“Form and Composition”
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Higginbotham (1985) outlined a conception of semantics as part of the larger study of “systems of human linguistic knowledge that result from native endowment and the ambient environment.” This conception leads one to emphasize—with regard to data and explananda—facts about how competent speakers *cannot* understand certain strings of words. It also leads one to describe *compositionality* as a natural phenomenon whose character is to be discovered, not defined in advance.

Today, I want to revisit some aspects of Higginbotham’s strategy for specifying “human semantic knowledge” in terms of event variables and three combinatorial operations:

(i) *theta-marking*, akin to Frege’s notion of saturation
(think of ‘see *Jupiter*’)

(ii) a conjunctive operation of *modification*
(think of ‘*bright* planet’ or ‘see Jupiter *now*’)

(iii) *theta-binding*, akin to Tarski’s notion of quantification.
(think of ‘see *every* planet’, or ‘*which* Galileo saw’)

Heim and Kratzer (1998) invoke three analogous operations: *Function Application*, in Church’s sense (“no unsaturateds”); a conjunctive operation of *Predicate Modification*; and Church-style *Predicate Abstraction*, via which an expression of type <**t**> can be converted into an expression of type <e, **t**>. But given some familiar assumptions about how grammatical form is related to logical form—assumptions shared by Higginbotham, Heim and Kratzer (though not everyone)—certain facts favor Jim’s formulation. These facts also invite attempts to unify *theta-marking* and *modification*.

Some Initial References

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A. Linguistic Knowledge and Constrained Homophony

Davidson, Psychologized and Kaplanized

(1) for each human language H:
each speaker of H (tacitly) knows a theory **T**
such that for each sentence *S* of H,
T has a theorem of the form ⌈True*(*S*, c) ≡ K(c)⌉

—True*(*I saw Jim*, c) ≡ ∃e:e<TIME(c)[SEE(e, SPEAKER(c), JIM)]

—True*(*S*, c): *S* is True-in-H *relative to* c

(2) **T** is not just *any* specification of truth relative to contexts:
human specifications respect substantive *constraints*

Stress on "negative" facts

(3) the men told the women to vote for each other

(a) The men told each woman to vote for the other woman.
#(b) Each man told the women to vote for the other man.
#(c) Each man told the women he would vote for the other man.

(4) Mary saw the boy walking towards the bus (Chomsky '64)

(a) Mary saw the boy while walking towards the bus.
➔ Mary walked.
✕ The boy walked.
(b) Mary saw the boy who was walking towards the bus.
➔ The boy walked.
✕ Mary saw the boy walk.
(c) Mary saw the boy walk towards the bus.
➔ Mary saw the boy walk. ➔ The boy walked.

for each string: n but not n+1 meanings, for some n

(5) this is the bus Mary saw the boy walking towards

This is the bus such that…

#(a) Mary saw the boy while walking towards it.
#(b) Mary saw the boy who was walking towards it.
(c) Mary saw the boy walk towards it.

(6) what did Mary see the boy walking towards

Which thing is such that…

#(a) Mary saw the boy while walking towards it?
#(b) Mary saw the boy who was walking towards it?
(c) Mary saw the boy walk towards it?

(7) a woman saw a man with a telescope

A woman saw a man, and…

(a) the man had a telescope when she saw him.
(b) the woman used a telescope to see him.
#(c) the woman had a telescope when she saw him.

(8) every cat which Fido chased

(a) ∀x:CAT(x) & CHASED(FIDO, x) *Restricted Quantifier*
#(b) ∀x:CAT(x)[CHASED(FIDO, x)] *Complete Sentence*

(9) *the child seems sleeping

(a) the child seems to be sleeping
#(b) the child seems sleepy

B. Event Positions and Thematic Relations

(10) Plum stabbed Mustard in the library with a candlestick
(11) Plum stabbed Mustard in the library
(12) Plum stabbed Mustard with a candlestick
(13) Plum stabbed Mustard

Davidson (1967a): (10) ➔ (11) ➔ (13); (10) ➔ (12) ➔ (13)

(14) Plum stabbed Mustard in the library, *and*
Plum stabbed Mustard with a candlestick

Evans/Taylor (1983): (10) ➔ (14); but (14) *doesn't imply* (10)

∃x(Fx & Gx) ➔ ∃x(Fx) & ∃x(Gx)

(10a) ∃e[STABBED(e, PLUM, MUSTARD) &
IN-THE-LIBRARY(e) & WITH-A-CANDLESTICK(e)]

If you don't worry about *non*implications,
capturing the actual implications is easy:
just say that each sentence implies every sentence.

