1. Review of Current Framework

1. Basic Principles

The following are the fundamental principles of **Basic (Simple) Categorial Grammar**.

(1) Every significant-phrasal-unit (*constituent*) is assigned a **type**.

(2) Types include **primitive types** and **derivative types**.
  (a) primitive-type phrases are complete, and accordingly do not take input.
  (b) derivative-type phrases (a.k.a. **functors**) are incomplete; they take input.

(3) Functors are categorized according to what types of phrases they take as input and what types of phrases they produce as output.

(4) (**simplified**) Every syntactic composition is achieved by applying a **unary functor** to an argument. In particular, a phrase of type $\mathfrak{I}_2$ is obtained by combining a functor of type $\mathfrak{I}_1 \rightarrow \mathfrak{I}_2$ with a phrase of types $\mathfrak{I}_1$.

(5) Further syntactic formatting restrictions apply to composition.

2. Inductive Definition (Unary Types)

1. Primitive Types

(1) D is a type [definite-noun-phrase (DNP) {"name"}]
(2) C is a type [common-noun-phrase (CNP)]
(3) S is a type [sentence]

2. Derivative Types (Functors)

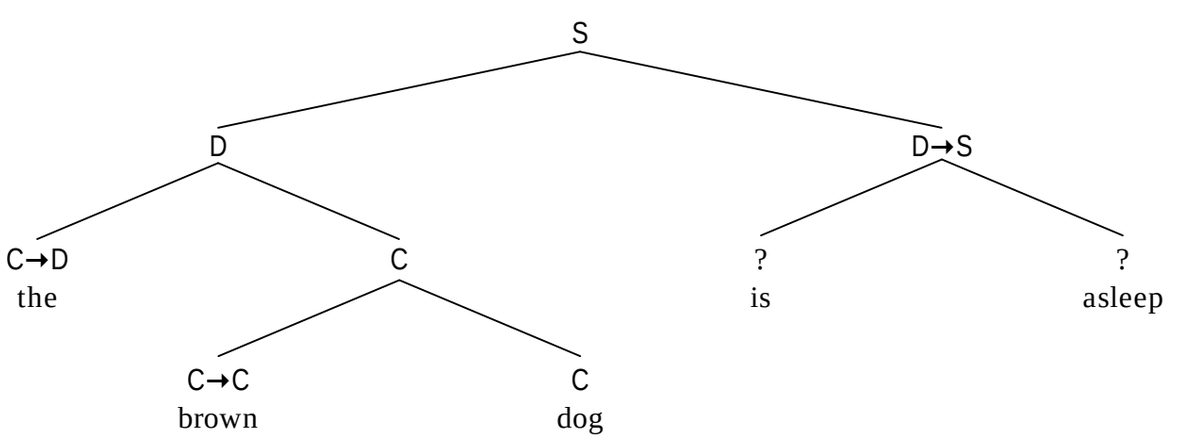
(4) if $\mathfrak{I}_1$ and $\mathfrak{I}_2$ are types, then $(\mathfrak{I}_1 \rightarrow \mathfrak{I}_2)$ is a type.

3. Extremal Clause

(5) nothing else is a type.

2. Examples of Categorial Analysis

1. Example 1: the brown dog is asleep

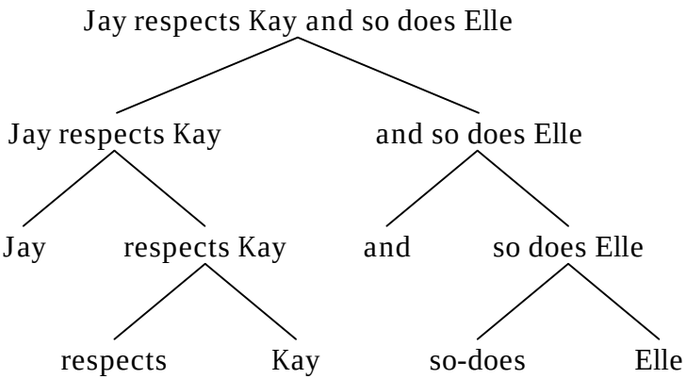


What remains is to provide a categorial analysis of ‘is’ and ‘asleep’ that enables us to construct ‘is asleep’ out of them, which we postpone to a later section of this handout.

