EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

Faculty of Philosophy
General Linguistics

Syntax & Semantics WiSe 2022/2023

Lecture 5: Dependency Grammar II (DG)

10/11/2022, Christian Bentz

Overview

Q&As Tutorial Week 1

> *Exercise 2: one of the example sentences in Polish should be corrected to:*
>
> *Marek jest najlepszy-**m** student-**em**.*
> *Marek is best-M.NOM.SG student-M.NOM.SG*
> *"Marek is the best student."*

Yes, thanks. Note that this doesn't change the result of the task though.

Q&As Tutorial Week 1

> *In Exercise 1, for "Susan met" in the permutation test, we could have "The white shark Susan met in the hotel lobby". So is it OK if the respective permutation would change the meaning of a sentence, and the permuted string of words would result in a different sentential structure?*

The meaning and the general structure of the sentence should be preserved. So the permutation test would fail here. However, of course this raises the more general problem of how to determine constancy in meaning and structure preservation without already assuming a structural framework.

Q&As Tutorial Week 1

> *In case of the coordination test for "white shark" is it possible to use "the white shark and blue pidgeon"?*

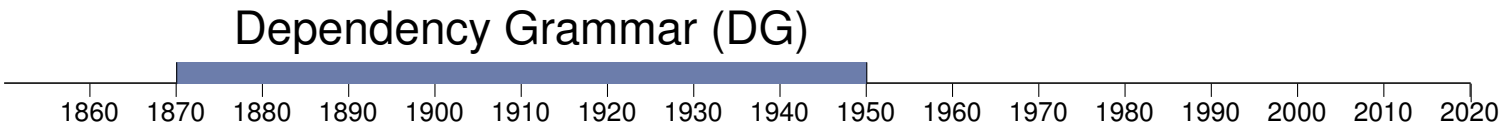
The question here is whether this sentence would be accepted as grammatical without a second determiner. I currently do not have a clear answer to this.

Section 1: Recap of Lecture 4

Historical Perspective

"Dependency Grammar (DG) is the oldest framework described in this book. According to Hudson (2019), the basic assumptions made today in Dependency Grammar were already present in the work of the Hungarian Sámuel Brassai in 1873 (see Imrényi 2013), the Russian Aleksej Dmitrievsky in 1877 and the German Franz Kern (1884). The most influential version of DG was developed by the French linguist Lucien Tesnière (1893–1954)."

Müller (2019). Grammatical theory, p. 365.

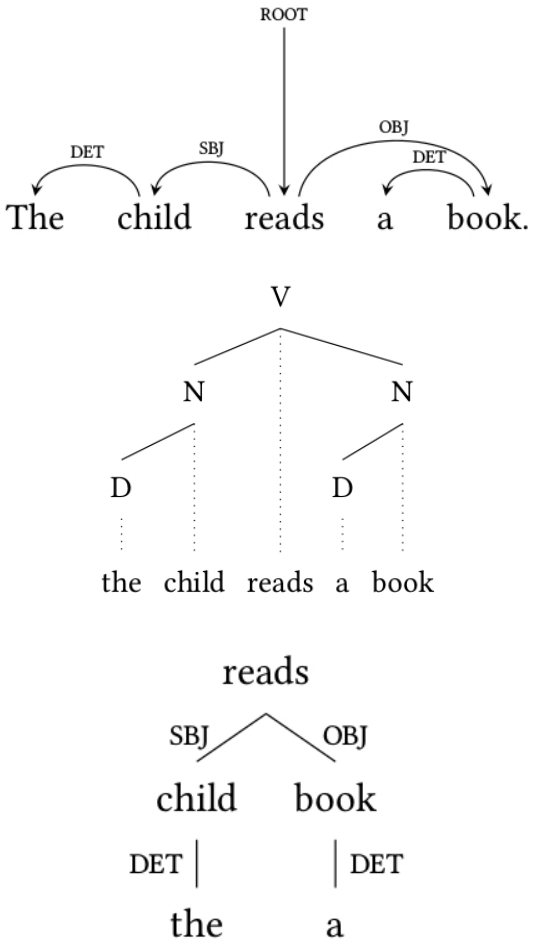


Note: The chronology bars indicate the rough time period where the first and foundational works relating to a framework were published. All of the theories discussed here still have repercussions also in current syntactic research.

The Representational Format

There are (at least) *three different ways* of illustrating a dependency grammar analysis of a given phrase/sentence (see Müller 2019, p. 268-269). We here generally follow the approach by Hudson (2007), namely, illustrating dependencies by curved arrows from the head to the dependent.

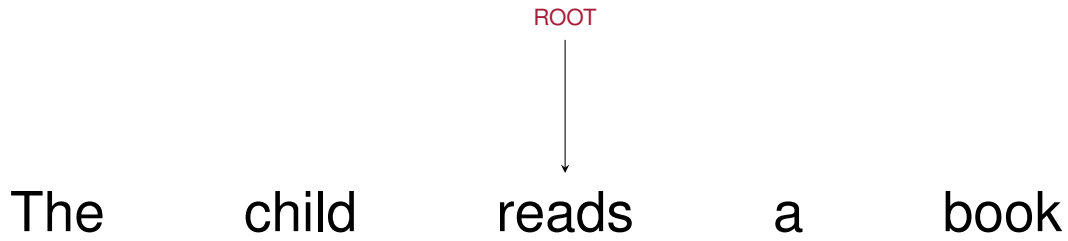
Note: There is an online tool at www.spacy.io that automatically generates lemmas, POS, etc. for sentences of a set of languages (English, German, French, etc.). This can also be used to generate dependency graphs.



Adopted from Müller (2019). Grammatical theory, p. 369.

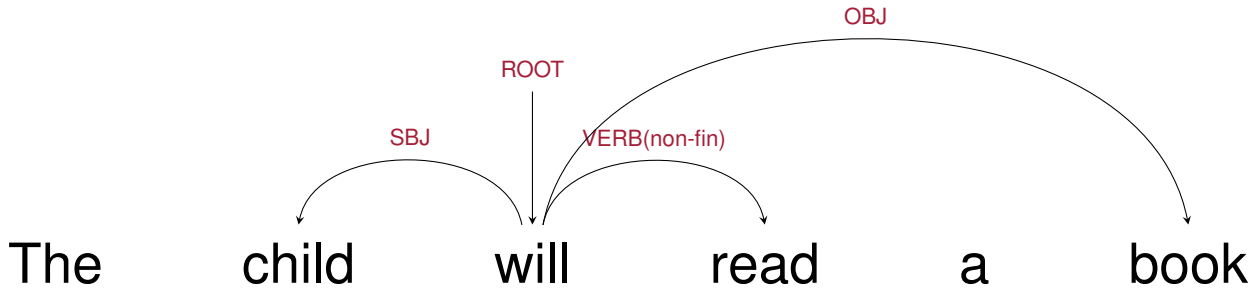
Notation: The Head/Root

The **root** of a sentence is the overall **head** of the maximal projection (i.e. a verb with all arguments filled). The root is indicated by a downwards arrow to the lexical item that represents it.



