FUNCTIONAL READINGS

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1 *Roadmap*

- In the last weeks, we've pitted two approaches to pied-piping in *wh*-questions against one another:
- According to the Charlow 2019c/Demirok 2019 theory of pied-piping, overtly pied-piped material is interpreted at LF.

(1) Whose picture do you admire?
(2) LF (Charlow-style):
$\star$ [$\star$ who] λx ? t_x's painting λi ? you admire t_i.
(3) LF (Demirok-style):
λp [$\exists$ λi [$\exists$ person] ?(i) λx x's painting] λi ?(p) you admire t_i.

- Advantages:
  - Treating ? as a polymorphic function seeking an *intensional* argument resolves von Stechow's problem, by forcing the pied-piped material to semantically reconstruct for intensionality.
  - Remember, a crucial component of this explanation was the *scope theory of intensionality* (von Fintel & Heim 2021, Keshet 2008, 2011), according to which whether an expression is interpreted *de dicto*/*de re* is determined by scope.
  - A theory with world-pronouns such as Percus's (2000) (the *binding theory of intensionality*) isn't sufficiently restrictive to derive the same results, in the absence of some additional restrictions.[1]
- Disadvantages:
  - Although the attested reading of pied-piping configurations can be derived, the unattested *total de re* interpretation that concerns von Stechow isn't blocked without additional stipulations — concretely, the pied-piped material can't leave behind an *extensional* trace.
  - As pointed out by Filipe, the Charlow/Demirok approach gives rise to over-generation issues, e.g., involving responsive predicates as illustrated in (4).

[1] We need to say something like: a world-pronoun whose sister is an intensional trace is obligatorily bound by the most local λw operator.

- There's an incompatibility between the Charlow/Demirok approach and the *copy theory of movement* (Fox 1999), stemming from an (apparent) incompatibility between the copy theory and the scope theory of intensionality. This can be appreciated in even simple *wh*-questions like (5).[2]
- According to the scope theory of intensionality, the lower copy gets interpreted in the skein of the question operator, whereas the higher-copy gets interpreted relative to the utterance evaluation world.

[2] It's difficult to see how to account for the intricate interactions between semantic reconstruction and condition C without some version of the copy theory — see, e.g., Fox 1999.

(4) Who knows [what Mary bought]?
   a. # John knows that Mary bought War and Peace,
      Bill knows that Mary bought The Idiot...
   b. John knows what Mary bought.

(5) Which book [? did you read which book].

An alternative perspective on pied-piping has been outlined by Danny over the last couple of weeks: overt pied-piping is *undone* at LF via syntactic reconstruction.

(6) Who [do you admire [*t*'s painting]]?

Evidence for this perspective, and an important challenge for pied-piping at LF, comes from facts concerning Parasitic Gap (PG) licensing (Fox and Nissenbaum; last week's class).

(7) [Whose$_1$ painting]$_2$ did you try to see [before talking to PG$_1$]?

Assuming Nissenbaum's (2000) theory of PG-licensing, it's difficult to see how to get this without invoking cyclic scope of the pied-piper alone at LF.

Today, we'll be looking at a phenomenon which we haven't seen before — *functional answers to questions*.

The account of functional answers we'll lean on is Heim's (2012), which leans crucially on the copy theory of movement.[3]

[3] If there is time/interest next week, I can talk about ways of deriving functional readings of questions without copies (Jacobson 2000, Charlow 2019a).

This will raise important questions about how functional readings of questions fit into a broader theory of intensionality.

2 *Functional answers*

(8) Who/which person does every Italian male love?
   a. his mother.
   b. Giovanni, Maria; Paolo, Francesca; …

(Chierchia 1992: p. 78)

QUESTION: can the answer in (8a) be viewed as shorthand for the Pair List (PL) answer in (8b)?

ANSWER: No. (8a) and (8b) just don't convey the same information.

(9) a. Gennaro knows who every Italian male loves,
   but he doesn't know that Giovanni loves Maria
   and that Paolo loves Francesca.
   b. Gennaro knows that Giovanni loves Mari,
   and that Paolo loves Francesca,
   but he doesn't know who every Italian male loves.

Crucially, certain questions with certain quantifiers countenance *functional answers* but not PL answers (Groenendijk & Stokhof 1984).