2. Example 2

Jay respects Kay, and so does Elle

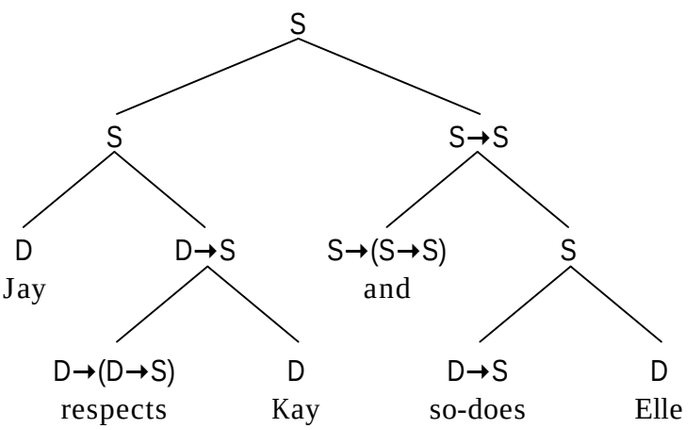
We propose the following parse,



Note that we treat 'so does' as a **morpheme** (smallest meaningful unit). English is replete with expressions that are syntactically-complex but semantically-simple.

Note also that we treat 'respects Kay' as a constituent. There are numerous tests that this phrase satisfies that suggest that it is understood as a unit. For example, in this very example, the phrase 'so does' is **anaphoric** to it. When we semantically process 'so does', we look for an earlier phrase that it *alludes* to; in this case, that phrase is 'respects Kay'.

Type-Analysis:



3. Quantifiers and Quantifier Phrases

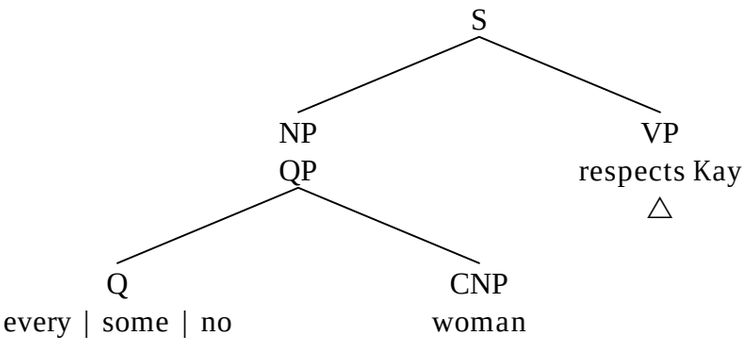
Consider the following examples.

every woman respects Kay
some woman respects Kay
no woman respects Kay

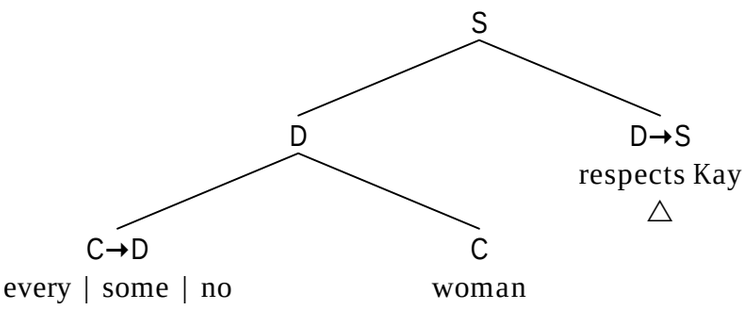
The words 'every', 'some', and 'no' are examples of *quantifiers*. The basic *syntactic* idea is that:

a quantifier followed by a common-noun (-like) phrase
is a quantifier(-headed) phrase, which is a species of noun-phrase

We accordingly have the following phrase structures for the above sentences.