Notation: Auxiliary Verbs

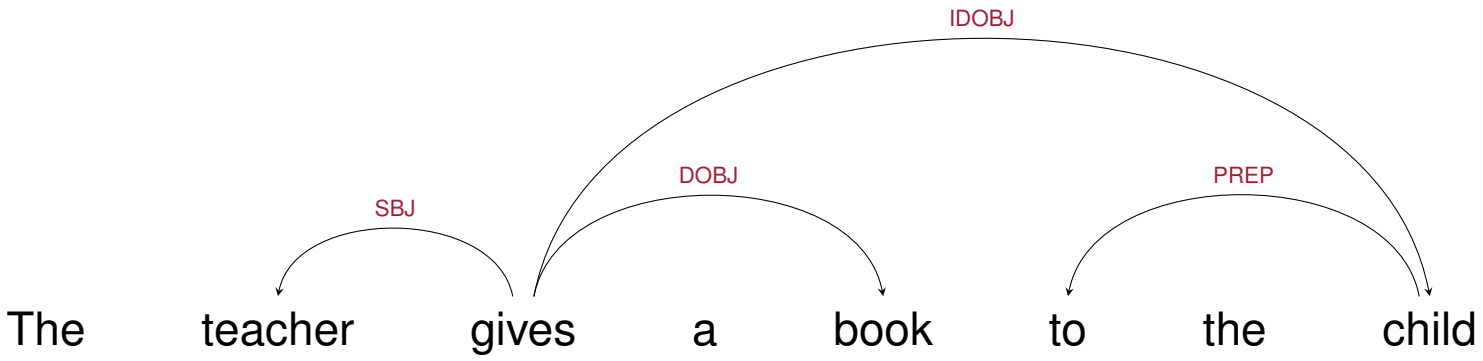
When an **auxiliary verb** is used in a sentence, it is the finite verb (inflects for person and number). This is then considered the root of the sentence. The second verb form is then a non-finite verb (e.g. participle or infinitive), which depends on the auxiliary verb. Also, note that the arguments of the sentence (SBJ and OBJ) now depend on the auxiliary verb, rather than the non-finite verb. This is because agreement and case-assignment to the arguments is related to the inflected auxiliary rather than the non-finite verb form.[1]



[1] From a valency perspective it could be argued that the non-finite verb form determines the valency of the verb complex, rather than the auxiliary, but here morphosyntax is given precedence over semantics. For a discussion see also Müller (2019), p. 594-595. In the Universal Dependencies Corpora of English, the auxiliary is considered to depend on the non-finite verb form.

Problem: Dative Alternation

In English, speakers can decide between using a construction with or without a preposition for ditransitive (trivalent) verbs. This is the so-called **dative alternation**.

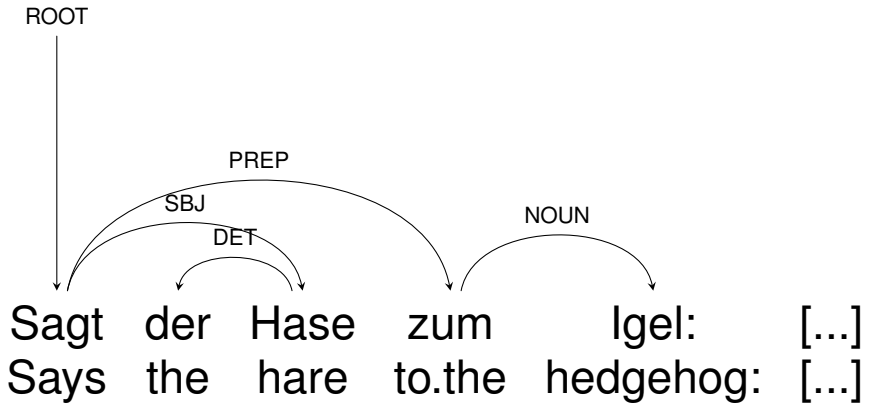


Note: In this lecture series, the analysis with **the indirect object depending on the verb** (and the preposition then depending on the indirect object) is preferred, though a reference for this analysis in the dependency grammar literature is missing. We here follow the English Corpora of Universal Dependencies.

Verb position (Initial)

In **head-initial sentences**, the dependencies – at least of the arguments – project *forwards* (i.e. from left to right).

German (deu, Indo-European)

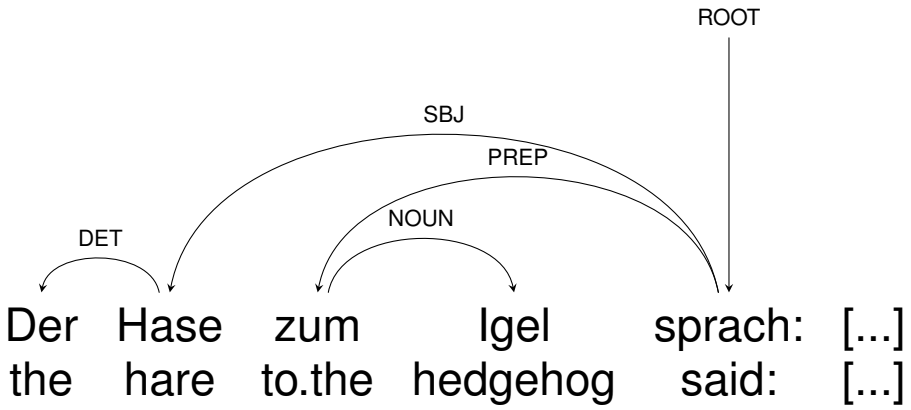


“The hare says to the hedgehog: [...]”

Verb position (Final)

In **head-final sentences**, the dependencies – at least of the arguments – project *backwards* (i.e. from right to left).

German (deu, Indo-European)

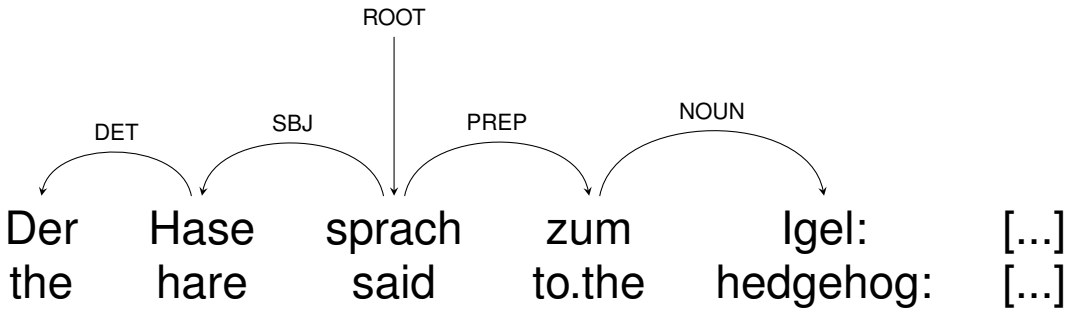


“The hare said to the hedgehog.”