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(15) Peacock heard Mustard
∃e[HEARD(e, PEACOCK, MUSTARD)]

(16) Peacock heard something
∃e∃x[HEARD(e, PEACOCK, x)]

(17) Peacock heard Mustard yell
∃e∃x[HEARD(e, PEACOCK, x) & YELL(x, MUSTARD)]

(18) Peacock heard Mustard yell in the hall

(a) [Peacock [heard **[Mustard [yell [in the hall]]**]]]
∃e∃x[HEARD(e, P, x) & YELL(x, M) & IN-THE-HALL(x)]

(b) [Peacock [**[heard [Mustard yell]]** [in the hall]]]
∃e∃x[HEARD(e, P, x) & YELL(x, M) & IN-THE-HALL(e)]

(8) a woman saw a man with a telescope

A woman saw a man, and…

(a) …the man had a telescope when she saw him.
[[a woman] [saw [a **[man [with a telescope]]**]]]

(b) …the woman used a telescope to see him.
[[a woman] **[[saw [a man]] [with a telescope]]**]

#(c) …the woman had a telescope when she saw him.
[[a woman] **[[saw [a man]] [with a telescope]]**]

If you don't worry about *non*ambiguities,
capturing the actual structure-meaning pairs is easy:
just say that each structured string has every meaning.

But why <u>*can't*</u> structure (8b) support interpretation (8c)?

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(19) [[see a man] [with a telescope]]

(a) ∃y:MAN(y)[SEE(**e**, x, y) & ∃z:SCOPE(z)[WITH(**e**, z)]]
#(b) ∃y:MAN(y)[SEE(e, **x**, y) & ∃z:SCOPE(z)[WITH(**x**, z)]]

(20) [[a woman] [[see a man] [with a telescope]]]

(a) ∃y:W(x)[∃y:M(y)[SEE(**e**, x, y) & ∃z:SCOPE(z)[WITH(**e**, z)]]]
#(b) ∃y:W(x)[∃y:M(y)[SEE(e, **x**, y) & ∃z:SCOPE(z)[WITH(**x**, z)]]]

C. Combinatorial Operations, Types, and Overgeneration

(1) for each human language H: each speaker of H (tacitly) knows a theory **T** such that for each sentence *S* of H, **T** has a theorem of the form ⌜True*(*S*, c) ≡ K(c)⌝

(21) The twenty-first example is not true.
(22) True('The twenty-first example is not true.') ≡ ~True(21)
(23) ~True(21) ≡ ~True('The twenty-first example is not true.')

(24) White likes wheat, and Green hates grass. (Foster 1975)
(25) True('White likes wheat.') ≡ White likes wheat.
(26) True('White likes wheat.') ≡ Green hates grass.

(27) He is both eager to please us and eager that we please him.
(28) True('He is eager to please.') ≡ He is eager to be a pleaser.
(29) True('He is eager to please.') ≡ He is eager to be pleased.

Higginbotham's (1985) three modes of combination:

(i) Θ-marking (saturation, allowing for event variables) ♒
(ii) modification (fundamentally conjunctive) ▶
(iii) Θ-binding (∃-closure, and overt quantification) ↪

(30) the verb 'stab' has the following Θ-grid: STAB(e, 2, 1)

(31) [stab Mustard] ♒ STAB(e, 2, MUSTARD)
[Plum [stab Mustard]] ♒ STAB(e, PLUM, MUSTARD)

(32) [[Plum [stab Mustard]] today] ▶
STAB(e, PLUM, MUSTARD) & TODAY(e)

(33) [-ed [[Plum [stab Mustard]] today]] ↪
∃e:PAST(e)[STAB(e, PLUM, MUSTARD) & TODAY(e)]

(34) [brown dog] ▶ DOG(x) & BROWN-ONE(x)
DOG(x) & ιY:DOGS(Y)[BROWN-FOR[Y, x]

DOG(x) is a *Tarskian sentence* satisfied by certain *entities*.
But we could also introduce ***Churchy denoters*** of **functions**.

