

Head-Initial and Head-Final Coordinate Structures in Two Annotation Schemes of Dependency Grammar

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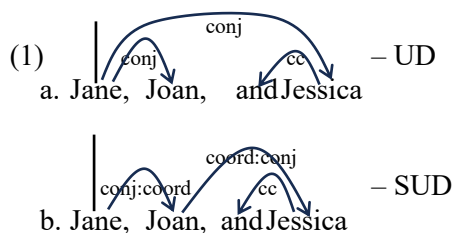
Abstract

The *Universal Dependencies* (UD) and *Surface-Syntactic Universal Dependencies* (SUD) annotation schemes view coordinate structures as head-initial. This contribution argues that a more flexible approach to coordinate structures is linguistically motivated, one that sees coordinate structures as head-initial in greater head-initial structures and as head-final in greater head-final structures. Support for this flexible approach comes from two areas: dependency distance and a nearness effect. In addition, two arguments that have been produced supporting the strictly head-initial approach are examined and refuted.

1 Introduction

The *Universal Dependencies* (UD: de Marneffe et al. 2014; Nivre et al. 2019) and *Surface-Syntactic Universal Dependencies* (SUD: Gerdes et al., 2018, 2019; Kahane et al. 2021) annotation schemes agree to an extent in their annotation choices concerning coordination.¹ They both view coordinate structures as head-initial, the initial (i.e. leftmost) conjunct being head over the following conjunct(s). In doing so, they are following other DGs (e.g. Engel, 1982; Mel'čuk, 1988; Groß, 1999; Eroms, 2000). The two annotation schemes also disagree in an important way, however, concerning the hierarchical status of non-initial conjuncts. The next two trees serve to illustrate major points of agreement and disagreement (conj =

conjunction, coord = coordinate, cc = coordinate conjunction):



UD annotation assumes a *bouquet* structure, whereby the non-initial conjuncts are equi-level dependents of the initial conjunct. SUD annotation, in contrast, chooses a more right-branching structure such that each successive conjunct is an immediate dependent of the immediately preceding conjunct. The two schemes agree insofar as coordinate structures are head-initial, the initial conjunct being head over the following conjuncts. They disagree, however, in all cases where the coordinate structure at hand contains three or more conjuncts, UD choosing the flatter bouquet structure, and SUD the more layered one.

The intent of this contribution is to critique the strictly head-initial approach to coordinate structures that both annotation schemes espouse. In doing so, the message delivered is similar to the messages of other recent accounts of the dependency analyses of coordinate structures (Kanayama et al. 2018; Przepiórkowski and Wóznik 2023; Przepiórkowski et al. 2024a, Przepiórkowski et al. 2024b; Stempniak 2024). More specifically, the account here pursues the approach to coordination

¹ The claims about the UD and SUD accounts of coordinate structures are based mainly on the guidance provided in the UD website (<https://universaldependencies.org/u/overview/complex-syntax.html>) and the SUD website (https://surfacesyntacticud.github.io/guidelines/u/oral_language/conj_coord/). Note that the UD claims in the area seem contradictory. The UD website states that

“coordinate structures are in principle symmetrical, but the first clause is by convention treated as the parent (or “technical head”) of all subsequent coordinated clauses via the conj relation.”

This statement is then followed by examples in which the standard dependency arcs are provided, with the initial conjunct shown as dominating the non-initial conjuncts.

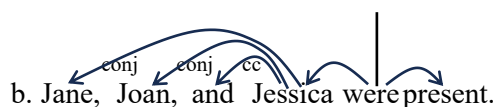
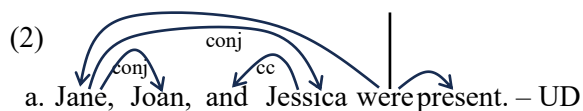
developed in Osborne and Groß (2017); this approach sees coordinate structures as head-initial or head-final within one and the same language depending on the greater structure in which the given coordinate structure appears. Two types of support are presented in favor of this flexible approach, the one being based on dependency distance and the other on a nearness effect having to do with mismatches in form. The account also examines and refutes two arguments supporting the strictly head-initial approach to coordinate structures.

