'Grammatical' vs. 'Lexical' Meaning Constructors for Glue Semantics

Avery D Andrews
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It is a standard idea in current formal semantics that the type of ordinary 'intersective' adjectives such as *Swedish* is $e \rightarrow p$ in both attributive and predicative uses, that is, something which, when presented with an entity, produces a proposition, with attributive uses produced by a type-shifting operation.[1] But other kinds of adjectives, such as especially the 'modal' adjectives such as *alleged* and *self-proclaimed*, are generally taken to be of the type $(e \rightarrow p) \rightarrow e \rightarrow p$, originally proposed for attributive adjectives by Montague. These apply to a property to produce a property (note the conventional omission of the rightmost parentheses, around the final $e \rightarrow p$).

However, this semantic type can be regarded as undesireable, since it allows a kind of non-occurring modal adjective that can be exemplified by the hypothetical, but impossible, adjective **alleger*, used as follows:

(1) He is an alleger murderer
(meaning: he is someone who has alleged that somebody is a murderer)

What seems to be wrong here is that the modal adjectives that actually exist involve some kind of predication of the property denoted by the head N to the referent of the NP, even if it is modally embedded, which is not the case for the hypothetical meaning of *alleger* in (1).

I will here show that this kind of adjectival meaning can be blocked in LFG's 'glue semantics' by means of the following ideas:

(2) a. There are two kinds of meaning-constructors (buildings blocks out of which sentence-meanings can be assembled):

b. Lexical constructors, which constitute an open-ended supply, taking only arguments of atomic types (in particular, no property arguments of type $X \rightarrow p$).

c. Grammatical constructors, which can take arguments of higher types, but which are chosen from a limited inventory, fixed by UG.

This is a rather strong, possibly over-strong, hypothesis, which will have to deal with quite a range of evident problems in order to survive. But I will argue here that it's worth working on.

[1] I here use $\rightarrow$ rather than than angle-brackets to construct implicational types, and use p to designate 'propositions', without taking any position on whether they are a semantically basic type, as in for example Pollard (2008), or functions from sets of indexes to truth-values. I'm also ignoring the problems posed by individual concepts such as *the temperature* in *the temperature is ninety and rising*. e might in fact have to be individual concepts rather than 'entities' as commonly understood.

1 Glue

All approaches to semantic interpretation that I am aware of respect what might be called the 'use once and once only' principle,[2] to the effect that each meaningful element must contribute to the assembled meaning once and only once. For example, one cannot construe a denial such as *I did not eat the last brownie* as a confession, either by failing to interpret the negative at all, or interpreting it twice. A central technique for enforcing this respect is to do the semantics by scanning a tree, with one of the usual methods that visits each node once and only once. But in LFG, the structure most centrally involved in semantic interpretation, the f-structure, is not a tree, since it can contain multiattachments, and perhaps even cycles. It is also typically 'too flat' to provide a reasonable basis for phenomena such as quantifier scope amibiguities. The flatness provides a nice account of many agreement phenomena, but is problematic for semantic interpretation.

Glue semantics, developed in the 1990s at Xerox PARC,[3] deals with this problem by using (a small fragment of) linear logic to control semantic interpretation. Linear logic was developed by J.-Y. Girard in the 1980s, although many of its essential ideas were investigated earlier, for example by Carew Meredith in the 1950s, and, later, by Relevant Logicians such as Robert Meyer in the 1970s. The basic idea of linear logic is that each premise must be used once and only once in a linearly valid deduction. Furthermore, there is something called the Curry-Howard Isomorphism (CHI), which says that the structure of the (single conclusion = intuitionistic) logic of implication is exactly the same as that of the structure of systems describing the application of functions to arguments where the objects are all of specified types, and the use of lambda-abstraction to define such functions in terms of others. Putting these ideas together, we get a system wherein meaning-assembly obeys the once-and-once-only constraint without relying on tree-scanning algorithms, or tricky modifications thereof to deal with things that aren't quite trees. Furthermore, the logical aspect of the system turns out to automatically handle a significant amount of type-shifting phenomena, such as type lifting, function composition and the Geach rule, which often require special provisions in other kinds of systems.[4]

In this paper, I'll use a rather heavily modified presentation of glue semantics, discussed from a formal point of view in Andrews (2008a), and presented informally in Andrews (2009), wherein the 'glue proofs' that represent meaning-assembly are specified in the lexicon as pre-assembled chunks, which are then assembled to form a full specification of semantic composition by connecting 'output' to 'input' nodes according to various rules.

The semantic type information for a two-place predicate such as *Like* can for example be represented like this ('give me an entity, and I'll give you something which, if you give it an entity, will produce a proposition'):

[2] Which I found first stated as such in Dougherty (1993).

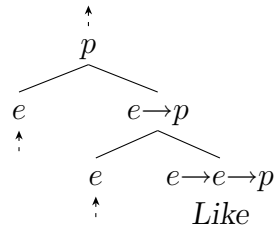
[3] See Dalrymple (2001) and Asudeh (2004) for recent and thorough presentations.

[4] Any type-shift rule whose semantic aspect involves only abstraction and implication can be produced by the logic alone; if something like identity or conjunction is required, then an explicit meaning-constructor must be introduced to effect the type-shift.

(3) *Like* : $e \rightarrow e \rightarrow p$

Andrews (2008a, 2009) shows how to restructure (3) as a 'prefab' piece of an assembled meaning, where arrows coming out of nodes represent 'outputs' (final resultant meanings) and ones coming in represent 'inputs' (argument):[5]

(4)

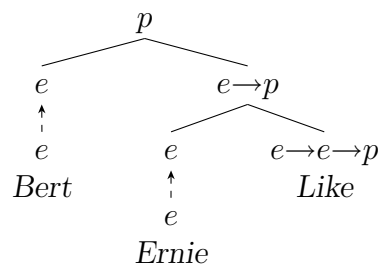


Given suitable prefabs for proper names:

(5) a. b.

we can plug outputs into inputs of matching type to produce this (and of course one other possibility):

(6)



The rules for a conceptually coherent assembly are:

(7) a. Compatibility: an input arrow can only be connected to an output arrow of the same semantic type

b. Monogamy: an input arrow can be connected to only one output arrow and vice-versa

c. Completeness: every input arrow must be connected to an output arrow

d. Only one left over: every output arrow but one must be connected to an input arrow

[5]The outbound arrows appear on atom-labelled nodes with 'negative polarity', the inbound ones on atom-labelled nodes with 'positive polarity' in the terminology of these papers.

e. Correctness: from every element with a specified meaning, there must be a path to the sole unconnected ouput, oriented upwards along the dotted lines and in the directionality of the arrow in the dashed ones (those added to effect the assembly).