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(35) ‖dog‖ = λx . ⊤ if DOG(x), otherwise ⊥
= λx . **DOG**(x)

(35a) ‖brown‖ = λx . **BROWN-ONE**(x)

•(35b) **UP:**‖brown‖ = λ**X** . λx . **X**(x) & **BROWN-ONE**(x)

(36) ‖brown dog‖ = **UP:**‖brown‖(‖dog‖)
= λx . **DOG**(x) & **BROWN-ONE**(x)

(37) ‖stab‖ = λy . λx . λe . **STAB**(e, x, y)

(38) ‖stab Mustard‖ = ‖stab‖(‖Mustard‖)
= λx . λe . **STAB**(e, x, MUSTARD)

(39) ‖Plum [stab Mustard]‖
= ‖stab Mustard‖(‖Plum‖)
= λe . **STAB**(e, PLUM, MUSTARD)

(40a) ‖today‖ = λe . **TODAY**(e)

•(40b) **UP:**‖today‖ = λ**E** . λe . **E**(e) & **TODAY**(e)

(41) ‖[Plum [stab Mustard]] today‖
= **UP:**‖today‖(‖Plum [stab Mustard]‖)
= λe . **STAB**(e, PLUM, MUSTARD) & **TODAY**(e)

•(42) ‖-ed‖ = λ**E** . **∃**e:**PAST**(e)[**E**(e)]

(43) Plum stabbed Mustard today

(44) ‖-ed [[Plum [stab Mustard]] today]‖
= ‖-ed‖(‖[Plum [stab Mustard]] today‖)
= ∃e:**PAST**(e)[**STAB**(e, PLUM, MUSTARD) & **TODAY**(e)]

So if (43) *can* be described in terms of a type-lifting operation
and four applications of "Function Application,"
why invoke Θ-marking and Θ-binding?

Higginbotham: no *unsaturated* arguments; no higher types;
no lexical items that express "functionals"
(functionals: functions from *functions* to values)

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(45) <e> and <**t**> are types;
if <α> and <β> are types, then so is <α, β>

0.	<e>	<**t**>	(2)
1.	<e, e> <e, **t**>	<**t**, e> <**t**, **t**>	(4) of <0, 0>
2.	eight of <0, 1>	eight of <1, 0> sixteen of <1, 1>	(32), including <e, e**t**> and <e**t**, **t**>
3.	64 of <0, 2> 128 of <1, 2> 1024 of <2, 2>	64 of <2, 0> 128 of <2, 1> <<e, e**t**> , **t**>	(1408), including <e, <e, e**t**>> <e**t**, <e**t**, **t**>> <<e, **t**> , <e, <e, **t**>>>
4.	2816 of <0, 3> 5632 of <1, 3> 45,056 of <2, 3> 1,982,464 of <3, 3>	2816 of <3, 0> 5632 of <1, 3> 45,056 of <3, 2>	(2,089,472) including <<e**t**, **t**>, <<e**t**, **t**>, **t**>> <<e, e**t**>, <<e, e**t**>, **t**>>

(46*) [whonk$_1$ [Plum __$_1$ Mustard]] λ**R** . **R**(PLUM, MUSTARD)

Theorists can *posit* semantic values of expressions in terms of (45) and Church's Lambda Calculus. But is this the vocabulary that *kids* (tacitly) deploy in *acquiring* linguistic knowledge?

Given a human language H, we can try to specify theories *knowledge of which would suffice* for agreement (with speakers of H) on the truth conditions of sentences. But if we want more than this kind of "descriptive adequacy," perhaps we should reject (45) and ask which if any "functionals" can be *human* semantic values.

