Free and bound pro-verbs: A unified treatment of anaphora*

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1 Goals

To unify so-called "bound" and "free" anaphora approaches to verb ellipsis, so that ellipsis resolution functions analogously to pronominal resolution—i.e. like pronouns, ellipsis sites can be bound *or* free.

To show that the distinction between bound and free pro-verbs has consequences for an alternative semantics (cf. Rooth (1985)) which seem to be confirmed in English.

2 Free and bound NP anaphora

4 arguments for argument-reductive pronominal binding (and the "bound"–"free" distinction):

(a) Quantificational antecedents and non-referring pronouns (indices used only to highlight readings):

(1) No man$_i$ loves his$_{i/j}$ mother.

(b) Focused antecedents + *only*:

(2) Only SUE$_i$ thinks she$_i$ is smart.
only **Sue** $\in \{x : x$ thinks Sue is smart$\}$ (*free focus*)
only **Sue** $\in \{x : x$ thinks x is smart$\}$ (*bound focus*)

If **only** takes a proposition p and a focus value ϕ and returns a presupposition equivalent to p and an assertion equivalent to the conjunction of the negation of every member of ϕ, the "bound focus" reading requires an "unmixed" focus set—i.e. such that antecedent and pronoun co-vary on every member.

One way to do this is to have the VP *thinks she is smart* characterize something like the following set: $\{x : x$ thinks x is smart$\}$—i.e. via the Derived VP rule of Sag (1976) and Partee (1975).

(c) Strict and sloppy identity in VPE constructions:

(3) Chris$_i$ loves his$_i$ mother. NATE$_j$ does [$_\emptyset$ love his$_{i/j}$ mother] (too).

Rooth's focus constraint on ellipsis (informally and in lieu of an identity condition on ellipsis cf. Sag (1976)): if some part of some sentence A serves as an antecedent for the elision of some part of some sentence B, $[\![A]\!]$ must be a member of B's focus set, B_ϕ. B_ϕ is calculated by replacing the denotations of the focus-marked elements in B with salient alternatives.

So, the proposition that Chris$_i$ loves his$_i$ mother (roughly *that Chris loves Chris's mother*) must be a member of the focus set associated with the ellipsis clause.

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On the strict reading (such that Nate loves Chris's mother), focus set associated with ellipsis clause is something like the following:

$\{[\![S]\!] : [\![S]\!] = x$ loves Chris's mother, for all $x \in D_e^c\}$

Focus constraint on ellipsis is satisfied.

On the sloppy reading (such that Nate loves Nate's mother), focus constraint on ellipsis is satisfied if we assume something like a Derived-VP-like shift of the elided VP:

$[\![VP]\!] = \lambda x[\mathbf{love}(\mathbf{mom}(x))(x)]$

Here the focus set associated with the ellipsis clause will be something like the following:

$\{[\![S]\!] : [\![S]\!] = x$ loves x's mother, for all $x \in D_e^c\}$

Proposition expressed by antecedent clause is a member of this set, and so the focus constraint on ellipsis is satisfied.

(d) ATB binding and "simultaneous" co-reference

(4) John$_i$ loves but Bill$_j$ hates his$_{i/j}$ mother.

Means something like John loves John's mother, and Bill hates Bill's mother.

Suggests a non-referential pronominal.

Argument-reductive binding, in particular that characteristic of Jacobson (1999)'s variable-free logic for anaphora—as explicated in Jacobson (1996)—is well suited to dealing with such cases.

3 Adapting these arguments to VP ellipsis (VPE) and antecedent-contained deletion (ACD)

Hardt (1993), Jacobson (1992), Schwarz (2000), Szabolcsi (1992), Kratzer (1991)?, Webber (1978)?—arguments for treating ellipsis sites as pro-forms.

We'll develop a logic based on Jacobson (1999)'s variable-free logic for anaphora. Jacobson (1992) originally extends this to treat VPE and ACD as free anaphora (variable-free rejoinder to Hardt (1993)).

But if we have a free pro-form account, are there reasons to believe in a bound pro-form account—how about an ambiguity between free and bound ellipsis sites?

It turns out that 3 of the above 4 arguments for binding in NP anaphora can be adapted to verb anaphora:

(a) Focused antecedents + *only*—originally due to Kratzer (1991)

(5) I only went to TANGLEWOOD after you did.
only **Tanglewood** $\in \{x :$ I went to x after you went to $x\}$
Easy to see how we could achieve this with NP binding/QR.

(6) I only drive PINK Edsels because you do.
only **pink** $\in \{P :$ I drive P Edsels because you drive P Edsels $\}$
Harder to see how QR could help us here. *Pink* isn't the type of object we generally like to move.

Kratzer (1991)'s solution: representational—focus indices, new set of assignments.

