CGELBank: CGEL as a Framework for English Syntax Annotation

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Abstract

We introduce the syntactic formalism of the Cambridge Grammar of the English Language (CGEL) to the world of treebanking through the CGELBank project. We discuss some issues in linguistic analysis that arose in adapting the formalism to corpus annotation, followed by quantitative and qualitative comparisons with parallel UD and PTB treebanks. We argue that CGEL provides a good tradeoff between comprehensiveness of analysis and usability for annotation, which motivates expanding the treebank with automatic conversion in the future.

1 Introduction

Parsing hierarchical syntactic structure is a central endeavour in computational linguistics (Jurafsky and Martin, 2021; Kübler et al., 2009). Many syntactic theories and annotation frameworks exist. The venerable Penn Treebank (PTB; Marcus et al., 1994) has been the leading approach to annotating English constituent structure; its detailed annotation guidelines have been applied to many corpora over the years (e.g., Bies et al., 2012; Pradhan et al., 2013). Other theories applied to large-scale annotation for English have included Universal Dependencies (UD; Nivre et al., 2016), Combinatory Categorial Grammar (Hockenmaier and Steedman, 2007), Role and Reference Grammar (Bladier et al., 2018), Head-Driven Phrase Structure Grammar (Miyao et al., 2004), and so on. Each formalism makes different theoretical claims (e.g., are there transformations?) and computational tradeoffs (e.g. complexity vs. parsing efficiency).

In this paper, we introduce a treebank for English built on the syntactic formalism of the Cambridge Grammar of the English Language (CGEL; Huddleston and Pullum, 2002). CGEL is the authoritative descriptive grammar for English and analyses many syntactic phenomena in extreme detail with minimal theoretical claims (§2). Our motivations for introducing yet another treebank are: (a) existing annotation guidelines for other formalisms cannot approach the depth of CGEL; (b) neither of the most common frameworks for descriptive annotation in English (PTB and UD) offers a coherent account of both constituent structure and grammatical functions; and (c) annotating a real-world treebank is a strong test of the expressivity and consistency of the CGEL formalism.

Below, we delve into the linguistic issues surmounted in building the initial version of CGELBank (§3). We then compare the CGEL trees with UD and PTB trees of the same sentences (§4).

2 What is CGEL?

CGEL is the most comprehensive and up-to-date descriptive grammar of English (Brew, 2003). It uses a morphosyntactic formalism for describing English from first principles (Pullum and Rogers, 2003).

Figure 1: CGELBank-style tree for interrogative clause which Liz bought (as in There are three options; I wonder which Liz bought).

1https://github.com/nert-nlp/cgel/
its analyses in a nearly 2000-page volume that is widely referenced by linguists. Finally, a companion textbook (Huddleston and Pullum, 2005; Huddleston et al., 2021) introduces language learners to the major points of English syntax. A CGEL-style treebank (CGELBank), potentially with a parser, would therefore be of interest to English learners familiar with the framework.

3 Linguistic decisions

Despite its breadth, depth, and specificity (Culicover, 2004), there are elements of English grammar that are not fully specified in CGEL. While CGEL does use some corpus data in its analyses and descriptions of English, the grammar is largely based on contrived examples. CGEL also only describes an idealized standard variety of English—internet-sourced text is out-of-distribution. As a treebank forces us to be explicit in our linguistic decisions, here we describe a number of the issues we ran into and the (not necessarily final) decisions we made.

3.1 Categorizing individual lexemes

Designing part-of-speech (POS) tagsets and delineating boundaries between tags has long been a contentious problem in treebanking (Atwell, 2008). CGEL is detailed but non-exhaustive in this regard.

In developing CGELBank, we had to collate the many mentions of lexemes and their categories distributed throughout CGEL, along with the careful application of CGEL principles to the categorization of hundreds of lexemes not explicitly mentioned. Examples of words categorized this way include the determinative said (e.g., as in said contract), the coordinator slash (e.g., Dear God slash Allah slash Buddha slash Zeus), and the preposition o’clock (Pullum and Reynolds, 2013).

3.2 Simplifying and un-simplifying

As shown in CGEL’s figure 5b (p. 48; reproduced in the appendix as figure 5), CGEL uses a variety of subtypes of head within clause structure: Nucleus is the head of a clause which is itself a clause, Predicate is a VP that is the head of a clause, and Predicator is the V that is the head of a VP. We

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2E.g., the general principle of content-heads, leading to verbal auxiliaries being treated as dependents of the main verb in English but main-verb copulas (which are not used in some languages) being analysed as dependents of the predicate.