Verb position (Medial)

In **head-medial sentences**, the dependencies project *in both directions*.

German (deu, Indo-European)



“The hare said to the hedgehog: [...]”

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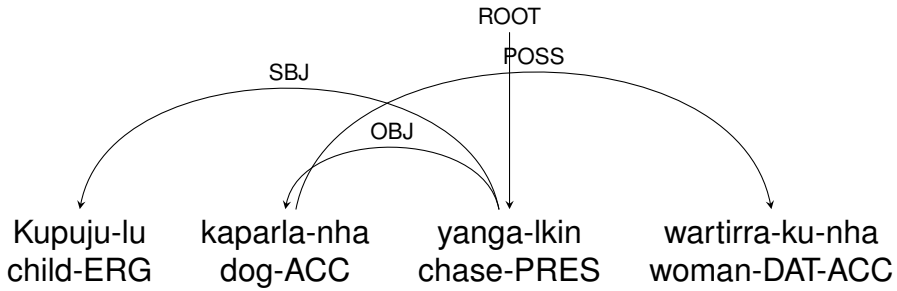
Section 2: Further Syntactic Phenomena

Linearization

The fact that dependency grammars do often not require particular rules for the *linearization* of words,[2] is the reason for why they are seen as particularly appropriate for languages with discontinuous constituents (or even no constituency at all?). Remember the example by Evans & Levinson (2009) in Lecture 2.

Thalanyji (?, Pama-Nyungan(?))



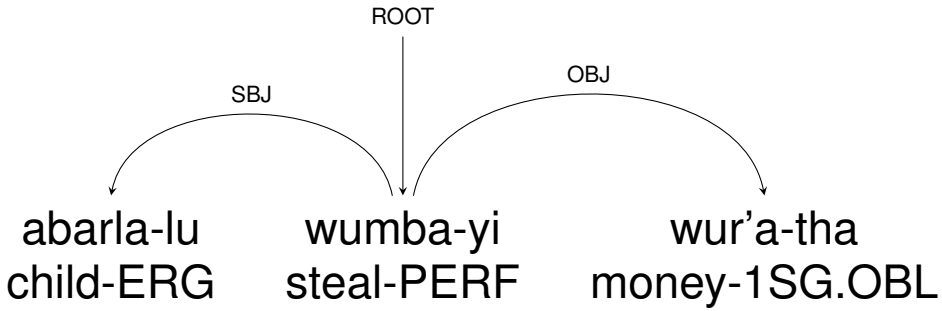
“The child chases the woman’s dog."

[2] Though see the discussion in Müller (2019), pp. 371, for dependency grammar accounts that additionally formulate such rules.

Linearization: Free Word Order

If a language has **completely free word order**, then linearization might not be required by the syntactic framework. All orders are grammatical and hence "licensed". See the permutation examples below.

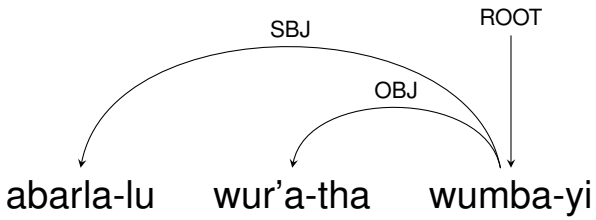
Nhanda (nha, Pama-Nyungan)

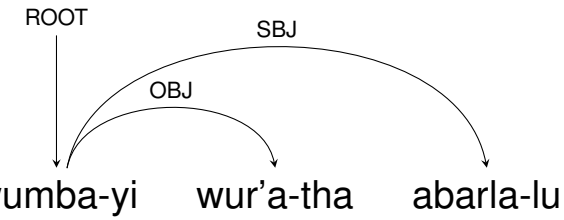


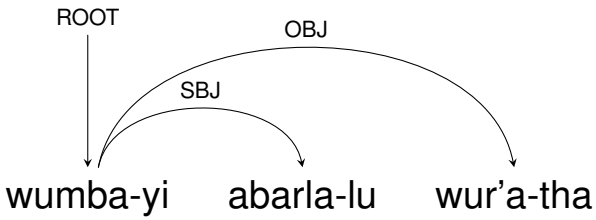
"The child stole my money."

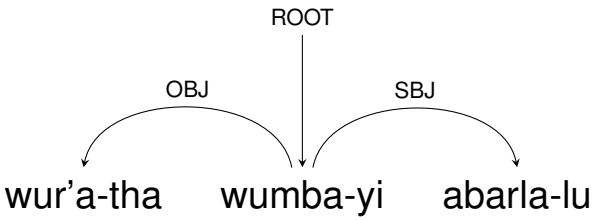
Adopted from Velupillai (2012), p. 282.

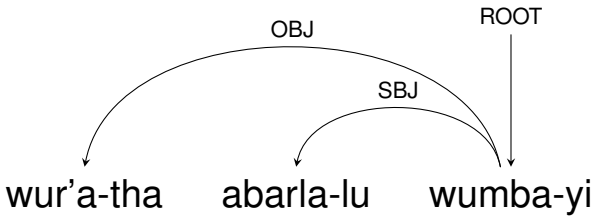
Free Permutation:





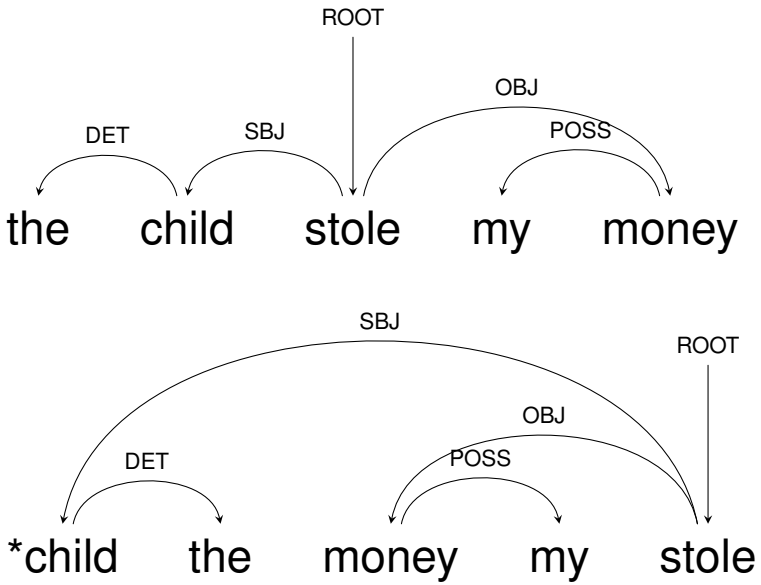






Linearization: Fixed Word Order

If a language has **fixed word order**, however, then the lack of linearization constraints licenses ungrammatical sentences.