There are two important points about the UD and SUD annotation choices concerning coordination and the proposal here that must be stated and acknowledged before proceeding. The first has to do with the tendency among the authors of UD and SUD to emphasize that their schemes are *not* intended to be theoretically stringent, linguistically unimpeachable analyses of sentence structures. They emphasize that the necessity to create easily implementable annotation guidelines has forced difficult decisions in the interest of practicality. Given this concession, it can be emphasized here from the outset that the proposal presented and defended below is easily implementable, for there is nothing complex or difficult about it, nothing that would prevent it from being adopted as a simple improvement to existing annotation guidelines.

The second point concerns the challenge posed by various phenomena of coordination, e.g. *gapping*, *right node raising* (RNR), *non-constituent conjuncts*, etc. The discussion of coordination presented here does not attempt to present coherent accounts of these phenomena, since doing so would require much more space than is available. The discussion concentrates instead on the core issue, which is the head-initial vs. head-final accounts of coordinate structures.

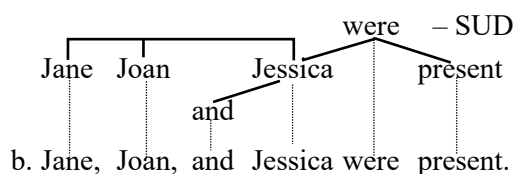
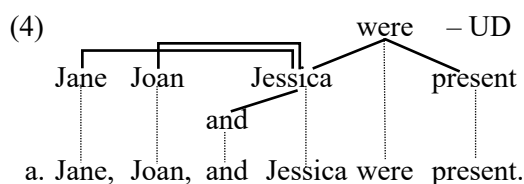
2 The proposal and the convention

The core proposal presented and defended here is now illustrated with the sentence *Jane, Joan, and Jessica were present*. The current UD and SUD annotation choices for this sentence are given next as the a-trees, and the alternative trees of the current proposal are given as the b-trees.



In all those cases where the coordinate structure precedes its head (*were* here), the coordinate structure is in fact head-final instead of head initial. In all those cases where the coordinate structure follows its head, the coordinate structure continues to be head-initial as shown in examples (1a-b).

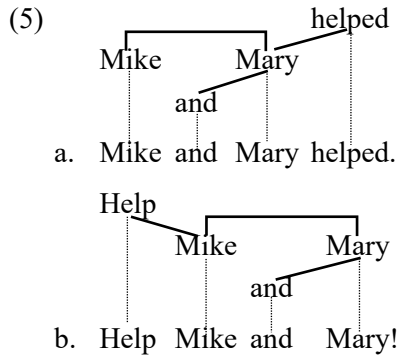
A special graphic convention for rendering coordinate structures shall henceforth be employed here: completely horizontal edges. These edges require little space and capture well the nature of the conjuncts of coordinate structures. The dependency structures are henceforth rendered as follows:



The benefit of this tree convention is that the conjuncts now clearly appear on the same level of the structure. The syntactic functions on the dependency edges (e.g. CONJ or COORD) are no longer necessary to help indicate the presence of coordination. Observe as well that the edges in (4a-b) are all still directed due to the fact that the tree is rooted. From a graph-theoretic standpoint, *Jessica* dominates *Joan* and *Jane* (and *and*) in (4a) because *Jessica* is linearly closer to the root *were* than *Joan* and *Jane* (and *and*). Similarly, *Jessica* dominates *Joan* in (4b) because *Joan* is linearly closer to the root *were* than *Joan*, and *Joan* dominates *Jane* because *Joan* is linearly closer to the

root *were* than *Jane*. Trees (4a) and (4b) are therefore isomorphic to trees (2b) and (3b), respectively.

Given this new convention, the proposal here is that coordinate structures that precede a shared head are head-final and coordinate structures that follow a shared head are head-initial. The next trees illustrate the proposal with respect to the coordinate structure *Mike and Mary*.



There are two benefits to these annotation choices. Both are due to the fact that the coordinate structure is now linked into the greater sentence at the closest point. This reduces dependency distances and accommodates the aforementioned nearness effect.

Note next that the proposal here is, as stated above, in line with the recent accounts of coordination that present corpus-based reasoning against inflexible “asymmetric” approaches to coordinate structures, the current basic UD and SUD annotation schemes being such inflexible approaches (i.e. Kanayama et al. 2018; Przepiórkowski and Wóznia 2023; Przepiórkowski et al. 2024a, Przepiórkowski et al. 2024b; Stempniak 2024). The proposal here is that coordinate structures are in

fact asymmetric, but asymmetric in the special way suggested by Przepiórkowski and Wóznia (2023: 15501): coordinate structures can be head-initial or head-final within one and the same language depending on the position of the shared governor with respect to the conjuncts of the coordinate structure.