As an initial conjecture, let us consider the following type-rendering of this sentence.



In other words, 'every' has the same type as 'the', and so 'every woman' has the same type as 'the woman', which has the same type as 'Kay'.

Syntactically speaking, this seems entirely plausible. It seems that quantifier-phrases behave syntactically just like determiner-phrases,[1] which behave just like proper-nouns. In particular, a determiner-phrase and a quantifier-phrase are permitted wherever a proper-noun is permitted. However, semantically speaking, quantifier-phrases don't behave like determiner-phrases and proper-nouns. In particular, a proper-noun – e.g., 'Kay' – denotes a *particular individual*; similarly, a determiner-phrase – e.g., 'the brown dog' – denotes a *particular individual*. On the other hand, a quantifier-phrase – e.g., 'every woman' – does not denote a *particular individual*.[2]

The syntactic data we wish to reproduce is that a quantifier-phrase followed by a verb-phrase is a sentence. One way to achieve this categorially is to treat QPs as proper-noun phrases. In this case, a VP takes a QP as argument and yields a sentence. But this does not work semantically. Another way to achieve this categorially is to turn the tables, and treat the VP as the argument and treat the QP as the functor, as follows.

$$\begin{aligned} \text{type(QP)} &= \text{VP} \rightarrow \text{S} \\ &= (\text{D} \rightarrow \text{S}) \rightarrow \text{S} \end{aligned}$$

In other words, type-theoretically speaking, a QP is a **second-order predicate**,[3] which yields the following type-analysis.

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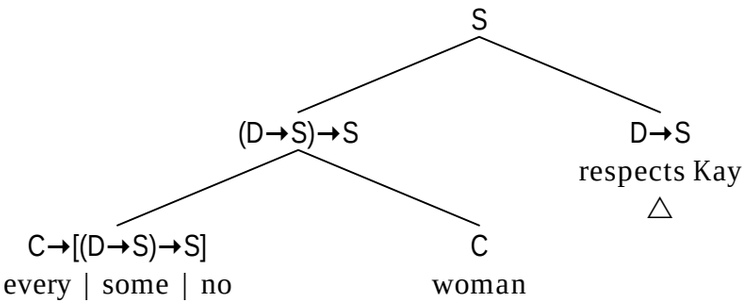
[1] Henceforth, whenever 'determiner' is unmodified, we mean 'definite determiner'.

[2] We are currently concentrating on *singular* constructions. Whereas singular proper nouns denote particular singular-entities, plural proper nouns denote particular plural-entities. The key concept is *particular*, not *individual*.

[3] Whereas a first-order predicate denotes a property of individuals, a second-order predicate denotes a property of properties of individuals. See later appendix for an account of order.



Notice the affiliated type-rendering of quantifiers.

$$\begin{aligned} \text{type(Q)} &= \text{CNP} \rightarrow \text{QP} \\ &= \text{CNP} \rightarrow (\text{VP} \rightarrow \text{S}) \\ &= \text{C}\rightarrow[(\text{D}\rightarrow\text{S})\rightarrow\text{S}] \end{aligned}$$

We conclude this section by noting that our original category NP sub-divides into proper-nouns, determiner-phrases, and quantifier-phrases. Whereas the former categories are both type-rendered as type D, the latter category is type-rendered as type (D→S)→S.