(6′) I only [$_{\text{ANT}}$ drive pink$_{\text{F1}}$ Edsels] because you [$_{\text{ELL}}$ drive pink$_{\text{F1}}$ Edsels]

Co-focus-indexation (a necessary product of copy mechanism for ellipsis) guarantees that the Adj in antecedent VP and the Adj in elided VP co-vary across the members of (6_ϕ).

(b) Sloppy identity readings—due to Schwarz (2000).

(7) (a) When John has to cook, he doesn't want to [$_{\text{ELL}}$ cook]
(b) When he has to CLEAN, he doesn't [$_{\text{ELL}}$ want to clean] (either)

Problem for any "strict" ellipsis account—i.e. Sag (1976), Williams (1977), Kratzer (1991)—what's the antecedent for the elided VP *want to clean* in (7b)?

Schwarz's solution: VP binding (accomplished by QR):

(7′) (a) [$_{\text{VP}^+}$ cook] λ_1[When John had to t_1, he didn't [$_{\text{VP-ANT}}$ want to Δ_1]]
(b) [$_{\text{VP}^+}$ clean$_\text{F}$] λ_1[When John had to t_1, he didn't [$_{\text{VP-ELL}}$ want to Δ_1]]

Binding (as before) guarantees un-mixed focus set, which in turn guarantees that the proposition expressed by (7a) is in the focus set associated with (7b). Satisfies the focus constraint on ellipsis.

Schwarz (2000)'s solution generalizes readily to Kratzer (1991) cases.

(c) ATB binding (marginal but OK for most speakers).

(8) John and Mary are both inveterate copycats. John ran$_i$ and Mary jumped$_j$ after Sue did $\emptyset_{i/j}$

(9) John had to print$_i$ and Mary had to file$_j$ every document you and I neglected to $\emptyset_{i/j}$

Suggests a non-referential ellipsis site. We'll see how to deal with these below.

4 The basic apparatus

4.1 Crash course in CCG and the logic of Jacobson (1999)

FIG. 1: Functional application (FA)

A/B	B	$\Longrightarrow_{\text{FA}}$	A
$\lambda b[f(b)]$	b	$\lambda f \lambda x[fx]$	$f(b)$
B	A\B	$\Longrightarrow_{\text{FA}}$	A
b	$\lambda b[f(b)]$	$\lambda f \lambda x[fx]$	$f(b)$

A/B denotes a function which takes a constituent of category B to its right to yield a constituent of category A. A\B denotes a function which takes a constituent of category B to its left to yield a constituent of category A. In other words, in the notation adopted here arguments always occur to the right of the slash, and the direction in which the slash leans indicates whether the functor "wants" its argument to its right or left.

Jacobson treats pronouns as identity maps. Notational convention: an A^B distributes like an item of category A but hosts an unbound pro-form of category B:

$$\frac{\textit{him}}{\text{NP}^{\text{NP}} : \lambda x[x]}\ \text{lex}$$

Combinatory Categorial Grammar (CCG): geach (**g**), lift (**T**) let pronominal gap be passed up indefinitely. **g** is a unarized, Curry'd version of composition. My **T** is a unarized version of Curry and Feys's lift operator—reverses the function-argument relationship between two constituents a and f.

FIG. 2: Geach

C/A	$\Longrightarrow_{\mathbf{g}}$	$\text{C}^\text{B}/\text{A}^\text{B}$
C/A	$\Longrightarrow_{\mathbf{g}}$	(C/B)/(A/B)
$\lambda a[f(a)]$	$\lambda f \lambda g \lambda b[f(gb)]$	$\lambda g \lambda b[f(gb)]$

FIG. 3: Lift

$$\begin{array}{ccc} \text{A} & \Longrightarrow_{\mathbf{T}} & \text{B/(B\backslash A)} \\ a & \lambda x \lambda f[f(x)] & \lambda f[f(a)] \\ \hline \text{A} & \Longrightarrow_{\mathbf{T}} & \text{B\backslash (B/A)} \\ a & \lambda x \lambda f[f(x)] & \lambda f[f(a)] \end{array}$$

Together, **T** and **g** allow pronominal meanings to be passed up repeatedly, all the way to the level of the sentence. An example derivation follows for a case of pronominal anaphora:

(10) John$_i$ likes him$_j$

$$\dfrac{\dfrac{\dfrac{\dfrac{\textit{John}}{\text{NP} : \mathbf{j}}\text{lex}}{\text{S/(S\backslash NP)} : \lambda f[f(\mathbf{j})]}\mathbf{T}}{\text{S}^{\text{NP}}\text{/(S\backslash NP)}^{\text{NP}} : \lambda g \lambda x[g(x)(\mathbf{j})]}\mathbf{g} \qquad \dfrac{\dfrac{\dfrac{\textit{likes}}{\text{(S\backslash NP)/NP} : \lambda x \lambda y[\mathbf{like}(x)(y)]}\text{lex}}{\text{(S\backslash NP)}^{\text{NP}}\text{/NP}^{\text{NP}} : \lambda f \lambda x \lambda y[\mathbf{like}(fx)(y)]}\mathbf{g} \quad \dfrac{\textit{him}}{\text{NP}^{\text{NP}} : \lambda x[x]}\text{lex}}{\text{(S\backslash NP)}^{\text{NP}} : \lambda x \lambda y[\mathbf{like}(x)(y)]}\text{FA}}{\text{S}^{\text{NP}} : \lambda x[\mathbf{like}(x)(\mathbf{j})]}\text{FA}$$