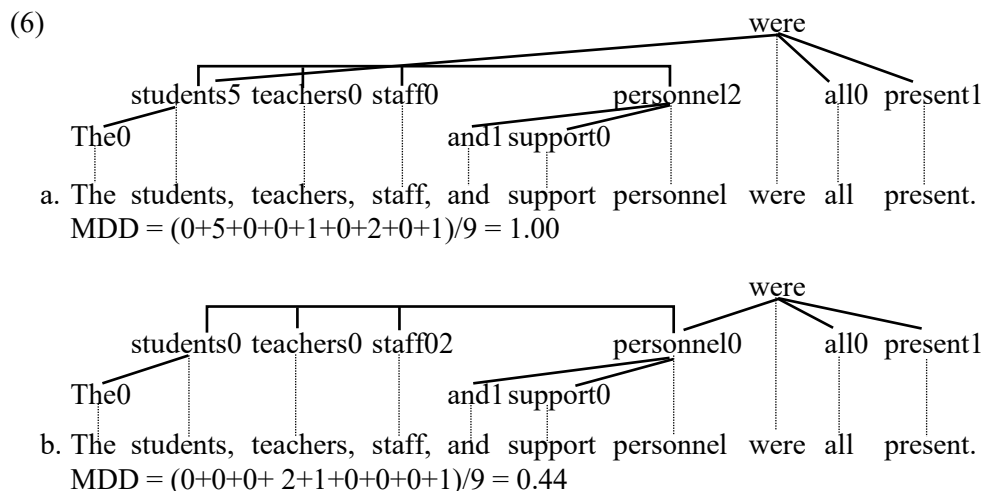
Finally, just the trees analogous to SUD annotation are produced henceforth in order to save space. All conclusions reached apply equally to UD and SUD annotations, though.

3 Two arguments

The following two sections present the two arguments just mentioned in favor of the flexible approach to coordination.

3.1 Dependency distance

The first source of motivation for the proposal comes from dependency distance (cf. Hudson, 1995; Temperley, 2007; Liu, 2008; Liu, et al. 2017; Wang and Liu, 2017). Attaching the shared head of a coordinate structure to the closest conjunct can significantly reduce dependency distances. This is particularly true of head-final structures where the shared head follows the coordinate structure, as is frequently the case in head-final languages (cf. Kanayama et al. 2018: 81; Stempniak 2024). This occurs in English, for instance, with coordinated subject phrases. The *mean dependency distance* (MDD) of the next sentence is significantly reduced when the shared head reaches just to the closest conjunct of the coordinate structure:

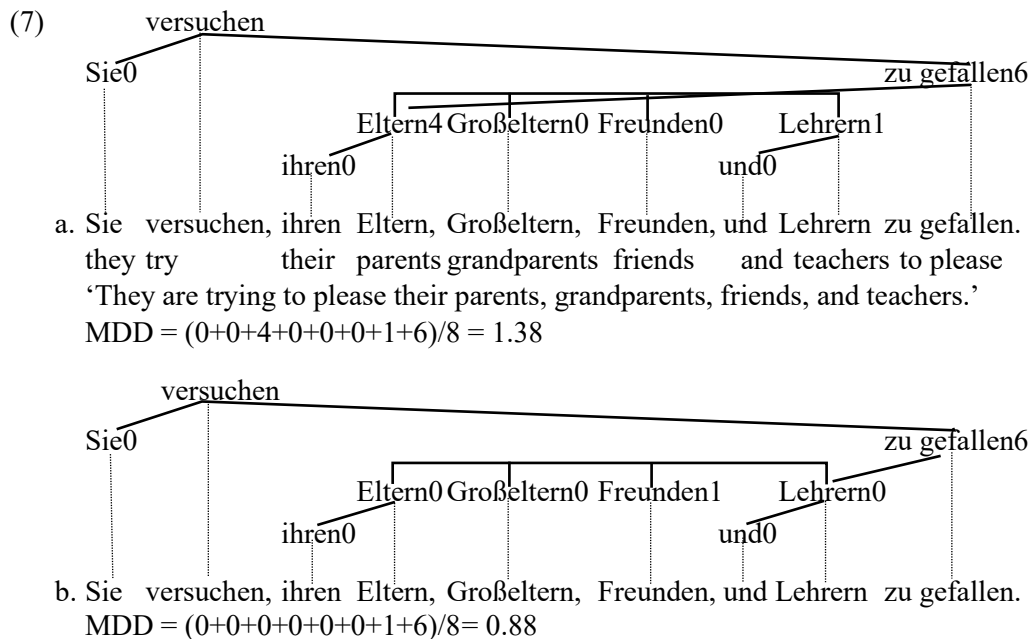


The number immediately after each node gives the dependency distance measured in terms of intervening words from that word to its head.

The dependency in (6a) reaching from *students* to *were* is long, pushing the mean score for the entire sentence up to 1.00, a score high enough

that one might expect the sentence to be difficult to process. In contrast, linking *personnel* directly to *were* cuts the MDD score in more than half; this much lower score matches the ease with which the sentence is processed.

A second example can further illustrate the benefit of attaching a shared head to the closest conjunct of the coordinate structure. The next sentence from German contains a post-dependent *zu*-infinitive phrase that has a four-conjunct coordinate structure preceding the *zu*-infinitive:



The MDD score of 1.38 is quite high, so high that one might expect processing difficulty with such a sentence. In contrast, linking the shared head *zu gefallen* ‘to please’ to the closest conjunct significantly reduces the MDD score, down to 0.88. The lower score is more consistent with the relative ease with which the sentence is processed.

The lower MDD values of the current proposal align well with the widespread and well-documented tendency for shorter conjuncts to precede longer conjuncts in English, English in general having more head-initial than head-final structures. Crucially in this area, none of the four established annotation schemes cited in [Przepiórkowski and Wóznia \(2023\)](#) – not the “symmetric” nor the “asymmetric” ones – can achieve the overall mean dependency distance scores that are as low as those of the current asymmetric proposal, because none of those annotation schemes is flexible in the manner of the current proposal, allowing for both head-initial and head-final coordinate structures within one and the same language.

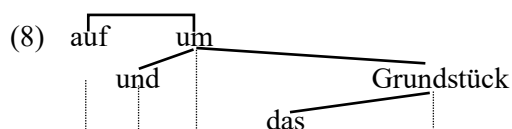
Given that coordinate structures occur frequently in most languages, the current proposal can have a significant impact on overall dependency distance values. This is particularly

true of those languages that have many head-final structures. Consider in this regard that approximately 45% of the world’s languages are deemed SOV, which means they are more head-final than head-initial.

3.2 Nearness effect

The second source of support for the current proposal comes from mismatching forms that occur with coordinate structures. Material that appears outside of a given coordinate structure is shared by the conjuncts of the coordinate structure. This shared material tends to be congruent in form with the closest conjunct. The concord can be much weaker or non-existent with the conjunct(s) that are further removed. The mismatches that occur in this area involve number, gender, case, and definiteness, as well as subcategorization requirements more broadly.

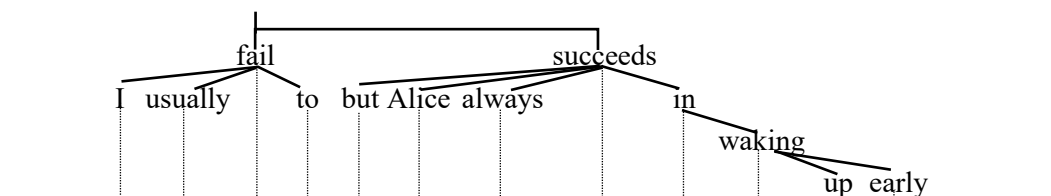
The first example is from German and involves case. It is taken from Müller (1990: 253):

- (8) 
- a. auf und um das Grundstück
on and around the.ACC property
- b. *auf und um dem Grundstück
on and around the.DAT property

The preposition *auf* ‘on’ requires its complement to appear in the dative case, whereas the preposition *um* ‘around’ demands a complement in accusative case. Thus, the fact that *das Grundstück* ‘the property’ is accusative marked sees case concord occurring with the closest preposition only. The ungrammaticality of (8b) demonstrates that case concord cannot occur

with the preposition that is further removed. In other words, there is a clear nearness effect concerning case concord.