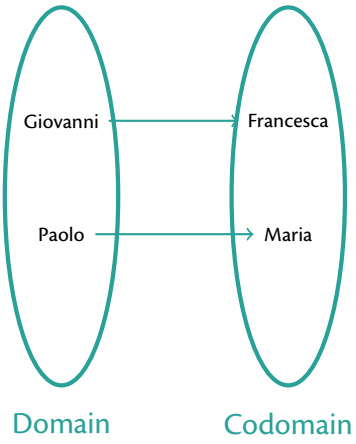
(10) Who/which person does no Italian male like?
   a. His mother-in-law.
   b. *Giovanni, Maria; Paolo, Francesa; …

(Chierchia 1992: p. 78)

(11) Who/which person do few Italian males like?
   a. Their mother-in-law.
   b. *Giovanni, Maria; Paolo, Francesa; …

Intuitively, the answer in (8a) and (10a) specifies a *function* whose domain is the set of *Italian males* — concretely, that the function that maps Italian males to their mothers in (8a), and to their mother-in-laws in (10a).

Figure 1: *mother-of* function



Another reason to doubt the equivalence: let's add that as well as his mother *Maria*, Giovannni also loves *Carmela*.

- The PL answer in (12b) is no longer felt to be a complete answer to the question.
- The functional answer in (12c), on the other hand, is still felt to be a complete answer (or so claim Groenendijk & Stokhof 1984).

(12) Who does every Italian male love?
   a. Giovanni loves Francesca and Carmela, and Paolo loves Maria.
   b. #Giovanni loves Francesa, and Paolo loves Maria.
   c. His mother.

3 *Engdahl's analysis (via Heim)*

In Heim's (2012) presentation of Engdahl 1986, Heim focuses on cases involving a bound reflexive in the restrictor of the *which*-phrase:

(13) Which picture of herself did no girl submit?
  a. Her self-portrait. *functional answer*

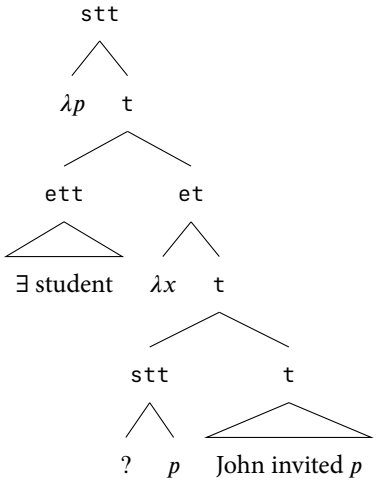
An immediate question that arises is how *herself* comes to be bound. This is one important respect in which Engdahl and Heim's analyses come apart; according to Engdahl, *herself* is bound indirectly by a type-shifted **E** inserted at the edge of the restrictor. According to Heim, *herself* is really semantically bound by *no girl*.

Background assumption: the ∃-theory of *wh*-composition, as introduced by Kai/Danny.[4]

[4] The discussion here and in Heim 2012 is fully compatible with a selective scope-taker approach, as far as I can see.

(14) Which student did John invite?

(15)



(16) $\lambda p\,.\,\exists x[\textbf{student}_{@}(w) \wedge p = \lambda w\,.\,\textbf{John invited}_{w}\ x]$

Engdahl's analysis of functional readings is as follows:

(17) Which picture of herself did no girl submit?

Important ingredients:

- A covert type-shifter **E** is inserted at the edge of the restrictor, which semantically binds the reflexive, and converts the restrictor into a predicate of skolem functions.

- *which* denotes a *polymorphic* existential determiner — as well as individuals, *which*-phrases can also quantify over *skolem functions* (i.e., functions from individuals to individuals, of type $\langle \mathtt{e}, \mathtt{e} \rangle$).
- *Wh*-movement may leave behind a *layered trace*, consisting of a functional variable f, and a covert pronoun x, the latter of which may be semantically bound by something other than the moving expression.

A schematic LF:

(18) λp which $\mathbf{E}_1$ picture of herself$_1$ λf ?(p) no girl $\lambda x\ t_x$ submitted $t_f(x)$

The operator $\mathbf{E}_n$ combines with a property P, and triggers abstraction over n, forming a derived relation R.

