Supplements and monadic interaction

Computational semantics seminar

March 22, 2017

Today

Today we'll be looking at appositive relative clauses (ARCs):

1. Sue, who's smart, bribed Jon, who isn't.

We'll explore two related questions:

- What sort of meaning should we assign this sentence?
- How is the ARC compositionally integrated?

Gameplan

After setting up some key empirical desiderata, we'll explore a monadic treatment of supplemental content.

We'll see how this treatment interacts with our existing proposal for monadic dynamic semantics, and use properties of this interaction to derive some non-trivial empirical patterns pertaining to the interaction of appositive content and other kinds of content (and the absence thereof).

Basic data

Entailments

Supplements provide information. (1) $\vDash$ (2), and (1) $\vDash$ (3):

1. John, who is a linguist, works on binding.
2. John works on binding.
3. John is a linguist.

[For some sense of $\vDash$.]

Independence

In general, content introduced by ARCs seems not to interact with other operators in a sentence:

1. I didn't read Beowulf, which is a stone-cold classic.
2. If John, who likes dancing, comes, the party will be great.

Not presupposition

This “projective” behavior is reminiscent of presupposition, but distinct. As Potts (2005) points out, the ARC’s content can’t be presupposed:

1. John is a semanticist, and Mary knows that John’s a semanticist.
2. John is a semanticist. #Mary likes John, who is a semanticist.

Islands and independence

An earlier example already shows that ARCs project out of islands:

2. If [John, who likes dancing, comes], the party will be great.

Scope of the anchor

The following sentence only allows a wide-scope reading for the indefinite. of the anchor (after AnderBois, Brasoveanu & Henderson 2015: ex. 72):

1. John didn’t read a book, which Mary had recommended.

ARCs force exceptional wide scope for anchored indefinites:

2. If [a rich relative of mine, who made a lot of money in oil, dies] I’ll inherit a fabulous mansion.

Possible anchors

While ARC's can be anchored to indefinites, they're unhappy when they get anchored to true quantifiers:

1. *Everybody reads everything by Shakespeare, which is a classic.
2. *No linguist, who's a semanticist, was at the party.

Occasional local scope

There are certain cases that seem to suggest an ARC can take non-maximal scope (examples after Schlenker 2013):

1. If tomorrow I call the Chair, who in turn calls the Dean, then we'll be in deep trouble.
2. If tomorrow I call the Chair, who'll in turn call the Dean, then we'll be in deep trouble.

These cases are highly mysterious and not very well understood. As Schlenker points out, tense seems to be playing a crucial role.

Nevertheless, I think it's fair to focus on independence as a core property of ARCs, and perhaps circle back to these examples later.

Summing up

ARCs can be anchored to proper names and indefinites.

ARCs take widest scope, dragging their anchor along for the ride.

ARC scope is island-insensitive.

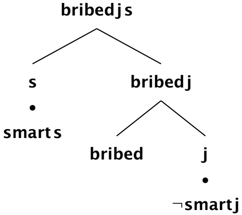
Two-dimensionality

Potts (2005): radical separation

Potts (2005) argues that the independence of ARCs requires a **two-dimensional** treatment. ARC content lives in a separate dimension, segregated from regular, ‘at-issue’ content.

Parsetrees

Potts maps phrase markers into **parsetrees**, structured semantic entities where certain nodes can be decorated with appositive content:



This representation is interpreted by **pruning** the bulleted meanings and conjoining them with the main content of the utterance.

Non-compositional (cf., e.g., DRT). What’s special about indefinites?

Interaction

Indefinites freely bind into and out of ARCs:

1. John, who nearly killed a woman$_i$ with his car, later ended up visiting her$_i$ in the hospital.
2. A young boy$_i$ read Beowulf, which he$_i$ loved.

(AnderBois, Brasoveanu & Henderson 2015)

Still doesn't extend to quantifiers:

3. *John, who nearly killed no woman$_i$ with his car, later ended up visiting her$_i$ in the hospital.
4. *No boy$_i$ read Beowulf, which he$_i$ loved.

AnderBois, Brasoveanu & Henderson (2015)

No distinguished dimension for supplemental content.

Distinguish two kinds of dynamic updates:

- Proposals to update the common ground, subject to negotiation.
- Immediate, non-negotiated updates to the common ground.
- Cf. also Murray 2009.

Proposals associated with at-issue content, impositions with not-at-issue content (e.g. what's introduced by a ARC).

ARCs in situ?

You can think of AnderBois, Brasoveanu & Henderson's (2015) analysis as a kind of in situ theory of ARCs, roughly analogous to in situ theories of indefinites.

