Ellipsis, binding, & Logical Form

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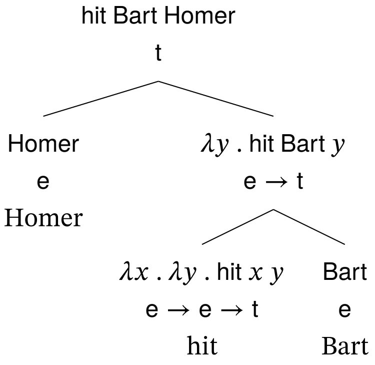
1 *Overview*

- Pronouns: the semantics of assignment-sensitivity.
  - The presentation of assignment-sensitivity will be largely based on Charlow (2018); see also Büring (2005) for another excellent reference on this topic.
- Strict vs. sloppy readings: the classic account (Sag 1976, Williams 1977).
- Focus: the semantics of alternatives.
- Rooth's account of strict vs. sloppy readings and ellipsis identity.

2 *The semantics of pronominals*

- Background:
  - Semantic types:
    - $\mathsf{e} \coloneqq \mathsf{Homer} \mid \mathsf{Bart} \mid \mathsf{Burns} \mid \ldots$
    - $\mathsf{t} \coloneqq 1 \mid 0$
    - If a and b are types then $\mathsf{a} \to \mathsf{b}$ is the type of a function from inhabitants of a to inhabitants of b.
    - There is one basic rule of semantic composition – *function application*.
  - A basic computation:[1]



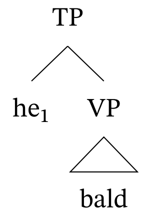
- Sentences containing free pronouns aren't true simpliciter.

[1] I assume a one-to-one mapping between *merge* in the syntactic computation, and *function application* in the semantic computation.
The direction of application is flexible: $[\![[\alpha\,\beta]]\!] = [\![\alpha]\!]\,([\![\beta]\!])$ or $[\![\beta]\!]\,([\![\alpha]\!])$, whichever is defined.
Generally, complements and specifiers are the arguments of their sisters, although this parallelism will break down when we consider quantificational DPs.

(1) He is bald.

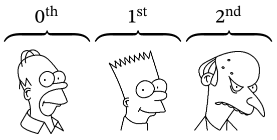
- Intuitively, (1) is *true* iff the individual who the speaker intended this tokening *he* to pick out is bald.
- First, we need a formal device for distinguishing the intended reference of pronoun tokenings at the level of the semantics.
- In order to do this, let's suppose that pronouns are assigned an *index* $n \in \mathbb{N}$.

(2)

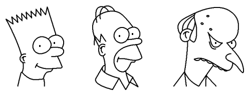


- In formal semantics, the standard way of modelling the context of utterance is via *assignments*. Assignments are ways of mapping indices/variables to entities in the domain.
- Formally, we can treat an *assignment* as an n-long *sequence* of individuals, given a set of indices $\{ i \mid 0 \leq i \leq n \}$.[2]
- Here are two example assignments, given a set of indices $\{ 0, 1, 2 \}$

$g =$



$h =$



- We can think of the meaning of a pronoun as picking out the n^{th} entity in the assignment g.
- Typically, the context of utterance is represented as a parameter on the interpretation function $[\![.]\!]$ (see, e.g., Heim & Kratzer 1998).

$$[\![\text{he}_n]\!]^g = g_n$$

- A sentence, such as *he*$_1$ *is bald* ends up as true or false *relative* to the assignment.

[2] We'll adopt the convention whereby initial member of the sequence is the 0th.

