Crossover ii[1]

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[1] 24.979: Topics in semantics
Getting high: Scope, projection, and evaluation order

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1 *From continuation semantics to dynamic semantics*

At the beginning of the semester, we learned about a theory of scope-taking with a built-in left-to-right bias – *continuation semantics*.

Concretely, due to the way that the composition rule Scopal Function Application (SFA) was defined, evaluation of quantificational effects *mirrors* linear order.[4]

[4] To cash this out, we needed to say something concrete about the syntax-semantics interface – concretely, we committed to the ideas that (a) the basic combinatoric operation MERGE is asymmetric, and (b) the syntactic and semantic composition proceed in lockstep (direct compositionality).

As we saw in the last class, an appealing consequence of this linear bias was a natural account of Weak Crossover (WCO) in terms of evaluation order.[5]

[5] See especially Shan & Barker 2006 and Barker & Shan 2014: chapters 2 and 4.

Recall, a simplified version of the WCO paradigm: scope can feed binding (1), unless the binder doesn't precede the bound expression (2).

(1) [Everyone^x's mother] bought them$_x$ a bicycle.

(2) Their$_x$ mother showered everyone^x with gifts.
cf. a different person showered everyone with gifts.

The idea, briefly, was to generalize our notion of a scope-taker to make sense of the idea that pronouns also *scope*.

In Barker & Shan's system, pronouns take scope in the following way: they expect *a proposition*, and they return an *open proposition*.[6]

[6] We can helpfully think of an open proposition in this framework as a proposition with anaphoric effects (i.e., environment sensitivity).

In order for a Quantificational Phrase (QP) to bind a pronoun, it must first be *bind-shifted*. A bind-shifted QP expects an open proposition, and returns a proposition. Successful binding is illustrated in figure 1.

Putting mechanisms for inverse scope to one side, WCO follows straightforwardly from this system. Since both pronouns and bind-shifted QPs are scope-takers, for the pronoun to be bound, the QP has to be evaluated first. Scope can feed binding, but the QP must precede the pronoun, since *evaluation order mirrors linear order*.[7]

[7] One of the virtues of continuation semantics is that it straightforwardly accounts for scope out of **dp!** (**DP!**) without requiring *movement* out of **DP!**.

Continuation semantics includes mechanisms for subverting the linear bias

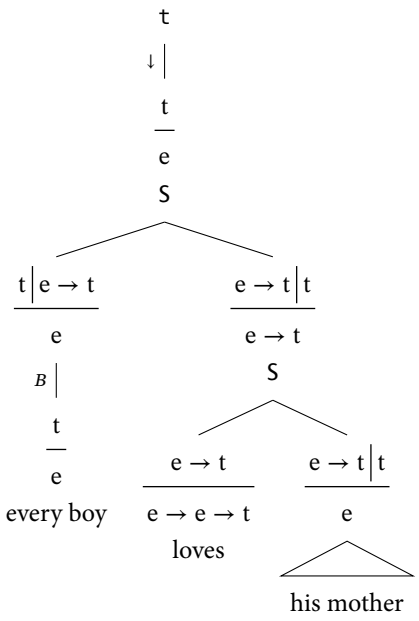

Figure 1: Successful binding

(namely, higher-order continuations), in order to account for inverse scope.

With mechanisms for inverse scope in the picture, things become a little less neat. Barker & Shan (2014) must stipulate that *lower* – the operation via which continuized meaning are collapsed into ordinary meanings – is rigidly typed. If we assume that *internal lower* is derived as lifted *lower*, this also has consequences for its type:

(3) a. $\downarrow : \frac{a \mid t}{t} \rightarrow a$

b. $\downarrow\downarrow : \frac{\frac{b}{a \mid t}}{t} \rightarrow \frac{b}{a}$

This move basically guarantees, via a syntactic stipulation, that in order for a bind-shifted QP to bind a pronoun, it must take scope at the same tower-story as the pronoun. If it takes scope on a high level, then the resulting meaning cannot ultimately be lowered by a rigidly typed *lower*.

An unsuccessful attempt at getting internal lift to feed binding is illustrated in figure 2.

What's crucial here is that both lower and internal lower are rigidly typed.