4. Wh-Pronouns and Wh-Clauses

A ***wh-pronoun*** is a pronoun that begins with 'wh' or at least *would* if English were more uniformly spelled and/or pronounced.[4] These include.

who, whom, whose, when, where, why, which, what, how

On the other hand, a ***wh-clause*** is a phrase headed by a wh-pronoun, which behaves in many ways like a sentence (e.g., it has a subject, a verb, and perhaps an object or two). Wh-clauses divide into four classes, as follows.[5]

interrogative clause	**who** is the greatest philosopher?
complementary clause	I don't know **who** the greatest philosopher is
restrictive relative clause	the greatest philosopher **who** studied with Frege is Carnap
non-restrictive relative clause	the greatest philosopher, **who** studied with Frege, is Carnap

In the latter two sentences, note carefully the punctuation. The following are similar examples.

there is exactly one student-who-is-smart [restrictive]
there is exactly one student... who is smart [non-restrictive]

Here the punctuation has been exaggerated to make a point. In the first one, 'student who is smart' is a unit. In the second one, 'there is exactly one student' is a unit. The first sentence does not specify how many students there are, but it does specify that there is exactly one smart student. The second one specifies that the number of students is exactly one, and it further claims that *this* student is smart.

[4] Note, in particular, that there are two pronunciation groups
who, whom, whose, how
when, where, why, which, what

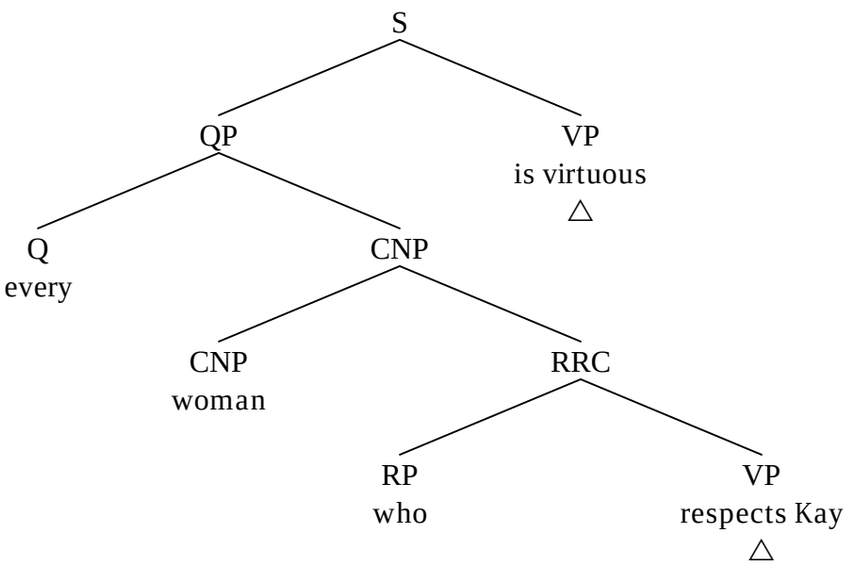
[5] The word 'how' is deficient as a wh-pronoun: although it can be used to form an interrogative clause and a complementary clause, it cannot be used to form a relative clause, either restrictive or non-restrictive.

5. Restrictive Relative Clauses

For the moment, we concentrate on restrictive relative clauses, as in the following example.

every woman who respects Kay is virtuous

The intuitive phrase structure goes as follows.