(3) a. $[\![\text{he}_1\text{is bald}]\!]^g = \textsf{bald}\,g_1 = \textsf{bald}$ $= 0$

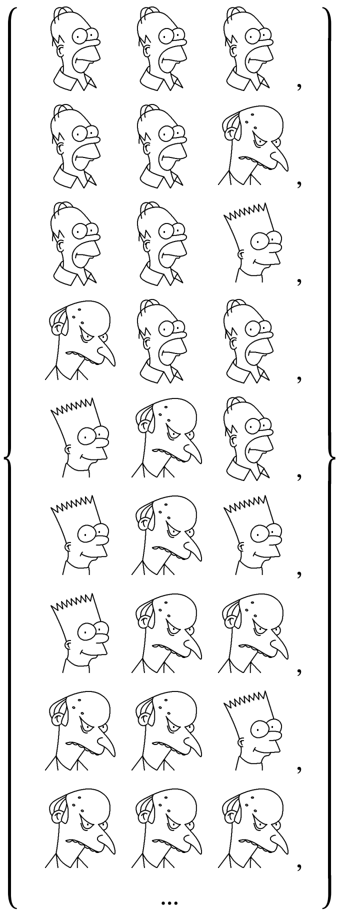
b. $[\![\text{he}_1\text{is bald}]\!]^h = \textsf{bald}\,h_1 = \textsf{bald}$ $= 1$

- Equivalently, we can think of sentence meanings *characteristic functions* of assignments.

(4) $[\![\text{he}_1 \text{ is bald}]\!] = \lambda g\,.\,\textsf{bald}\;g_1$

- The sentence *he*$_1$ *is bald* maps an assignment g to *true*, if and only if the 1st member of *g* is bald.
- When *g* is fed in as the argument of the function, the result is 0, since the 1st member of *g* is Bart, and Bart is not bald. When *h* is fed in as the argument, the result is 1, since the 1st member of *h* is Homer, and Homer is bald.
- Recall from intro semantics that we can retrieve a *set* from a function to truth values. We can equivalently think of the meaning of an assignment-sensitive sentence as a set of assignments.

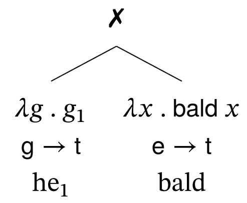
(5) $[\![\text{he}_1 \text{ is bald}]\!] =$



- Notice that the 1st column *only* features Homer and Bart. Since only Homer and Bart are bald.
- How do we derive such meanings compositionally?
- For us, pronouns will denote functions from assignments to individuals, i.e., *assignment sensitive individuals*.

$$[\![pro_n]\!] = \lambda g \,.\, g_n$$

- How do we get assignment-sensitive individuals to play nicely with ordinary compositional apparatus?

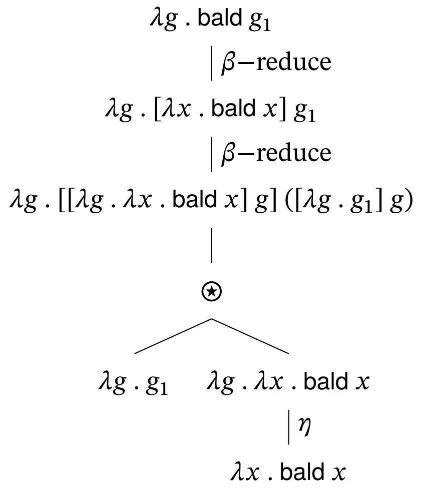


- We need two type-shifters – η and $\circledast$ – in order to integrate assignment sensitive meaninings (Charlow 2018).[3]
  - η shifts an ordinary meaning to a trivially *assignment sensitive* meaning.
  - $\circledast$ is an enriched form of function application that we use to compose assignment-sensitive meanings.

(7) a. $a^{\eta} = \lambda g \,.\, a$

b. $\mathbb{f} \circledast \mathbb{x} = \lambda g \,.\, \mathbb{f}\; g\; (\mathbb{x}\; g)$

- Let's see how these shifters work in practice:


$\lambda g \,.\, \textsf{bald}\; g_1$
β–reduce
$\lambda g \,.\, [\lambda x \,.\, \textsf{bald}\; x]\; g_1$
β–reduce
$\lambda g \,.\, [[\lambda g \,.\, \lambda x \,.\, \textsf{bald}\; x]\; g]\; ([\lambda g \,.\, g_1]\; g)$
$\circledast$
$\lambda g \,.\, g_1$
$\lambda g \,.\, \lambda x \,.\, \textsf{bald}\; x$
η
$\lambda x \,.\, \textsf{bald}\; x$

- Pronominals can be interpreted as *bound variables*. The truth of (8) does not depend on what the 1st member of the assignment is, i.e. (8) is *true* if Lisa said that Bart teased Lisa, and $g_1 = \textsf{Homer}$.

