known to affect scope, we cannot invoke obligatory reconstruction as an explanation. The crucial example is (83): Scrambling of an ‘every’-DP fails to block the cumulative construal in the way predicted by the D-hypothesis.

- (83) Každuju        ustricu        povara        otkryli.  
*every.FEM.ACC oyster.SG.ACC cook.PL.NOM open.PERF.PL*  
 ‘The cooks opened every oyster.’        ✓ **cumulative** (Russian, Chatain 2020, 330, (37b))

Taken at face value, the contrast between (83) and, say, (18b) in German could reveal a point of cross-linguistic variation in the syntax/semantics interface, which should ideally be related to the other differences between German and Russian scrambling (e.g. differences in locality; cf. Müller and Sternefeld 1994). But note that (83) is not completely analogous to our German examples: It involves an unmodified NP unmarked for definiteness, while our questionnaire used indefinites modified by numerals. We thus wonder if the relative acceptability of (83) in a cumulative scenario might be due to a non-maximal construal of the lower plural, which should be blocked by the numeral-modified indefinites in our examples. If this construal is available in principle,<sup>45</sup> QUD-based approaches to non-maximality (cf. Križ 2016) would actually lead us to expect it in (83), where the most natural QUD is presumably whether the oysters are ready to eat.<sup>46</sup> A closer look at non-maximality in Russian would be needed to see whether this is a viable alternative explanation of the contrast.

The Italian data discussed by Flor (2017) pose another challenge for the cross-linguistic applicability of the D-hypothesis. The determiner *ogni* ‘every’ exhibits a subject-object cumulativity asymmetry in active sentences. In passive sentences, however, cumulative readings are available (although dispreferred) for *ogni* DPs both in the derived subject position (84a) and within a *by*-phrase (84b). In the context of our

<sup>45</sup> To our knowledge, this issue has not been studied; however, see Šimík and Demian (2020) for other potential semantic similarities between bare plural NPs in Russian and plural definites in German.

<sup>46</sup> We did not investigate cumulative readings of definites, but it seems that even in German cumulativity asymmetries are less pronounced if the other plural is a definite and the context licenses a non-maximal construal: (i) strikes us as acceptable in a cumulative scenario. (We use the contrastive-focus structure to motivate the scrambled word order, which would otherwise be highly marked without additional context, and to make salient the ‘weak’ QUD whether every oyster was opened by a cook.)

- (i) Es ist gut, dass jede Auster die Köche geöffnet haben und  
 EXPL COP.3SG good that every.ACC oyster[ACC] the.NOM cooks[NOM] open.PTCP AUX.3PL and  
 nicht die Lehrlinge.  
 not the.NOM apprentices[NOM]  
 ‘It is good that the cooks and not the apprentices opened every oyster.’

D-hypothesis, these data are surprising: even if reconstruction is an option, one of the two configurations in (84) should license cumulativity less easily than the other.<sup>47</sup> This suggests that either traces of passivization in Italian are not relevant for the semantics of plurals in the way we described, or the contrast with German scrambling is due to independent factors. One potential hypothesis which would allow us to extend the D-hypothesis to Italian would be the following: First, Italian has more than one attachment site for the *by*-phrase. Second, the surface subject of a passive sentence with a *by*-phrase in Italian does not have to move across the *by*-phrase (i.e., given our discussion of English passives above, Italian and English would differ in this respect). Whether these claims are feasible (and have any predictive power for a broader cross-linguistic sample) must be left to future research.

- (84) a. Ogni ladro è stato visto da tre testimoni.  
*every burglar is been seen by three witnesses*  
 ‘Every burglar was seen by three witnesses.’  
 ✓ **cumulative [with suitable context]** (Flor 2017, 53, (4.13))
- b. Le pecore in vendita sono state comprate da ogni visitatore.  
*the sheep on sale are been bought by every visitor*  
 ‘The sheep on sale have been bought by every visitor.’  
 ✓ **cumulative [with suitable context]** (Flor 2017, 24, (2.27))

A more problematic case also discussed by Flor (2017) is Clitic Left Dislocation in Italian, which does not block a previously available cumulative reading of an *ogni* DP. In fact, due to its information-structural properties, CLLD is argued to make the cumulative reading more prominent. Unlike passivization, CLLD has been analyzed alternatively as A'-movement or as a base-generated dependency; since scrambling is also usually analyzed as A'-movement, it is not obvious that this apparent cross-linguistic contrast could be attributed to the A/A' distinction. To see whether there is a unified cross-linguistic pattern here, we would thus need to take a closer cross-linguistic look at the interaction of cumulativity asymmetries with movement dependencies other than scrambling. A comparison of movement types that clearly differ in how easily they permit reconstruction might be particularly instructive.

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<sup>47</sup> Flor (2017) also shows that cumulative readings of unaccusative subjects with *ogni* are blocked, (i). This is surprising: The subject should be an underlying internal argument, as in the passive examples. Yet, our editor points out that (i) involves two non-agentive arguments and could thus have an underlying structure akin to that of double object constructions. If there are grammatical factors blocking cumulativity in double object constructions, the same factors could be at work in (i).

- (i) Ogni studente è piaciuto a tre insegnanti.  
*every student is pleased to three teachers*  
 ‘Every student pleased three teachers.’  
 \***cumulative** (Flor, 2017, 55, (4.16))

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## Declarations

**Conflict of interest** The authors declare that they have no conflict of interest.

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