Alternatives via scope

April 1, 2015

1 Today

- We'll take a look at a type-shifting approach to nominal interpretation, following a classic paper by Partee 1986 (which expands on an approach pioneered by Rooth & Partee 1982; Partee & Rooth 1983).

- I'll suggest that we can leverage this perspective to build a new approach to the semantics of alternatives — more specifically, a new approach to the way in which alternatives are compositionally integrated.

- I will sketch a very minimal departure from the standard picture to interpretation (Heim & Kratzer 1998). We will see that alternatives can be dealt with by supposing they *take scope*, and that this can be accomplished with the addition of two type-shifters to the grammar. I will spend some time arguing that these type-shifters are *natural* in the sense advocated by Partee.

- We'll start deploying this new analysis on the data we've been considering in the previous weeks. Some questions will remain unanswered today. We will tackle them in the coming weeks.

2 Type-shifting

- Partee 1986: instead of assuming that DPs (NPs, for her) consistently have the same sort of denotation — which, given the existence of DPs like *no linguist*, we would need to assume is (at least as high as) $(e \to t) \to t$ — treat the category DP as corresponding to a *family of types*, related in a systematic way by various **type-shifting** operators.

- A textbook case is the LIFT type-shifter:

$$\textsc{lift}(x) = \lambda\kappa.\, \kappa(x) \tag{1}$$

- Uses for LIFT: turning proper names into scope-takers, allowing e.g. conjunction with quantifiers. No semantic effect otherwise. Just forces a reversal of function-argument relationships, nothing more.

- NB: we generally think of LIFTing only names, and moreover of LIFTing them to functions into type t. But this is not necessitated by the form of LIFT. That is, LIFT is in the business of creating scope-takers, period. Thus, the type of LIFT is in its most general form as follows:

$$\alpha \to (\alpha \to \beta) \to \beta \tag{2}$$

- Staying neutral about the types in this way means treating LIFT as **polymorphic**: it corresponds to a single operation, but it's an operation which makes sense to apply in a huge range of contexts.

- Partee is concerned with the relative **naturalness** of various possible type-shifting operations. Ceteris paribus, type-shifters that have a "minimal effect"— i.e. which preserve structure across type domains, do not add bits of meaning in unprincipled ways, and so on — are to be preferred.

- For example, it is clear that for any type α, LIFT preserves all the structure in α, merely just blows it up into the domain $(\alpha \to \beta) \to \beta$. You neither lose nor gain information when you LIFT. Relatedly, LOWER — the function that takes any lifted individual back to its generator, i.e. IOTA ∘ BE — is a "natural" operation because it is the (partial) inverse of LIFT.[1] Thus, for any a and Q:

$$\begin{aligned} \textsc{lower}(\textsc{lift}(a)) &= a \\ \textsc{lift}(\textsc{lower}(Q)) &= Q \;\; \text{(when defined)} \end{aligned} \tag{3}$$

- Moreover, as Partee emphasizes, LIFT is in some sense just a consequence of the type-theory! Much work in the *type-logical* tradition mines this vein.

- Approaches along these lines can be leveraged into fully general accounts of scope-taking — i.e. without the need for any level of representation intermediate between surface structure and $[\![\cdot]\!]$. See e.g. Hendriks 1993; Barker 2002; Barker & Shan 2014; Charlow 2014.

3 Back to alternatives

- So what does this have to do with alternatives, again? Well, first, let's take stock of where we've been in the past few weeks, and what our goals are.

- Alternatives seem to be a useful way to think about the semantics of questions. That is, regardless of the compositional implementation, much work assumes that a question denotes a set containing the propositions which count as possible answers.

[1] This LOWER presupposes that LIFT is type $e \to (e \to t) \to t$. See Barker 2002 for another take.

- Similarly, alternatives seem useful for theorizing about free choice, either on an assertion-based view such as Simons 2005, or an implicature-based view such as Kratzer & Shimoyama 2002.

- Alternatives are also useful in another way: supposing that certain expressions *introduce* alternatives, and coupling this supposition with an enriched mechanism for composition, allows us to characterize (to some degree) the fact that certain things seem to be able to take exceptional scope-taking, which we observe in (at least) the following domains:

  - Indefinites and disjunction
  - *Wh* in situ
  - Indeterminate pronouns
  - Assocation with focus

- Finally, alternatives seemed to be a useful way to talk about the semantics of indefinites and disjunction in a *dynamic* setting.