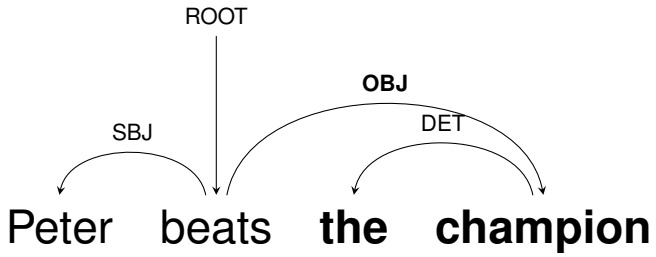


Note that both of these sentences (and all other permutations) are licensed by a dependency grammar that does not specify linearization constraints.

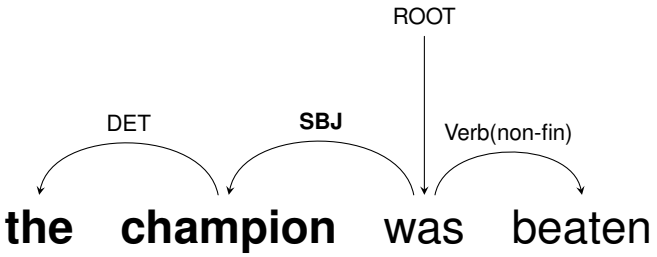
The Passive

In a **passive construction**, the object of the corresponding *active sentence* becomes the subject. If we want to further license case assignments (e.g. nominative to the subject of the active sentence and the subject of the passive sentence, while accusative to the object of the active sentence) then we have to invoke further lexical rules (see Müller, 2019, pp. 373).

Active:

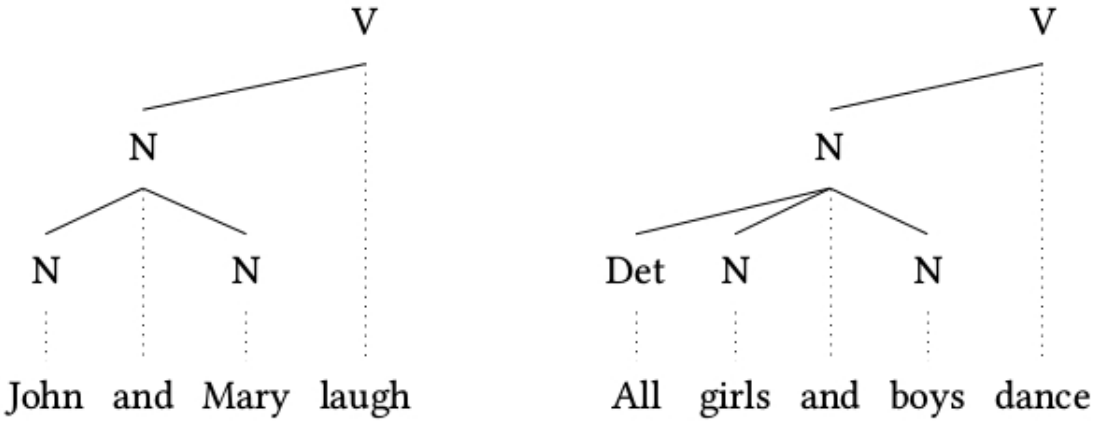


Passive:



Coordination

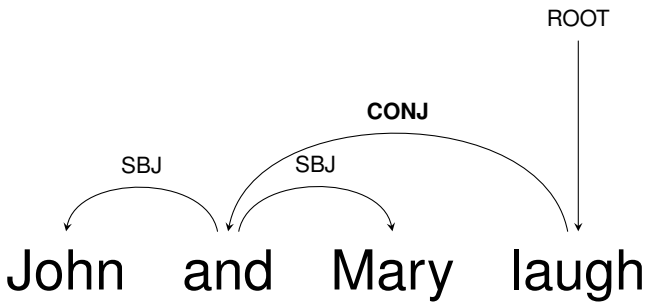
There are different ways to model **coordination** in a dependency grammar framework (see discussion in Müller 2019, p. 384). We here follow one of the proposals, which considers the conjunction (i.e. *and*) as the head of the conjoined noun phrases.



Müller (2019), p. 385.

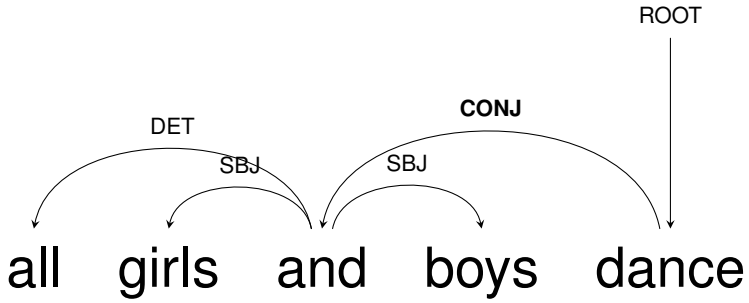
Coordination: Arrow Notation

Proper nouns:



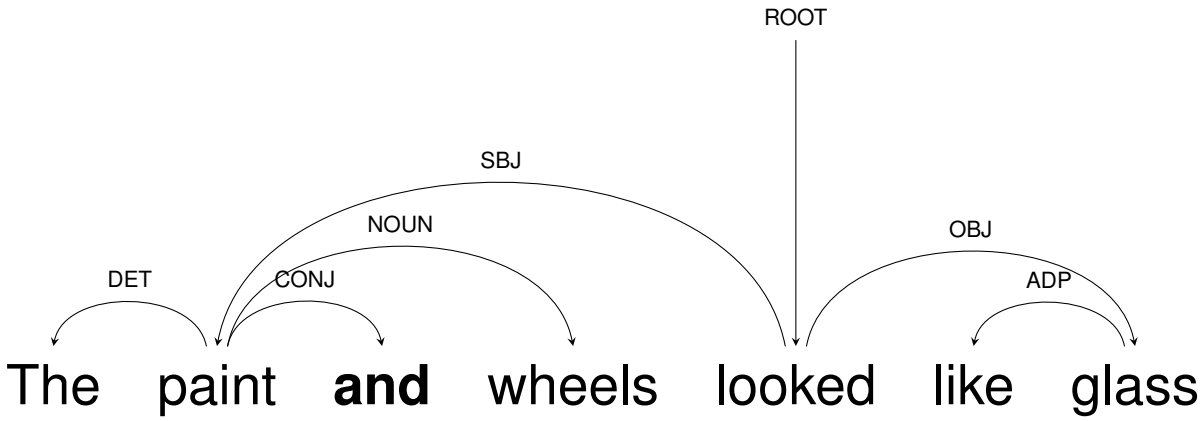
Notes: We here need two SUBJ arrows, since both proper nouns are subjects of the sentence. In the case of noun phrases with determiners (Müller considers *all* a determiner here), the determiner also depends on the conjunction.