(8) Someone^1 said that Bart teased them$_1$.
$\exists x[x\; \textsf{said}\; (\textsf{teased}\; x\; \textsf{Bart})]$

- In order to account for bound variable readings of pronominals, we're going to introduce a new operator Λ_n. Λ_n composes with an assignment-sensitive expression and *abstracts* over pronominals with a matching index *pro*$_n$.

(9) $\Lambda_n\; \mathbb{t} = \lambda g \,.\, \lambda x \,.\, \mathbb{t}\; g^{[n \to x]}$

[3] Together with the type-constructor for assignment-sensitive meanings G defined below, η and $\circledast$ form an *applicative functor* (see Charlow 2018 for a demonstration).

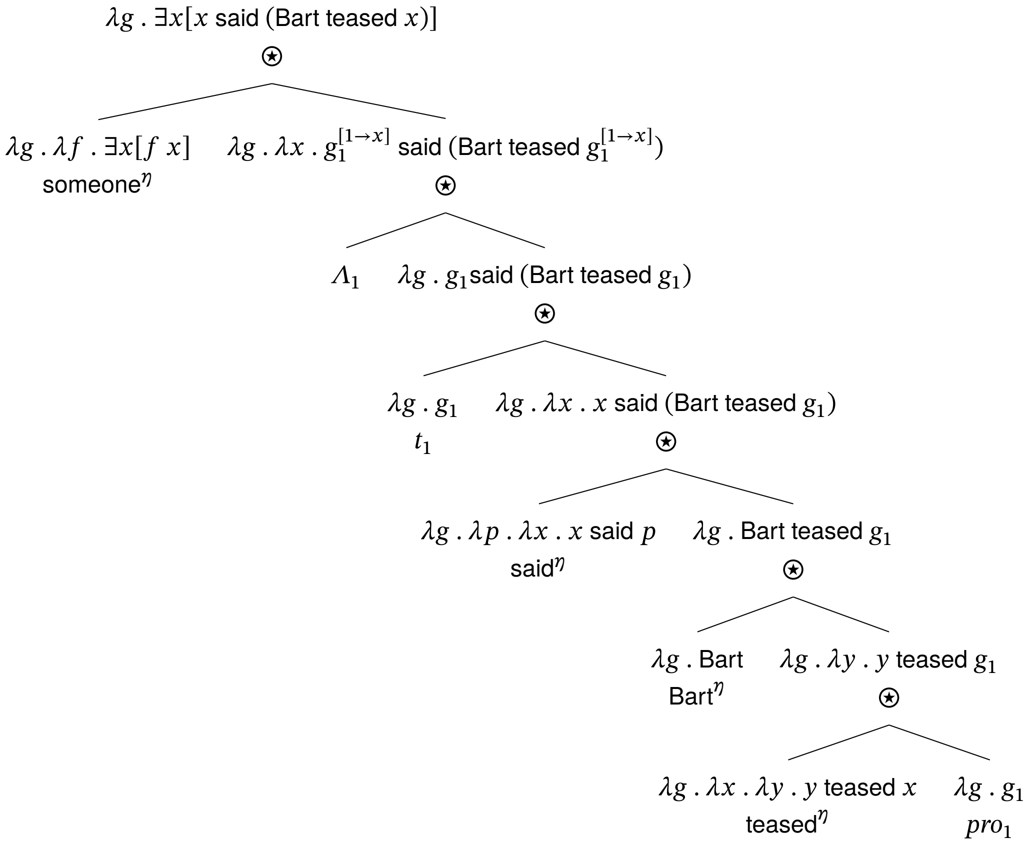
(6) $\textsf{G a} \coloneqq \textsf{g} \to \textsf{a}$

Applicative functors provide a useful technique for modelling *enriched* semantic composition.