3Carried out since 2006 in consultation with Huddleston and Pullum and recorded in the Simple English Wiktionary.
dispense with these subtypes, simply using Head in all cases, as shown in figure 1.

In some cases, CGEL simplifies tree structures by removing intermediate unary nodes, such as by removing an intermediate Head:Nom between Head:N and its projected NP. We always include such nodes, as in figure 1. Moreover, we show complements as sisters of N and V but modifiers as sisters of Nom and VP, where CGEL again simplifies at times.

3.3 Gaps

CGEL posits gaps in tree structures when a constituent appears in prenuclear position, as in which Liz bought in figure 1, but is inconsistent in indicating it. In most cases, we have decided to explicitly indicate a gap. We identify the following unclear cases and present our decisions.

3.3.1 Subject gaps

In open interrogatives such as (1a), “inversion accompanies the placement in prenuclear position of a non-subject interrogative phrase” (CGEL, p. 95), while there is no inversion in those like (1b).

(1) a. What did she tell you?  
b. Who told you that?

This suggests two possible analyses for the structure of (1b): either they both have a prenucleus and a co-indexed gap, or only (a) does, the who in (b) being a normal subject (Maling, 2000). Unfortunately, it is not clear to us which position CGEL takes. The discussion on p. 96 suggests that there is no inversion in (1b) because there is no prenucleus, and thus no gap. However, this is not a consistent rule throughout the text. Given the ambiguity, we have taken what we see as the standard position that there is indeed a gap (e.g. Maling, 2000; Bies et al., 1995) in clauses with subjects that have been questioned or relativized.

3.3.2 Adjunct gaps

The issue here concerns adjuncts such as the PP in after lunch, we left saying that its extraposed subject is “in a matrix clause containing be + a short predicative complement” (p. 953). Unfortunately, this leaves the precise structure unclear. After considering various options, we have decided to attach the extraposed constituent as a second complement in the VP with ternary branching. Despite the seeming difference implied by the labels “extraposed” and “internalized”, we see this as analogous to the position of the internalized

3.4 Branching & tree structure

3.4.1 Extraposition

CGEL posits extraposed subjects and objects, such as the underlined clause in It’s a good thing that we left early, 6 saying that its extraposed subject is “in a matrix clause containing be + a short predicative complement” (p. 953). Unfortunately, this leaves the precise structure unclear.

After considering various options, we have decided to attach the extraposed constituent as a second complement in the VP with ternary branching. Despite the seeming difference implied by the labels “extraposed” and “internalized”, we see this as analogous to the position of the internalized

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5CGEL recognizes explicitly that a subject gap may exist in a construction like Whq [do you think [_i was responsible]]? (p. 1082), but this involves a subordinate clause.

6These are semantic agents, patients, etc., but not syntactic Subj and Obj.
complement—the by phrase—in the VP in passive clauses (p. 674).

3.4.2 Coordinates & markers

A coordination is a non-headed construction with coordinates as daughters (CGEL p. 1278). Therefore, coordinates are neither heads nor dependents. Consider, though, the following coordination: the guests and indeed his family too (p. 1278), represented here as figure 2.

Unlike coordinations, NPs like and indeed his family too are headed constructions. The NP has two modifiers: indeed and too, which, like all modifiers, are dependents requiring a head sister. But if coordinates are not heads, then this NP is headless.

Markers7 are sisters of heads when they are subordinators (see (9) on p. 954 and (51) on p. 1187), so a marker is a dependent. This, however, is incompatible with Marker:Coordinators like and in and indeed his family too being the sister to the Coordinate:NP his family (p. 1277).

Given these facts, the NP his family in figure 2 must be a head and not a coordinate. We generalize from this to the principle that a coordinate is only the daughter of coordination, and a marker is always a dependent with a sister head.

3.4.3 Indirect complements

Indirect complements are those such as the underlined phrase in enough time to complete the work which are licensed by a dependent in the phrase, here the Det enough, but CGEL is inexplicit about it attachment. We construct a superordinate phrase of the head type and branch the indirect complement from that, as in [[enough time]Head:NP [to do the work]Comp:Clause]NP. When the complement

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7Though CGEL uses “marker” both non-technically (e.g., marker of distinctively informal style), and technically as a function term, we discuss only the latter.

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Figure 2: CGEL flat coordination—rejected in CGEL-Bank, where indeed his family too is an NP serving as the Head of the second coordinate.

is further delayed, we branch it from the nearest possible parent phrase, as in figure 3.