There are various ways of stating these rules; they are in effect the rules for hooking up valid proof-nets in linear logic.[6] The system has significant resemblances to what is proposed for assembling conceptual structures in Jackendoff (2002), but the logical formulation suppresses various kinds of perverse combinations that might otherwise arise.

The theory is highly noncommittal about exactly what the meanings are, as long as they can be presented in a typed lambda-calculus, so that the underlying semantic theory could be model-theoretic, proof-theoretic, or purely representational.[7]

The standard technique for producing the constructors involves the c-structure rules and the lexicon, but here (mostly to reduce the amount of stuff that the reader has to look at at one time) I will use a method presented in Andrews (2007, 2008b) that works directly off the f-structure. To see how it works, consider a sentence such as:

(8) Bert likes Ernie

The f-structure for this will be (ignoring tense, number, etc.; glue obviates the need for argument-lists in PRED-features, as discussed in Andrews (2008b)):

$$(9)\quad f{:}\begin{bmatrix} \text{SUBJ} & g{:}\begin{bmatrix}\text{PRED} & \text{`Bert'}\end{bmatrix} \\ \text{PRED} & \text{`Like'} \\ \text{OBJ} & h{:}\begin{bmatrix}\text{PRED} & \text{`Ernie'}\end{bmatrix}\end{bmatrix}$$

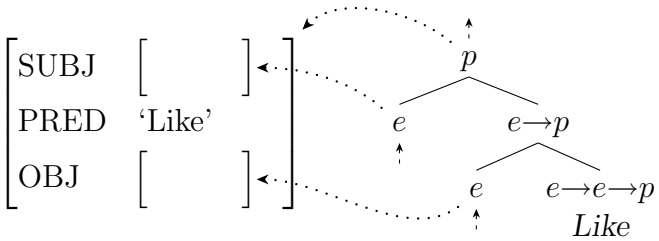
In this rather simple case, each feature-value will 'trigger' the introduction of a meaning-constructor via a 'Semantic Lexicon Entry' (SLE), whose glue-side terms will be connected to f-structures in the vicinity of the feature-value.

The connection is indicated in the SLEs by links connecting atom-labelled nodes in the semantic tree to substructures in an f-description, which can be perspicuously represented as an AVM:

(10)

[6] See de Groote (1999), Moot (2002) and Andrews (2008a) for discussion.

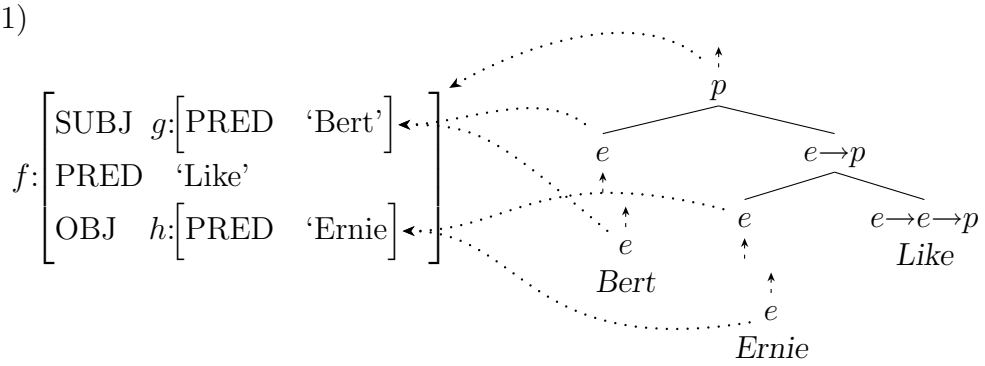
[7] For example, Andrews (2006) investigates the possibilities for using NSM to specify the meanings. One could regard NSM as a 'purely representational' semantic theory in that the explications it proposes have intuitively definite entailments, regardless of whether or not there is any formal account of what those entailments are.



A significant feature of this account is the from-semantics-to-syntax directionality of the linking; this is implicit in the standard presentations due to the use of f-structure labels in the meaning-constructors, but somewhat obscured by the involvement of an additional 'semantic projection', argued against in Andrews (2008a).

When an SLE introduces a constructor on the basis of the presence of a feature, that feature is 'checked off', and not used for further feature introductions. Well-formedness then requires that all 'interpretable' features be checked off by SLEs (syntactic case would not be intepretable, while number would be; the notion is discussed further in Andrews (2007, 2008b)). Adding the results of the obvious SLE's for the subject and object of (10), we get:

(11)



The next step is to assemble the constructors by plugging each small outbound arrow into an inbound one, subject to the purely semantic constraints plus two additional ones:

(7) f. Syntactic Matching: an output and input can only be matched if their f-structure correspondents are the same

g. Final Output: the unpaired output must be connected to the entire f-structure

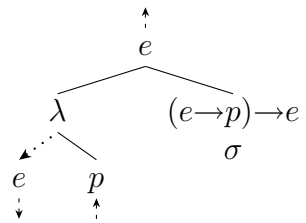
The only way to assemble the constructors of (9) so as to satisfy all the constraints is now (6), the other semantically OK possibility being ruled out by the syntax.

It surely the case that if all glue assemblies were as straightforward as this, then glue wouldn't be very hard to learn. But problems arise with various constructions that can be argued to involve arguments of non-basic types, such as, in particular $e \rightarrow p$, that is, 'properties', things that, when fed an entity, produce a proposition. These include attributive adjectives, and various other kinds of lexical items such as control predicates and intensional verbs. In this paper, I will only attempt to analyse the adjectives, but will mention some of these other cases at the end.