But many of the features that fall out of a two-dimensional analysis need to be, in effect, stipulated:

- Non-interaction
- Types of anchors
- Scope of the anchor
- Differential binding capabilities of indefinites, true quantifiers

ARCs ex situ?

By contrast, an account that treats ARCs as actually taking widest scope may not need to stipulate these facts, if we can somehow derive the ability of indefinites to out-scope ARCs.

Something you might hope for: start with a dynamic semantics, tack on a second dimension, and let the chips fall where they may.

We will go about this *monadically* today, and see how far it takes us.

A monad for supplements

Finding a type

What is a type constructor for things hosting “appositive” content?

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$$\mathsf{A}\,a ::= (a, \mathtt{t})$$

Associated operations

Let's follow the types to generate appropriate values for η and $\gg\!=$.

First, what's an appropriate $\eta :: a \to \mathrm{A}\,a$?

$$\eta\, x := (x, \mathbb{T})$$

And what's an appropriate $\gg\!= :: \mathrm{A}\,a \to (a \to \mathrm{A}\,b) \to \mathrm{A}\,b$?

$$(x, p) \gg\!= f := (\mathbf{fst}\,(f\,x), p \wedge \mathbf{snd}(f\,x))$$

(See Giorgolo & Asudeh 2012.)

Meaning for the comma intonation

Type: $(\mathtt{e} \to \mathtt{t}) \to \mathtt{e} \to \mathtt{A}\,\mathtt{e}$

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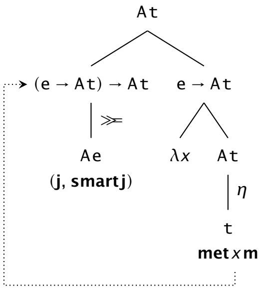
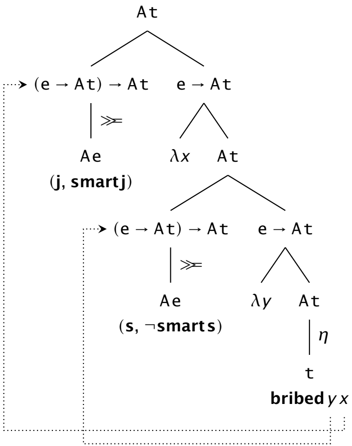
Simple cases work in a familiar away: scope!



$$(\mathbf{metjm},\ \mathbf{smartj})$$

Cases with two appositives are seamless



$$(\mathbf{bribed\,s\,j},\ \mathbf{smart\,j} \wedge \neg\mathbf{smart\,s})$$

Island-insensitivity predicted

Like any monad, A's $\ggg$ operation is *associative*. Like with indefinites (with or without dynamic binding), this guarantees island-insensitivity of appositive content!

Selectivity?

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Not really! Since ARCs always project maximally (modulo those tricky Schlenker cases), there is no need for selectivity. Just let everything float to the top.

Follows from absence of lexical operators with type $\mathrm{A}a \to b$. (The only thing with this type is *grammatical*, i.e., $\ggcurly$.) Nothing can capture appositive content.

Interaction

Monadic dynamic types

$$\begin{tikzcd}
 & a \arrow[dl] \arrow[dr] & \\
\mathsf{g} \to a \arrow[dr] & & \mathsf{S}\,a \arrow[dl] \\
 & \mathsf{g} \to \mathsf{S}\,a \arrow[d] & \\
 & \mathsf{g} \to \mathsf{S}\,(a \times \mathsf{g}) &
\end{tikzcd}$$

Recalling our dynamic monad

For $\mathrm{D}\,a ::= \mathrm{g} \to \mathrm{S}\,(a \times \mathrm{g})$:

$$\begin{aligned} \eta \quad &:: \; a \to \mathrm{D}\,a & \gg\!= \quad &:: \; \mathrm{D}\,a \to (a \to \mathrm{D}\,b) \to \mathrm{D}\,b \\ \eta\, x &:= \lambda g.\, \{(x, g)\} & m \gg\!= f &:= \lambda g.\, \textstyle\bigcup_{(x,h) \in m\,g} f\, x\, h \end{aligned}$$

Indefinites and pronouns

Semantics for indefinites:

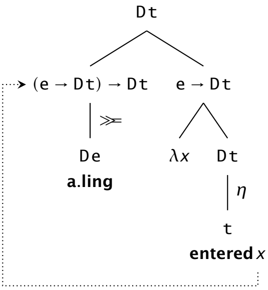
$$\textbf{a.ling} := \lambda g.\, \{(x, g) \mid \textbf{ling}\, x\}$$

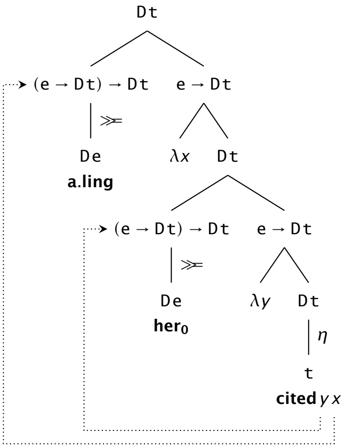
Semantics for pronouns:

$$\textbf{she}_\mathbf{0} := \lambda g.\, \{(g_0, g)\}$$

[Both are type D e.]