RRC $=_{df}$ restrictive relative clause
RP $=_{df}$ relative pronoun

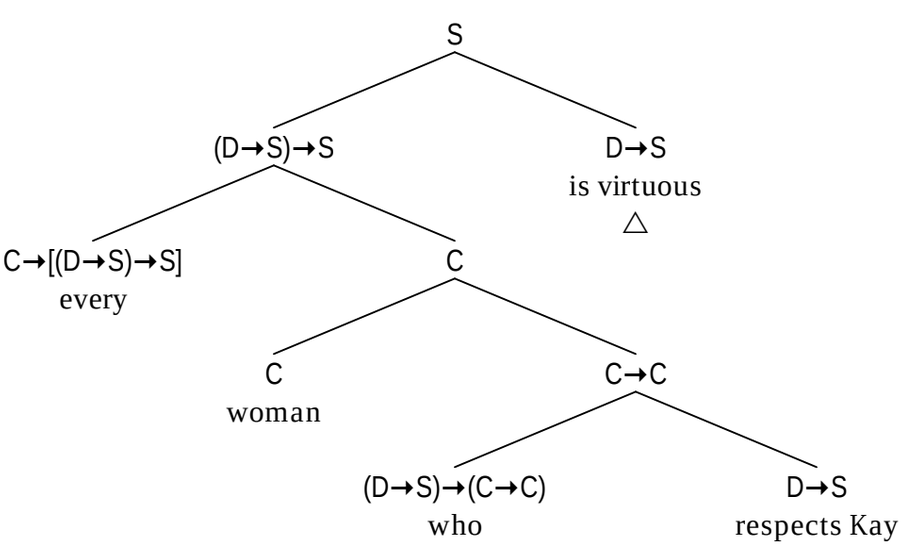
How do we type-render the new categories? Well, in the above example, a restrictive relative clause combines with a common-noun phrase to form a common-noun phrase. By way of capturing this datum, it is plausible to propose that a restrictive relative clause is a CNP-modifier, which is to say an adjective (-like phrase). Thus:

$$\begin{aligned} \text{type(RRC)} &= \text{Adj} \\ &= \text{CNP} \rightarrow \text{CNP} \\ &= \text{C}\rightarrow\text{C} \end{aligned}$$

Next, in the above example, the relative pronoun 'who' combines with a VP to produce an RRC, which is now understood to be an adjective. So it is plausible to propose the following type-rendering of relative pronouns.

$$\begin{aligned} \text{type(RP)} &= \text{VP} \rightarrow \text{Adj} \\ &= (\text{D}\rightarrow\text{S})\rightarrow(\text{C}\rightarrow\text{C}) \end{aligned}$$

Putting this all together, we have the following type analysis of our original example.



3. Copular ‘be’ [the ‘is’ of predication]

1. Initial Account

So far we have not further analyzed the following sort of phrase.

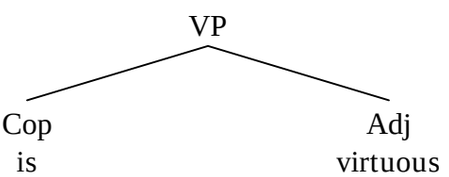
is virtuous

Rather, we have been content simply to say that it is a VP [type D→S]. On the other hand, we have so far treated ‘virtuous’ as a primitive (lexical) item. We must now reconcile these accounts by further analyzing ‘is virtuous’ into ‘is’ and ‘virtuous’

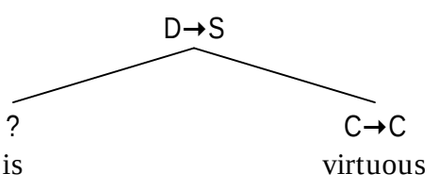
The traditional account goes as follows.

(1) ‘be’ is a copula;[6]
(2) ‘virtuous’ is an adjective;
(3) a copula followed by an adjective is a verb phrase.

The following is the corresponding tree.



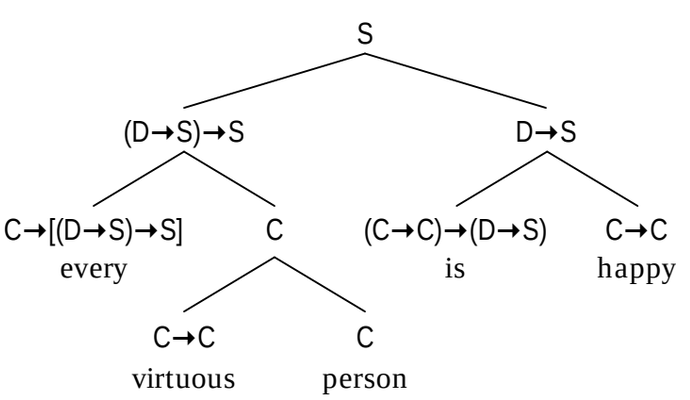
Given what we have proposed so far concerning Adj and V, we have the following type-tree.