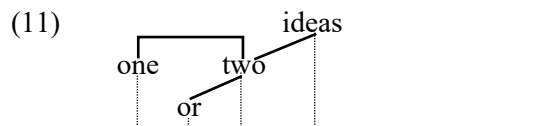
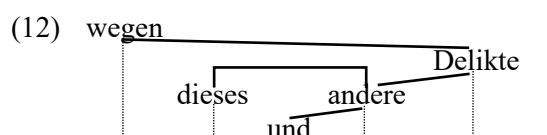
The next two example pairs are instances of so-called *right node raising* (RNR) – examples (9a-b) are taken from Belk et al. (2023: 690). The numbers to the right document informant responses concerning the grammatical acceptability of the sentences. All four sentences were tested in the crowdsourcing service Amazon Mechanical Turk. The number before the slash is the number of informants that judged the sentence, and the number after the slash is the average score the sentence received on a four-point scale from 1 (perfectly grammatical) to 4 (quite ungrammatical):³

- 
- (9) a. ?I usually fail to, but Alice always succeeds in, waking up early. 18/2.22
b. *I usually fail to, but Alice always succeeds in, wake up early. 18/3.38
- (10) a. ??Henry is going to, and Alice will soon be, working with every student. 18/2.44
b. *Henry is going to, and Alice will soon be, work with every student. 18/3.56

The particle *to* in (9) subcategorizes for a bare infinitive (*wake*), whereas the preposition *in* subcategorizes for a nominal form (the gerund *waking*). Similarly, the particle *to* in (10) subcategorizes for a bare infinitive (*work*) whereas the auxiliary *be* subcategorizes for a present participle (*working*). The scores for the a-sentences reveal that they are marginally possible, whereas the scores for the b-sentences demonstrate that they are clearly ungrammatical. There is hence again a nearness effect concerning the preferred form of the shared material.

The examples (8-10) involve a coordinate structure that precedes a shared dependent. In this regard, the nearness effect that they illustrate is not inconsistent with existing UD and SUD annotation choices, since the coordinate structures assumed are head-final in all cases under consideration. The next examples, in contrast, involve a coordinate structure that precedes a shared head. It is precisely in this area that the current proposal differs from UD and SUD annotation choices. The first examples are

from English and German; they involve number concord. The German example is from Müller (1990: 248):

- (11) 
- a. one or two ideas
b. *one or two idea
- (12) 
- a. wegen dieses und andere Delikte
due.to this.SG and other.PL crimes.PL
- b. *wegen dieses und andere Delikt
due.to this.SG and other.PL crime.SG

³ Note that the coordinate structure in (9) is deemed to be head-initial. This is the default assumption when the roots of the conjuncts are the roots of the tree.

A further similar example from German is taken from [Lobin \(1993: 226\)](#):

- (13) die vielen dicken und der
 the.PL many fat and the.SG
 eine dünne Mann/*Männer
 one thin man men

Note the order of the singular and plural conjuncts in this case, the plural conjunct preceding the singular one. Note as well that the dependency tree is not provided; it is not because of the difficulties analyzing such examples, the three words in each conjunct being equi-level dependents of the noun. The nearness effect is quite pronounced in all of these cases; the shared head agrees in number with the closest conjunct only.

The next eight examples sentences are from English and they again involve number concord. They were tested in Mechanical Turk using the same procedure as for examples (9-10) above. The head-final coordinate structure is presented first, followed by the corresponding head-initial one:

- (14)
-
- a. ?Lee or Lee's kids were present. 18/1.72
 b. *Lee or Lee's kids was present. 18/3.50
 c. ?Lee's kids or Lee were present. 18/1.94
 d. ??Lee's kids or Lee was present. 18/2.83

- (15) Were
-
- a. Were Lee or Lee's kids present? 18/1.39
 b. ??Was Lee or Lee's kids present? 18/2.50
 c. Were Lee's kids or Lee present? 18/1.38
 d. *Was Lee's kids or Lee present? 18/3.61

On the whole, there is strong preference for plural agreement when at least one of the conjuncts is plural. Nearness is, though, also quite apparently a factor influencing the clarity of the judgment. The sentence at hand is most felicitous when the verb is plural and the closest conjunct is plural, and it is most ungrammatical when the

⁴ The dependency trees are not provided in these cases due to the lack of space on the page. They would not fit.

verb is singular and the closest conjunct is plural.