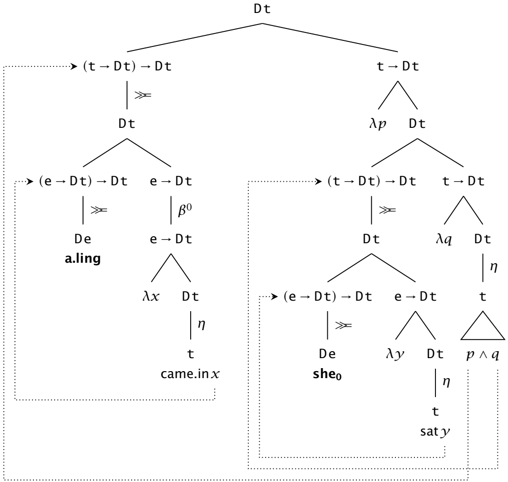
Some simple derivations





$\lambda g.\,\{(\textbf{entered}\,x,\, g) \mid \textbf{ling}\,x\}$ $\qquad$ $\lambda g.\,\{(\textbf{cited}\,g_0\,x,\, g) \mid \textbf{ling}\,x\}$

Cross-sentential anaphora with β^n



$$\lambda g.\,\{(\mathbf{came.in}\,x \wedge \mathbf{sat}\,x,\, g^{0\to x}) \mid \mathbf{ling}\,x\}$$

Negation, universals, etc

Negation should have type $\mathtt{Dt} \to \mathtt{Dt}$:

$$\mathbf{not}\, p := \lambda g.\, \{(\neg \exists h : (\mathbb{T}, h) \in p\, g,\, g)\}$$

A universal quantifier, type $(\mathtt{e} \to \mathtt{Dt}) \to (\mathtt{e} \to \mathtt{Dt}) \to \mathtt{Dt}$:

$$\mathbf{every}\, f\, g := \mathbf{not}\, (\mathbf{a}\, f \gg\!= \lambda x.\, \mathbf{not}\, (g\, x))$$

Important feature of both entries: they demand they they scope over something of type $\mathtt{Dt}$! Keep this in mind, it'll become important.

How they [don't] relate...

$$
\begin{tikzcd}
 & \mathsf{D}\,a \arrow[dl, "\not\gg"'] & \\
(a \to \mathsf{D}\,b) \to \mathsf{D}\,b & a \arrow[l, "\mathbf{LIFT}_{\mathsf{D}\,b}"'] \arrow[u, "\eta"] \arrow[r, "\mathbf{LIFT}_{\mathsf{A}\,b}"] \arrow[d, "\eta"] & (a \to \mathsf{A}\,b) \to \mathsf{A}\,b \\
 & \mathsf{A}\,a \arrow[ur, "\not\gg"'] &
\end{tikzcd}
$$

Two monads!

So we have two monads: one for dynamics and one for appositive content. Can we define a combined one? Need we?

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In fact, we *can* (exercise: try to!). But as it turns out, we **needn't**.

Monadic polymorphism

Remember η and $\gg\!=$ are **polymorphic**. Given a monadic T:

$$\begin{aligned}\eta \quad &:: a \to T\,a \\ \gg\!= &:: T\,a \to (a \to T\,b) \to T\,b\end{aligned}$$

This fact was important to us before. Do you remember why?

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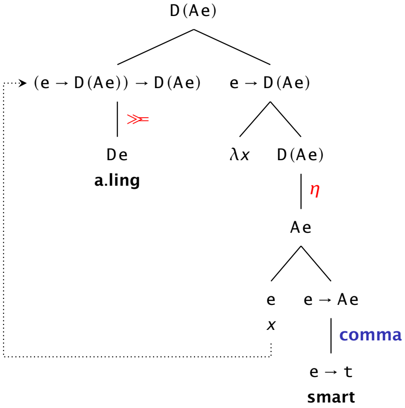
This fact was important to us before. Do you remember why? It allowed us to derive **higher-order** meanings, with a monad layered inside itself.

