Pronouns

- ► Let's schedule the final!
- No class next week! Sleep some more. But do PS7.
- Read Grice 1975 on Luminus for week 10.

1 Notes on variables

(1) **Some math "sentences":**

a.	$1 = 2 - 1$	a sentence with no variables; not context-sensitive
b.	$n = 2 - 1$	a sentence with a variable; context-sensitive
c.	$\forall n\,(2(n+1) = 2n + 2)$	a sentence with a variable; *not* context-sensitive

- We say (1b) contains a *free variable* because the truth of the sentence depends on the context. In particular, the sentence is true iff the variable "n" is interpreted as 1.
- The truth of sentence (1c), like (1a), does not depend on the context at all.

(2) **Some terminology, using (1c) as an example:**

$$\underset{\textit{binder}}{\forall n}\ \underbrace{\left(2(\underset{\textit{bound}}{n}+1) = 2\ \underset{\textit{bound}}{n} + 2\right)}_{\textit{scope}}$$

- *Binders* control the interpretation of a particular variable within a certain part of its structure, which we call its *scope*. Here, $\forall$ *binds* the variable n in its scope.
- We call variables that are in the scope of a matching binder *bound variables*.

2 Pronouns

This "free" vs "bound" terminology is also useful for natural language sentences as well:

(3)

a.	John likes Mary.	a sentence with no variables; not assignment-sensitive
b.	John likes him.	a sentence with a variable; assignment-sensitive
c.	Every boy likes himself.	a sentence with a variable; *not* assignment-sensitive

We'll formalize this by making pronouns denote variables. To keep track of different pronouns/variables, we use numerical *indices*.

(4) **Pronouns Rule (to be replaced later):**
If α is a pronoun, $[\![\alpha_i]\!] = v_i$ in *IFS* notation

But how do we interpret variables? We use the assignment function!

(5) $[\![v_i]\!]^{M,g} = g(i)$ in *IFS* notation

Think of the assignment function as a mapping of (free) variables to the individuals that they refer to, in a given context/conversation.

(6) Suppose g is a function and $g(3) = \text{Sam} \in D_e$.

a. Translating from English to predicate logic:

i. $[\![\text{him}_3]\!] = v_3$

ii. $[\![\text{John likes him}_3]\!] = \text{Like(John}, v_3)$

b. Translating from predicate logic to individuals and truth values in the model M:

i. $[\![v_3]\!]^{M,g} = g(3) = \text{Sam}$

ii. $[\![\text{Like(John}, v_3)]\!]^{M,g} = 1$ iff John likes Sam in M

Q: Does it matter what g returns for other values in (6)?

A: No. It might even be undefined for other values.

Q: Why did we use 3? Does the number matter?

A: The choice of number was arbitrary, but it is important whether or not we reuse numbers:

(7) a. He_2 thinks that he_2 is smart.

b. He_2 thinks that he_7 is smart.

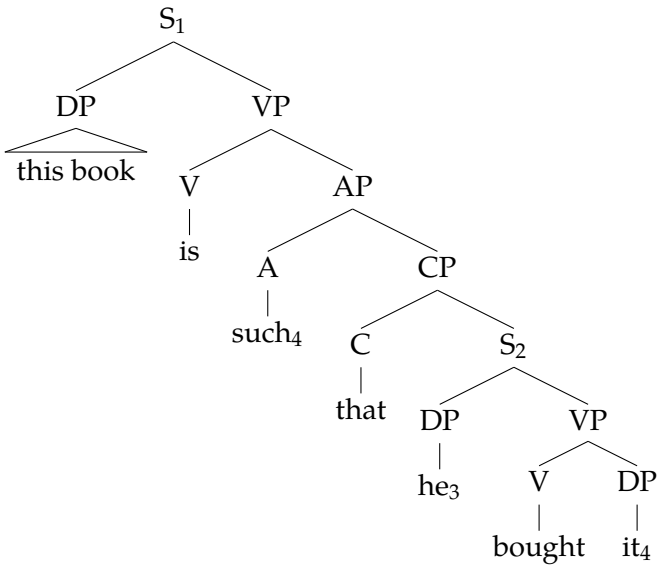
Q: Does the assignment function affect other parts of the sentence?

A: No. "John" and "likes" are *constants*, meaning their values are the same no matter the assignment: for any assignment function g, $[\![\text{John}]\!]^g = \text{John}$.