Likes looks for an NP to its right to form a VP. Finding an NP$^{\text{NP}}$—an NP with an unbound pronominal—instead, it undergoes **g** to resolve a type and category mismatch (spirit of Partee/Rooth (1983)). This facilitates the formation of a constituent with following category: (S\NP)$^{\text{NP}}$—a VP$^{\text{NP}}$. *John* lifts over VPs, undergoes **g**—in effect composing with the VP$^{\text{NP}}$—and an S$^{\text{NP}}$ results.

Jacobson's **z** rule facilitates binding via argument reduction. Binds an unbound pro-form at some functor f's first argument slot:

FIG. 4: the z rule

$$\begin{array}{ccc} \text{(A\backslash B)/C} & \Longrightarrow_{\mathbf{z}} & \text{(A\backslash B)/C}^{\text{B}} \\ \lambda c \lambda b[f(c)(b)] & \lambda f \lambda g \lambda b[f(gb)(b)] & \lambda g \lambda b[f(gb)(b)] \end{array}$$

If a constituent X with denotation f is looking for a C and instead finds itself adjacent to a C$^{\text{B}}$, it could shift by **g**, combine with the C$^{\text{B}}$, and pass up the free pro-form B. Alternatively, X could shift by **z**, which like **g** allows it to combine with a C$^{\text{B}}$ but, unlike **g**, binds the pronominal to f's second argument. An example derivation follows for a case of quantificational pronominal binding:

(11) Every man$_i$ likes his$_i$ mother.

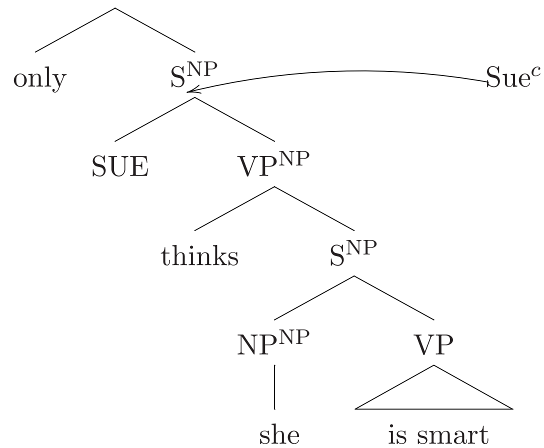
$$\dfrac{\dfrac{\textit{Every man}}{\text{S/(S\backslash NP)} : \lambda P[\mathbf{every}(\mathbf{man})(P)]} \qquad \dfrac{\dfrac{\dfrac{\textit{likes}}{\text{(S\backslash NP)/NP} : \lambda x \lambda y[\mathbf{like}(x)(y)]}\text{lex}}{\text{(S\backslash NP)/NP}^{\text{NP}} : \lambda f \lambda x[\mathbf{like}(fx)(x)]}\mathbf{z} \quad \dfrac{\textit{his mother}}{\text{NP}^{\text{NP}} : \lambda x[\mathbf{mom}(x)]}}{\text{S\backslash NP} : \lambda x[\mathbf{like}(\mathbf{mom}(x))(x)]}\text{FA}}{\text{S} : \mathbf{every}(\mathbf{man})(\lambda x[\mathbf{like}(\mathbf{mom}(x))(x)])}\text{FA}$$

4.2 The bound/free distinction and NP anaphora

(2) Only SUE$_i$ thinks she$_i$ is smart.

Two readings correspond to two ways to make the pronoun and *Sue* co-refer.

"Accidental" coreference: apply this meaning to a contextually salient individual:



The second-highest branching node in this tree is of category S^{NP} and denotes an open proposition—a function from (contextually salient) individuals to propositions.

If free meanings are picked up without focus marking, our tree has the following denotation:

(2′) $[\![$only $[_{\text{S}}$ SUE thinks Sue is smart$]]\!]$

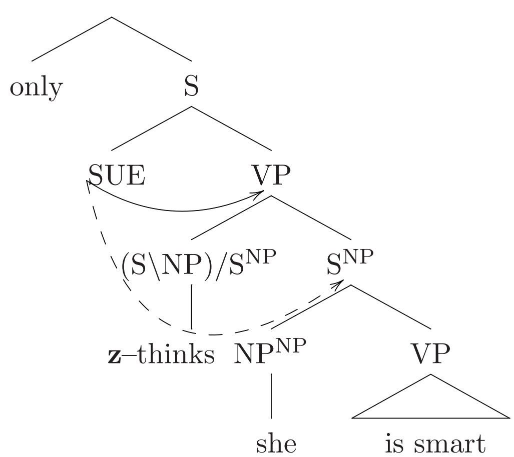
Yields assertion that no one but Sue thinks Sue is smart—the so-called "free focus" reading.