- We can take quantificational DPs such as *someone* to simply denote generalised quantifiers.

(10) someone $= \lambda f \,.\, \exists x[f\ x]$

- Now we have all the apparatus we need in order to derive *bound readings* of pronominals.


$\lambda g \,.\, \exists x[x$ said (Bart teased x)$]$
⍟
$\lambda g \,.\, \lambda f \,.\, \exists x[f\ x]$
someone$^\eta$
$\lambda g \,.\, \lambda x \,.\, g_1^{[1\to x]}$ said (Bart teased $g_1^{[1\to x]}$)
⍟
Λ_1
$\lambda g \,.\, g_1$said (Bart teased g_1)
⍟
$\lambda g \,.\, g_1$
t_1
$\lambda g \,.\, \lambda x \,.\, x$ said (Bart teased g_1)
⍟
$\lambda g \,.\, \lambda p \,.\, \lambda x \,.\, x$ said p
said$^\eta$
λg . Bart teased g_1
⍟
λg . Bart
Bart$^\eta$
$\lambda g \,.\, \lambda y \,.\, y$ teased g_1
⍟
$\lambda g \,.\, \lambda x \,.\, \lambda y \,.\, y$ teased x
teased$^\eta$
$\lambda g \,.\, g_1$
pro_1

- Note that we can treat traces as having the same semantics as pronouns – namely, they're assignment-sensitive individuals.

3 *Strict vs. sloppy readings*

- There are two conceivable LF's for the following sentence, under the reading *Ivan sold Ivan's telecaster*:

- We'll refer to the LF in (11a) as the *accidental coreference* LF. Here, the pronominal just happens to pick out the same individual as the subject, given an assignment g.

- The LF in (11b) is the *binding* LF. The sentence is interpreted relative to a shifted assignment $g^{[1\rightarrow\mathsf{Ivan}]}$. This is achieved compositionally via scoping Ivan over a Λ_1 operator.

(11) Ivan sold his_1 telecaster.

a. Ivan sold (telecaster g_1) where $g_1 = \mathsf{Ivan}$

b. Ivan sold (telecaster $g_1^{[1\rightarrow\mathsf{Ivan}]}$)

- The LF's are truth-conditionally indistinguishable – which is actually attested?
- As we learned in Andy and I's class on the syntax of *ellipsis*, deletion of a VP is attested in English and other languages.

(12) a. Yasu regrets teaching another class,
and Daniele will regret teaching another class too.

b. If Yasu ordered an espresso,
then Daniele did order an espresso too.

c. After Yasu had been bitten by a mosquito,
Daniele was bitten by a mosquito too.

- Consider the following elliptical sentence, with the interpretation of the antecedent fixed as *Ivan sold Ivan's telecaster*:

(13) Ivan sold his telecaster. Jorge also did Δ.

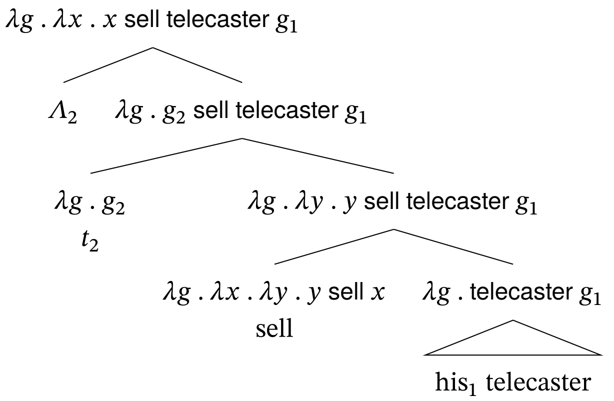
(14) a. Δ = sell Ivan's telecaster. strict