Noun phrases:



Coordination: Alternative Coding in UD

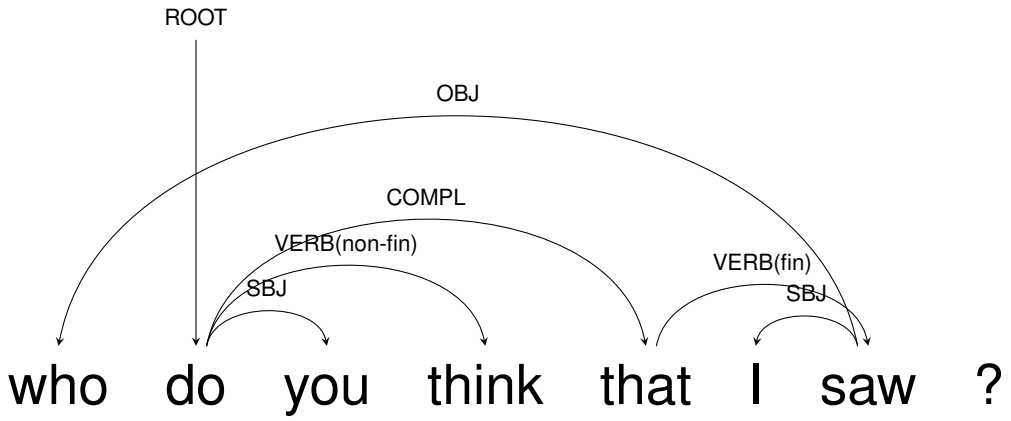
The English UD corpora rather opt to consider the conjunction ‘and’ (as well as the second noun) to depend on the first noun.



Source: en_ewt-ud-dev.conllu

Crossing Dependencies

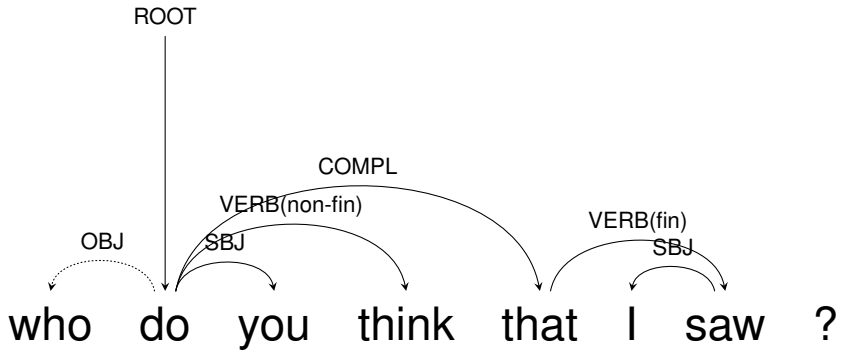
In certain syntactic constructions (and languages), dependencies might cross. Such constructions are referred to as *non-projective*. This is often seen as dispreferred from a processing and learning perspective, though there is no reason a priori why dependencies should not cross.



See the German equivalent in Müller (2019), p. 379.

Crossing Dependencies

In fact, some researchers propose to try and analyze dependencies in a way to avoid crossing dependencies.



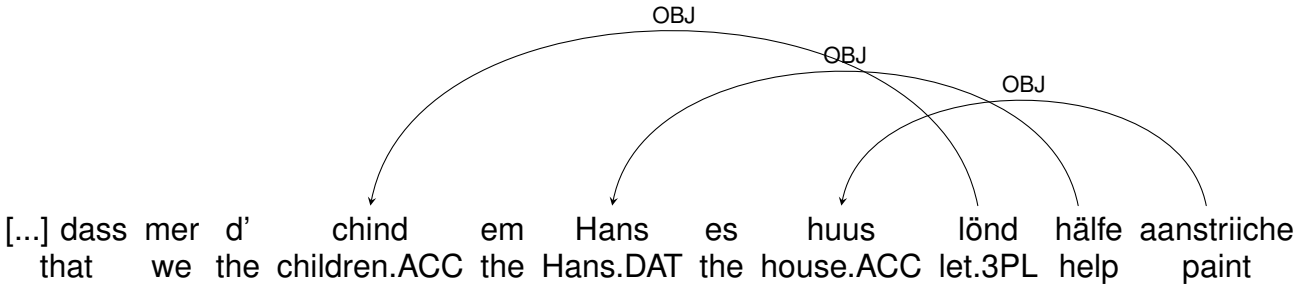
See the German equivalent in Müller (2019), p. 380.

Note: In this particular case, we remove the long-distance dependency from *saw* to *who*, and rather conceptualize *who* as the object of the main clause (i.e. the auxiliary verb *do*). However, this raises another interesting problem: the verb of the complementizer clause *I saw* is then considered monovalent (i.e. doesn't have an object), which clearly contradicts the general valency assumption of the verb *see*. This kind of problem nicely illustrates the trade-offs and contradictions we sometimes face in syntactic analyses.

Crossing Dependencies

In any case, in some languages and constructions crossing dependencies just seem unavoidable, and we have to accept them as a fact of human languages.

Swiss German[3] (gsw, Indo-European)



"[...] that we let the children help Hans paint the house."

Shieber, S. (1985). Evidence against the context-freeness of natural language.

[3] Central Alemannic in Glottolog 4.0.

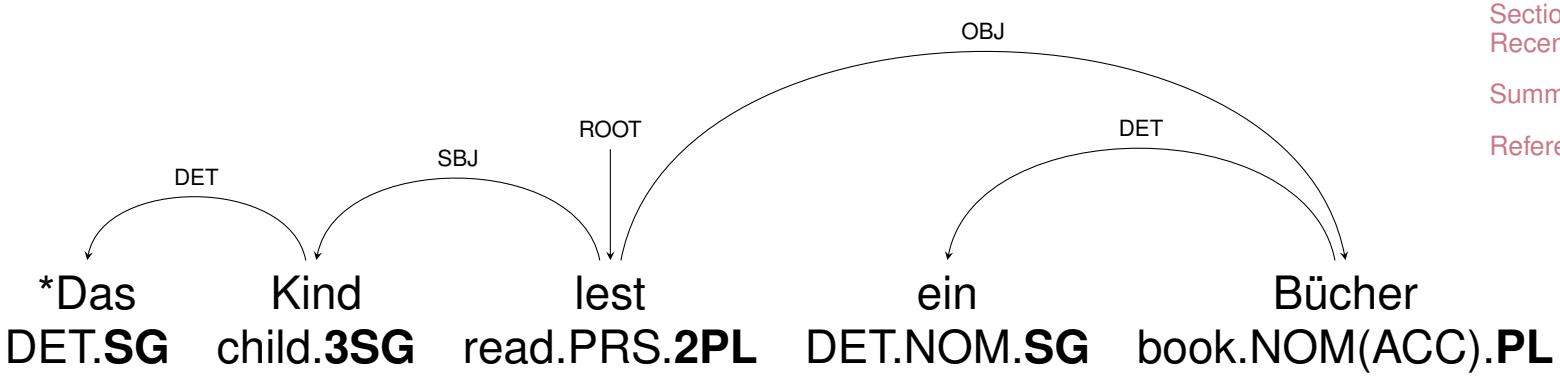
Section 3: Pros and Cons of DG

Pros (Advantages)

- It is valid also for languages with no *linearization constraints*.
- It is relatively easily implementable in *computational frameworks*.
- It follows from some basic definitions regarding the *headedness of phrases*.