Another way to get *SUE* and *she* to "co-refer": binding via **z**:

FIG. 5: z(think)

$$\begin{array}{ccc} (\text{S}\backslash\text{NP})/\text{S} & \Longrightarrow_{\mathbf{z}} & (\text{S}\backslash\text{NP})/\text{S}^{\text{NP}} \\ \lambda p \lambda y[\mathbf{think}(p)(y)] & \lambda f \lambda g \lambda x[f(gx)(x)] & \lambda g \lambda x[\mathbf{think}(gx)(x)] \end{array}$$

z(**think**) takes a sentence with a free pronoun (i.e. *she is smart*) and binds that free pronoun to **z**(**think**)'s second argument:



z(**think**)(**she is smart**) $= \lambda x[x$ thinks x is smart$]$, cat = VP

This function is identical to the "Derived VP" we saw before. Again, the semantics of **only** guarantee no one but Sue is an x who thinks x is smart—the so-called "bound focus" reading.

5 VP ellipsis and ACD as anaphora resolution

5.1 VP ellipsis

(12) Nate sneezed after Rori did ∅

Jacobson (1992): same apparatus that allows free pronouns to be passed up can allow free pro-verbs to be passed up. If *did* shifts to VP^{VP}—which is intuitively plausible since in ellipsis constructions auxiliaries distribute much like full VPs (modulo complexities)—and its superscript can subsequently be passed up with lift and geach:

(12′) $[_{\text{S}^{\text{VP}}}$ Nate $[_{\text{VP}^{\text{VP}}}$ sneezed $[_{(\text{VP}\backslash\text{VP})^{\text{VP}}}$ after $[_{\text{S}^{\text{VP}}}$ Rori $[_{\text{VP}^{\text{VP}}}$ did$]]]]]$

(12′) denotes an open proposition—function from salient VP-type meanings to propositions.

VP ellipsis as free anaphora resolution (cf. Hardt (1993)).

5.2 ACD

(13) Nate reads every book that Rori does ∅

What's the elided meaning here? Something like *read*.

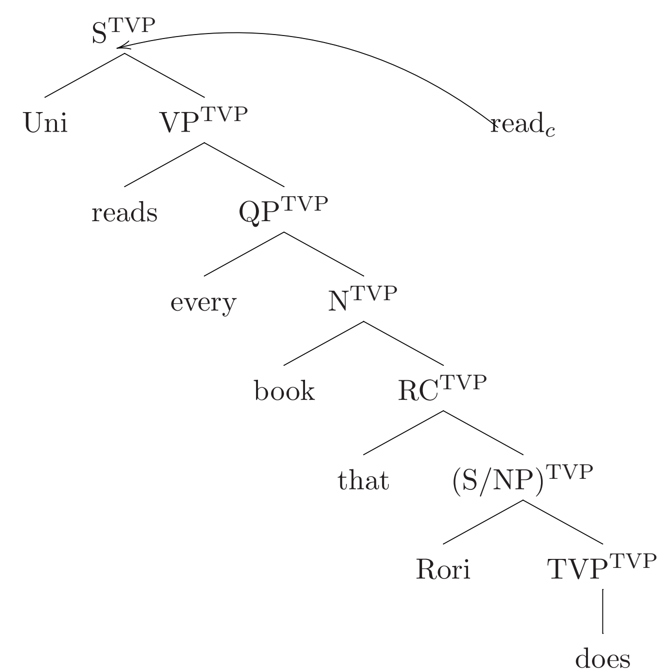
CCG: no traces or extraction needed to compose up relative clauses (Steedman, Oehrle, Jacobson). Use function composition (**g**).

So if no trace, all that's "missing" is transitive relation *read*, not *read* t_1.

Similar story can be told as for VP ellipsis. *Does* is category TVP^{TVP}—i.e. if combined with transitive verb would yield transitive verb, and distributes like a TVP in ACD cases. We can obtain this category from auxiliary *does* with **g**—TVP abbreviates VP/NP. So since (a) a transitive verb is actually what we need in ellipsis site to get syntax/semantics of relative clauses, and (b) the pro-verb category of *does* lets it "act" like one and simply pass up the transitive pro-form gap, we have a free anaphora analysis of ACD:

FIG. 6: g(does$_{pro}$)

$does_{pro}$	$\Longrightarrow_{\mathbf{g}}$	$\mathbf{g}$–$does_{pro}$
VP^{VP}	$\Longrightarrow_{\mathbf{g}}$	$(\text{VP/NP})^{\text{VP/NP}}$
$\lambda P \lambda y[\mathbf{does}(P)(y)]$	$\lambda f \lambda R \lambda x[f(Rx)]$	$\lambda R \lambda x \lambda y[\mathbf{does}(Rx)(y)]$



6 Verb ellipsis as bound anaphora

6.1 VP ellipsis as binding

Szabolcsi (1992) shows how argument reduction ("binding") offers a mechanism for VP ellipsis resolution.