- At the same times, certain difficulties arise in connection with alternatives:

  - Hamblin functional application seems to necessitate a pervasively syncategorematic and/or significantly complicated compositional regime (cf. Simons 2005; Rooth & Dong 2011).
  - It seems that Hamblin functional application is in some sense incompatible with Predicate Abstraction (Shan 2004; Charlow 2014).
  - Hamblin functional application plus syncategorematically characterized closure operators (e.g. ∃) seems to predict the existence of intervention effects where none are observed (e.g. Wold 1996; Rooth 1996).
  - Other implementations of alternative-generation (i.e. those following Karttunen 1977) have little to say about exceptional scope phenomena, and have trouble giving a semantics for pied-piping constructions (including LF pied-piping).
  - Finally, it is not really clear what static alternatives-based theories really have to do with dynamic alternatives-based theories, despite the *prima facie* formal connection.

- As we'll see today, taking a page out of Partee 1986's book will give us traction on some of these questions, and set us up to profitably explore the others.

4 A new way to compositionally integrate alternatives

- Whenever some A of type $\{\alpha\}$ occurs in a context Γ where something of type α is expected, A is *not intepretable in* Γ. The situation is entirely parallel to the situation with quantifiers in object position (so long as verbs expect their objects to be type e).

- So much so familiar! However, heretofore, we have proposed to remedy this type mismatch by rewriting the grammar to allow in a notion of set-friendly functional application (and perhaps predicate modification) — i.e. Hamblin 1973 functional application.

- We're going to start looking at another approach. On this approach, we take the quantifier-in-object-position analogy *totally seriously*. In short, we are going to see what happens when we let **alternatives take scope**.

- Of course, simply QRing an alternative-introducing expression doesn't get us where we need to be (the type mismatch will just be re-created at the scope position of the QR'd alternative generator). Instead, this approach relies on two type-shifters, defined below. We will assume that these apply freely, subject only to interpretability considerations.

$$\boxed{x} = \{x\} \qquad\qquad m^{\Uparrow} = \lambda\kappa.\bigcup_{a\in m}\kappa\, a \tag{4}$$

- Reasoning through the types may help with starting to intuit what these things do ($\{\alpha\}$ abbreviates $\alpha \to t$, i.e. the type of sets of things of type α):

$$\boxed{\cdot} :: \alpha \to \{\alpha\} \qquad\qquad \Uparrow :: \{\alpha\} \to (\alpha \to \{\beta\}) \to \{\beta\} \tag{5}$$

- Recognize one of them? It's just the proto-question operator! (Karttunen 1977; Heim 2000). Also known in Partee 1986 as IDENT! Think of this operation as a way to coax regular meanings into sets.

- As for the second, notice that its type looks *very* similar to the type for LIFT given in (2). So think of ⇑ this way: it's just like LIFT, but it presupposes that our "result" — the semantic context of the ⇑'d expression — will be something set-like.

- To give you a preliminary sense of how these pieces fit together, consider the following case. Say we have some set of individuals $S = \{\text{A}, \text{B}, \text{C}\}$. Then, by combinining $\Uparrow$ with $\boxed{\cdot}$, we can piece together the following:

$$\begin{aligned} S^{\Uparrow}\,(\lambda x.\boxed{\textsc{left}(x)}) &= (\lambda\kappa.\bigcup_{y\in S}\kappa\, y)(\lambda x.\{\textsc{left}(x)\}) \\ &= \bigcup_{y\in S}\{\textsc{left}(y)\} \\ &= \{\textsc{left}(y)\mid y\in S\} \\ &= \{\textsc{left}(\textsc{a}),\textsc{left}(\textsc{b}),\textsc{left}(\textsc{c})\} \end{aligned} \tag{6}$$

- Notice with respect to this case that replacing $\textsc{left}(x)$ with just x would give us back S! That is:

$$S^{\Uparrow}\,(\lambda x.\boxed{x}) = S^{\Uparrow}\boxed{\cdot} = S \tag{7}$$

- Notice also: $\Uparrow \circ \boxed{\cdot} = \textsc{lift}$! See. Thus, these two operations are literally decompositions of Partee's $\textsc{lift}$:

$$\begin{aligned} \boxed{a}^{\Uparrow} &= \lambda\kappa.\bigcup_{x\in\{a\}}\kappa\, x \\ &= \lambda\kappa.\,\kappa(a) \\ &= \textsc{lift}(a) \end{aligned} \tag{8}$$

As expected, the type of $\boxed{a}^{\Uparrow}$ jibes with the type schema for $\textsc{lift}$ given in (2); here, we instantiate (2)'s β as $\{\sigma\}$.