D. Quantifiers as Functionals: To Raise or To Lift?

(47) Fido chased every cat
(48) Most of the dogs chased every cat

(47a) [[every cat]$_1$ [Fido [chased t$_1$]]]
(48a) [[most of the dogs]$_2$ [[every cat]$_1$ [t$_2$ chased t$_1$]]]

(47b) [Fido [chased [every cat]]]
(48b) [[most of the dogs] [chased [every cat]]]

For the moment, let's ignore event variables.
Let '**X**' be a variable of type <e, **t**>
Let '**Φ**' and '**Ψ**' be variables of type <e**t**, **t**>

(49) ‖every cat‖ = λ**X** . ∀y:**CAT**(y)[**X**(y)] <e**t**, **t**>

(50-LC) ‖chased‖ = λy . λx . **CHASED**(x , y) <e, <e**t**>>

(50-HC) ‖chased‖ = λ**Ψ** . λ**Φ** . **Φ**(λw . **Ψ**(λz . **CHASED**(w, z)))
<<e**t**, **t**>, <<e**t**, **t**>, **t**>>

High Church, Uplifting Derivations...

1. $\|\text{chased}\| = \lambda\boldsymbol{\Psi}\,.\,\lambda\boldsymbol{\Phi}\,.\,\boldsymbol{\Phi}(\lambda w\,.\,\boldsymbol{\Psi}(\lambda z\,.\,\textbf{CHASED}(w, z)))$

2. $\|\text{every cat}\| = \lambda\mathbf{X}\,.\,\forall y{:}\textbf{CAT}(y)[\mathbf{X}(y)]$

3. $\|\text{chased [every cat]}\|$

$= \|\text{chased}\|(\|\text{every cat}\|)$

$=$ Function-1(Function-2)

$= \lambda\boldsymbol{\Psi}.\lambda\boldsymbol{\Phi}.\boldsymbol{\Phi}(\lambda w\,.\,\boldsymbol{\Psi}(\lambda z\,.\,\textbf{CHASED}(w, z)))(\lambda\mathbf{X}\,.\,\forall y{:}\textbf{CAT}(y)[\mathbf{X}(y)])$

$= \lambda\boldsymbol{\Phi}.\boldsymbol{\Phi}(\lambda w\,.\,\lambda\mathbf{X}\,.\,\forall y{:}\textbf{CAT}(y)[\mathbf{X}(y)](\lambda z\,.\,\textbf{CHASED}(w, z)))$

$= \lambda\boldsymbol{\Phi}.\boldsymbol{\Phi}(\lambda w\,.\quad \forall y{:}\textbf{CAT}(y)[\lambda z\,.\,\textbf{CHASED}(w, z)(y)])$

$= \lambda\boldsymbol{\Phi}.\boldsymbol{\Phi}(\lambda w\,.\quad \forall y{:}\textbf{CAT}(y)[\quad \textbf{CHASED}(w, y)\quad])$

$<<e\mathbf{t}, \mathbf{t}>, \mathbf{t}>$

4. $\|\text{some dog}\| = \lambda\mathbf{X}\,.\,\exists x{:}\textbf{DOG}(x)[\mathbf{X}(x)]$

5. $\|\text{[some dog] [chased every cat]}\|$

$=$ Function-3(Function-4)

$= \lambda\boldsymbol{\Phi}.\boldsymbol{\Phi}(\lambda w.\forall y{:}\textbf{CAT}(y)[\textbf{CHASED}(w, y)])(\lambda\mathbf{X}\,.\,\exists x{:}\textbf{DOG}(x)[\mathbf{X}(x)])$

$= \lambda\mathbf{X}\,.\,\exists x{:}\textbf{DOG}(x)[\mathbf{X}(x)](\lambda w\,.\,\forall y{:}\textbf{CAT}(y)[\textbf{CHASED}(w, y)])$

$= \exists x{:}\textbf{DOG}(x)[\lambda w\,.\,\forall y{:}\textbf{CAT}(y)[\textbf{CHASED}(w, y)](x)]$

$= \exists x{:}\textbf{DOG}(x)[\quad \forall y{:}\textbf{CAT}(y)[\textbf{CHASED}(x, y)]\quad]$