Both Jacobson's **z** and Szabolcsi's/Curry and Feys's **W** work similarly to explain the full range of Szabolcsi's cases. I'll adopt Jacobson's **z** here for ease of exposition. Repeating (12):

(12) Nate sneezed after Rori did ∅

Szabolcsi assigns *after* the category in (14)

(14) (VP\VP)/S

z shifts (14) to $(\text{VP}\backslash\text{VP})/\text{S}^{\text{VP}}$:

FIG. 7: z(after)

after	$\Longrightarrow_{\mathbf{z}}$	**z**–*after*
(VP\VP)/S	$\Longrightarrow_{\mathbf{z}}$	$(\text{VP}\backslash\text{VP})/\text{S}^{\text{VP}}$
$\lambda p \lambda P \lambda x[\mathbf{after}(p)(P)(x)]$	$\lambda f \lambda g \lambda Q[f(gQ)(Q)]$	$\lambda g \lambda Q \lambda x[\mathbf{after}(gQ)(Q)(x)]$

So **z**(**after**) wants to take a sentence hosting a pro-VP and bind this pro-VP to its next argument. Here, **sneezed** binds both of these argument slots to yield a VP-type meaning equivalent to that of *sneezed after Rori sneezed*.

Notice that (12) is syntactically similar to Kratzer (1991)'s cases—in particular, both have VP modifiers with elided VPs (cat $(\text{VP}\backslash\text{VP})^{\text{VP}}$) occurring directly adjacent to a VP which serves as the antecedent for ellipsis:

(6′) I only $[_{\text{VP}_i}$ drive PINK Edsels$]$ $[_{(\text{VP}\backslash\text{VP})^{\text{VP}}}$ because you do $\emptyset_i]$

Since the antecedent VP *binds* the ellipsis site in our analysis, it follows that antecedent and elided VP will co-vary across the members of the focus sets associated with their host clauses. We therefore have a CCG binding analysis of the full range of Kratzer (1991)'s data.

6.2 A binding account of ACD

Most theories of semantics needs something "extra" to account for quantified phrases in object position.
Special category—i.e. VP\TVP—allows them to occur in object position, in particular by combining with a transitive verb to yield a VP. So the quantifier itself has the category in (14):

(14) (VP\TVP)/N

This is all we need for a binding analysis of ACD. Recall sentence (13):

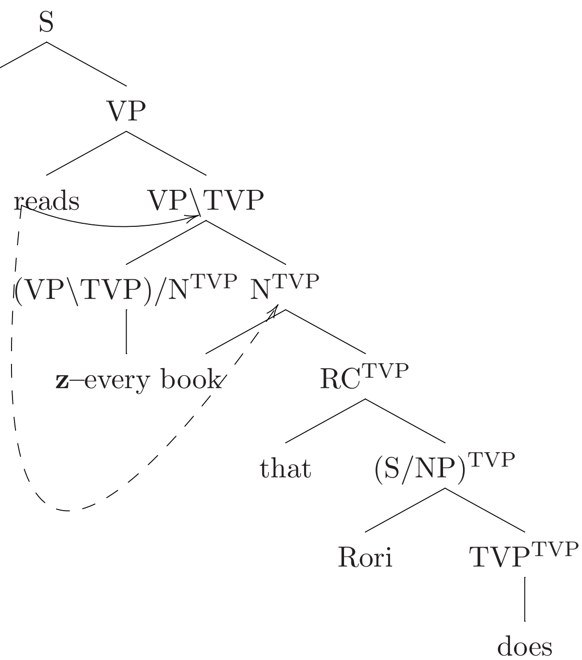
(13) Nate reads every book that Rori does ∅

Applying **z** to **every** yields a constituent with the category in (15), and from here on this works as before.

(15) $(\text{VP}\backslash\text{TVP})/\text{N}^{\text{TVP}}$

FIG. 8: z($\mathbf{every}_{obj}$)

$every_{obj}$	$\Longrightarrow_{\mathbf{z}}$	**z**–$every_{obj}$
(VP\TVP)/N	$\Longrightarrow_{\mathbf{z}}$	$(\text{VP}\backslash\text{TVP})/\text{N}^{\text{TVP}}$
$\lambda P \lambda R \lambda y[\mathbf{every}(P)(\lambda x[Rxy])]$	$\lambda f \lambda g \lambda R[f(gR)(R)]$	$\lambda g \lambda R \lambda y[\mathbf{every}(gR)(\lambda x[Rxy])]$



The high-level point here is that *any* pro-type gap anaphoric to intra-sentential syntax can in principle be resolved by binding, although certain syntactic/semantic configurations might not allow this.