Cons (Disadvantages)

- It is not valid for languages with *strong linearization constraints* (without further linearization rules).
- It does not explicitely model *agreement* and *case assignment* (at least not in the version presented here in class), and hence licenses sentences that would normally be assumed ungrammatical.



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Section 4: Universal Dependencies

This page pertains to UD version 2.

Universal Dependencies

Universal Dependencies (UD) is a framework for consistent annotation of grammar (parts of speech, morphological features, and syntactic dependencies) across different human languages. UD is an open community effort with over 300 contributors producing nearly 200 treebanks in over 100 languages. If you're new to UD, you should start by reading the first part of the Short Introduction and then browsing the annotation guidelines.

- Short introduction to UD
- UD annotation guidelines
- More information on UD:
  - How to contribute to UD
  - Tools for working with UD
  - Discussion on UD
  - UD-related events
- Query UD treebanks online:
  - SETS treebank search maintained by the University of Turku
  - PML Tree Query maintained by the Charles University in Prague
  - Kontext maintained by the Charles University in Prague
  - Grew-match maintained by Inria in Nancy
  - INESS maintained by the University of Bergen
- Download UD treebanks

If you want to receive news about Universal Dependencies, you can subscribe to the UD mailing list. If you want to discuss individual annotation questions, use the Github issue tracker.

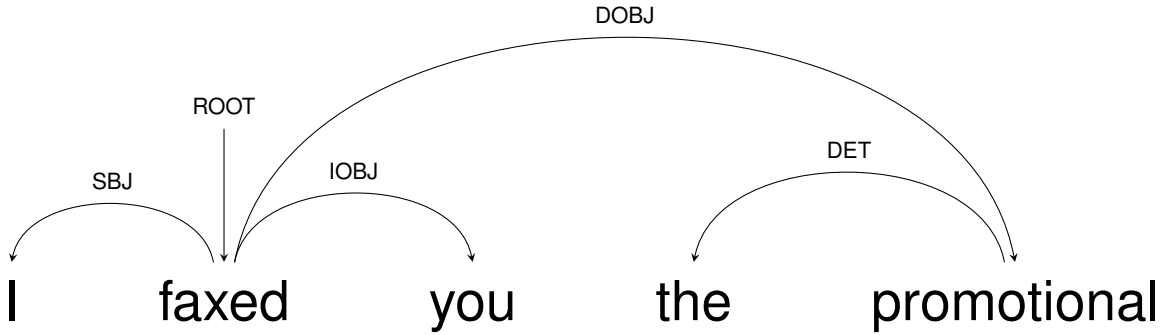
Current UD Languages

Information about language families (and genera for families with multiple branches) is mostly taken from WALS Online (IE = Indo-European).

Abaza	1	<1K		Northwest Caucasian
Afrikaans	1	49K		IE, Germanic
Akkadian	2	25K		Afro-Asiatic, Semitic
Akuntsu	1	<1K		Tupian, Tupari
Albanian	1	<1K	W	IE, Albanian
Amharic	2	10K		Afro-Asiatic, Semitic
Ancient Greek	2	416K		IE, Greek
Apurina	1	<1K		Arawakan
Arabic	3	1,042K	W	Afro-Asiatic, Semitic
Armenian	2	55K		IE, Armenian

Example Sentence

Lecture Notation:



Universal Dependencies Notation:

```
# sent_id = email-enronsent00_02-0047
# text = I faxed you the promotional [...]
ID      FORM    LEMMA   UPOS    XPOS    FEATS                                   HEAD    DEPREL  DEPS
1       I       I       PRON    PRP     Case=Nom|Number=Sing|Person=1|PronType=Prs      2       nsubj   2:nsubj
2       faxed   fax     VERB    VBD     Mood=Ind|Tense=Past|VerbForm=Fin        0       root    0:root
3       you     you     PRON    PRP     Case=Acc|Person=2|PronType=Prs          2       iobj    2:iobj
4       the     the     DET     DT      Definite=Def|PronType=Art               5       det     5:det
5       prom.   prom.   NOUN    NN      Number=Sing                             2       obj     2:obj
```

Glossary: Fields (Column Names) in UD

- ID: word index
- FORM: word form or punctuation symbol
- LEMMA: Lemma or stem of word form
- UPOS: Universal part-of-speech tag
- XPOS: Language-specific part-of-speech tag
- FEATS: List of morphological features from the universal feature inventory
- HEAD: Head of the current word, which is either a value of ID or zero (0)
- DEPREL: Universal dependency relation to the HEAD (root iff HEAD = 0) or a defined language-specific subtype of one
- DEPS: Enhanced dependency graph in the form of a list of head-deprel pairs

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Section 5: Basic Concepts in DG

Basic Concepts in DG

- Constituency x
- POS ✓
- Heads ✓
- Valency ✓ [4]
- Grammatical Functions ✓ [5]

[4] Valency does play a role in the sense that we assign SBJ, DOBJ, and IOBJ labels to certain dependencies. And it plays a role for deciding on the structural analyses of certain constructions, e.g. dative alternation. On the other hand, dependency analyses of sentences do not heavily built on the idea that a given word will require certain argument positions to be filled (see the English example with crossing dependencies, where the valency of "see" is flexible in different analyses).

[5] Grammatical functions play an indirect role for dependency relations. At least SBJ, IOBJ, and DOBJ are marked on dependency arrows in the framework outlined here.

Section 6: Recent Research

Two competing pressures that shape word order:

1. Dependency length minimization

The head of a sentence/phrase (e.g. the verb) should be placed in a way that **minimizes** dependency lengths.