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6. $\|\text{Fido}\| = \textbf{\textit{MONTY}}(\text{FIDO}) = \lambda\mathbf{X}\,.\,\mathbf{X}(\text{FIDO})]$

6a. $\|\text{Fido}\| = \lambda\mathbf{X}\,.\,\iota x{:}\textbf{FIDOIZER}(x)[\mathbf{X}(x)]$

7. $\|\text{Fido [chased every cat]}\|$

$=$ Function-3(Function-6)

$= \lambda\boldsymbol{\Phi}.\boldsymbol{\Phi}(\lambda w.\forall y{:}\textbf{CAT}(y)[\textbf{CHASED}(w, y)])(\lambda\mathbf{X}\,.\,\mathbf{X}(\text{FIDO})])$

$= \lambda\mathbf{X}\,.\,\mathbf{X}(\text{FIDO})(\lambda w\,.\,\forall y{:}\textbf{CAT}(y)[\textbf{CHASED}(w, y)])$

$= \lambda w\,.\,\forall y{:}\textbf{CAT}(y)[\textbf{CHASED}(w, y)](\text{FIDO})$

$= \forall y{:}\textbf{CAT}(y)[\textbf{CHASED}(\text{FIDO}, y)]$

(51) $\forall x\forall y\{\mathbf{=}(x, y) \equiv \forall\mathbf{X}[\mathbf{X}(x) \equiv \mathbf{X}(y)]\}$

(52) $\|\text{Fido}\| = \text{FIDO}$

$\|\text{Felix}\| = \text{FELIX}$

${}^{\downarrow}\|\text{chased}\| = \lambda\boldsymbol{\Psi}\,.\,\lambda x\,.\,\|\text{chased}\|(\textbf{\textit{MONTY}}[x], \boldsymbol{\Psi})$

$\|\text{chased}\|^{\downarrow} = \lambda y\,.\,\lambda\boldsymbol{\Phi}\,.\,\|\text{chased}\|(\boldsymbol{\Phi}, \textbf{\textit{MONTY}}[y])$

${}^{\downarrow}\|\text{chased}\|^{\downarrow} = \lambda y\,.\,\lambda x\,.\,\|\text{chased}\|(\textbf{\textit{MONTY}}[x], \textbf{\textit{MONTY}}[y])$

Adding event variables is not entirely trivial...

(53) $\|\text{chase}\| = \lambda\boldsymbol{\Psi}\,.\,\lambda\boldsymbol{\Phi}\,.\,\lambda e\,.\,\boldsymbol{\Phi}(\lambda w\,.\,\boldsymbol{\Psi}(\lambda z\,.\,\textbf{CHASE}(e, w, z)))$

(54) $\|\text{[some dog] [chase every cat]}\|$

$= \ldots$

$= \lambda e\,.\,\exists x{:}\textbf{DOG}(x)[\forall y{:}\textbf{CAT}(y)[\textbf{CHASE}(e, x, y)]]$

AWKWARD POINT: no ONE event is a chase of every cat;
consider 'Three dogs (together) chased every cat'

But even waiving such concerns...

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can lexical items have Level Four semantic values of type
$<<e\mathbf{t}, \mathbf{t}>, <<e\mathbf{t}, \mathbf{t}>, \mathbf{t}>>$ or $<<e\mathbf{t}, \mathbf{t}>, <<e\mathbf{t}, \mathbf{t}>, e\mathbf{t}>>$?

And if so, are semantic values of the *other* 2,089,470
Level Four types also available, at least in principle?