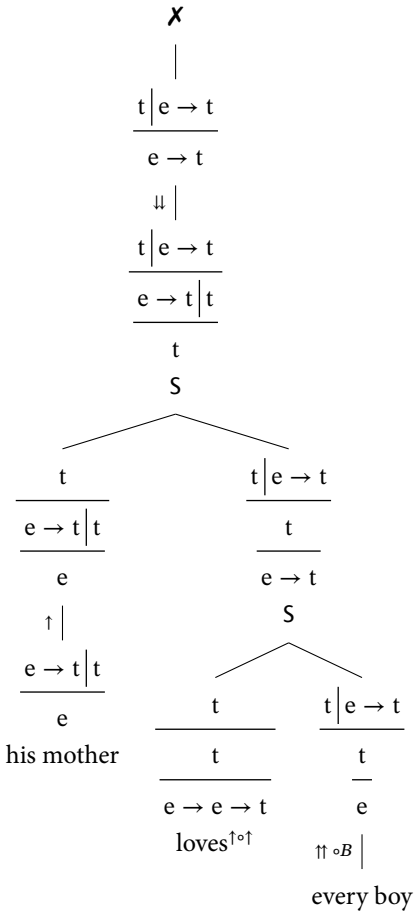

Figure 2: Unsuccessful binding (WCO)

Just how satisfying is this as an explanation though? If we look at what lower actually *does*, there's no intrinsic reason why it should be so rigidly typed:

(4) $m^{\downarrow} := m\ id$

2 *Dynamic Semantics*

In dynamic semantics (Heim 1982, Groenendijk & Stokhof 1991) sentences denote *relations between assignments* (equivalently: functions from assignments, to sets of assignments).

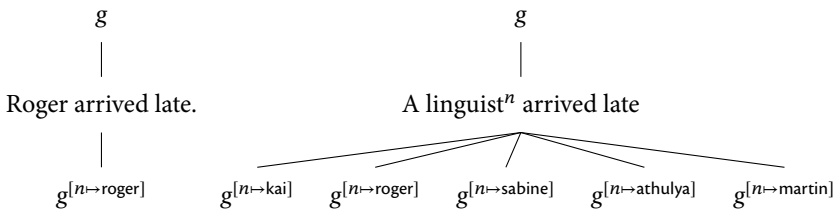

Figure 3: Relations between assignments

Assignments are functions from variables to individuals; as is standard, we'll represent the set of variables as $\mathbb{N}$:

(5) Type of assignments (def.)
$\mathsf{g} := \mathsf{n} \to \mathsf{e}$

Chierchia assumes that assignments are *partial* functions.[8] That is to say, an assignment may only be defined for certain indices. The following are all valid assignments:

[8] See also Rothschild & Mandelkern (2017) for a dynamic semantics using partial assignments.

$$[1 \mapsto \text{roger}] \qquad \begin{bmatrix} 1 \mapsto \text{roger} \\ 3 \mapsto \text{martin} \end{bmatrix} \qquad \begin{bmatrix} 4 \mapsto \text{kai} \\ 5 \mapsto \text{athulya} \\ 7 \mapsto \text{sabine} \end{bmatrix}$$

In order to characterize a dynamic sentential meaning, we define a type constructor T to abbreviate relations between assignments:

(6) Type of Context Change Potentials (CCPs) (def.)
$\mathsf{T} := \mathsf{g} \to \mathsf{g} \to \mathsf{t}$

Add some example sentential meanings here

We can get back an "ordinary" sentential meaning from a CCP by existentially closing the output assignment, as defined in (6).

(7) Dynamic closure (def.)
$m^{\downarrow g} \coloneqq \exists g'[m\ g\ g']$ $\qquad \downarrow : \mathtt{T} \to \mathtt{t}$

How do we build up CCPs compositionally? Chierchia assumes that predicates are fundamentally Montagovian (i.e., functions of type $\mathtt{e} \to \mathtt{t}$):

(8) $[\![\text{swim}]\!] \coloneqq \lambda x\ .\ \textsf{swim}\ x$ $\qquad \mathtt{e} \to \mathtt{t}$

Predicates are lifted into a dynamic setting by a type-shifter *dynamic lift*; d-lift takes a function from an individual to a truth-value, and shifts it into a function from an individual to a CCP – specifically, a dynamic *test*.

(9) Dynamic lift (def.)
$f^{\Delta} \coloneqq \lambda x\ .\ \lambda g\ .\ \lambda g'\ .\ g = g' \wedge f\ x$ $\qquad \Delta : (\mathtt{e} \to \mathtt{t}) \to \mathtt{e} \to \mathtt{T}$

Tests don't do much interesting to input contexts. In orthodox dynamic fragments, all of the interesting dynamic action is triggered by arguments – specifically, indefinite arguments.

Chierchia's innovation is to posit a second way of lifting predicates into a dynamic setting: *Discourse Referent (DR) introduction*.