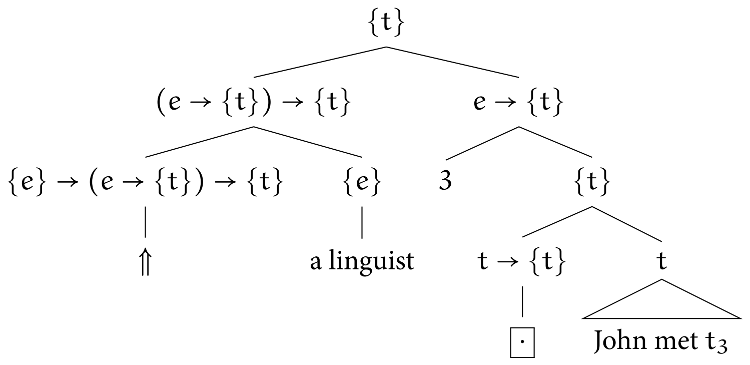
$$\alpha \to (\alpha \to \{\sigma\}) \to \{\sigma\} \tag{9}$$

- Background: $\boxed{\cdot}$ and $\Uparrow$ form a *monad*, a technique developed in theoretical computer science (following category theory) for theorizing about *side effects* in the semantics of programming languages (e.g. Moggi 1989; Wadler 1992, 1995; Shan 2002).
- Generally, *any* monad is comprised of two "type-shifters" that obey the identities in (7) and (8). These are *independently motivated* constraints within category theory/theoretical computer science, ones which are closely related (at least in part) to Partee 1986's somewhat informal criteria of naturalness.[2]

[2] Moreover, we can define a derivative notion of lowering, $\Downarrow$, such that $M^{\Downarrow} = M\boxed{\cdot}$. Notice that these set-friendly versions of lift and lower are, like Partee's, partial inverses of each other. That is: $m^{\Uparrow\Downarrow} = m$, and (when defined and restricted to the nominal domain), $M^{\Downarrow\Uparrow} = M$.

5 Basic cases

- Here is an example of how things fit together on this approach. We give an analysis for *John met a linguist*.



(10)

- The meaning we derive for this case is the standard set of propositions of the form x left, with x ranging over the linguists.
- Some things to notice in this tree:
  - $\Uparrow$ changes the set-denoting expression *a linguist* into a scope-taker.
  - The resulting scope-taker QRs out of its in situ position, leaving behind a trace of type e, which is duly abstracted over.
  - Functional application pieces everything together, with $\boxed{\cdot}$ ensuring that the argument to *a linguist*$^{\Uparrow}$ is of the correct type, i.e. $e \to \{t\}$.
- Notice that we are relying on Predicate Abstraction to intepret this LF. Does this create problems, given our discussion in Week 6? In fact, no. Our semantics for PA is *totally standard*, and corresponds to the "naïve abstraction" discussed in connection with alternative semantics in Romero & Novel 2013:

$$[\![n\ X]\!]^{g} = \lambda y.\, [\![X]\!]^{g[n\to y]} \tag{11}$$

Of course, we need to do more work to show that naïve abstraction plays well with things like quantifiers, negation, and so on. We'll take this up a bit in the next section, more in the coming weeks.

- At the end of the day, for this simple case the result is exactly the same as was achieved with Hamblin functional application.

- Similarly for questions. In this case, the LF we end up with is sort of a *hybrid* between the Hamblin 1973 and (neo)-Karttunen 1977 LFs we posited in earlier weeks. That is, we treat *wh* words as alternative generators, but we form a proto-question, over which the *wh* word must acquire scope. Here is an example analysis for the Japanese question *what did Taro ask?*:

$$\text{nani-o}^{\Uparrow}\ [2\ \boxed{\text{Taro-wa } t_2 \text{ tazunemasita ka}}\ ] \tag{12}$$

  For simplicity, I'm assuming here that *nani* scopes over *ka*, and that the latter has a vacuous semantics. Of course, other options are available.

- Multiple indefinites can be handled straightforwardly:

$$\text{somebody}^{\Uparrow}\ [5\ \text{something}^{\Uparrow}\ [6\ \boxed{t_5 \text{ read } t_6}\ ]] \tag{13}$$

  If you work through this, you'll find exactly the same result as yielded by an alternative semantics à la Kratzer & Shimoyama 2002. You can get most of the intuition simply by realizing that the argument of *somebody*$^{\Uparrow}$ has type $e \rightarrow \{t\}$, exactly as in the case with a single indefinite.