Why ACD binding? Cases like (16):

(16) Nate's not such a copycat afterall. He only READ everything Rori did.
only **read** $\in \{R : \text{Nate } R_{past} \text{ everything Rori } R_{past}\}$

What constructions like (16) seem to mean suggests the existence of an unmixed focus set containing alternative propositions of the form *Nate* R_{past} *everything Rori* R_{past}, on which **only** operates.

7 An extension

Need **S** in addition to **z**/**W** for cases where the gap-hosting constituent is the second argument rather than the first argument of a propositional operator—i.e. **if**.

S independently motivated in Barker (2002), Steedman (1987), Russell (2005)—though only for NP-type binding.

(17) If Uni has to CLEAN, she won't want to.

FIG. 9: The S rule

$$\begin{array}{ccc} (A/C)/B & \Longrightarrow_{\mathbf{z}} & (A/C^B)/B \\ \lambda b\lambda c[f(b)(c)] & \lambda f\lambda g\lambda b[f(b)(gb)] & \lambda b\lambda g[f(b)(gb)] \end{array}$$

To derive the bound analysis of (17), we begin by composing *if Uni has to*:

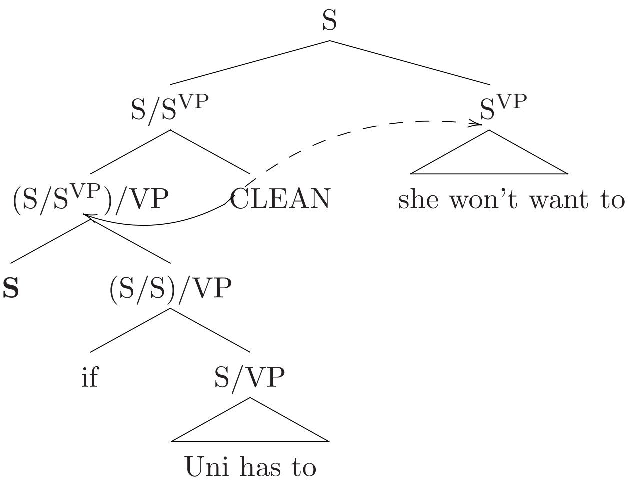
$$\dfrac{\dfrac{if}{(\text{S/S})/\text{S}: \lambda p\lambda q[\mathbf{if}(p)(q)]}\text{lex} \quad \dfrac{\dfrac{\dfrac{Uni}{\text{NP}: \mathbf{u}}\text{lex}}{\text{S/VP}: \lambda P[P(\mathbf{u})]}\mathbf{T} \quad \dfrac{has\ to}{\text{VP/VP}: \lambda Q\lambda x[\mathbf{has\text{-}to}(Q)(x)]}\text{lex}}{\text{S/VP}: \lambda Q[\mathbf{has\text{-}to}(Q)(\mathbf{u})]}\mathbf{B}}{(\text{S/S})/\text{VP}: \lambda Q\lambda q[\mathbf{if}(\mathbf{has\text{-}to}(Q)(\mathbf{u}))(q)]}\mathbf{B}$$

S next applies to this constituent, as follows:

S(if Uni has to)

$$\begin{array}{ccc} (\text{S/S})/\text{VP} & \Longrightarrow_{\mathbf{S}} & (\text{S/S}^{\text{VP}})/\text{VP} \\ \lambda Q\lambda q[\mathbf{if}(\mathbf{has\text{-}to}(Q)(\mathbf{u}))(q)] & \lambda f\lambda P\lambda g[f(P)(gP)] & \lambda P\lambda g[\mathbf{if}(\mathbf{has\text{-}to}(P)(\mathbf{u}))(gP)] \end{array}$$

So applying **S** to *if Uni has to* merges the VP argument of the (S/S)/VP *if Uni has to* with the pro-VP hosted in *she won't want to*, which (ignoring pronouns for expository ease) is of category S^{VP}:



By linking antecedent to ellipsis site by binding, we get correct (unmixed) focus sets. Guarantee ellipsis site varies with antecedent in focus values.

Jacobson (1999) points out that allowing **S** to apply freely yields violations of Weak Crossover (i.e. **His$_i$ mother loves every man$_i$*).

Avoid Weak Crossover violations simply by keeping verbs out of the domain of **S**.
S will also allow us to derive an inverse scope reading with ACD binding—but space and time preclude a proper treatment here.