2 Adjectives

In a classic Montague-grammar analysis of noun-phrases, common nouns are of type $e \rightarrow p$ (Kermit is, Frodo is not, a Muppet). Perhaps the simplest illustration of how such a type can functon as an argument is provided by the popular (oversimplified) analysis of the definite article as an operator which applies to a property so as to produce as value the unique entity of which that property holds, nothing otherwise.[8] The type of this meaning, commonly represented as 'σ', is $(e \rightarrow p) \rightarrow e$. To represent this in our format, we need an additional kind of substructure in the trees, whereby an argument of type $a \rightarrow b$ is represented by a node labelled λ, with a left 'pseudo daughter' labelled a, and a right daughter labelled b. The pseudo-daughter has an arrow coming out of it, and is connected to its mother by a dotted line, so that the constructor for the definite article looks like this:

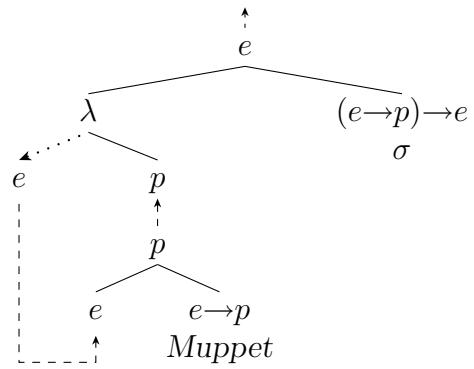
(12)



As discussed in Andrews (2008a), the λ-labelled nodes represent arguments of type $a \rightarrow b$ for some a, b, here e, p, respectively, but since the type can be easily read off from the daughters, and the function of these nodes is that of lambda-abstractions, this labelling makes for easier readability.

The arrow out of the pseudo-daughter (so-called because it gets different treatment from the well-formedness constraints (the proof-net Correctness Criterion) than a regular daughter) then plugs into some input of the property-argument, whose output then plugs into its right-sister node. Therefore, the assembled constructors for *the Muppet* would be:

(13)



The structure can be seen as a somewhat exploded syntax tree for a lambda-calculus expression (equivalently, a proof in Natural Deduction tree format), but one which

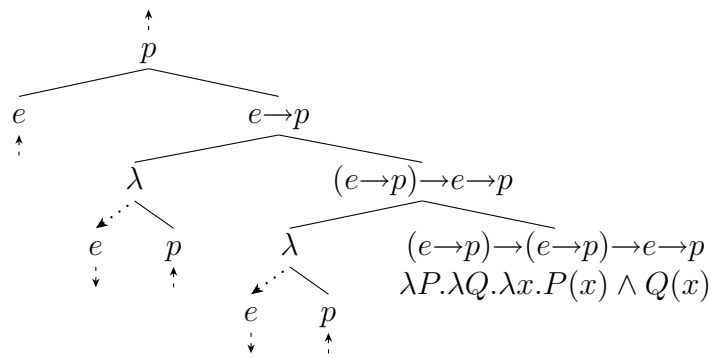
[8] A tutorial exposition of a more developed version of this kind of analysis can be found for example in Landman (1991).

obeys the 'linear restriction' that every λ must bind exactly one variable in the body of its lambda abstraction.[9]

So what about attributive adjectives? In the original Montague treatment, as discussed above, these were of type $(e{\rightarrow}p){\rightarrow}e{\rightarrow}p$, which would apply to a meaning of type $e{\rightarrow}p$ to produce a new one of the same type, such as *Angry*(*Muppet*). But this leads to a rather complicated relationship between attributive and predicate uses of adjectives, the latter being evidently of type $e{\rightarrow}p$. This relationship could be described by a lexical rule producing an attributive adjective of meaning $\lambda PX.Adj(x) \wedge P(x)$ from one of meaning *Adj*,[10] but there is a further problem, raised in the HPSG literature by Kasper (1995), and discussed in LFG+glue by Dalrymple (2001), which is that the original Montogovian type doesn't allow for an adequate treatment of adverbial modifiers in combinations such as *the apparently angry Muppet*, where there is no doubt in the judgement that Kermit is a Muppet, but whether his yelling represents genuine or feigned anger is not so clear.

Dalrymple's LFG glue version of Kasper's solution is to associate the adjective with two meaning-constructors. One, which we can call the 'lexical' constructor, is of type $e{\rightarrow}p$, and expresses the basic meaning of the adjective, in a form which also works fine for predicate adjectives. The other is a grammatical constructor that we can call the 'Intersector', since its function is to combine the meanings of a noun and intersective adjective. It can be formulated like this:

(14)

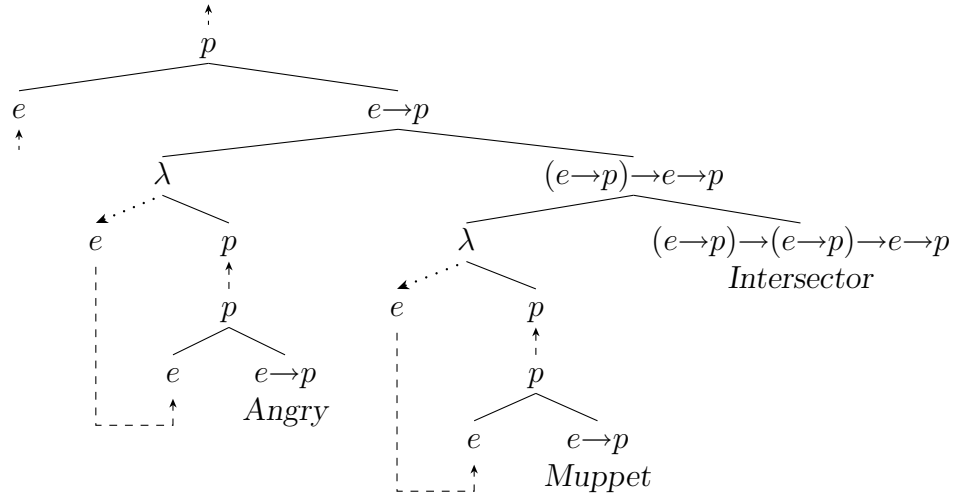


Which is a bit intimidating, but its basic workings aren't so different from those the σ-constructor. It has two λ's, one for the adjective, one for the noun, so that a sample complete assembly with both hooked in would be:

[9] de Groote and Retoré (1996) and Perrier (1999) present proof-net reading schemes for construing the assemblies as lambda terms that integrate and undergo β-reduction with the lexical meanings, in the same general manner has happens with Type-Logical Grammar (Morrill 2005).