(10) Discourse referent introduction (def.)
$f^{\Delta_n} \coloneqq \lambda x\ .\ \lambda g\ .\ \lambda g' g \overset{n/x}{=} g' \wedge f\ x$ $\qquad \Delta_n : (\mathtt{e} \to \mathtt{t}) \to \mathtt{e} \to \mathtt{T}$

In dynamic semantics, the connectives manipulate CCPs directly. At the heart of the system is the entry for dynamic sequencing/conjunction, given in (10).[9]

(11) Dynamic sequencing (def.)
$m\ ;n \coloneqq \lambda g\ .\ \lambda g'\ .\exists g''[m\ g\ g'' \wedge n\ g''\ g']$ $\qquad (;) : \mathtt{T} \to \mathtt{T} \to \mathtt{T}$

(12) Dynamic negation (def.)
$\neg\ m \coloneqq \lambda g\ .\ \lambda g'\ .\ g = g' \wedge m^{\downarrow g}$ $\qquad \neg : \mathtt{T} \to \mathtt{T}$

(13) Dynamic lift (def.)
$P^{\Delta} \coloneqq \lambda x\ .\ \lambda g\ .\ \lambda g'\ .\ g = g' \wedge p\ x$ $\qquad \Delta : (\mathtt{e} \to \mathtt{t}) \to \mathtt{e} \to \mathtt{T}$

[9] $g \overset{n/x}{=} g'$ is defined iff g_n is *un*defined, and is true just in case g' differs from g at most in what n is mapped to.

Heim's *novelty condition* is essentially built into the rule for DR introduction.

(14) Discourse referent introduction (def.)
$P^{\Delta n} := \lambda x\,.\,\lambda g\,.\,\lambda g' g \overset{n/x}{=} g' \wedge P\ x$ $\qquad \Delta n : (\mathtt{e} \to \mathtt{t}) \to \mathtt{e} \to \mathtt{T}$

(15) Pronouns (def.)
$\text{pro}_n := \lambda k\,.\,\lambda g\,.\,(k\ g_n)\ g$[10] $\qquad \text{pro}_n : (\mathtt{e} \to \mathtt{T}) \to \mathtt{T}$

(16) Someone (def.)
$\text{someone}_n\ m := \lambda g\,.\,\lambda g'\,.\,\exists x[m\ g\ g']$

[10] Chierchia actually posits a syncategorematic rule for composing pronouns and dynamic predicates – instead, I've built what Chierchia's rule does into the meaning of the pronoun.

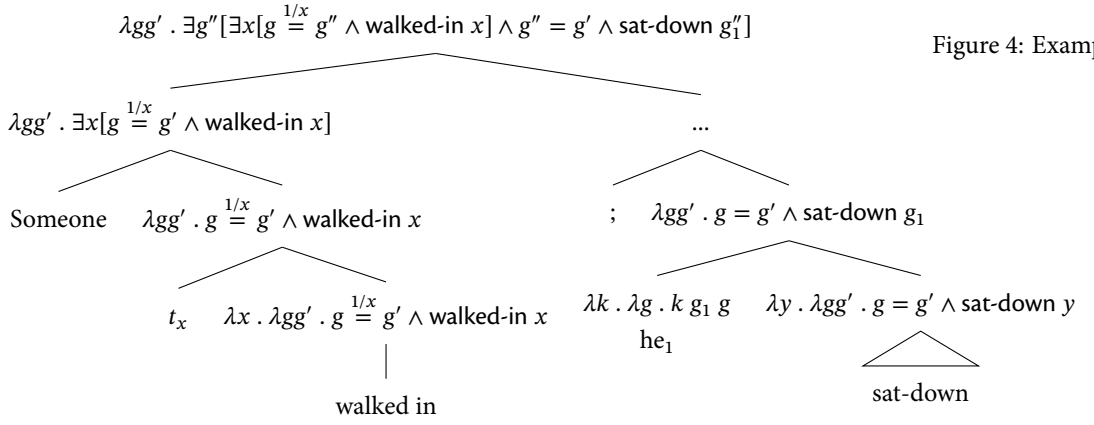

Figure 4: Example derivation

2.1 *Accessibility*

3 *The problem of existentials*

4 *Rethinking the system*

Conceptual issues:

- Much like, e.g., Dynamic Montague Grammar (DMG), Chierchia's system implicitly makes a syntactic distinction between two different kinds of variables.[11] Can we do better? Continuations provide a way of doing scope-taking without any need for traces, so this issue should (hopefully) dissolve if we shift to a continuation-based theory.

[11] See Barker & Shan's (2008) criticism of DMG for related discussion.

Putative generalization: only (potentially monadic) individuals introduce discourse referents.

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