<u>Less Uplifting Derivations (Heim and Kratzer)</u>

(FA) $\| <\alpha>\verb|^|<\alpha, \beta> \|^{\mathcal{A}} = \| <\alpha, \beta> \|^{\mathcal{A}}(\| <\alpha> \|^{\mathcal{A}})$

(PM) $\| <e, \mathbf{t}>\verb|^|<e', \mathbf{t}'> \|^{\mathcal{A}} = \mathbf{UP}\text{:} \| <e', \mathbf{t}'> \|^{\mathcal{A}}(\| <e, \mathbf{t}> \|^{\mathcal{A}})$

$= \lambda x . \| <e', \mathbf{t}'> \|^{\mathcal{A}}(x)\ \mathbf{\&}\ \| <e, \mathbf{t}> \|^{\mathcal{A}}(x)$

(PA) $\| i\verb|^|<\mathbf{t}> \|^{\mathcal{A}} = \mathcal{ABSTRACT}(i, <\mathbf{t}>, \mathcal{A})$

$= \lambda x . \top$ iff for some $\mathcal{A}^*$ such that $\mathcal{A}^*(i) = x$,

and $\mathcal{A}^*$ is an i-variant of $\mathcal{A}$: $\| <\mathbf{t}> \|^{\mathcal{A}^*} = \top$

(47a) [[every cat]$_1$ [Fido [chased t$_1$]]]
(47a′) [[every cat] [1 [Fido [chased t$_1$]]]]

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1. $\|$ chased $\|^{\mathcal{A}} = \lambda y . \lambda x . \mathbf{CHASED}(x , y)$

2. $\|$ every cat $\|^{\mathcal{A}} = \lambda \mathbf{X} . \forall y\text{:}\mathbf{CAT}(y)[\mathbf{X}(y)]$

3. $\| t_1 \|^{\mathcal{A}} = \mathcal{A}[1]$

4. $\|$ chased $t_1 \|^{\mathcal{A}}$ = Function-1(Entity-3) $= \lambda x . \mathbf{CHASED}(x , \mathcal{A}[1])$

5. $\|$ Fido $\|^{\mathcal{A}}$ = FIDO

6. $\|$ Fido [chased t_1] $\|^{\mathcal{A}}$ = Function-4(Entity-5)

$= \mathbf{CHASED}(\text{FIDO} , \mathcal{A}[1])$

7. $\|$ 1 [Fido chased t_1] $\|^{\mathcal{A}} = \mathcal{ABSTRACT}(1, [\text{Fido chased } t_1], \mathcal{A})$

$= \lambda x . \mathbf{CHASED}(\text{FIDO}, x)$

*Step 7, via (PA), is <u>syn</u>categorematic: the <u>upper</u> index doesn't indicate a function of <u>any</u> Frege-type; certainly not <**t**, e**t**>;*
cp. $\langle \top,\ \lambda x . x = \mathcal{A}[1] \rangle$ $\langle \bot,\ \lambda x . \sim(x = \mathcal{A}[1]) \rangle$

8. $\|$ [every cat] [1 [Fido [chased t_1]]]] $\|^{\mathcal{A}}$

= $\|$ every cat $\|$ (Function-7)

$= \lambda \mathbf{X} . \forall y\text{:}\mathbf{CAT}(y)[\mathbf{X}(y)](\lambda x . \mathbf{CHASED}(\text{FIDO}, x))$

$= \forall y\text{:}\mathbf{CAT}(y)[\lambda x . \mathbf{CHASED}(\text{FIDO}, x)(y)]$

$= \forall y\text{:}\mathbf{CAT}(y)[\ \ \mathbf{CHASED}(\text{FIDO}, y)\ \ ]$

(PA*) $\| <e\mathbf{t}, \mathbf{t}>_i\verb|^|<\mathbf{t}> \|^{\mathcal{A}} = \| <e\mathbf{t}, \mathbf{t}> \|^{\mathcal{A}}(\mathcal{ABSTRACT}(i, <\mathbf{t}>, \mathcal{A}))$

But is this really different than the High Church treatment?

(50b) $\|$ chased $\| = \lambda \mathbf{\Psi} . \lambda \mathbf{\Phi} . \mathbf{\Phi}(\lambda w . \mathbf{\Psi}(\lambda z . \mathbf{CHASED}(w, z)))$

(48a) [[most of the dogs]$_2$ [[every cat]$_1$ [t$_2$ chased t$_1$]]]

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  [[most of the dogs] [2 [[every cat] [1 [t2 chased t1]]]]]
                    |            |         |     |      |
λΨ . λΦ  . Φ(             λw    .    Ψ(   λz . CHASED(w, z)))
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And does 'every cat' <u>really</u> combine with an analog of a relative clause? If so, then why is the (9b) interpretation <u>un</u>available?

