564 Lecture 17 Oct. 19, 1999

1 Type-shifting Ps and Adjs vs. Predicate Modification

1. Problems with adapting the copula to combine with functions of type <<e,t>,<e,t>> (last time's 29):

    (a) The copula will no longer combine with our type for nouns:
        #Kaline is a cat.
    (b) There are languages without a copula in this type of predication.
    (c) Small clauses: John considers Kaline grey.

So **gray** and **in** have to have the <e,t> and <e,<e,t>> denotations that we already gave them. How could we reconcile this difference in their types for modification and predication, under the Functional Application system?

Well, we could adopt the position that they've got *both* types. That is, anything of type <e,t> also has a type <<e,t>,<e,t>>, and anything of type <e,<e,t>> has a type <e,<<e,t>,<e,t>>. If we restrict this type-shifting to things labeled "Adj" and "P", then we also have a principled reason why Ns and Vs (or really, at least V -- Ns pretty much can) can't occur as modifiers without some special adaptation.

2. *the run shoe
    the runn*ing* shoe

So, we've got two proposals at hand:

3. Proposal one:
    Allow things of type <e,t> to combine with other things of type <e,t> by Predicate Modification, expanding our small base of interpretation rules.
    Proposal two:
    Adjs and Ps (and maybe Ns) whose basic type contains <e,t> also have a type where <e,t> is replaced by <<e,t>,<e,t>> (or vice versa).

2 Nonintersective adjectives

Recall our rule for PM:

4. *Predicate Modification* (PM)

If α is a branching node, $\{\beta, \gamma\}$ the set of α's daughters, and $[[\beta]]$ and $[[\gamma]]$ are both of type <e,t>, then $[[\alpha]] = [\lambda x \quad D_e \,.\, [[\beta]](x)=[[\gamma]](x)=1]$

This gives us the prediction that the following three sentences are logically equivalent:

5. (a) Julius is a gray cat.
   (b) Julius is gray and a cat.
   (c) Julius is gray and Julius is a cat.

(Remember our rule for conjoining VPs from last week? (b) works like that -- and is also equivalent to (c). Since our rule for PM is just like conjunction of VPs, (a) and (b) have very similar things going on in them).

In the type-shifting F.A. approach, the denotation of "gray" in 5a is:

6. (a) type: <<e,t>,<e,t>>
   (b) [[**gray**]] = $[\lambda f \quad D_{<e,t>} \,.\, [\lambda x \quad D_{<e>} \,.\, f(x) = 1$ and x is gray]]

In this approach, the equivalence of 5(a) and 5(c) follows from the lexical meaning of "gray" -- the conjunction part is built into the semantics of the lexical item. In PM, the conjunction part is part of the rule, so without even looking at the lexical item, we could prove that for any two predicates α,β of type <e,t> that can occur in the structure "Julius is a β α", the individual sentences "Julius is β" and "Julius is α" are independently true.

Further, if we know some things about the class membership of one of the predicates, in this situation we can substitute one for the other.

7. (a) Julius is a gray cat.
   (b) Cats are animals.
   (c) Julius is a gray animal.

We can prove that this sequence is a logically valid argument, no problem. However, as we've already seen, there are adjectives for which this type of argument does not, prima facie, hold:

8. (a) Jumbo is a small elephant
   (b) Elephants are animals.
   (c) #Jumbo is a small animal.

Now, using PM, we can see that the equivalence in 8 should follow, no matter what the lexical content of the predicates involved are, if **small** is of type <e,t>. However, if **small** is of type <<e,t>,<e,t>>, we can define the lexical item appropriately so that the equivalence in 8 doesn't hold. We don't want a denotation like the one for "gray" (for which these equivalences do hold), but we could make out with something like this:

9. $\lambda f \quad D_{<e,t>} . [\lambda x \quad D_e . f(x) = 1$ and the size of x is below the average size of the elements of $\{y: f(y) = 1\}]$

This would mean that for 8a, "Jumbo is a small elephant" asserts that Jumbo is an elephant and Jumbo is below the average size of things in the set of elephants. But for 8c, "Jumbo is a small animal" asserts that Jumbo is an animal and Jumbo is below the average size of things in the set of animals (not elephants).

So here we (seem to) have a solid argument for allowing at least *some* adjectives to have the type <<e,t>,<e,t>>.