7.1 Deriving the sloppy reading of Schwarz's cases

Repeating (7) from above:

(7) (a) When John has to cook, he doesn't want to [$_{\text{ELL}}$ cook]
    (b) When he has to CLEAN, he doesn't [$_{\text{ELL}}$ want to clean] (either)

Recall how Rooth's focus constraint on ellipsis requires an unmixed focus set to be associated with (7b). Schwarz accomplished this by QRing the VP *clean* and having it bind a silent pro-form at the ellipsis site.

Here we begin by applying **S** to *if John has to* (as above) and combine the result with the VP *clean*:

$$\dfrac{\dfrac{\dfrac{\textit{if John has to}}{\text{(S/S)/VP} : \lambda P\lambda q[\mathbf{if}(\mathbf{has\text{-}to}(P)(\mathbf{j}))(q)]}}{\text{(S/S}^{\text{VP}}\text{)/VP} : \lambda P\lambda g[\mathbf{if}(\mathbf{has\text{-}to}(P)(\mathbf{j}))(gP)]}\,\mathbf{S} \quad \dfrac{\textit{clean}}{\text{VP} : \lambda x[\mathbf{clean}(x)]}\,\text{lex}}{\text{S/S}^{\text{VP}} : \lambda g[\mathbf{if}(\mathbf{has\text{-}to}(\mathbf{clean})(\mathbf{j}))(g(\mathbf{clean}))]}\,\text{FA}$$

To derive *he won't* on the understanding such that what's missing isn't actually a full VP but rather a VP^{VP}—i.e. *want to*—we geach *won't* and combine the result with the NP *John* (ignoring the unbound pronominal), which requires lifting *John* and geaching the result twice:

$$\dfrac{\dfrac{\dfrac{\textit{he} = \textit{John}}{\text{NP} : \mathbf{j}}}{\text{S/VP} : \lambda P[P(\mathbf{j})]}\,\mathbf{T} \quad \dfrac{\dfrac{\dfrac{\textit{won't}}{\text{VP/VP} : \lambda P\lambda x[\mathbf{wont}(P)(x)]}\,\text{lex}}{\text{VP}^{\text{VP}} : \lambda P\lambda x[\mathbf{wont}(P)(x)]}\,\text{pro}}{(\text{VP}^{\text{VP}})^{\text{VP}^{\text{VP}}} : \lambda C\lambda P\lambda x[\mathbf{wont}(CP)(x)]}\,\mathbf{g}}{(\text{S}^{\text{VP}})^{\text{VP}^{\text{VP}}} : \lambda C\lambda P[\mathbf{wont}(CP)(j)]}\,\mathbf{gg}$$

The constituents derived in these two derivations may subsequently compose, thereby passing up the free pro-$\mathrm{VP}^{\mathrm{VP}}$ in *he won't* and binding off its free VP superscript (i.e. that of the S^{VP}):

$$\dfrac{\dfrac{\textit{if John has to clean}}{\mathrm{S/S^{VP}} : \lambda g[\mathbf{if}(\mathbf{has\text{-}to}(\mathbf{clean})(\mathbf{j}))(g(\mathbf{clean}))]}\cdots \quad \dfrac{\textit{he won't}}{(\mathrm{S^{VP}})^{\mathrm{VP^{VP}}} : \lambda C\lambda P[\mathbf{wont}(CP)(j)]}\cdots}{\mathrm{S^{VP^{VP}}} : \lambda C[\mathbf{if}(\mathbf{has\text{-}to}(\mathbf{clean})(\mathbf{j}))(\mathbf{wont}(C(\mathbf{clean}))(j))]}\mathbf{B}$$

In other words, the derivation binds off the pro-VP in the "consequent" clause but allows the missing (i.e. superscripted) $\mathrm{VP}^{\mathrm{VP}}$ to be passed up. So our resulting sentence is in fact of category $\mathrm{S}^{\mathrm{VP}^{\mathrm{VP}}}$ and denotes a function from $\mathrm{VP}^{\mathrm{VP}}$-type meanings—specifically, control-verb-like meanings—to propositions.

A similar story to Schwarz's.

The strict reading (such that when John has to clean, he doesn't want to cook) is derived either by two instances of anaphoric resolution (i.e. the derivation of (7b) yields a constituent of category $(\mathrm{S}^{\mathrm{VP}})^{\mathrm{VP}^{\mathrm{VP}}}$—to which the processor supplies *want to* and then *cook*) or one (on which a relevant VP-type meaning is inferred, in the vein of Webber (1978)).

8 ATB Binding (briefly)

Recall sentences (8) and (9):

(8) John and Mary are both inveterate copycats. John ran_i and Mary jumped_j after Sue did $\emptyset_{i/j}$

(9) John had to print_i and Mary had to file_j every document you and I neglected to $\emptyset_{i/j}$

An analysis of (9) exists in the framework under discussion (an analysis of (8) seems to require Szabolcsi's **W**). Reminiscent of Jacobson (1996)'s analysis of ATB pronominal binding (interested readers referred to her paper for full details).