(9) every cat which Fido chased

(a) $\forall x\text{:CAT}(x)\ \&\ \text{CHASED}(\text{FIDO}, x)$ *Restricted Quantifier*
#(b) $\forall x\text{:CAT}(x)[\text{CHASED}(\text{FIDO}, x)]$ *Complete Sentence*

So do we really want to invoke…
(FA)
(PA)
and (TYPES) <e>, <**t**>, and <α, β> if <α> and <β> are types

E. Raising Without Lifting

Higginbotham (1985):

(i) Θ-marking (saturation, allowing for event variables) ♒
(ii) modification (fundamentally conjunctive) ▶
(iii) Θ-binding (∃-closure, and overt quantification) ↪

I have no objection—and no alternative—to positing an operation like Θ-binding or PA, according to which instances of (55) are understood as instances of (56).

(55) [[every cat]$_1$ [...t_1...]]
(56) $\forall x_1$:CAT(x_1)[...x_1...]

Given quantificational direct objects (and relative clauses), *some* syncategorematicity is unavoidable. So the question is which _other_ operations and categories/types we _need_ to posit.

Higginbotham proposed Θ-marking and modification, but no "functionals." Heim and Kratzer suggest (FA), (PM), and (TYPES). Others suggest (FA), (TYPES), and type-adjusting operations. But recall the *absence* of abstractions on relations.

(46*) [whonk$_1$ [Plum __$_1$ Mustard]] λ**R** . **R**(PLUM, MUSTARD)

Frege had to _invent_ a language—governed by (FA) and (TYPES)—that allowed for abstraction over relations.

ANCESTRAL[λy.λx.**PRECEDES**(x, y), λy.λx.**PREDECESSOR**(x, y)]
|
<<e, e**t**>, <<e, e**t**>, **t**>> Level Four is useful for _logic_.

But to handle the _meaning_ of 'chased every cat'?
Do we really need/want
(TYPES), (FA), *and* (PA) along with LF-raising?

If human quantifiers *raise*, as in (47a),

(47a) [[every cat]$_1$ [Fido [chased t_1]]]

they seem to combine with open *sentences*, not relative clauses. So why think that [every cat] _both_ raises _and_ is of type <e**t**, **t**>?

Given raising, the best overall account may well posit a syncategorematic operation according to which (47a) is true iff *the cats are such that each one of them is such that Fido chased it*.

In Tarski-ese: (47a) is satisfied by an assignment $\mathcal{A}$, of values to variables, iff every cat is such that it is assigned to the index by *some 1-variant of* $\mathcal{A}$ that satisfies [Fido [chased t_1]]

If we want to say that 'every' and 'cat' are true of some things, we can say that (47a) is true relative to $\mathcal{A}$ iff
there are some ordered pairs that meet three conditions:

(a) _every_ one of their "internal elements"
is one of their "external elements";

(b) their internal elements are the _cat_s; and

(c) their external elements *are* the internal elements
that are assigned to the index by *some* 1-variant of $\mathcal{A}$,
$\mathcal{A}^*$, such that [Fido [chased t_1]] is true relative to $\mathcal{A}^*$.

But if we can handle (47a) with Θ-marking and Θ-binding, as opposed to (TYPES) and (FA), _do_ we need the latter?

If some syncategorematicity is unavoidable, how much categorematicity/typology do we need?

F. Some Remaining Questions, and a Possible Reduction

Should we posit (constrained) "covert raising" of quantifiers?

(57) It is false that every senator lied [Hornstein '84]
(57a) ~{∀x:SENATOR(x)[LIED(x)]}
#(57b) ∀x:SENATOR(x)[~LIED(x)]

(58) Most of the dogs chased most of the cats
(58a) Most of the dogs were agents of events that were chasings (by those dogs) of most the cats.
#(58b) Most of the cats were patients of events that were chasings (of those cats) by most of the dogs.