So, we still have our choice between our two theories, one with type-shifting and one with PM. If we add adjectives like "small" to the mix, we don't still have any particular reason to chose one over the other. (In H&K's terms: "our theory does not place any premium *per se* on having a uniform semantic type for all members of a given syntactic category"). However, what about sentences like the following??

10. (a) Jumbo is small.
(b) I consider Jumbo small.

Now, above we showed that in their function as modifiers, adjectives like **small** *can't* have the type <e,t>. But here, we're back to where we were with those other adjectives -- they *have* to be of type <e,t> to combine.

Now, we could assume that all (intransitive) adjectives are basically of type <<e,t>,<e,t>> and they can all type-shift to <e,t> for predication purposes. However, once we allow type-shifting, we can take care of all our adjectives so far with just that, and get rid of PM. So should we?

Let's go back and consider our argument again.

11. (a) Jumbo is a small elephant.

Could this ever be uttered in such a way that it's true even if Jumbo isn't small on average for elephants? H&K propose a scenario where you've got a monster contest, and King Kong and Godzilla and Gargantua and Jumbo are all pitted against one another -- then you could say, "Jumbo doesn't have a chance, he's only a small elephant." Same scenario with monster trucks, e.g.

Now, in this context, our meaning for "small" only covers what is meant when it's uttered out of context. For any given utterance of "small", H&K claim, we establish a contextually salient standard. In the monster contest scenario, the standard is the average size of the monster. When we don't have any scenario, we use the contextually salient size provided by the head noun. The arguments in 8 only *seem* invalid, because in 8c we've changed the contextually salient size. Now, since we have to build context-dependence into the meaning of **small,** the meaning of type <<e,t>,<e,t>> isn't any better than one of type <e,t>. Really, **small** can be of type <e,t> and interpreted by PM after all:

12. [[**small**]] = [λx D_e **.** x's size is less than a contextually salient standard]

I'm going to skip their discussion of nonintersective adjectives like **former**, although it's interesting; mainly, such adjectives show that our extensional semantics is ultimately not going to be powerful enough, and we'll have to move to an intensional semantics.

13. Moral of this section:

(a) we're going to use Predicate Modification as one of our interpretive rules

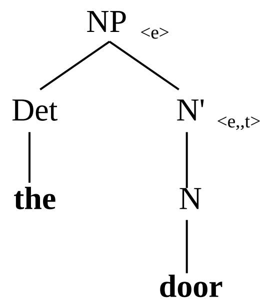
(b) we've pushed some important-feeling material off in the domain of context-dependence, i.e. pragmatics. If we were trying to make an adequate NLP for English, we'd definitely have to figure out a formal system for that stuff too (how do we decide what's the contextually salient standard?).

3 The definite article

The above material constituted real semantic meat: a piece of an ongoing empirical debate about the appropriate interpretation of nonintersective adjectives. Now we're going to consider another piece of real semantic meat, the appropriate treatment of determiners. This will lead us naturally into discussion of the correct treatment of quantification (which sometimes seems like *all* that semanticists talk about, although of course that's not so). Before we do quantification, though, next week we're going to segue into relative clauses so we can get a good understanding of variables in a Fregean semantics before attacking quantifiers.

Let's look at a tree for a definite description:

14.



H&K say that the usual intuition about definte descriptions is that they denote individuals, in particular, the salient individual from the set of things described by the head N. So, we're going to want the NP that dominates a definite determiner to denote an <e>. (They refer obliquely to Russell's analysis of the definite determiner, whereby it's a quantifier that picks out a singleton set -- we may or may not talk more about this later -- it's a huge debate, with a huge literature). It seems pretty clear that we want the determiner to do the work here, since we've got a good idea of what the N heads denote, and a good idea of what we want the NP to denote, but no real idea of what the Det is. (If we had a good idea about what the Det is, maybe we'd type-shift the N to take the Det as its argument and produce an <e>, but since we don't know what Dets are but we do know what the other things are, we'll adopt the idea that the Det head is doing the work.)

So, let's consider an appropriate lexical entry for the definite determiner. It's got to take arguments of type <e,t> and map them to things of type <e>. So, it's going to be of type <<e,t>,e>.

15. **the** is of type <<e,t>, e,>

And what does it mean? Let's consider an example like "the negative square root of 4" or "the queen of England".

16. (a) [The negative square root of 4] is -2.
(b) [The queen of England] is Elizabeth II.