We begin by deriving *John printed*, as follows:

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\textit{John}}{\mathrm{NP} : \mathbf{j}}\mathrm{lex}}{\mathrm{S/VP} : \lambda P[P(\mathbf{j})]}\mathbf{T}}{\mathrm{(S/NP)/TVP} : \lambda R\lambda x[R(x)(\mathbf{j})]}\mathbf{g}}{\mathrm{(S/(S/VP))/TVP} : \lambda R\lambda f[f(\lambda x[R(x)(\mathbf{j})])]}\mathbf{AR}_{in}}{\mathrm{(S/(S/VP)^{TVP})/TVP} : \lambda R\lambda g[g(R)(\lambda x[R(x)(\mathbf{j})])]}\mathbf{S} \quad \dfrac{\textit{printed}}{\mathrm{TVP} : \lambda x\lambda y[\mathbf{print}(x)(y)]}}{\mathrm{(S/(S/VP)^{TVP})} : \lambda g[g(\mathbf{print})(\lambda x[\mathbf{print}(x)(\mathbf{j})])]}\mathrm{FA}$$

Yields something which takes a generalized quantifier hosting an unbound TVP and returns a sentence.

We derive *Mary filed* similarly and conjoin the two via the semantics of generalized conjunction—cf. Partee and Rooth (1983)—and apply the result to the $\mathrm{(S/VP)^{TVP}}$ *every document we neglected to*:

$$\dfrac{\dfrac{\textit{John printed and Mary filed}}{\mathrm{S/(S/VP)^{TVP}} : \lambda g[g(\mathbf{print})(\lambda x[\mathbf{print}(x)(\mathbf{j})]) \wedge g(\mathbf{file})(\lambda x[\mathbf{file}(x)(\mathbf{m})])]}\cdots \quad \dfrac{\textit{every document we neglected to}}{\mathrm{(S/VP)^{TVP}} : \lambda R\lambda P[\mathbf{doc}(R)(P)]}}{\mathrm{S} : \mathbf{doc}(\mathbf{print})(\lambda x[\mathbf{print}(x)(\mathbf{j})]) \wedge \mathbf{doc}(\mathbf{file})(\lambda x[\mathbf{file}(x)(\mathbf{m})])}\mathrm{FA}$$

The derivation thus guarantees that (34) means that John had to print every document we neglected to print, and Mary had to file every document we neglected to file.

9 Bound or free?

So we have mechanisms for VPE and ACD as free anaphora or as binding.

Which is correct? We've run through the arguments for pro-verb binding and shown how these analyses go through in a variable-free logic.

But as we'll see in the following section, free focus readings of VPE cases appear to exist as well!

It is, of course, no inconsistency to suggest ellipsis resolution can happen both ways. Pronominals exhibit both free and bound behavior, and the most general version of the framework predicts both free and bound behavior for pro-verbs.

10 Free focus

Schwarz, Kratzer, Hardt assume that "unmixed" focus sets are the only kinds of focus sets you get when a focused VP is an antecedent for VP ellipsis.

This doesn't seem quite right:

(18) (a) You are so annoying at track meets. You're always following me around, doing whatever I'm doing. And you can't ever leave it that, either. Not only are you a copycat but you insist on outdoing me every chance you get. At yesterday's meet, after I pole-vaulted, you pole-vaulted and somersaulted. After I sprinted, you sprinted and did jumping jacks.

(b) In general, I suppose you're right. But here's a counterexample: Yesterday, I only RAN after you did. I didn't run and try to juggle or anything like that.

(18b) means something like *running was the only* P *such that I* P_{past} *when you ran.*

Assume that material picked up anaphorically by the processor (i.e. free) is picked up without its focus value—as with NP anaphora above.

The only way to make the ellipsis site variable in the computation of an expression's focus value, then, is by binding the ellipsis site to a focus-marked antecedent—i.e. within the grammar.

This is *exactly* analogous to the free reading of *only SUE thinks she's smart* (ellipsis site doesn't vary in focus value):

(a) **Sue** is the only x such that x thinks Sue is smart

(b) **run** is the only P such that I P_{past} when you ran.

Compare to the "bound" readings (unmixed focus set):

(a) **Sue** is the only x such that x thinks x is smart

(b) **run** is the only P such that I P_{past} when you P_{past}.

In fact, if we buy that VPE is like pronominal anaphora, we'd be surprised if we *didn't* get the free-focus readings.

11 Conclusions

Free, bound behavior in ellipsis. Focus semantics gives us special insight into how ellipsis sites are behaving.

We're able to deduce that pro-verbs behave much like pronouns.

General set of grammatical, processing mechanisms underlying anaphora resolution.
Potentially exciting: syntactic accounts of ellipsis undergenerate. semantic accounts overgenerate. A hybrid account (such as has been offered here) has the possibility of capturing the insights of each.

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