3.4.4 Verbless clauses

CGEL’s treatment of so-called “verbless clauses” (VICs; ch. 14§10) is incompatible with its treatment of clauses in general. Though CGEL provides no definition of a clause, a clause is a phrase (p. 23) and a phrase is a constituent with a head and possible dependents (p. 22). A predicate is a VP that functions as the head of a clause (p. 24). Therefore, a clause is a phrase headed by a VP. But VICs have no verb and no VP, so they must not be clauses in the syntactic sense that CGEL implies. That is not to deny that, like clauses, VICs express a semantic connection between a predicand and a predicate, but there are other constructions in CGEL that do this without being analyzed as clauses (e.g., it made them happy; p. 217).

Seeing no clear alternative, we treat PPs like with his hands in his pockets as having two complements, analogous to complex transitive verbs (e.g., made him happy) and PPs like while happy as taking predicative complements, similar to as. Finally, we analyze supplement VICs (e.g., bag in hand, they set out) as headless nonce constructions like those in gapped coordination (see §3.4.2).

3.4.5 Names

Despite CGEL’s claim that “to a large extent the syntactic structure of proper names conforms to the rules for the structure of ordinary NPs,” (p. 517), it also observes that “there is no convincing evidence for treating one element as head” in personal names (p. 519). Additionally, it notes that “titles [of books,
are much less constrained than other kinds of proper name and are excluded from [our] account” (p. 517). For these reasons, we have chosen to treat proper names such as Pierre Vinken as single lexical items. We similarly treat chemical compounds such as carbon dioxide as single lexical items.

In the dataset itself, multiple tokens in such a construction are analysed using the Flat relation, structured similarly to headless coordination.

### 3.4.6 Supplements

Supplements are adjuncts which are only loosely attached to a phrase, “set off from the rest in speech by separate intonational phrasing and in writing by punctuation” (CGEL p. 25). A clear example is:

(2) \textit{The necklace, which her mother gave her, was in the safe}

There are, however, other cases where the distinction between supplements and modifiers is quite fuzzy. A fronted if-PP, for instance, meets the prosodic and punctuational criteria of the definition. But we currently have no practical and principled way to say whether the same PP at the end of a VP, for instance, is a modifier or a supplement. We have proceeded on intuition using discussions to try to resolve disagreements.

Another issue is that the structural treatment of supplements in CGEL is sui-generis and inconsistent with typical trees. It consists of an anchor node to which a supplement such as the underlined relative clause in (2) is attached by means of a dashed arrow going from the supplement to the anchor. Under this analysis, the anchor and the supplements are not in a head-dependent relationship (p. 1350). For convenience and practicality, we instead attach supplements as dependents to the anchor head, even if that leads to three or more branches from the node, so that the NP in (2) would be \textit{[the necklace which her mother gave her]}.

### 3.4.7 Miscellaneous

- We treat comma splices as distinct clauses.
- Clauses set off by punctuation such as commas, dashes, or (semi-)colons are analyzed as supplements.
- We take particles such as up in \textit{pick up the kids} to be complements in a ternary branching VP along with the head and the object (CGEL p. 280).
- Ungrammatical aspects of the source sentence are kept and corrected using a special annotation.

## 4 Comparison with existing frameworks

Having resolved some of the linguistic issues that arose while annotating a treebank in the CGEL formalism, we look towards comparing CGELBank with two established formalisms for computational syntax: Universal Dependencies (Nivre et al., 2020; de Marneffe et al., 2021) and Penn Treebank (Marcus et al., 1994).

### 4.1 Corpus

To enable quantitative comparisons, two selections of sentences were annotated as CGELBank trees:

- **EWT**: 100 sentences from the English Web Treebank, which were previously annotated with Penn and UD trees (Bies et al., 2012; Silva et al., 2014)—we annotated CGELBank trees;
- **Ling**: 65 sentences observed to be linguistically interesting—we separately annotated CGELBank and UD trees.

This resulted in a small set of parallel data. Summary statistics about our datasets are reported in table 2, and a breakdown by CGELBank labels (POS, phrasal category, grammatical function) in table 1. CGELBank trees were originally created in \textsc{LATEX} using the \textsc{forest} package and later converted into a PENMAN-like textual notation (Mathiessen and Bateman, 1991). Further details are in appendix B.