An appropriate definition of the meaning of the definite determiner for these examples might be 17:

17. $[[\textbf{the}]] = [\lambda f \quad D_{<e,t>}$ **.** the unique individual $x \quad D_e$ such that $f(x) = 1]$

This works well for the examples in 16, where there can only *be* one indivdual that satisfies f(x); sentences like 18 are odd:

18. (a) #? A negative square root of 4 is -2.
(b) #? A queen of England is Elizabeth II.

However, this won't do in general. What happens if there is more than one potential element that satisfies f(x)? or if there's no particular individual that satisfies f(x)?

19. (a) The window is closed.
(b) The credenza is made of maple.

Here in Douglass 206, there's more than one window and no credenza, so the idea is that these sentences are uninterpretable as is. That is, they have no denotation -- they're neither true nor false. They want it to work out the same as a presupposition failure works out in a sentence like

20. Paul stopped smoking

Is 20 true or false in a situation where Paul has never smoked? The idea is that it's neither true nor false, but rather suffers from a presupposition failure.

Their claim is that "the" can only be appropriately used when there is only one element x in D that makes the given f(x) true. If "the" is used when there's more than one such element or no such element, then it just doesn't produce a denotation. So we're going to revise the domain of D to include only those functions of type <e,t> whose characteristic sets contain exactly one element -- those functions for which there's only one element that can make them true.

21. [[**the**]] = [λf $D_{<e,t>}$for which there is exactly one x such that f(x) =1 **.** the unique individual y D_e such that f(y)=1]

(the intuitive content of the range specification above is "that x":
[[**the**]] = [λf $D_{<e,t>}$for which there is exactly one x such that f(x) =1 **.** that x])

So, what happens if I utter 19a or 19b in this room, Douglass 206? The sentences don't get a truth value because [[**window**]] is not in the domain of [[**the**]] since there's more than one element that could satisfy [[**window**]](x), and [[**credenza**]] is equally not in the domain of [[**the**]] because there's no element that can satisfy [[**credenza**]](x).

(At this point, we can introduce a new mathematical term: *partial function*.

22. A *partial* function from A to B is a function from a subset of A to B.

[[**the**]] is a partial function from $D_{<e,t>}$ because its domain doesn't include all functions of type <e,t>, rather, just the subset of functions of that type that are made true by only one individual. Note that 22 just says "subset", it doesn't say "proper subset", so any of our functions can now be thought of as partial functions, even if we don't see any reason to restrict their domains in any way -- every set is a subset of itself.)

Back to what happens if we try to interpret 19a or 19b: since they contain an element that's trying to combine with something that's not in its domain. The failure here is of the same type as occurs in a string like "Above laughed." The string is just *uninterpretable*, it's not true or false.

Now, this works fairly well for the sentences in 19; our intuition tells us (at least it tells me) that something like 19b isn't true or false, but just that the speaker has uttered an infelicitous phrase. The same will necessarily be true of a sentence like 23, although perhaps it's less obvious:

23. Heidi is on the credenza.

Intuition seems to tell us that 23 is false, rather than uninterpretable. H&K say, rather, that we've got a non-technical usage of the word "false", different from the technical sense, and when we can't come up with a semantic value for something, we're faced with a situation in which we have to say one of two options, and since something is clearly not true, it must then be false. They say that really, we need a three-valued semantics, one for true statements, one for false ones, and one for one which lack an interpretation. The lack of an interpretation can be correlated with presupposition failure. They term their analysis of **the** a *presuppositional* analysis.

4. Presupposition failure vs. uninterpretability

24. Likely dialogues:

(a)	A:	Above laughed.
	B:	What??
(b)	A:	Paul stopped smoking.
	B:	I didn't know he ever did smoke!
(c)	A:	The credenza is made of maple.
	B:	What credenza?
(d)	A:	Heidi is on the credenza.
	B:	No she isn't! There isn't even a credenza here!

There seems to be a significant difference between the response to a flat-out failure of a sentence to functionally compose, as in 24a, and a presupposition failure, as in b-c, and things that should be presupposition failures like 24d. Now, according to H&K, all of the above should have the same status, when in fact they don't.