The next examples are from Hungarian; they are taken from [Kiss \(2012: 1052\)](#) and have been adapted slightly for ease of presentation. They involve verb-object agreement in terms of definiteness/indefiniteness:⁴

- (16) a. Melyik professzort és hány diákot
 Which professor and how.many students
 ültessünk / *ültessük
 make.sit-INDEF.1PL / *make.sit-DEF.1PL
 le egymással szemben?
 down each-other opposite
 'Which prof and how many students shall we make sit down opposite each other?'
- b. Hány diákot és melyik professzort
 how.many students and which professor
 *ültessünk / ültessük
 *make.sit-INDEF.1PL / make.sit-DEF.1PL
 le egymással szemben?
 down each-other opposite
 'How many students and which prof shall we make sit down opposite each other?'

The object conjunct *hány diákot* 'how many students' is indefinite, whereas *melyik professzort* 'which professor' is definite. The verb agrees with the closest conjunct each time and cannot agree with the conjunct further removed.

The final example considered in this section is from Japanese and is taken from [Vermeulen \(2006: 417\)](#). The particle *-to* 'and' in Japanese cliticizes to a preceding noun. When it does so, it appears between conjoined nouns:⁵

- (17)
-
- John-ga Mary-to Bill-o mita.
 John-NOM Mary-and Bill-ACC saw
 'John saw Mary and Bill.'

The aspect of this example that illustrates the nearness effect is the presence of the accusative case marker *-o* on the final conjunct. This case marker does not appear on the initial conjunct (cf. [Kanayama et al. 2018: 77](#)). Thus there is an asymmetry among the conjuncts and the current account accommodates this asymmetry insofar as the case-marked noun can receive case

⁵ Vermeulen's account is in terms of phrase structures. The dependency analysis is my addition.

directly from the governing verb. On the UD and SUD accounts, in contrast, the initial noun would have to serve as an intermediary, passing the case marker down through the hierarchy to the following noun. Note further that coordinate structures in Japanese must be head-final as shown here because (almost) all dependencies are head-final in Japanese to begin with. That Japanese is a strictly head-final language is a widely acknowledged fact.

4 Two counterarguments

The next two sections consider and refute two counterarguments against the proposal here.

4.1 Irreversible conjuncts

Mel'čuk (1988: 26-28) argues that coordinate structures must be head-initial because there is often a logical relationship between the conjuncts such that their order is fixed; they are not reversible. Mel'čuk illustrates the point with the next pairs:

- (18) a. He stood up and gave me the letter.
 b. He gave me the letter and stood up.
- (19) a. not only a good worker but also a nice man
 b. not only a nice man but also a good worker

These a- and b-examples do not mean quite the same thing, of course. There is a chronological relationship between the conjuncts of (18a-b) such that reversing their order changes the meaning (cf. Kanayama et al. 2018: 78). Similarly, reversing the order of the conjuncts across (19a-b) shifts the pragmatic focus. Mel'čuk therefore concludes that the dependency hierarchy must be sensitive to meaning in this area; the hierarchy is fixed, with the initial conjunct being head over the non-initial conjuncts.

While Mel'čuk's point is of course correct regarding the meaning difference that often result from reversing the order of the conjuncts, this fact should not be construed as an indication about the dependency relationship between the conjuncts. Mel'čuk's reasoning is influenced by his multi-stratal approach to syntax. All aspects of meaning are to be captured in the two *Meaning to Text* (MTT) levels of syntax (deep and surface), both of which lack linear order. Thus his system cannot appeal to linear

order alone to capture the differences in meaning associated with conjunct order; these differences must be located in the hierarchy of structure instead.

The approach espoused here is monostratal in syntax; there is just one level of syntax, surface syntax, where linear order is indeed present. Given just surface syntax, syntactic units are organized in both dimensions simultaneously, in the hierarchical dimension and in the linear dimension. When syntactic unit U1 precedes a syntactic unit U2, U1 is more prominent than U2 in the linear dimension. This prominence is sufficient to capture the logical and pragmatic relationships between the conjuncts that Mel'čuk observes. There is hence no reason to also put these relationships into the hierarchical dimension. Observe further that the manner in which the conjuncts are organized in the linear dimension helps account for the fact that the coordinator usually introduces just the final conjunct of a coordinate structure.