### 4.2 POS tags

The part-of-speech tagset used in CGELBank contains only 11 tags, fewer than the equivalent tagset for aligned tokens in both UD (18) and PTB (37).\(^9\) The multilingual UD tagset is coarse due to the language-specific nature of fine-grained labels. The PTB tagset is fine-grained, reflecting morphological inflections of verbs, nouns, pronouns, adjectives, and adverbs, as well as WH status of pronouns, determiners, and adverbs. Even if the PTB tagset were coarsened, the correspondences across the three tagsets would not be exact.

**Quantitative comparison.**\(^10\) Applying information theoretic measures to our data, we can estimate

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\(^8\) UD trees were generated with Stanza v1.4.0 (Qi et al., 2020) and hand-corrected in the UD Annotatrix tool (Tyers et al., 2017)

\(^9\) CGELBank currently omits punctuation tokens, which account for some missing POS categories in UD and PTB. Of the substantive PTB tags we are missing only \texttt{wp$} (whose).

\(^10\) Numbers reported henceforth were computed on a preliminary version of the CCGBank release (except for table 1,
We induced an alignment of tokens between parallel trees (given that our hand-annotated CGELBank trees omitted punctuation, for example) and compared the aligned tokens’ tags. As expected, when it comes to predicting the CGELBank tag, tags from other frameworks are informative, producing a marked reduction in entropy. By this measure, the PTB tagset proves slightly more informative than UD.

\[
H(X) = -\sum_{x \in X} p(x) \log p(x)
\]

\[
H(X | Y) = -\sum_{x \in X, y \in Y} p(x,y) \log \frac{p(x,y)}{p(y)}
\]

We induced an alignment of tokens between parallel trees (given that our hand-annotated CGELBank trees omitted punctuation, for example) and compared the aligned tokens’ tags. As expected, when it comes to predicting the CGELBank tag, tags from other frameworks are informative, producing a marked reduction in entropy. By this measure, the PTB tagset proves slightly more informative than UD.

Table 1: Counts in CGELBank POS tags, phrasal categories, and grammatical functions. Special phrasal categories for coordination and some functions are not listed due to low frequency.

| POS | Phrasal Category | Gram. Function |
|-----|-----------------|----------------|
| 691 | N               | 1113 Nom       | 4444 Head |
| 361 | V               | 890 NP         | 627 Mod  |
| 327 | P               | 807 VP         | 409 Comp |
| 303 | D               | 619 Clause     | 403 Subj |
| 265 | N_pro           | 343 PP         | 299 Det  |
| 224 | V_aux           | 302 DP         | 295 Subj |
| 173 | Adj             | 195 AdjP       | 209 Coordinate |
| 133 | Adv             | 134 AdvP       | 205 Marker |
| 104 | Sdr             | 103 Coordination | 88 PredComp |
| 101 | Coordinator     | 86 Clause_el   | 68 Supplement |
| 4   | Int             | 6 NP+PP        | 53 Flat  |
|     |                 | 4 IntP         | 52 Del-Head |
| 3   | NP+AdvP         | 43 Prenucleus  | |
| 96  | GAP             | 2 NP+Clause    | 10 Postnucleus |

Table 2: Statistics for our data, including sizes and tag entropy values. Note: some UD tokens, such as punctuation, are omitted from CGELBank trees (unmatched).

| EWT | Ling | Combined |
|-----|------|----------|
| Trees | 99 | 65 | 164 |
| Tokens | 2102 | 908 | 3010 |
| % UD–CGELBk matched | 86.6% | 86.8% | 86.6% |
| $H$(CGELBk POS) | 2.85 | 2.87 | 2.87 |
| $H$(CGELBk POS | UD POS) | 0.38 | 0.46 | 0.42 |
| $H$(CGELBk POS | PTB POS) | 0.34 | 0.40 | 0.38 |

Table 3: Tagging of prepositions, subordinators, and related items in the three frameworks.

Differences. The major contributors to tag uncertainty are the CGELBank categories of determinatives (D), prepositions (P), and subordinators (Sdr). These categories do not correspond neatly to the POS hierarchies defined by UD and PTB, leading to complex overlapping of the distribution of tags.

As summarized in table 3, CGEL adopts an expansive view of the preposition (P) category, incorporating function words that head traditional prepositional phrases as well as distributionally similar phrases (including intransitive particles, adverbials taking the form of a clause, deictic adverbial words, and so on). According to CGEL, characteristics unifying traditionally disparate categories as prepositions include that they are mostly closed-class and uninflecting; can mostly be modified by right; and can mostly appear adnominally, adverbially, and as complement of be (but not become).