It takes R and returns (the characteristic function of) a set of skolem functions, i.e., a function from an entity x to an entity, such that $\langle f(x), x \rangle \in R$.[5]

[5] This definition for **E** is a little different to the one given by Heim 2012, i'm simply factoring out abstraction.

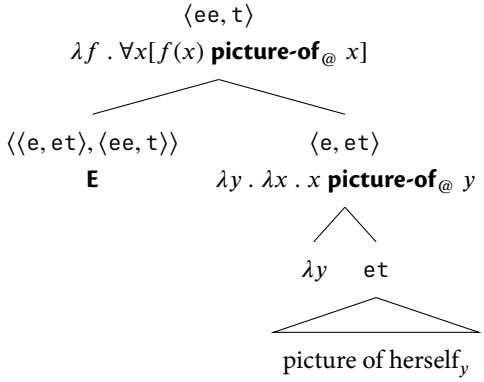
The official definition of **E**:

(19) $\mathbf{E} \coloneqq \lambda R\ .\ \lambda f\ .\ \forall x[R(x)(f(x))]$ $\qquad\qquad$ $\langle\langle \mathtt{e}, \mathtt{et} \rangle, \langle\langle \mathtt{e}, \mathtt{e} \rangle, \mathtt{t} \rangle\rangle$

E is inserted below *which* in the restrictor of the *which*-phrase, thereby binding the reflexive in the restrictor:

(20) [$\mathbf{E}_1$ [picture of herself$_1$]]

(21)



An aside — even in the absence of a reflexive, we can still get a functional reading by insert **E**, which induces vacuous abstraction:

(22) $[\![\mathbf{E}\ \text{picture}]\!]^{@} = \lambda f\ .\ \forall x[\mathbf{picture}_{@}(f(x))]$

Since the restrictor ends up denoting a set of skolem functions, we must treat

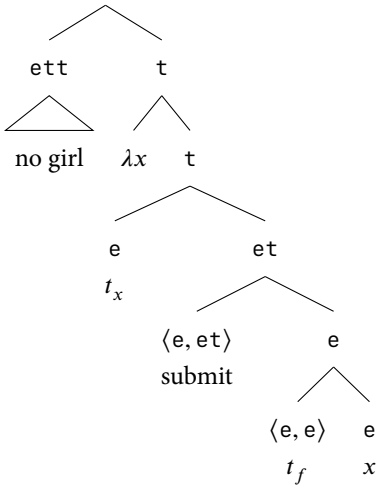
which as a polymorphic existential determiner — as well as individuals, *which* can quantify over skolem functions.

(23) $[\![\text{which}]\!]^{@} := \lambda r\,.\,\lambda k\,.\,\exists x[r(x) \wedge k(x)]$ $\quad\langle \sigma\mathtt{t}, \sigma\mathtt{tt}\rangle$

We can now compute the meaning of the TP — movement of the *which*-phrase will leave behind a functional trace — we insert a covert individual variable as the complement of the trace, semantically bound by *no girl*:[6] The result is a proposition:

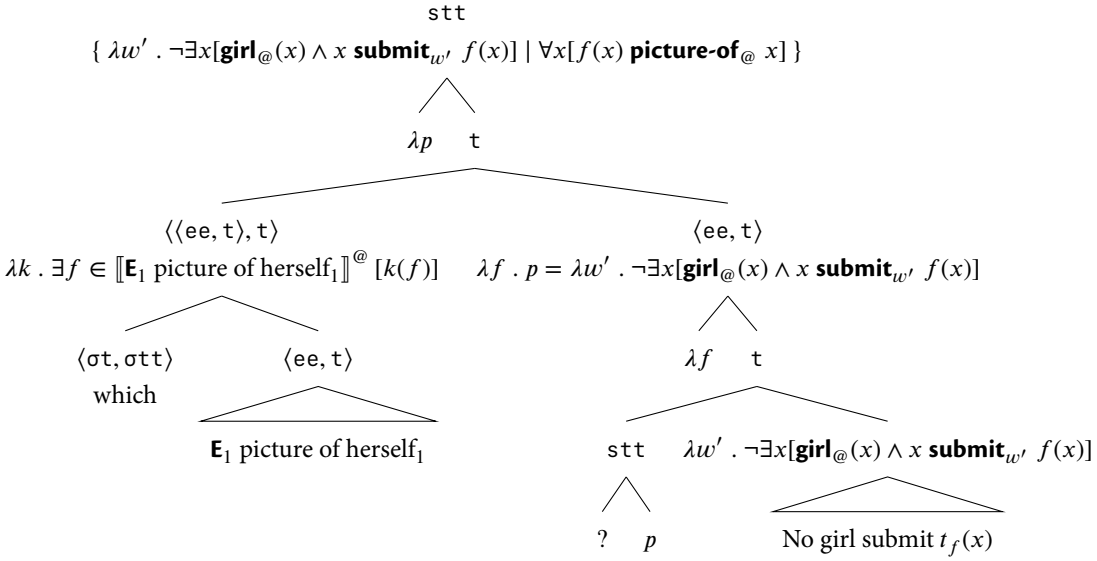
[6] N.b. throughout the discussion, Heim assumes that NPs are interpreted *de re*. We'll come back to this.