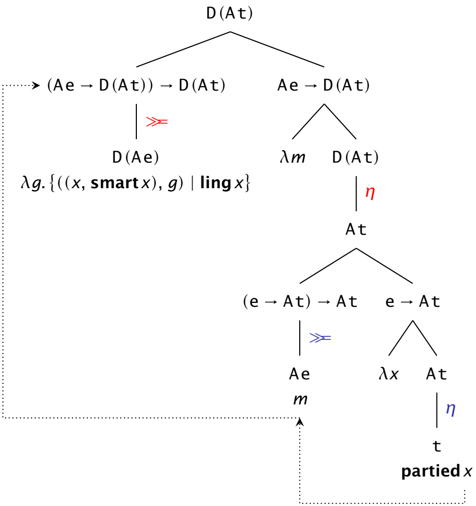
And it will also allow us to derive higher-order meanings, with different monads layered on top of each other!

Example: appositives anchored to indefinites



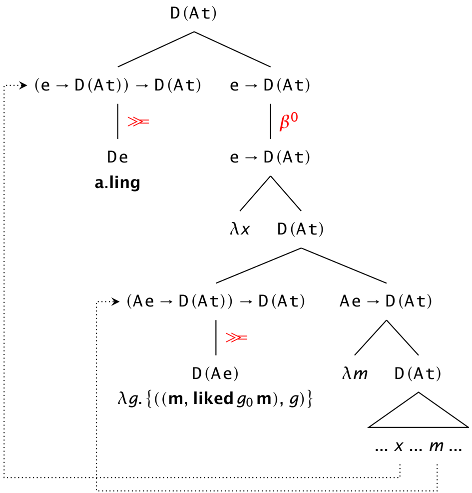
$$\lambda g.\{((x, \mathbf{smart}\,x), g) \mid \mathbf{ling}\,x\}$$

Composing this meaning with a predicate



$$\lambda g.\,\{((\mathbf{partied}\,x,\ \mathbf{smart}\,x),\ g) \mid \mathbf{ling}\,x\}$$

Binding into an appositive: *a linguist met Mary, who liked her*



$$\lambda g.\,\{((\mathbf{met}\,\mathbf{m}\,x,\ \mathbf{liked}\,x\,\mathbf{m}),\ g^{0\to x})\,\mathbf{ling}\,x\}$$

Independence

Why do negation, universals, etc. appear not to interact with appositive content?

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Why do negation, universals, etc. appear not to interact with appositive content? Their types are **incompatible**!

E.g., negation needs an argument of type `D t`. It doesn't know how to do anything with something of type `D (A t)`.

Impossibility of quantified anchors

For exactly the same reason, it's not possible to anchor an appositive to, e.g., a universal quantifier: the types just don't fit.

The universal needs to scope over something of type $\mathtt{D}\mathtt{t}$. If there is an appositive within its scope, the best it can manage is $\mathtt{D}(\mathtt{A}\mathtt{t})$.

Scope of the anchor

When an appositive is anchored to an indefinite, the indefinite is forced to take scope over negation and universals.

Again, this is predicted. The type of an indefinite with an appositive is $D(Ae)$. It's impossible for something with this high of a type to scope under a negation or a universal.

If the indefinite scopally gets out of the way of a higher universal or negation, all is well. Thus, the requirement for widest scope.

The `Writer` monad

Monoids

A monoid is a set M with a distinguished element $\varepsilon \in M$, and associated with a multiplication operation $\times :: M \rightarrow M \rightarrow M$ such that:

1. $\varepsilon \times a = a = a \times \varepsilon$ [ε is an identity of $\times$]
2. $(a \times b) \times c = a \times (b \times c)$ [$\times$ is associative]

Some familiar monoids:

- Numbers under addition (ε is 0)
- Numbers under multiplication (ε is 1)
- Strings under concatenation (ε is the empty string)
- 2^S under union (ε is the empty $S' \subseteq S$)
- 2^S under intersection (ε is S)

Monoids give rise to monads

For any monoid $(M, \varepsilon, \times)$, the following is a monad:

$$T_M\, a ::= (a, M)$$

$$\eta\, x := (x, \varepsilon_M)$$

$$(x, m) \gg\!= f := ((f\, x)_0,\ m \times_M (f\, x)_1)$$

This monad is called the **Writer** monad.

Another example of a monoidal monad

$$\mathsf{P}\,a ::= (a, \mathtt{D\,t})$$

$$\eta\, x := (x, \varepsilon_{\mathtt{D\,t}})$$

$$(x, m) \gg\!= f := ((f\,x)_0,\; m \times_{\mathtt{D\,t}} (f\,x)_1)$$

A monoid on `D t`

$$\varepsilon := \lambda i.\, \{(\mathbb{T}, i)\}$$

$$m \times n := \lambda i.\, \{(p \wedge q, k) \mid (p, j) \in m\, i, (q, k) \in n\, j\}$$

What might such a structure be useful for?

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