[10] Corresponding to the ADJUNCT type-shift rule of Landman (2004).

(15)



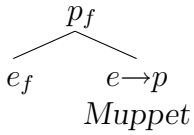
This is ready to be combined with the definiteness constructor, a quantifier (not discussed here), or another adjective (*a large angry Muppet*).

Note, however, that one could imagine a 'messy' variant of (15), in which the type p outputs of the two type $e \rightarrow p$ arguments were interchanged, without switching their type e inputs. This would in fact be an illegitimate assembly, ruled out by the following elaboration of Correctness (7e):

(7) e'. The path to the root from a left pseudo-daughter must pass through that pseudo-daughter's right sister (or, equivalently, mother).

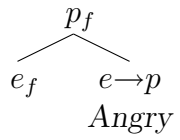
(14) satisfies (15), but wouldn't, if the type p but not the type e connections were interchanged (recall that the solid lines are oriented upwards, while the dashed lines go in the direction of their arrows; the dotted lines to the left of the pseudo-daughters don't count).

We've so far proceeded without reference to the syntactic constraints on assembly, which, in the case of these adjectival constructions, don't amount to very much. For common nouns, both the e input and p output can be linked to the f-structure of the associated f-structure, as here represented by co-labelling for easier typesetting:

(16) $f{:}\left[\text{PRED} \quad \text{'Muppet}\right]$ $\qquad$ 

A alternative worth considering, briefly discussed in Andrews (2008a), is to link the e-input to the CONCORD attribute that has been proposed in some recent LFG work to house nominal concord features.

For attributive (intersective) adjectives, the same form of constructor in fact seems workable:

(17) $f{:}\left[\text{PRED} \quad \text{`Angry'}\right]$ 

An f-structure that these would apply to would look like this:

(18) $$f{:}\begin{bmatrix}\text{PRED} & \text{`Muppet'} \\ \text{ADJUNCTS} & \left\{ g{:}\left[\text{PRED} \quad \text{`Angry'}\right]\right\}\end{bmatrix}$$

To fit this stuff together to get a result, the Intersector will have to connect to both the top level of the NP's f-structure, and to the adjective's ADJUNCT-value's member. We can write the meaning-constructor portion of the SLE in a more compact form, without expanding it into the prefab tree format:

(19) $$f{:}\left[\text{ADJUNCTS}\left\{ g{:}\left[\quad\right]\right\}\right]$$
$$\lambda PQx.P(x) \wedge Q(x) \;:\; (e_f \rightarrow p_f) \rightarrow (e_g \rightarrow p_g) \rightarrow e_f \rightarrow p_f$$

All these pieces will then fit together in only one way, so as to produce (15).

Adapting Dalrymple's analysis to the present account of how meaning-constructors are introduced, we can have a single adjectival PRED-feature trigger both the Intersector and the adjective's lexical constructor. Another possibility is to have the Intersector introduced by the phrase-structure rules, or perhaps even by the ADJUNCTS configuration, using the membership relation as a resource.[11]

An aspect of this that is worth pointing out is that although the Intersector is here represented symmetrically, this is inadequate once contextual effects such as those discussed in Kamp and Partee (1995:159-163) are taken into account. *A giant midget* seems to generally accepted to be somebody who is quite large for a midget, while *a midget giant* would be somebody who is small for a giant. Ultimately, the Intersector will have to be enhanced so that the nominal argument can set the standard for the interpretation of the adjectival argument.

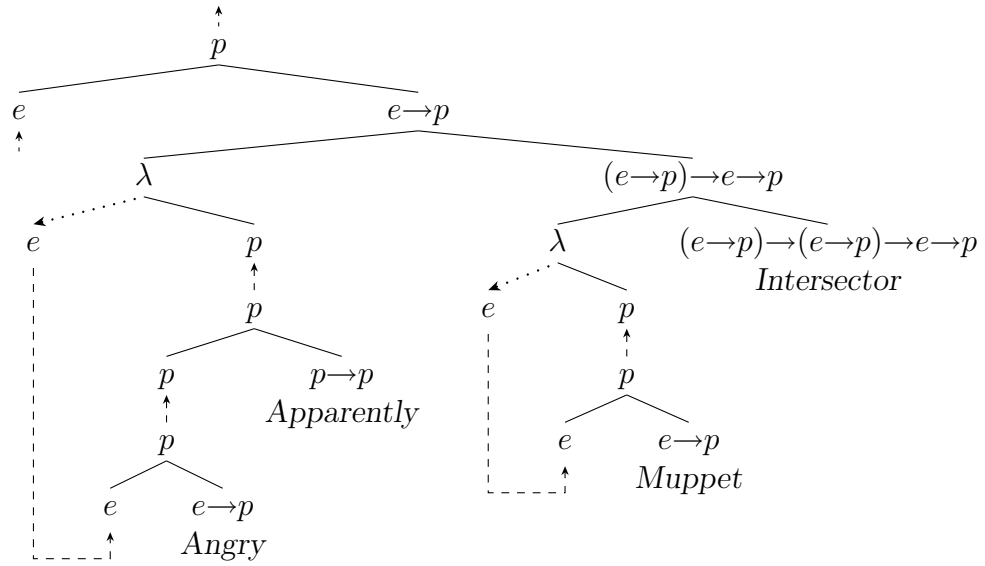
This kind of effect furthermore seems to exist when multiple adjectives appear in sequence. Australia, for example, is a land where lizards can get fairly big, while frogs are mostly very small. So the spotted grass frog (*Limnodastes tasmaniensis*) is *a large Australian frog*, but very modest-size by North American standards, whereas the Eastern bluetongue lizard (*Tiliqua scincoides*) wouldn't count as *a large Australian lizard* (being in competition with various much larger Varanids), but would be respectably large for North America. By contrast, the lace monitor *Varanus varius* could I think

[11] The idea would to to check off instances of the membership relation in the same manner as we have proposed to check off feature-values. Doing this with ordinary GF's would create problems with the LFG treatments of raising and control (Asudeh 2005), but it might be workable for f-structure set membership.

could be described as *an Australian large lizard* (big by world standards of size for lizards), while there just aren't any *North American large lizards*. The correct reading of multiple adjectives will be produced if each occurrence of an intersective adjective licenses the introduction of its lexical constructor together with the Intersector, but it then becomes unclear what rules out the incorrect orders of combination. Interpretation of concentrically nested modifiers is a substantial problem for LFG, due to the flatness of f-structures, which is considered from various points of view in Andrews and Manning (1993), Andrews (2004) and Andrews (2007), but I will not go into it here.