The difference between (a) and the rest (blank incomprehension on the part of B) can be ascribed to the fact that although, strictly speaking, the phrase "the credenza" in c-d has no interpretation, at least the item "credenza" is of the appropriate type to combine with "the". It doesn't meet the condition of the rider on the domain of "the", but it *could* combine with "the" if the real world was such that it did meet that condition. So we can "see" what speaker A must be trying to say by c-d, and we can see why it fails to assert anything. In (a), there's no chance that speaker A could ever make any sense, as far as we know. (Maybe we'll try to accomodate and make "Above" a proper name for something, or parse it as "a bove" and try to imagine what a bove is, or so on. But this type of accomodation requires the positing of a whole new lexical entry, while that in (b)-(d) only requires a change in assumptions about the instantiations of a particular lexical entry, whose meaning remains otherwise the same. The responses of speaker B illustrate the distance between the amount of accomodation required to make speaker A sensible in (a) vs. that required to make A sensible in (b)-d).) In (a), all you need to know is the type of the elements involved to know that the sentence gets no denotation. In (b)-(d) you need to know considerably more -- you need to know physical facts about the world (i.e. whether there exists exactly one credenza or not).

Now, let's reconsider 19(a).

25. *Let's say we all know that only one of the windows in Douglass 206 opens*.
A: The window is closed.
B: So it is.

Now, what happened here to make the definite description "the window" appropriate in this situation? There's still a number of items that could satisfy [[**window**]](x), not just one. However, the utterance context ("is closed") makes it the case that only one window is relevant to the discussion -- the one that could open. In fact, this is the most common usage of the definite article. We most often use the definite article with nouns that we know perfectly well have more than one instantiation (the book, the cat, the door, etc.) but we only use it when there's only one particular instantiation that's relevant to the discussion. That is, we need to put another rider on our definition of **the**.

26. [[**the**]] = [λf $D_{<e,t>}$ for which there is exactly one x C such that f(x) =1 **.** the unique individual y C such that f(y)=1, where C is a contextually salient subset of D_e].

Just as in the definition of "small", we have to include the notion that the set of items that might satisfy f(x) is not the whole set of entities in the universe, but rather the contextually salient set, as identified by the preceding discourse or the immediate setting or whatever.

Homework:

1. p. 67, last exercise on the page.

Interpretation of this question:

This question is asked in the context of the discussion of how to implement a type-shifting analysis of predicates/modifiers. They want you to write a rule that will apply to any n-place predicate (that is, to predicates that can take two arguments, like [[**in**]], as well as to predicates that can take one argument, like [[**gray**]]) to shift it from its type as a predicator (the simpler type) to its type as a modifier (the more complex type). Then they want you to write the same rule in reverse. This time, the rule will take the more complex type (as modifier) as input and give the simpler type (as predicate) as output. (In a type-shifting analysis, we would choose one of these two types as the basic type, to be listed in the lexicon, and then adopt one of the two type-shifting rules you'll produce as a general rule that could apply to any appropriate item in the lexicon). We're not adopting a type-shifting analysis here, but if we were, we'd need one of these rules. The crucial bit is to get it to apply to both one- and two-place predicates equivalently.

2. Exercise on p. 76

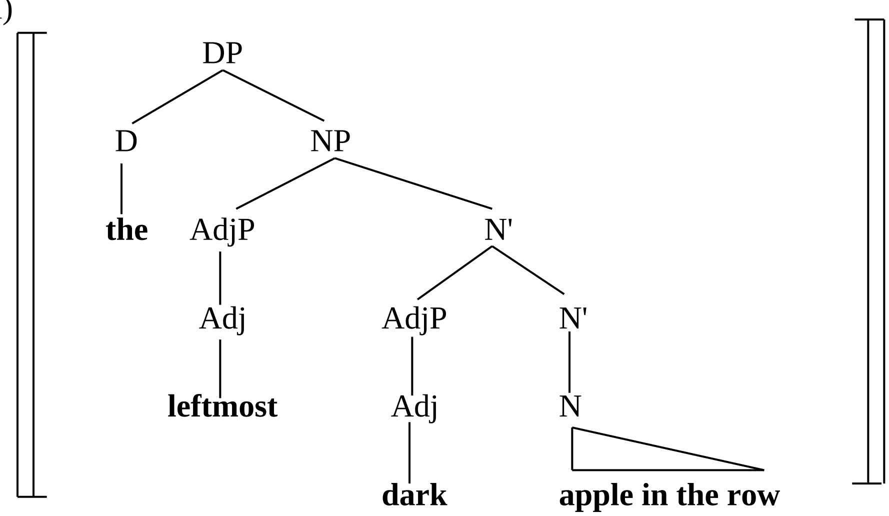
They've broken this one down pretty well, actually. Note that "killer" will be a 2-place nominal predicate, like "part". They don't actually want you to give a semantics for any of these, but just to use your knowledge of our treatment of definite descriptions to give the three scenarios they describe.