b. Δ = sell Jorge's telecaster. sloppy

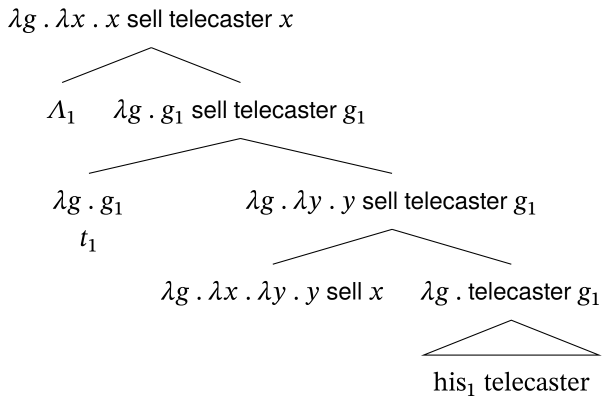
- The classical account of the strict/sloppy ambiguity, due to Sag (1976), is based on the fact that there are two routes to the attested reading of the antecedent in this case – accidental coreference, and binding via Λ.[4]

[4] Note that we need to make a couple of auxiliary syntactic assumptions here – namely, the VP must contain a trace of the moved subject. It is assumed that a moved expression and its trace are obligatorily co-indexed.

①: *accidental coreference*

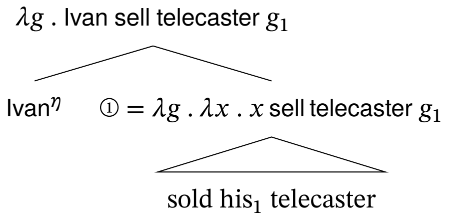

$\lambda g \,.\, \lambda x \,.\, x$ sell telecaster g_1
Λ_2
$\lambda g \,.\, g_2$ sell telecaster g_1
$\lambda g \,.\, g_2$
t_2
$\lambda g \,.\, \lambda y \,.\, y$ sell telecaster g_1
$\lambda g \,.\, \lambda x \,.\, \lambda y \,.\, y$ sell x
sell
$\lambda g \,.\,$ telecaster g_1
his$_1$ telecaster

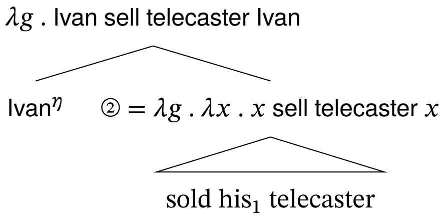
②: *binding*


$\lambda g \,.\, \lambda x \,.\, x$ sell telecaster x
Λ_1
$\lambda g \,.\, g_1$ sell telecaster g_1
$\lambda g \,.\, g_1$
t_1
$\lambda g \,.\, \lambda y \,.\, y$ sell telecaster g_1
$\lambda g \,.\, \lambda x \,.\, \lambda y \,.\, y$ sell x
$\lambda g \,.\,$ telecaster g_1
his$_1$ telecaster

- Note that ① and ② denote distinct functions:
  - ① denotes a function from an assignment g, to a function from individuals x to *true* iff x sold g_1's telecaster. In the utterance context g_1 = Ivan. ① is *assignment sensitive* because it contains a free pronouns, i.e., a pronoun not bound by a matching Λ.
  - ② denotes a function from an assignment g, to a function from individuals x to *true* iff x sold x's telecaster. ② is *assignment insensitive*, because every occurrence of a pronoun/trace is bound by a matching Λ.

- When the VP's compose with the type e expression Ivan, the resulting propositions are identical – just so long as g_1 = Ivan.


$\lambda g \,.\,$ Ivan sell telecaster g_1
Ivan$^{\eta}$
① $= \lambda g \,.\, \lambda x \,.\, x$ sell telecaster g_1
sold his$_1$ telecaster


$\lambda g \,.\,$ Ivan sell telecaster Ivan
Ivan$^{\eta}$
② $= \lambda g \,.\, \lambda x \,.\, x$ sell telecaster x
sold his$_1$ telecaster

Question: how is the *identity condition* on ellipsis met under the sloppy reading?