A benefit of employing the Intersector is that we no longer have any problem in principle of splicing adverbs such as *apparently* into the structure. Such an adverb will be of type $p \rightarrow p$, and can fit in semantically like this:

(20)



The type-shifting approach standard in current 'mainstream' formal semantics (for example the ADJUNCT rule in Landman (2004)) can also implement this kind of analysis.

But how about the connection to syntax? A standard LFG analysis would be to treat the adverb as an adjunct to the adjective:

(21)
$$\begin{bmatrix} \text{PRED} & \text{'Muppet'} \\ \text{ADJUNCTS} & \left\{ \begin{bmatrix} \text{PRED} & \text{'Angry'} \\ \text{ADJUNCTS} & \left\{ \begin{bmatrix} \text{PRED} & \text{'Apparently'} \end{bmatrix} \right\} \end{bmatrix} \right\} \end{bmatrix}$$

For 'propositional' adverbs applying to both sentences and adjectives in NPs, an SLE like this works out:

(22)
$$f{:}\begin{bmatrix} \text{ADJUNCTS} & \left\{ \begin{bmatrix} \text{PRED} & \text{'Apparently'} \end{bmatrix} \right\} \end{bmatrix} \qquad \textit{Obviously} : p_f \rightarrow p_f$$

Note that the adverb is characterized as taking a properly containing structure as the location both for its argument and its returned result; some more discussion of this form of constructor can be found in Andrews (2008b).

We have now managed intersective adjectives with a combination of a lexical meaning-constructor with no complex arguments, and a grammatical one, the Intersector, with two of them. There are however a number of other adjective types to deal with, of which the most clearly problematic are the modals.

The Intersector clearly produces completely wrong results for these, and they furthermore do not appear to be of type $e{\rightarrow}p$, as indicated by the fact that none of them work (except perhaps as somewhat ill-formed jocularities) as predicate adjectives:

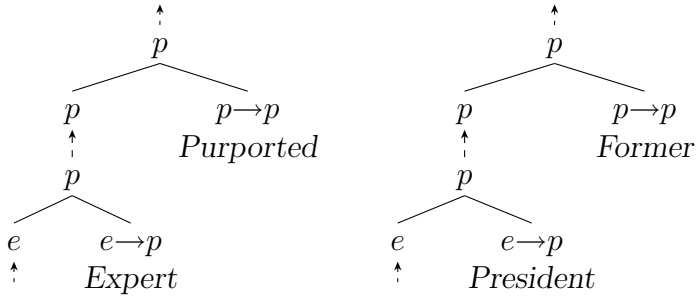
(23) a. *Bill is former

b. *Polly is purported

c. *Jack is self-proclaimed

We can give a workable account of many of them, such as *former*, *purported* and *alleged* (but not, quite, *self-proclaimed*), and many other of these adjectives by supposing that their type is $p{\rightarrow}p$. Sample assemblies will then be:

(24)



Former will have essentially the same meaning as the past-tense operator, while *Purported* will mean something like 'people say that P'.

To get this semantics to articulate with the syntax, we need to provide an appropriate SLE, and indeed the form just proposed above for the propositional adverbs seems to work fine here as well:

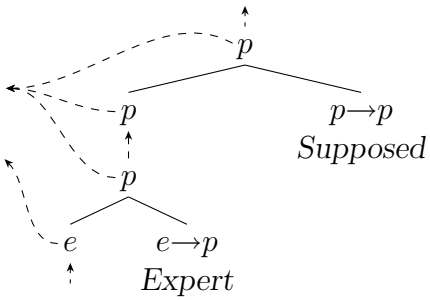
(25)

$$f{:}\left[\text{ADJUNCTS}\quad\left\{\left[\text{PRED}\quad\text{'Purported'}\right]\right\}\right]\qquad\lambda P.\exists x(Say(P(x)) : p_f{\rightarrow}p_f$$

It is perhaps worth discussing in a bit more detail how this treatment evades the need for an $(e{\rightarrow}p){\rightarrow}e{\rightarrow}p$ adjective type. In effect, by appropriate choice of syntactic locations to link the arguments and outputs of the meaning-assembly trees to, one can get the linear logic rules of glue to perform some of the effects of type-shifting. For example, given formulas $a{\rightarrow}b$ and $b{\rightarrow}c$, we derive $a{\rightarrow}c$ by transitivity of implication, which by the CHI yields composition of functions. A full structure diagram with all the links would be:

(26)

$$\left[\begin{array}{ll} \text{PRED} & \text{`Expert'} \\ \text{ADJUNCTS} & \left\{\left[\text{PRED} \quad \text{`Purported'}\right]\right\} \end{array}\right]$$



The potential of this structure to participate in further assembles is the same as that of a single common noun.

Like the previous one, this analysis also faces the problem of accounting for the effects of order, but this time on scope, as discussed in Andrews (1983) and Andrews and Manning (1993). But again, we won't pursue this here.

Adverbs do not seem to easily modify these adjectives, but to the extent that they can, the formally possible meaning-assemblies seem to be appropriate. For example *an apparently former president* would be somebody whose bid for re-election appears to have gone badly (from the evidential point of view of the speaker). The type $p \multimap p$ for these adjectives doesn't require any grammatical meaning-constructor, but there is another kind of intentional adjective that does, the type of *self-proclaimed*.