As for determinatives (D), CGEL again takes a broad view of the situation, shown in table 4. The articles a and the are the prototypical determinatives. Beyond those, determinatives are lexemes that are mutually exclusive with the articles in NP structure (*the this book) and/or can occur in the partitive construction (many of them) (p. 539). Unlike UD and PTB, determinatives (such as this) functioning as the sole constituent in the NP are not called pronouns; they are instead analyzed as fused determiner-heads of the NP (§4.4, item 4).

Named entities are another source of tag divergence. CGELBank makes no distinction between proper nouns and common nouns, unlike the other formalisms. PTB goes as far as to label every content word in a proper name as NNP: e.g., Supreme Court is labeled Adj by CGEL but NNP by PTB.

4.3 Gaps

Following the discussion in §3.3, we sought to characterize CGELBank gaps empirically. We at-
tempered to align them with PTB null/empty elements in the EWT set based on relative location between tokens in the sentence. This reveals that CGELBank’s gaps largely correspond to PTB elements *T* (e.g., trace of WH-movement; 28 of 33 aligned) and *RNR* (Right Node Raising; 2 of 2 aligned). There are 10 unaligned CGELBank gaps in EWT: these indicate noncanonical ordering of elements in a clause, whereas PTB signals this via a special constituent label—or not at all. Conversely, CGELBank does not use gaps for controlled subjects or other omitted subjects of nonfinite clauses (PTB *PRO*), nor for passivization.

### 4.4 Tree structures

With regard to parse structure, CGELBank offers a systematic and coherent encoding of both phrase structure (as in PTB) and grammatical relations (as in UD). In this sense, CGELBank parses are more informative than either PTB or UD parses.

**PTB.** Broadly speaking, CGELBank and Penn Treebank adopt comparable inventories of phrasal categories. But the trees look very different for the following major reasons:

1. **Heads and Grammatical Functions:** PTB does not specify heads within phrases or systematically provide the grammatical function of a phrase with respect to its parent phrase. Therefore, heuristic head rules (Collins, 1999) are necessary to convert to dependency structures.

2. **Branching:** Constituents in the PTB are notoriously flat, with potentially multiple adjunct modifiers and complements all attaching at the same level. Often they are heuristically binarized for parsing. CGEL constituents are mostly binary already, with outer attachments for adjuncts, which makes the underlying grammar more parsimonious.

3. **Empty Categories:** The PTB contains a variety of empty categories reflecting Government and Binding theory (Chomsky, 1981). Our treebank contains a single notion of a gap (§3.3), limited primarily to unbounded dependency constructions and ellipsis; gaps do not represent control, for example.

4. **Fusion:** CGEL’s fused-head construction occurs when the Head function is fused with a dependent function in NP structure (p. 332; more in ch. §5). The Prenucleus:NP in figure 1 illustrates one of three such fusions (see figure 4). The fused-head construction results in a directed acyclic graph (Pullum and Rogers, 2008). In these cases, the dependent simultaneously performs its usual function (e.g., Det:DP) and the function of Head in the NP, leading it to have two parent nodes in the graph. We maintained the tree structure in our dataset such that the fused-head relations were still recoverable; only one edge was kept but specially labelled as x-Head or Head-x.

PTB has no counterpart to CGEL’s fusion of functions. All PTB parses are properly trees.

**UD.** After aligning tokens between UD and CGELBank representations, we find that only 46.6% of them have the same head in both for-
malisms. This is largely due to CGEL’s treatment of many function words as heads, since e.g. a preposition projects a prepositional phrase, not a nominal phrase. Consequently, the proportion of UD dependencies with CGELBank equivalents is low for auxiliaries (aux, 4.1% head agreement), copulas (cop, 0.0%), and standard prepositions (case, 0.0%).

UD’s design decision to favor content heads was driven by valid crosslinguistic considerations but leads to awkward treatment of English prepositions and copular constructions (Gerdes et al., 2018). A second consequence of content heads (combined with the lack of constituent structure) is that some structural ambiguities are not resolved by the parse, as in the case of coordination: clause-level, verb phrase–level, and predicate-level coordination produce identical dependency structures.

Several dependency relations in UD accommodate “extrasyntactic” relationships that appear in corpus sentences, such as repair and headless expressions (e.g., personal names). But when it comes to compositional syntactic relations, CGELBank’s inventory of phrasal categories and functions is finer-grained and generally more informative.