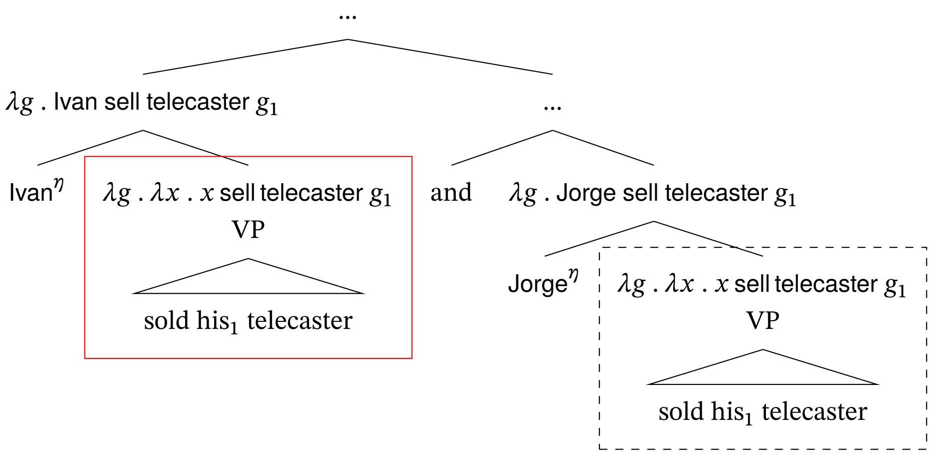
(15) *The parallelism condition*

Ellipsis of EC requires semantic identity with with an antecedent constituent AC.

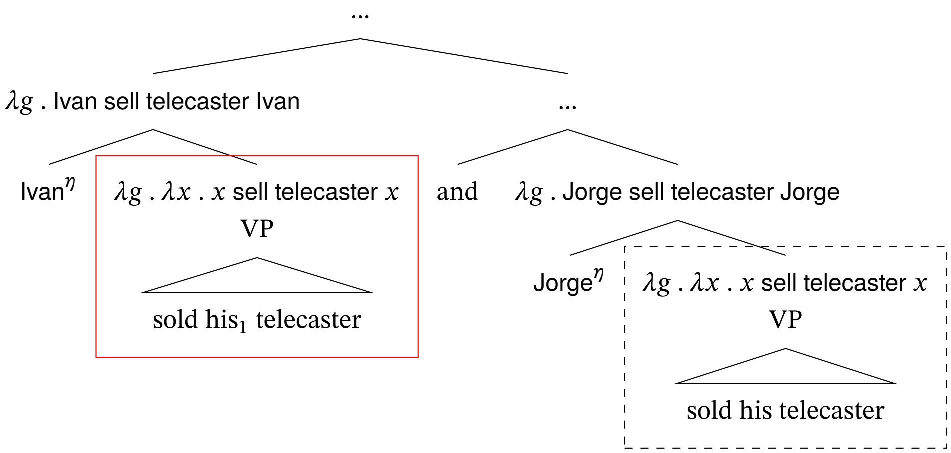
Following Sag (1976) and Williams (1977), positing a VP-internal Λ-operator allows us to capture the strict/sloppy ambiguity as an ambiguity in the *antecedent*.

- With an *accidental coreference* antecedent, we get the *strict* reading.
- With a *binding* antecedent, we get the *sloppy* reading.

Strict reading:


...
λg . Ivan sell telecaster g_1
...
Ivan$^\eta$
λg . λx . x sell telecaster g_1
VP
sold his$_1$ telecaster
and
λg . Jorge sell telecaster g_1
Jorge$^\eta$
λg . λx . x sell telecaster g_1
VP
sold his$_1$ telecaster

Sloppy reading:


...
λg . Ivan sell telecaster Ivan
...
Ivan$^\eta$
λg . λx . x sell telecaster x
VP
sold his$_1$ telecaster
and
λg . Jorge sell telecaster Jorge
Jorge$^\eta$
λg . λx . x sell telecaster x
VP
sold his telecaster

- In the next section, we'll introduce a new dimension of meaning – as well as dealing with *assignment-sensitive* meanings, we're going to be dealing with *alternative-sensitive* meanings.

References

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