The problem is that a self-proclaimed expert is not just somebody that somebody or people say is a expert, but rather somebody who says that they themselves are a expert: in standard glue, a plausible representation for the meaning-side of *self-proclaimed* would be:

(27) $\lambda x.\lambda P.Proclaim(x, P(x))$

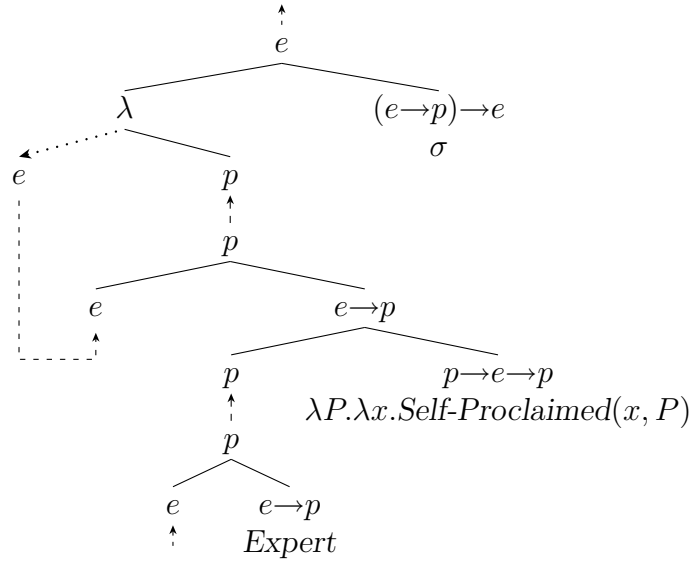
which calls for a semantic type of $(e \multimap p) \multimap e \multimap p$, violating our proscription against lexical meaning-constructors with arguments of non-basic type.

If we want to avoid violating the proscription, we'd have to use something like this, where the type of the adjective would be $p \multimap e \multimap p$

(28) $\lambda x.\lambda P.Proclaim(x, P)$

But if we try to use such a constructor in a sentence, we'll have problem, in the form of some unconnected input, either that of the adjective, or of the noun that the adjective is to apply to:

(29)

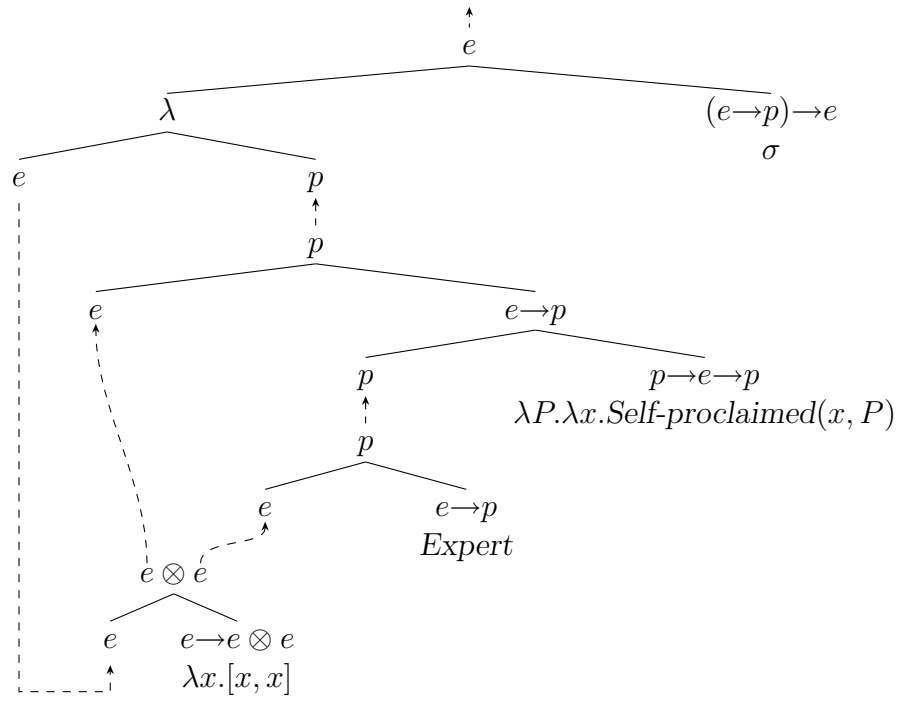


Here we've chosen the connect the determiner to the adjective and leave the noun's input hanging, but we could have done the opposite. The problem here is one of 'resource deficit', as discussed extensively in Asudeh (2004).

Our solution to this problem will be to use an additional grammatical meaning-constructor, whose semantic effects are the same as those of the constructor used to account for bound anaphora in Asudeh (2004). We'll call it the 'Nominal Reference Copier' (NRC), and its function is to make produce two copies of the e-input to a nominal, one for noun, the other for a *self-proclaimed*-type adjective.

This constructor, appearing at the lower left of (30), involves a 'tensor output' which can feed into two inputs of type e:

(30)

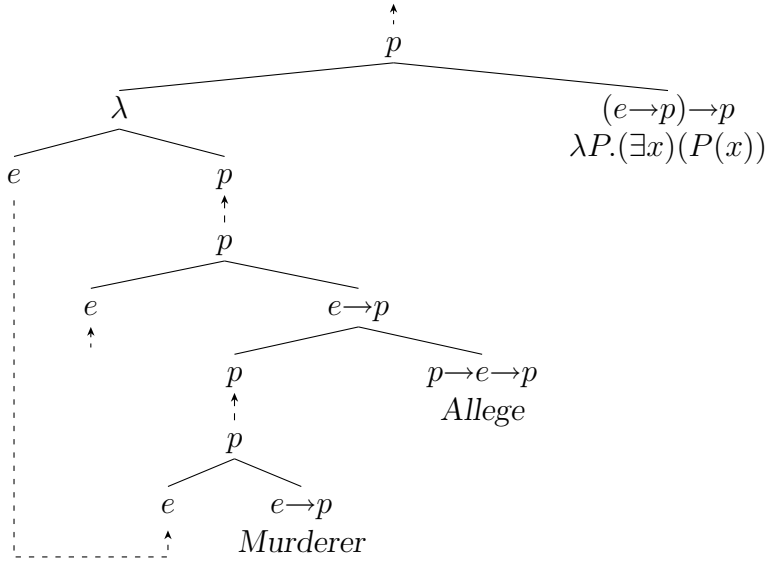


Tensor outputs are a further elaboration of the system, discussed extensively by Asudeh (2004), and, for the presentation of glue used here, by Andrews (2008a). Lev (2007) presents a possible alternative, using only implication rather than tensors, but I think it is harder to understand, so won't pursue it here. The NRC will have to collect an input of type e from the containing f-structure, and return one back to there, and pass the other to the adjunct.

A final point that is worth mentioning is that some modal adjectives seem to be able to use the NP's possessor rather than its referent as an argument, as in for example the NP *Israel's self-proclaimed 'propaganda war'*[12], where the whole NP's referent is presumably something that Israel has proclaimed as a propaganda war, rather than something that proclaims itself to be one. Another adjective that can take a possessor as argument is *favorite* (Partee and Borschev 1999).