One example is complementation: English UD only distinguishes complements from modifiers if they are non-prepositional dependents within a clause—subjects, objects, and complement clauses in UD are not prepositionally marked and can only be dependents of a clausal predicate. Thus, all clausal complements of nouns (the claim that there is life on Mars), as well as prepositional (oblique) clausal complements of any word (interested in living on Mars), are labeled the same as modifier clauses in UD (Przepiorkowski and Patejuk, 2019).

Sometimes UD basic (surface-level) structures provide more information than CGELBank:

1. The xcomp relation (borrowed from LFG; Dalemyple, 2001) is used within a clause to signal predicate-licensed control or raising. Control and raising are not indicated in CGELBank.

2. The UD expl relation marks expletive uses of it and there (It is clear that there is more work to do), signaling that these words are nonreferential and present only for syntactic reasons. In CGELBank, these are treated as pronouns filling ordinary grammatical functions (usually Subj)—though some constructions that trigger expletive pronouns, like extraposition (§3.4.1), are specially marked elsewhere in the tree.

3. The subject relations in English UD distinguish passive from non-passive subjects. CGELBank analyzes the passive construction as combining ordinary morphosyntactic components at the surface level, so no special label is present in the tree.

4. English UD has special relations for nominal expressions serving as temporal modifiers. Arguably this is a place where semantics has crept into the syntax.

5. As UD requires every word to be assigned a dependency relation, treebanks are required to make decisions about the internal structure of expressions like dates, though these are not well standardized at present (Zeman, 2021; Schneider and Zeldes, 2021).

In addition, several UD languages, including English, offer enhanced dependency graphs that augment the surface-syntactic tree with deeper relations (Schuster and Manning, 2016). CGELBank reflects mostly “surface structure”, though its coindexation of gaps can be used to recover some of the UD enhanced dependencies (e.g., for relative constructions).

5 Conclusion

Using the analysis developed in CGEL (Huddleston and Pullum, 2002), we introduced a new expressive and linguistically-informed syntactic formalism to corpus annotation of English. We released a small treebank with parallel annotation in CGELBank, UD, and PTB, and compared features of the three. The unique features of the CGEL formalism, combined with its minimal complexity, lend themselves to computational work on English syntax.

In the future, we plan to expand our treebank with more manually-annotated trees, using that to develop means for automatic conversion from UD and/or PTB to CGELBank. A full annotation manual is under development. We also are interested in incorporating more of CGEL’s analysis, particularly in morphology and fine-grained part-of-speech tags.
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A Functions

The hierarchy of the full set of functions used in the treebank is shown in Figure 4.

B Corpus design

EWT. We randomly sampled 200 trees from the portion of sentences in EWT that have token count between 15 and 30 inclusive. These sentences were long enough to naturally contain complex linguistic phenomena that could test our annotation guidelines, and preliminary attempts at rule-based conversion from UD to CGELBank found difficulties in sentences in this length range. 99 of the trees were manually annotated thus far by one of the authors. Another author performed extensive consistency checks and revisions, including splitting one of the sentences into two sentences, resulting in 100 annotated trees.

Ling. An author encountered linguistically-interesting and difficult-to-analyze sentences in a variety of contexts (news articles/headlines, social media posts, etc.) over the course of a year and manually annotated them in the CGEL formalism. These were annotated before some of the guidelines in this paper were agreed upon, leading to many necessary revisions.

C More tables

Table 5 lists lemmata with ambiguous POS tags in CGELBank. Table 6 lists all function words found in CGELBank.
Figure 4: The hierarchical relation of all functions in the treebank.

D [excluding numerals]: a, a few, a little, all, another, any, anybody, anyone, anything, anywhere, both, each, enough, every, everybody, everyone, everything, least, many, many a, million, more, no, no one, none, one, several, some, someone, something, sometimes, somewhere, that, the, this, three, two, which

Npro: he, I, it, its, mine, my, one, she, there, they, we, what, which, who, yesterday, you, your

P: @ a.m., about, above, after, against, along, around, as, at, away, back, because, before, behind, between, by, considering, coupled, down, due, during, for, forward, from, here, if, in, in order, including, into, irrespective, like, now, of, off, on, onboard, out, outside, over, past, per, regarding, since, so, so long as, than, then, there, through, to, up, upon, upstairs, when, while, with, within

Vaux: be, can, could, do, have, may, must, should, will, would

Sdr: for, if, that, to, whether

Coordinator: &, -, /, and, but, etc, or, plus, so

Table 6: Full list of function word lemmata in our data by POS

Figure 5: The interrogative clause what Liz bought as originally parsed in CGEL (p. 48, figure 5b).