3 *Such that* relatives

The English expression *such that* allows us to construct relative clauses without movement.[1]

(8) ? This book is such$_4$ that he$_3$ bought it$_4$. ($g(3)$ = John)



Here, (8) has only one free pronoun. But the Principle of Compositionality states that $[\![S_1]\!]$ be computed based on the meaning of $[\![S_2]\!]$, which — if interpreted in isolation as in (9) — contains *two* free pronouns.

(9) He$_3$ bought it$_3$.

Idea: *Such* binds *it*, doing the work of creating a *predicate* out of the assignment-dependent sentence "John bought it."

(10) ***Such* Rule (temporary):**[2]
$[\![\text{such}_i\ \gamma]\!] = \lambda v_i\ .\ [\![\gamma]\!]$

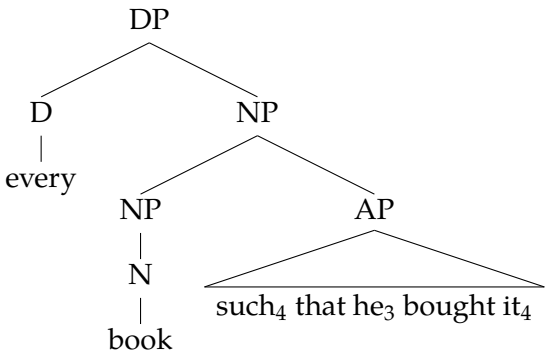
Exercise: Compute $[\![S_1]\!]$. Assume $[\![\text{that}]\!]$ = Id.

[1] Unfortunately, the use of *such that* sounds "unlyrical" (Quine, 1960: §23)... but we'll ignore that here.
[2] "Such" does not have a type. That's why it can only be interpreted using the *Such* Rule.

We can also use *such that* to construct (slightly awkward) *relative clauses*:

(11) ? the book such$_4$ that he$_3$ bought it$_4$

The semantics for *such* above works perfectly fine here.



4 Binding more or less than one variable

Binding multiple variables:

(12) ? This book is such$_4$ that he$_3$ bought it$_4$ and then gave it$_4$ to Sarah.

(13) ? every book such$_4$ that he$_3$ bought it$_4$ and then gave it$_4$ to Sarah

Binding no variables (vacuous binding):

(14) * This book is such$_4$ that today is Monday.

(15) * every book such$_4$ that today is Monday

The ungrammaticality of these examples shows that binding *no* variables is disallowed by the grammar. This is called *vacuous binding*.

5 Traces & Pronouns

(16) **The interpretation of movement:** (from handout 6)

Pick an arbitrary variable, such as x.

a. The base position of movement is replaced with a *trace*; $[\![t]\!] = x$, type e.

b. A *λ-binder* λx is adjoined right under the target position of the movement chain.

(17) **Traces and Pronouns Rule (T&P):** replaces Pronouns Rule in (4)

If α is a pronoun or trace, $[\![\alpha_i]\!]^g = v_i$.

(18) **Predicate Abstraction (PA):** replaces previous λ Rule and the *Such* Rule (10)[3]

If α has daughters β and γ, where β is a binder of variable x (λx or $such_x$), $[\![\alpha]\!] = \lambda x\ .\ [\![\gamma]\!]$

A motivation for thinking that traces and pronouns really are deeply related is the fact that relative clauses can simultaneously bind both traces and pronouns:

(19) every dog that bit its master (based on Heim and Kratzer, 1998: 245)

Exercise: Compute (19). Assume *master* is type $\langle e, e\rangle$: $[\![\text{master}]\!] = \lambda x\ .\ \text{master}(x)\ .$

[3]We can think of "such" as the pronunciation of a lexicalized binder index, not generated through movement.

6 Variable binding

Quantifiers can also bind pronouns:

(20) Every boy loves his mother.
'Every boy x is such that (x loves x's mother).'

Exercise: Compute (20). Notice that the VP-internal subject hypothesis makes a contribution. Assume *mother* is type $\langle e, e \rangle$: $[\![\text{mother}]\!] = \lambda x \ . \ \text{mother}(x)$

References

Heim, Irene, and Angelika Kratzer. 1998. *Semantics in generative grammar*. Malden, Massachusetts: Blackwell.

Quine, Willard Van Orman. 1960. *Word and object*. Cambridge.