(24) $\lambda w'\,.\,\neg\exists x[\textbf{girl}_{@}(x) \wedge x\ \textbf{submit}_{w'}\ f(x)]$



Now that we have the meaning of the TP, and the *wh* restrictor, we can compute the meaning of the question:

(25)



Consider the final meaning of the question:

(26) $\{\ \lambda w' \ .\ \neg\exists x[\textbf{girl}_{@}(x) \wedge x\ \textbf{submit}_{w'}\ f(x)] \mid \forall x[f(x)\ \textbf{picture-of}_{@}\ x]\ \}$

Answers will vary according to total functions f that map individuals in the domain to actual pictures of themselves. To simply, let's assume that our domain only contains *girls*.[7]

[7] This is an unrealistic simplification, as we'll see.

- $f_{\text{self-portrait}}$: maps individuals to their (actual) self-portraits.
- f_{selfie}: maps individuals to their (actual) selfies.
- $f_{\text{caricature}}$: maps individuals to their (actual) caricature.

$$\left\{\begin{array}{c}\textbf{that no girl}_{@}\ x\ \textbf{submitted}\ f_{\text{self-portrait}}(x)\\ \textbf{that no girl}_{@}\ x\ \textbf{submitted}\ f_{\text{selfie}}(x)\\ \textbf{that no girl}_{@}\ x\ \textbf{submitted}\ f_{\text{caricature}}(x)\end{array}\right\} = \left\{\begin{array}{c}\textbf{that no girl}_{@}\ x\ \textbf{submitted}\ x\textbf{'s self-portrait}_{@}\\ \textbf{that no girl}_{@}\ x\ \textbf{submitted}\ x\textbf{'s selfie}_{@}\\ \textbf{that no girl}_{@}\ x\ \textbf{submitted}\ x\textbf{'s caricature}_{@}\end{array}\right\}$$

To recap, three innovations were necessary to derive the functional reading:

1. Variable binding within NP, via a covert operator **E**.
2. A polymorphic entry for *which* (i.e., an existential determiner of type $\langle \sigma\mathtt{t}, \sigma\mathtt{tt}\rangle$).
3. Layered traces — complex traces consisting of a *choice-functional variable* f, bound in the usual by the moved constituent, and an *individual variable* x, bound by some other expression (here, the QP subject).

Heim's goal: (i) Refine the analysis in light of implicit assumptions regarding partiality. (ii) Reconstruct the analysis in terms of the independently-motivated machinery for interpreting chains in light of copy-theoretic approaches to movement; thereby eliminate **E**.

3.1 Interlude: projecting partiality

In the following we're going to be dealing with (potentially) partial functions, so let's be precise about how our semantic composition principles deal with potential partiality:

Function application (Heim & Kratzer 1998, von Fintel & Heim 2021):

$$\left[\!\!\left[\begin{array}{c} \cdots \\ \alpha \quad \beta \end{array} \right]\!\!\right]^{w,g} = \begin{cases} [\![\alpha]\!]^{w,g}([\![\beta]\!]^{w,g}) & [\![\beta]\!]^{w,g} \in \textbf{dom}([\![\alpha]\!]^{w,g}) \\ \text{undefined} & \text{else} \end{cases}$$