2. Predictability maximization

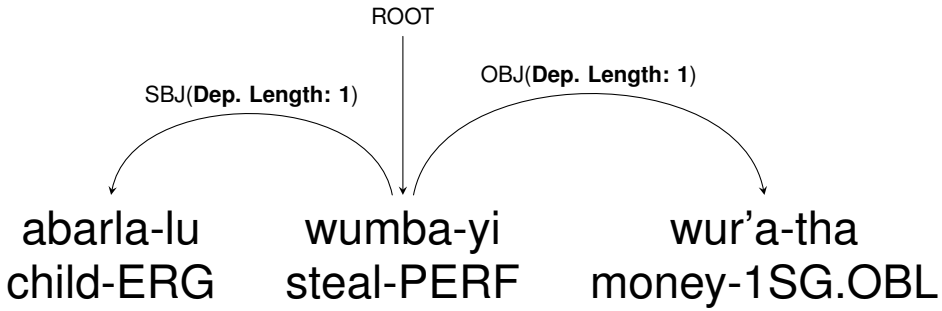
The head of a sentence/phrase should be placed in a way that **maximizes** its predictability.

Ferrer-i-Cancho (2017). The placement of the head that maximizes predictability. An information theoretic approach.

Dependency length minimization

Placing the verb (head) in the *medial position* **minimizes dependency lengths** (everything else being equal).

Nhanda (nha, Pama-Nyungan)



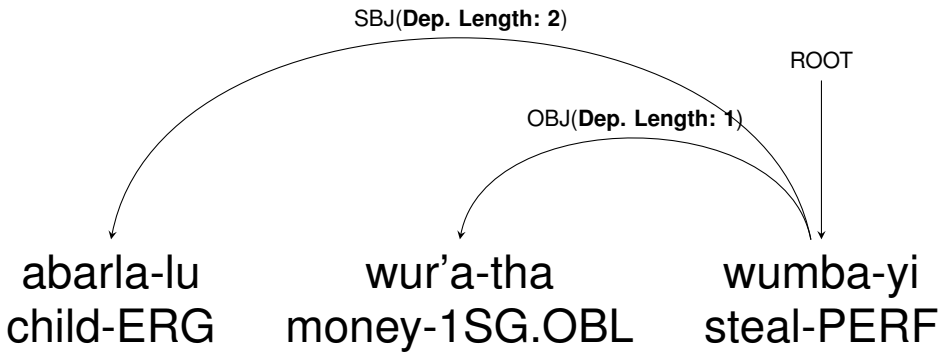
"The child stole my money."

Adopted from Velupillai (2012), p. 282.

Dependency length minimization

Placing the verb (head) in the *initial or final position* **increases dependency lengths** (everything else being equal).

Nhanda (nha, Pama-Nyungan)



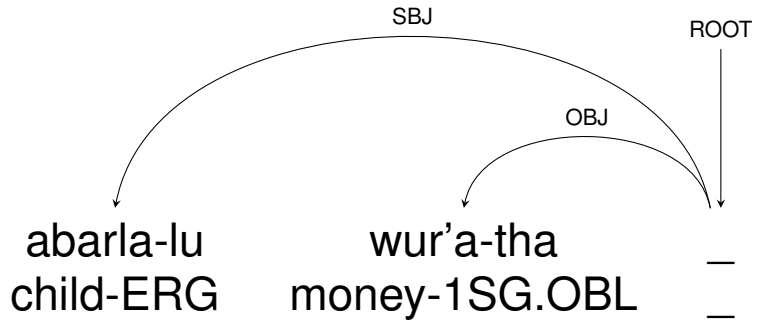
"The child stole my money."

Adopted from Velupillai (2012), p. 282.

Predictability maximization

However, placing the verb (head) in the *final position* increases its **predictability**.

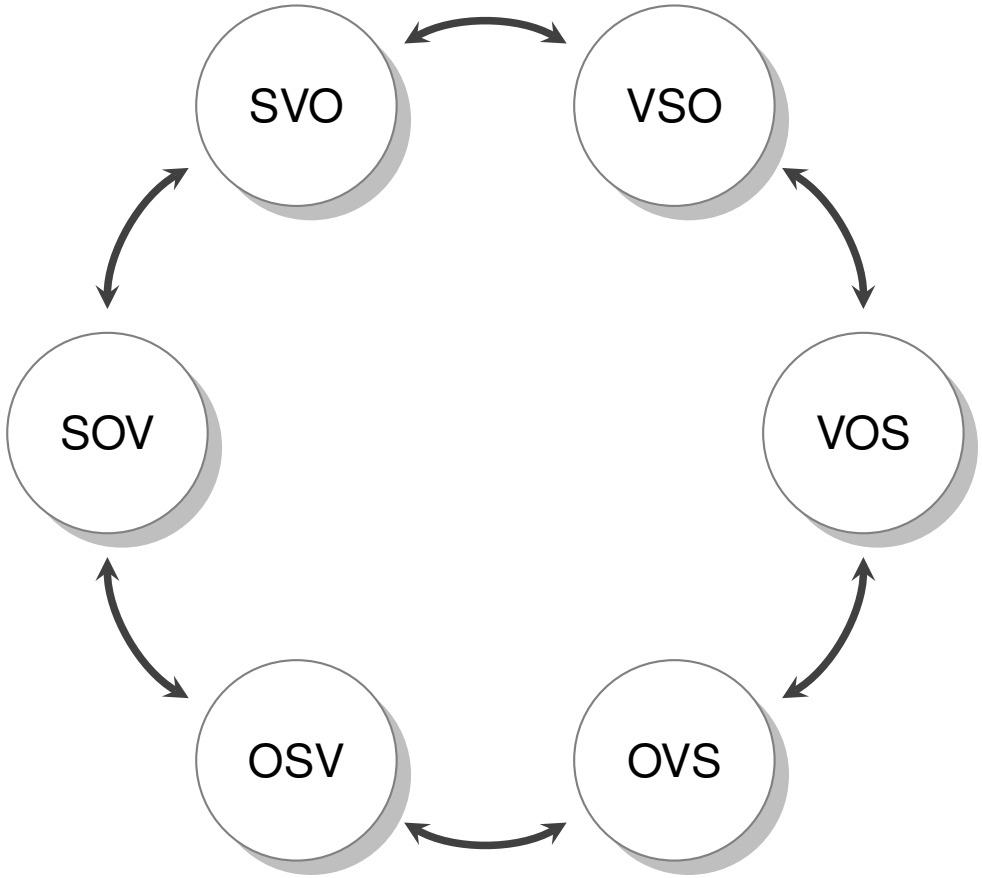
Nhanda (nha, Pama-Nyungan)



"The child _ my money."