4.2 Omission of final conjunct

UD, SUD, and the current DG agree concerning the status of coordinators such as *and*, *or*, *but*, etc. in English and related languages: these coordinators belong to the following conjunct rather than to the preceding one. This point is illustrated in many of the examples above insofar as the coordinator each time is shown as a dependent of the following conjunct root rather than of the preceding one. The conjuncts of coordinate structures such as *onions and rice* can therefore be understood in the following manner: [*onions*] [*and rice*]. This understanding of the conjuncts suggests that omission can be a diagnostic for discerning the hierarchical relationship between the conjuncts. Gerdes and Kahane (2015) construe the fact that the final conjunct can, but the initial cannot, be omitted at times without affecting grammaticality as an argument supporting the head-initial approach to coordinate structures.

The next examples illustrate the extent to which the one or the other conjunct of a coordinate structure can be omitted:

- (20) A: What did you eat?
 B: a. I ate onions and rice.
 b. *I ate onions and.
 c. *I ate and rice.
 d. I ate onions
 e. I ate rice.

The fact that one can omit *and rice* yielding the answer *I ate onions* in (20d) but one cannot omit *onions* yielding the answer **I ate and rice* in (20c) suggests that of the two conjuncts [*onions*] and [*and rice*], the latter is dependent on the former. In other words, the coordinate structure is head-initial. Note that the grammaticality of the answer *I ate rice* in (20e) should not be construed as suggesting that [*onions and*] is a conjunct because we already know that *and* forms a conjunct with *rice* rather than with *onions*, as established in the previous paragraph.

There are a number of problems with this argument in favor of head-initial coordinate structures. One difficulty is the general fact that omission as employed in (20) is an imperfect test for identifying sentence structure because contrary to expectation, certain heads are known to be omissible, e.g. the subordinator *that* in the sentence *Sam said (that) he would do it* and the preposition *on* in the sentence *Sam departs (on) Tuesday*. A second problem is that with certain coordinate structures, neither conjunct can be omitted, e.g. *Jack and Jane were present* vs. **Jack were present* and **And Jane were present*. A third problem is related to the second. Neither conjunct can be omitted when correlative coordinators are involved, as illustrated with the next examples from French:

- (21) a. Nous n'avons vu ni Jean ni Marie.
'We saw neither Jean nor Marie.'
- b. *Nous n'avons vu ni Jean.
'We saw neither Jean.'
- c. *Nous n'avons vu ni Marie.
'We saw neither Marie.'

A fourth problem is that in languages in which the coordinator is a clitic that attaches to the initial conjunct, the non-initial conjunct clearly cannot be omitted, as with the Japanese sentence from above, example (17), reproduced here as (22):

- (22) a. John-ga Mary-to Bill-o mita.
John-NOM Mary-and Bill-ACC saw
'John saw Mary and Bill'.
- b. John-ga Bill-o mita.
- c. *John-ga Mary-to mita.

If the behavior of the coordinator in head-final languages such as Japanese were a clue about the hierarchical status of the conjuncts with respect to each other, then one has to assume that coordinate structures in head-final languages

are in fact all head-final. The UD and SUD annotation schemes do not do this (but cf. Kahane et al. 2021).

Taken together, the four arguments just enumerated seriously weaken the strength of omission as an argument in favor of the stance that all coordinate structures are head-initial in English and related languages. A more plausible reason why the sentence **I ate and rice* is ungrammatical is that the appearance of a coordinator is only possible if a coordinate structure is present, hence for the coordinator *and* to appear, at least two conjuncts must be discernible. Apparent exceptions to this requirement, e.g. *And I ate onions*, are not really exceptions because in such cases, the conjuncts are complete sentences in discourse. Or in certain cases, the element at hand (e.g. *and*, *or*, *but*) is actually best construed as an adverb or subordinator rather than as a coordinator.

5 Conclusion

This contribution has drawn attention to an aspect of two prominent annotation schemes in the area of coordination. It has argued that a flexible account of coordination is preferable to the currently prevailing rigid approach. Instead of viewing all coordinate structures as head-initial, a linguistically more plausible approach allows flexibility of structure. A coordinate structure that appears in a greater head-initial structure is itself head-initial, and a coordinate structure that appears in a greater head-final structure is itself head-final. This flexible approach is motivated in two areas, with respect to dependency distance and the nearness effect. Two counterarguments suggesting that all coordinate structures are head-initial were discussed and revealed to be faulty.

6 References

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