But we are now finally in a position to produce our explanation of the nonexistence of **alleger* as discussed above. If we don't allow arguments of type $e \rightarrow p$, then we'll need a new grammatical meaning-constructor, such as perhaps one that takes an argument of type $e \rightarrow p$, and returns a result of type p, in the semantics quantifiying existentially over the argument of the property, producing a result like this:

(31)
$$f\!:\begin{bmatrix}\text{PRED} & \text{'Murderer'} \\ \text{ADJUNCTS} & \left\{ g\!:\begin{bmatrix}\text{PRED} & \text{'Alleger'}\end{bmatrix}\right\}\end{bmatrix}$$



But there is no reason to believe that any such constructor exists.

This might be seen as a somewhat 'uninteresting' hypothesis: there is a limited number of grammatical meaning-constructors, and none of them are capable of doing the job done by the one proposed in (31). But there are many situations where the least interesting hypothesis is the one that needs to be investigated first (if your computer

[12] `http://www.imemc.org/article/58311`

won't start, the most likely reason is that somebody has unplugged it), and I propose that this is one of them.

3 Possible Problems

There account of the nonexistence of **alleger* proposed here depends on the idea that meaning-constructors capable of taking arguments of type $e \rightarrow p$ are a finite list specified by UG. There are a great many possible problems with this idea; I'll go through some of them here.

3.1 How much is Universal?

One issue is exactly how much is supposed to be universal. A strong form of universality would say that the entire constructor is, syntactic and semantic parts together. This would entail that the intersective constructor proposed by Nordlinger and Sadler (2008) to combine the meanings of descriptive and generic nominals in NPs in certain Australian languages would have to be a different one from the one used here, due to the different f-structures. A weaker form would say that only the semantic operations are universal, with at least some degree of latitude as to the range of syntactic structures the constructor can apply to in different languages. I will leave this issue open here.

3.2 Intensional Verbs

Another is 'intensional verbs', such as *seek*, *find*, etc. These were originally analysed by Montague (1970, 1974) as taking object arguments of what would in our system be type $(e \rightarrow p) \rightarrow p$, which has also been the traditional analysis in LFG+glue, as discussed by Andrews (2008a). This rather obviously violates our proposed condition, as does the 'property analysis' proposed by Zimmermann (1993). Both of these are discussed in various recent works by Moltmann (2008a, 2008b, 2009), who proposes in recent work a different 'Nominalization' analysis which so far I can't reduce to glue meaning-constructors. McNally (in press) provides further coverage of relevant issues.

3.3 Subjectless VP Constructions

Another potential problem is VP constructions where a verb appears with no subject, including 'control predicates' such as *try* and *promise*, and various other constructions such as *criticizing rich people is fun.* These were often treated as constituing arguments of type $e \rightarrow p$ in early Montague Grammar, and such an analysis is proposed for control predicates in LFG+glue by (Asudeh 2005). However an alternative 'propositional analysis' can also be constructed, as discussed in Beryozkin and Francez (2004) and Dalrymple (2001). Many relevant issues are considered in Chierchia (1984), who argues that subjectless gerunds such as in *criticizing rich people is fun* must be formed with a

'nominalization; operator whose type would be $(e \rightarrow p) \rightarrow e$. This would be an excellent candidate for a grammatical meaning-constructor in the system proposed here.

Predicate modifiers such as 'I consider John *intelligent*' would also constitute a problem in some syntactic frameworks, but not LFG due to the fact that functional control with a non-thematic argument allows the adjectival argument to be analysed as a proposition with no issues.

3.4 Weak Quantifiers

Another possible problem is weak quantifiers such as *many*, *forty two*, *heaps of*, etc., which are arguably of type $(e \rightarrow p) \rightarrow e \rightarrow p$, but are too numerous to plausibly each be associated with a universal meaning-constructor. This problem can be solved by following Landman (2004) and much other work, in analysing the weak quantifier words as predicates of non-atomic lattice-elements (collections with more than one element, and quantities of stuff). These will be of type $e \rightarrow p$ (where e will not be a possible referent of a count singular noun, but only of a mass or plural one). Existential force can then be supplied as required by an appropriate grammatical meaning-constructor (to sort out exactly which one, we need to work out numerous issues involving DRT, choice-functional analyses of indefinites, etc).

3.5 Further Adjective Types

The last problem we'll consider, and the only one we give more than cursory attention to, is the existence of many further subclasses of adjectives, beyond the 'modal' and 'intersective' ones. The reason is that these constitute trouble right next door to the material of our argument, so that the issues they raise can impinge rather directly on our analysis. One problem in this area is that the terminology of adjective subclasses over the decades as been applied quite variably, in part due to differing analysis of what the adjective types actually are.

The term 'intersective', for example, has been consistently applied to adjectives such as *Swedish*, fow which the following inference rules clearly work, here formulated in the style of tree-format Natural Deduction, with rules of 'modifier elimination' and 'modifier introduction':

(32) Elimination:

$$\frac{\text{X is an Adj N}}{\text{X is Adj}}\ \text{Mod-elim}_A \qquad \frac{\text{X is an Adj N}}{\text{X is an N}}\ \text{Mod-elim}_N$$

(33) Introduction:

$$\frac{\text{X is Adj} \qquad \text{X is an N}}{\text{X is an Adj N}}\ \text{Mod-intr}$$

A simple deduction illustrating the behavior of a completely noncontroversially intersective adjective is:

(34)
$$\dfrac{\dfrac{\text{Jens is a Swedish surgeon}}{\text{Jens is a surgeon}}\,\text{Mod-elim}_N \qquad \text{Jens is a violinist}}{\text{Jens is an Swedish violinist}}\,\text{Mod-intr}$$

Adjectives for which the elimination rules fail include the modals, plus another inconsistently distinguished group sometimes called 'privatives', which are adjectives such as *fake*, which seem to obey a sort of negative version of the elimination rule: *this is a fake gun* implies *this is not a gun.* Privatives would appear to superfically class with the modals, but there is a problem in that they appear to have many grammatical properties in common with intersectives rather than modals:

(35) a. This gun is fake

b. *This gun is purported

On similarly syntactic grounds (in which their differential behavior with respect to NP-splitting in Slavic languages figures prominently, Partee (in press) argues strongly that the privatives are actually intersectives that, by virtue of conversational principles, have the effect of widening the denotations of their associated nominals to include things that only resemble, or, to a limited extent, play the role of the nominal, without actually being an instance of the nominal in the strict sense.