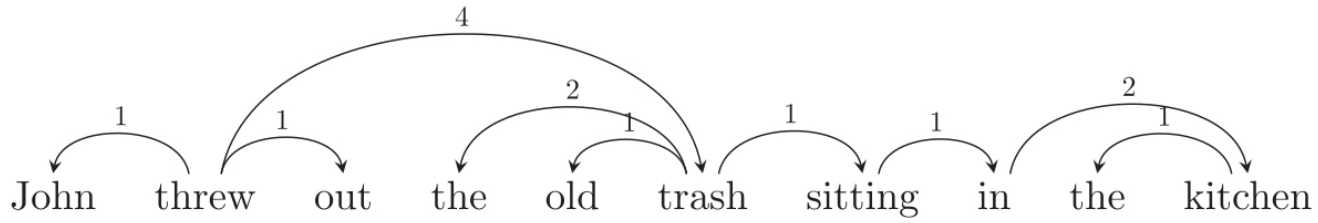
Adopted from Velupillai (2012), p. 282.

Word Order Change and Evolution: The Permutation Ring

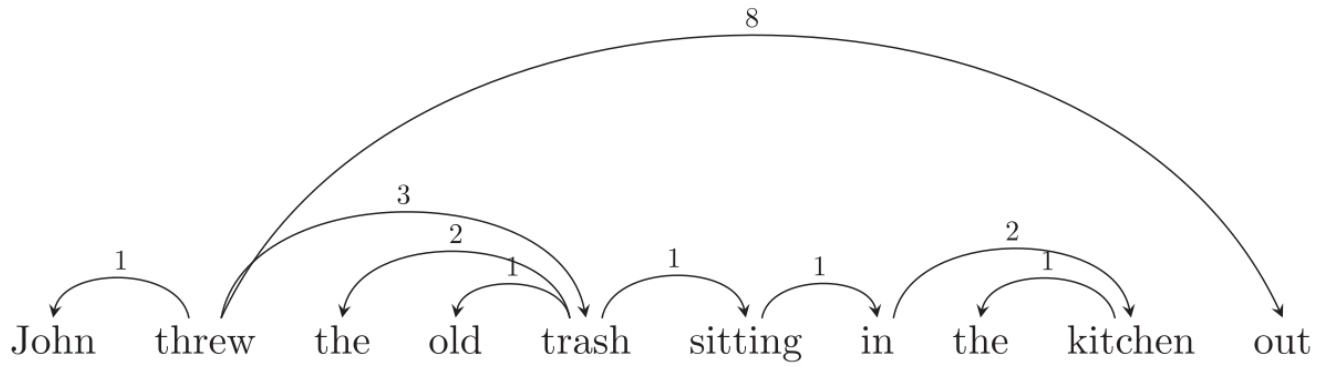


Ferrer-i-Cancho (2017). The placement of the head that maximizes predictability. An information theoretic approach.

Dependency length minimization

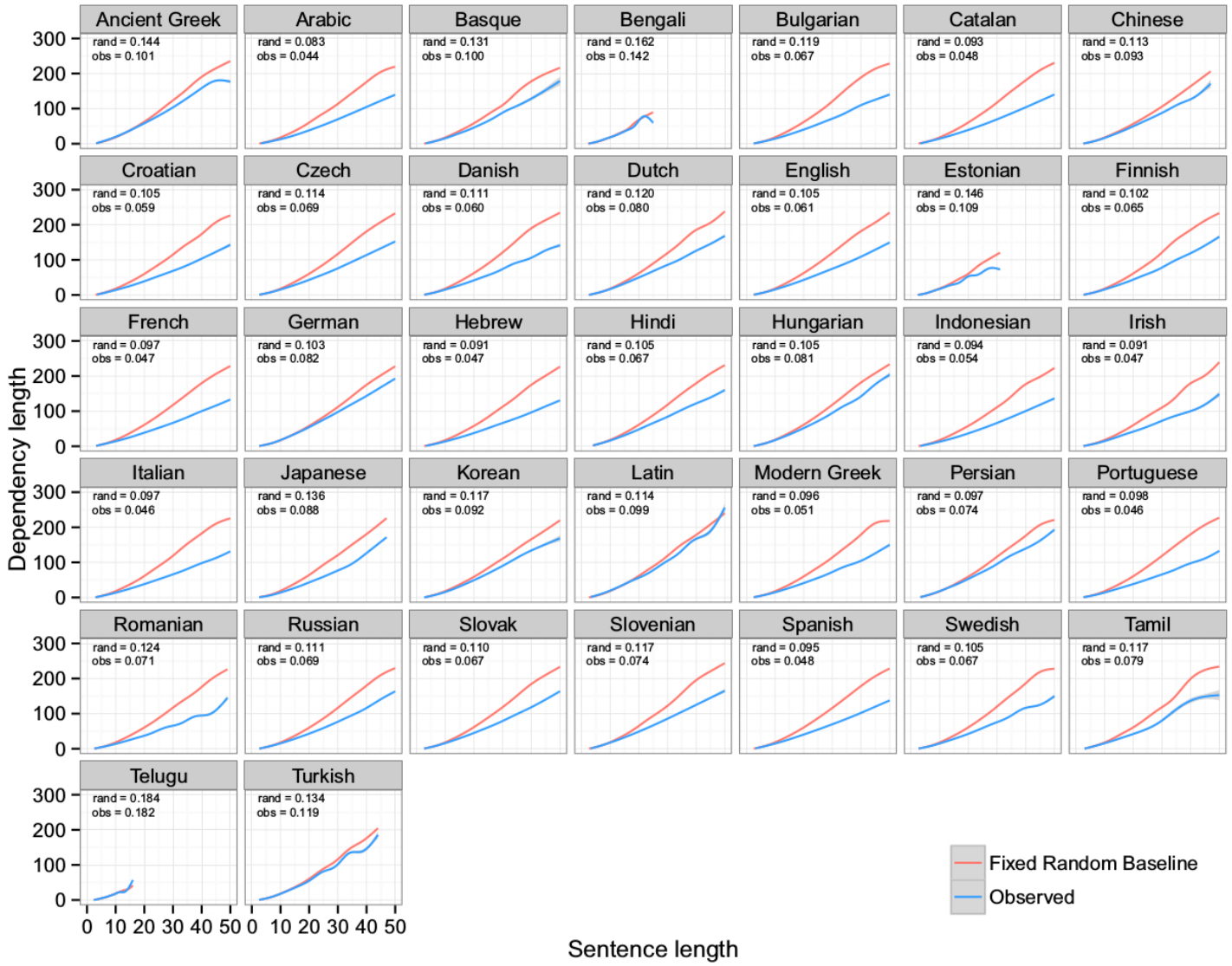


Sentence C: Total dependency length = 14



Sentence D: Total dependency length = 20

Futrell et al. (2015). Large-scale evidence of dependency length minimization in 37 languages.



Summary

- DG can cope with different syntactic phenomena, e.g. verb position, the passive, coordination, etc. in a relatively straightforward manner.
- However, without further linearization constraints, it is incomplete for languages with fixed word order patterns.
- It is currently implemented for >100 languages as part of the UD project, and widely used in computational linguistics.

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Thank You.

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