- Multiple questions work similarly (strictly speaking, it does not matter which order the *wh* words come in this structure; I have done a superiority-obeying movement for concreteness):

$$\text{who}^{\Uparrow}\ [5\ \text{what}^{\Uparrow}\ [6\ \boxed{t_5 \text{ read } t_6}\ ]] \tag{14}$$

  Again, if you work through this, you'll find exactly the same result as yielded by an alternative semantics à la Hamblin 1973, or indeed Karttunen 1977 (though we do not restrict ourselves, as Karttunen does, to true answers).

- NB: don't take the correspondence between indefinites and *wh* words *too* seriously. Just as we need a way to distinguish common nouns from VPs, even though both denote sets, we need a way to (at least in English-like languages) distinguish indefinite- and disjunction- alternatives from question-alternatives. The necessary distinction could be located in the syntax (see Kratzer & Shimoyama 2002) or the type theory (see Sternefeld 2001a).[3]

[3] It's also conceivable that we might wish to distinguish disjunction alternatives from indefinite alternatives, though is not something I have thought much about.

6 Solving some of our problems

- Because our treatment of composition is standard, the entire theory can be couched in a totally categorematic way. For example, we can give the following semantics for an indefinite determiner:

$$\textsc{indef} = \lambda P.\, P \tag{15}$$

  On a standard Hamblin 1973-style approach, the semantics for the indefinite determiner is generally given syncategorematically, since lexical expressions cannot "see" sets — rather, set manipulation is essentially the job of the *grammar*.

- Extends straightaway to disjunction. Again treated categorematically!

$$\textsc{or} = \lambda p.\, \lambda q.\, p \cup q \tag{16}$$

- Similarly, closure operations can be directly defined. Here is a simple meaning for an existential closure operator:

$$\textsc{e-clos} = \lambda S.\, \exists p \in S.\, p \tag{17}$$

- Indeed, we have no reason (at this point) to assign words like *not* or *every* anything other than their boring, standard lexical semantics. Thus, we suppose that $[\![\text{not}]\!]^g$ is the familiar $t \rightarrow t$ function, and $[\![\text{every}]\!]^g$ the familiar $(e \rightarrow t) \rightarrow (e \rightarrow t) \rightarrow t$ function. Any alternatives generated in their scope are simply dispensed with via an application of E-CLOS.

- Moreover, because the compositional apparatus is standard, standard techniques for abstraction carry over immediately. The naive abstraction approach dismissed by Romero & Novel 2013 works after all!

- Again, because we do not assume that anything *must* denote a set (whereas standard approaches assume that *everything* denotes a set), the standard semantics for Predicate Abstraction is immediately compatible with quantifiers like *no linguist*!

- As for exceptional scope... Assume you have some A that denotes something of type $\{\alpha\}$. The rules of the game predict that A should itself be a candidate for shifting and scope-taking (in the same way that the application of

LIFT is presumably cross-categorial). That is, we should be able to generate configurations like the following:

$$A^{\Uparrow}\,(\lambda x.\,\boxed{\cdots x \cdots}\,) \qquad (18)$$

- The effect of this will be to give the alternatives in A scope over the things in A's argument, rather like the result achieved by assuming that the compositional mechanism percolates alternatives around intervening operators. This treatment bears obvious resemblance to the notion of LF-pied piping (Nishigauchi 1990; von Stechow 1996). We will develop this connection in the coming weeks.

7 Wrapping up

- Summing up some key aspects of the theory: no need to generalize to the worst case, i.e. assume that everything denotes a set. No need to complicate the grammar with a multiplicity of compositional mechanisms. The compositional apparatus stays standard and, therefore, well-behaved. Even so, we observe a degree of exceptional scope-taking.
- One might wonder at this point: how general is this strategy, really? Consider the following sorts of sentences. They reflect "exceptional" scope of an island-embedded alternative generator, alongside binding into the embedding environment:

  (1) Every boy$_i$ will be pleased if ⟨his$_i$ mother invites a famous linguist⟩.

  (2) Who told every boy$_i$ ⟨he$_i$ should meet which famous linguist⟩?

  The key question: how is such a result to be achieved? The answer we will suggest in the coming weeks: *reconstruction* (Chierchia 1995; Cresti 1995; Sternefeld 2001b; Bumford to appear).
- However, if we appeal to reconstruction, how do we control what reconstructs and what does not? Do we lose explanatory force (cf. Dayal to appear)? Moreover, does the relevant notion of reconstruction itself need to be stipulated, or can we in some sense derive it? I will argue in the next few weeks that these questions all have happy answers.
- Much more to come: *selective* exceptional scope-taking out of islands, pied piping (both overt and covert), dynamics, intervention effects. Stay tuned...

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