Intriguingly, such a division between modal and privative adjectives seems supported by the behavior of adjectives in Bahasa Indonesia. This language appears appears to lack genuine modal adjectives. For example, the concept of *former* as in *former dictator* is expressed by what appears to be an ordinary postnominal possessive construction using a head noun that means 'trace':[13]

(36) a. Ia bekas diktator
He trace dictator
He is a former dictator

b. Ini bekas koran
this trace newspaper
this is something that used to be a newspaper

bekas can occur as an attributive adjective, but with a different meaning:

(37) Ini koran bekas
this newspaper non-current
This is non-current newspaper (that people threw away, no longer needed)

[13]The following data is from Quinn (2001) and Wayan Arka (pc).

Various other English modal adjectives are rendered by circumlocutions:

(38) a. orang yang men-yata-kan diri ber-wenang
person REL AV-say-APPL self to be-authority
self-proclaimed authority

b. pem-bunuh yang telah meng-aku
AgtNml-kill REL PERF AV-confess
confessed murderer; killer who has confessed

c. orang yang di-duga mem-bunuh
person REL PASS-allege AV.kill
alleged killer; person who has been alleged to have killed

Balinese appears to be similar (Wayan Arka, p.c.), and Australian Indigenous languages also appear to lack modal adjectives, except for possible issues with meanings related to *former*, which seem to arise with Russian and Polish as well.[14]

But there is a privative adjective *palsu*, which shows normal adjectival behavior, appearing with or without the relativizer *yang*:

(39) Cinta-nya cinta (yang) palsu
love-3sg love RE: false
His/her love is false love (Quinn 2001 entry for *palsu*)

This adjective is rather obviously borrowed from English, and it would be interesting to see if there are any truly native privative adjectives in the languages of the region, but, still, it may well be significant that a privative adjective appears to have been borrowed and assimilated into standard adjectival syntax, while this has not happened with the modals.

On the other hand, adjectives for which the elimination rules work, but the introduction rules fail, have often been called 'subsectives'; a standard example is *skillful*, which exhibits the following behavior, where the attempt to apply the introduction rule produces an invalid result:

(40) a. Jens is a skillful surgeon

b. ∴ Jens is a surgeon

c. ∴ Jens is skillful

d. Jens is a violinist

e. #Jens is a skillful violist

[14]Possibly because the same kind of widening that lets a fake gun be a gun might also allow a 'former camp' (*lyatenye apmere*, 'past-time camp' in Arrernte) be a camp. There seems in general to be a violable principle to the effect that 'once an X, always an X', e.g. former US Presidents can still be addressed as 'Mr. President'.

Model-theoretically, the extension of *skillful surgeon* does not appear to be the intersection of the extensions of *skillful* and *surgeon*, in spite the fact that rule (32) appears to work.

But the 'subsectives' appear to fall into many subclasses with quite a lot of different behavior. A useful classification is provided by Coppock (2008), drawing extensively on earlier work by Bolinger (1967), Siegel (1976) and Beesley (1982). Beesley provided arguments, summarized by Coppock, that 'degree adjectives' such as *tall* and 'evaluative' adjectives such as *good* in examples such as (41) are actually intersective, in spite of superficially appearing to fail to work with the Introduction rule, producing the pattern in (40).

(41) a. Mark is a tall man

b. Mike is a skillful surgeon

Siegel worked out that the difference between them is that they take parameters that are often supplied by the context, a scale for the degree adjectives and a criterion of evaluation for the evaluatives. These parameters are expressed differently:

(42) a. Merry is tall for/*as a hobbit

b. Jens is skillful as/*for a surgeon

c. Fred is a skillful mathematician for a linguist

If we specify the appropriate parameter explicitly, both kinds of adjectives behave intersectively:[15]

(43) a. Jens is a surgeon (who is) skillful as a violinist

b. ∴ Jens is a surgeon

c. ∴ Jens is skillful as a violinist

d. Jens is a violinist

e. ∴ Jens is a skillful violist

So I suggest that the nature of the problem we face with subsectives depends on what these parameters really are, when expressed overtly. If they are arguments of type $e \rightarrow p$, then the hypothesis of (2) is wrong, and must be either abandoned outright or limited.

Limitation would of course be undesireable, but not catastrophic, if we can limit type $e \rightarrow p$ arguments to a restricted range of functions. But if that latter is possible, it

[15]Note that the deduction would fail in the manner of (40) if the *as*-phrase in (a) were omitted (and, of course, it's redundant).

might also be possible to treat them as adjuncts of some kind, for example *as* might be associated with a grammatical constructor of type $(e\rightarrow p)\rightarrow(e\rightarrow p)\rightarrow e\rightarrow p$, whose function is to use the first argument to delimit the range of activity for which the second is helled to be competent. Note for example, that we can use an adverb such as *generally* to say that somebody shows skillfulness across a wide range of activities:

(44) John is generally skillful, but not so good with computer hardware

There is also the possibility that the arguments, if they are arguments, are of some type other than $e\rightarrow p$, such as 'kinds', 'activities', etc. (requiring various conversion operations, which could be performed by grammatical constructors).

These types, along with the privatives, can be construed as essentially intersective, and therefore treated with our current constructors, although there might be additional arguments that would be problematic for our proposals about grammatical vs lexical meaning-constructors. Coppock lists a number of other types of adjectives don't seem to have a good prospect of being treated intersectively; it remains to see how the proposal here will fare with them. Larson (1998), McNally and Boleda (2004) and McNally (2006) present further relevant discussion.

4 Conclusion

The idea of a fixed set of universal grammatical meaning-constructors is consistent with an interesting range of data, but we can't be sure that it will prevail over all challenges. Nevertheless, I think it's worth taking seriously, in part because it would allow semantic typology to be cast in a relatively simple form, in terms of what grammatical meaning-constructors are used by various lexical items, and what lexical meaning constructors are also allowed, the latter being chosen from a simpler inventory than would otherwise be plausible.

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