3. Exercise 2 p. 80

Interpretation of this question:

They've broken this one down pretty well, too. In part (b), it'll be helpful if you give a 1-place-predicate denotation for "leftmost", along the lines of the denotation for "gray" we've given earlier. A hint for part (c): keep in mind the first working treatment for "small" that we came up with; it'll be the easiest model to use for a good treatment for "leftmost". In part (d), they want you to compute the denotation using the lexical entries given plus the one for **leftmost** that you've worked out in (c), using our 4 rules of interpretation. I suggest you do it from the *top down* this time, starting with the tree as follows:

(i)



(ii)

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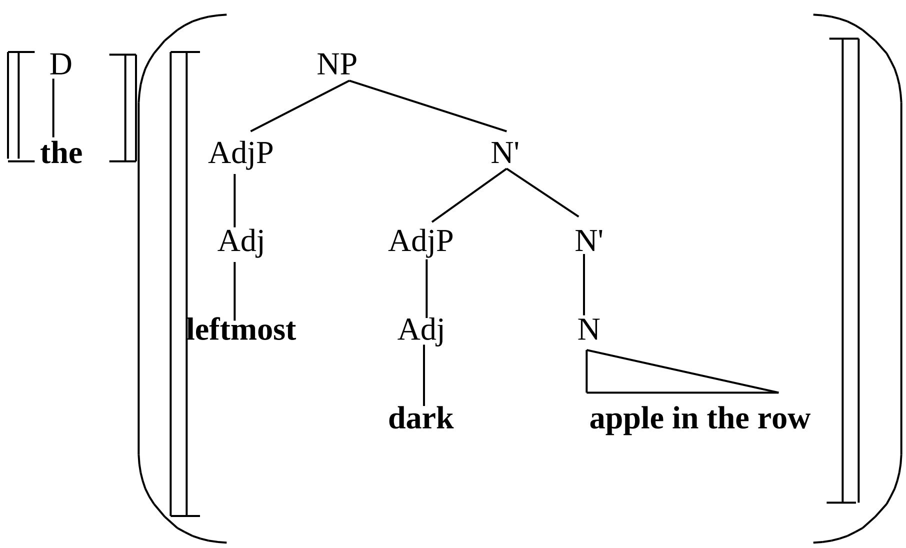
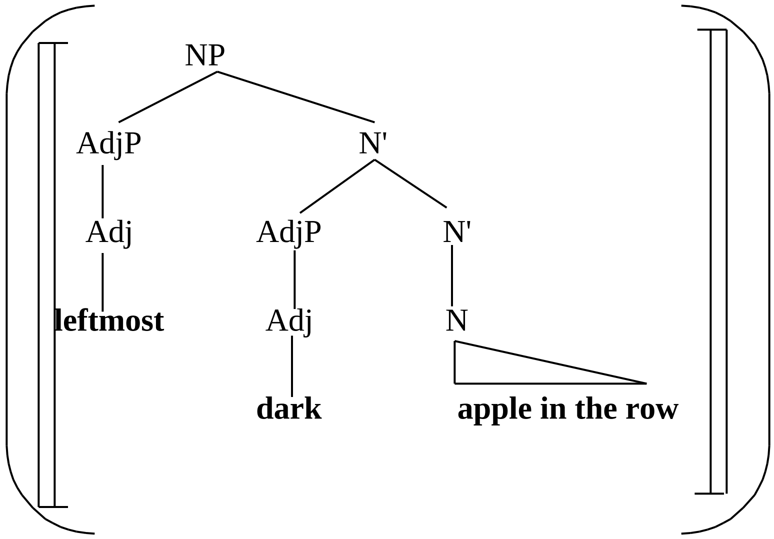


by F.A.

(iii)

= [[**the**]] 

by N.N.

... and so on. They warn you to assume that **apple in the row** is a simple predicate, i.e. that it's unanalysable and is of type <e,t>, just like the type for "apple". The lexical entry for **apple in the row** might look like this:

[[**apple in the row**]] = [λx D_e **.** x is an apple in the row].