The simplest way to implement this tree categorially is based on the following type-analysis of (copular) ‘be’.

type(be) = (C→C)→(D→S)

The following is an example tree.



[6] The word ‘be’ has other uses as well; and other phrases may serve as copulas.

2. Revised Account

Unfortunately, the above proposal is confounded by the following examples.

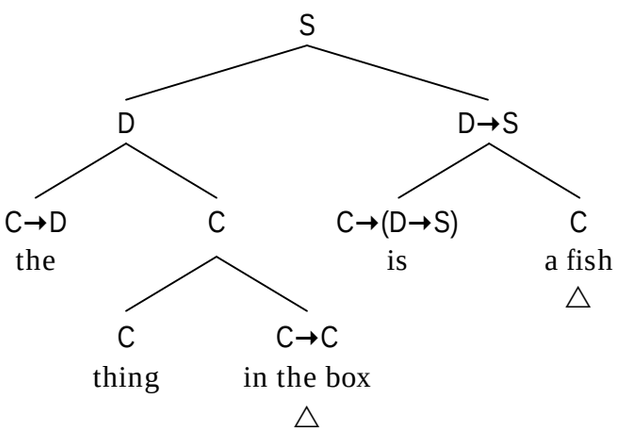
the individual in the box	is	a	fish
the individuals in the box	are	(s·m)	fish
the stuff in the box	is	(s·m)	fish

Here ‘s·m’ is unstressed ‘some’, which need not be pronounced, and which is the non-singular counterpart of ‘a’, which is an indefinite article. We will not go into detail here, but suffice it to say that the phrases

a fish
s·m fish
s·m fish

are not plausibly thought of as adjectives. They are more plausibly thought of as CNPs (of some sort).

In that case, the following appears to be a plausible account of copular-be.



Unfortunately, that means we now have two competing analyses of copular-be.

type(cop-be) = Adj → VP
= (C→C)→(D→S)

type(cop-be) = CNP → VP
= C→(D→S)

By way of correcting this inconsistency, we reject the first analysis, and we reconsider our analysis of the following example.

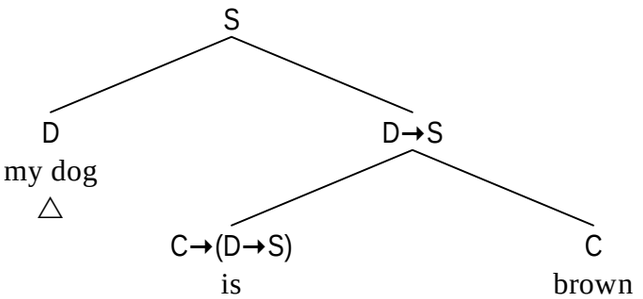
my dog is brown

Notice that, in this example, the adjective ‘brown’ does not modify a common-noun, but is rather "bare". How do we deal with bare-adjectives categorially? There are two approaches that come to mind.

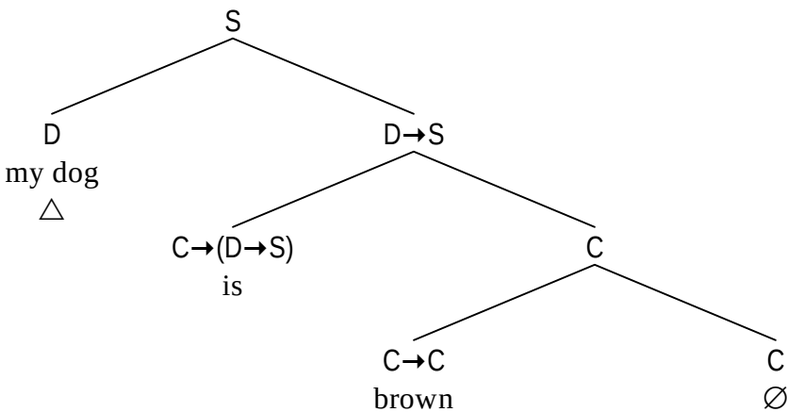
(1) We can treat bare-adjectives as a separate category from modifier-adjectives; in particular, we can simply propose that a bare-adjective has type C.