Which conjunction operation(s) do we want for modification?

(59) Fx **&** Gx

(60) Fa **&** Gb **&** Gx **&** Gy **&** Ryz **&** Rax **&** Szwv

(61) F(_)^G(_)
|_____|

(62) ∃X:THE-ANTS(X)[BIG-FOR(x, X)^ANT(x)]

(63) ∃x[EXTERNAL(e, x)^FIDOIZER(x)]

(64) ∃[Dyadic(_ , _)^Monadic(_)]
|___________|___________|

How many arguments can one verb really have?

(19) [[see a man] [with a telescope]]

(a) ∃y:MAN(y)[SAW(**e**, x, y) & ∃z:SCOPE(z)[WITH(**e**, z)]]
#(b) ∃y:MAN(y)[SAW(e, **x**, y) & ∃z:SCOPE(z)[WITH(**x**, z)]]

"Severate" e<u>x</u>ternal participants: Castañeda, Schein, Kratzer

(20) [[a woman] [see a man]]

∃x:WOMAN(x)[EXTERNAL(**e**, x)] & ∃y:MAN(y)[P-SEE(**e**, y)]

(20-*v*) [[a woman] [*v* [see a man]]]

(57) ‖see a man‖ = λ**E** . ∃y:MAN(y)[P-SEE(**e**, y)]

(58a) ‖*v*‖ = λ**E** . λx . λe . **EXTERNAL**(e, x) **& E**(e) *Level Three*
(58b) ‖*v*‖ = λ**E** . λΨ . λe . **EXTERNAL**(e, Ψ) **& E**(e) *Level Four*

Suppose each verb Θ-marks <u>*at most one*</u> argument: no Θ-<u>*grids*</u>

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(59) [[see ~~a~~ man] [with ~~a~~ telescope]] *Higgy 1987: 'a' as "grammatical grace note"*

(59a) ∃y[P-SEE(e, y)^MAN(y)]^∃z[WITH(e, z)^TELESCOPE(z)]

(59b) ∃[P-SEE(_ , _)^MAN(_)]^∃[WITH(_ , _)^TELESCOPE(_)]
|__________|________| |__________|______________|

(60) [hear [~~a~~ man fall]]

(60a) ∃y[P-HEAR(e, y)^∃z[FALL(y, z)^MAN(z)]]

 ____
| | |
(60b) ∃[P-HEAR(_ , _)^∃[FALL(_ , _)^MAN(_)]
|___________|__|______|

(61) [[~~a~~ woman] [see ~~a~~ man]]

(61a) ∃x[EXT(e, x)^WOMAN(x)]^∃y[P-SEE(e, y)^MAN(y)]

(61b) ∃[EXTERNAL(_, _)^WOMAN(_)]^∃[P-SEE(_, _)^MAN(_)]
|______________|___________| |_________|_______|

Three Packages

NC: limited Θ-marking/modification
syncategorematic Θ-binding
LF

HC: (TYPES)
(FA)
a few kinds of type-adjustment

LC: (TYPES; though in practice, higher types are less exploited)
(FA)
(PM)
LF
syncategorematic (PA)

It will be useful to develop and compare…

(i) the sparest versions of **NC** that have a prayer of approaching descriptive adequacy (i.e, not *under*generating) without appeal to further syncategorematic principles

(ii) the most constrained versions of **HC** that have a prayer of approaching explanatory adequacy (i.e, not *over*generating)

LC invites reduction. Indeed, absent reduction, it isn't clear what question **LC** is supposed to answer.

Higginbotham's conception of semantics, as articulated in "On Semantics," offered a substantive (though not yet adequate) answer to a relatively clear and very interesting question concerning "systems of human linguistic knowledge."

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7 dogs	D1 chased C1-C5	*<u>five</u> of the seven dogs*
7 cats	D2 chased C1-C5	*chased <u>five</u> of the seven cats;*
	D3 chased C1-C5	*but only <u>three</u> of the seven*
D6 and D7	D4 chased C3-C7	*cats were chased by*
slept	D5 chased C3-C7	*<u>more than three</u> of the dogs*