(2) We can treat each bare-adjective as having an understood unpronounced argument.

If we adopt approach (1), then the above sentence receives the following analysis.



If we adopt approach (2), then the above sentence receives the following analysis.



Here, we introduce the *null-phrase*, ∅, which in this particular example is a null common-noun.

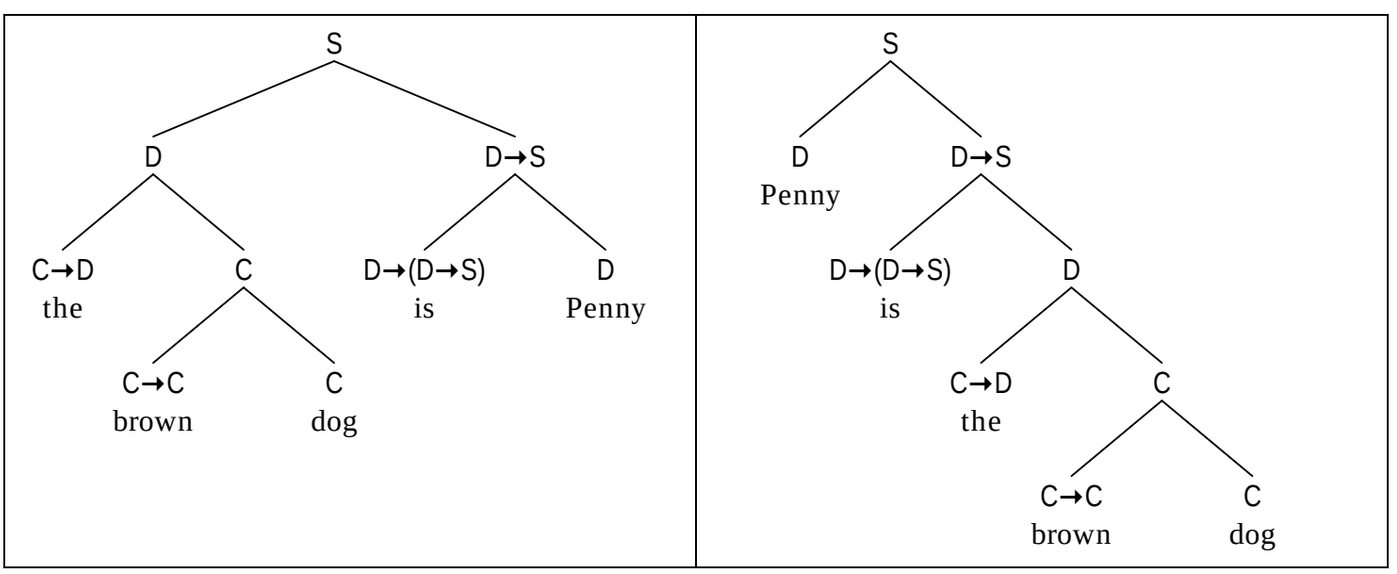
We officially adopt approach (1), which means that we distinguish bare-adjectives, which have type C, from modifier-adjectives, which have type C→C.

3. Transitive 'be'

So far, we have discussed copular 'be', which corresponds to what logicians call the '*is*' *of predication*. There is also transitive 'be', which corresponds to what logicians call the '*is*' *of identity*, which is illustrated in the following examples.

the brown dog **is** Penny
Penny **is** the brown dog

Here, 'is' is a transitive-*like* verb,[7] which is illustrated in the following trees.



[7] Transitive verbs in English take a nominative argument (the subject) and an accusative argument (the object). On the other hand, in the prestige dialect of English, transitive 'be' takes two nominative arguments, although accusative arguments sound more colloquial.