Predicate Abstraction:

$$\left[\!\!\left[\begin{array}{c} \cdots \\ n \quad \gamma \end{array} \right]\!\!\right]^{w,g} = \lambda x \,.\, \begin{cases} [\![\gamma]\!]^{w,g[x/n]} & \gamma \in \textbf{dom}([\![.]\!]^{w,g[x/n]}) \\ \text{undefined} & \text{else} \end{cases}$$

3.2 Partiality in functional readings

Consider again the meaning that Engdahl would ascribe to the question to capture the functional answer:

(27) $\{\, \lambda w' \,.\, \neg\exists x[\textbf{girl}_{@}(x) \wedge x\ \textbf{submit}_{w'}\ f(x)] \mid \forall x[f(x)\ \textbf{picture-of}_{@}\ x] \,\}$

Heim points out that elements of the answer set vary according to functions f, which, for every element x in the domain, map x to a picture of x.

As long as there is at least one individual in the domain which hasn't had its picture taken, no such functions will exist, so the denotation in (27) can't be quite right — in fact, the functions in question intuitively only need to be defined for *girls*.

Intuitively, the answers in the question denotation should vary according to *partial* functions. Let's change the definition of **E** so that it can handle partial functions:[8]

(28) $\textbf{E} \coloneqq \lambda R \,.\, \lambda f \,.\, \forall x[x \in \textbf{dom}(f) \rightarrow R(x)(f(x))] \qquad \langle\langle \mathtt{e}, \mathtt{et}\rangle, \langle \mathtt{ee}, \mathtt{t}\rangle\rangle$

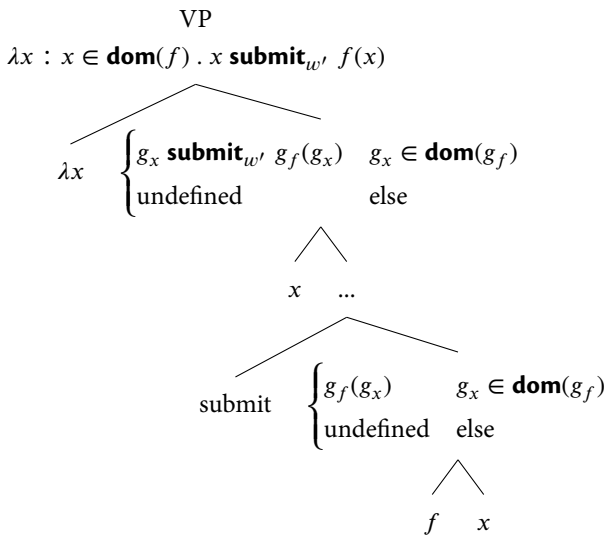
[8] The presupposition of f is accommodated within the restrictor of the universal.

As we've mentioned, the functions that the answers in the question denotation range over should (at least) be defined for all girls.

(29) Which picture of herself did no girl^{x} $\boxed{t_x \text{ submit } f(x)}$

Let's compute the meaning of TP (the scope site of the negative indefinite), taking into account the possibility that f is a *partial* function.

(30)



After abstraction triggered by movement of *no girl*, we have a partial function that is only defined for individuals already in the domain of f.

Now to compose *no girl* with its sister, a partial function.

(31) Which picture of herself did no girl^{x} t_x submit $f(x)$

Assumption: presuppositions project *universally* from under negative indefinites.

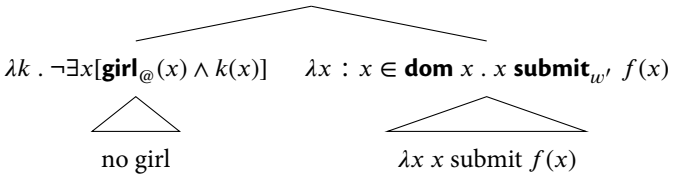
We can independently motivate this assumption by looking at the behaviour of presuppositions under the scope of negative indefinites.

(32) No girl parked her bicycle. presupposes: *every girl has a bicycle*

(33) $\begin{cases} \textbf{no girl parked her bicycle} & \textbf{every girl has a bicycle} \\ \text{undefined} & \text{else} \end{cases}$

Now we can compose the partial function denoted by the scope site with *no girl* — the resulting presupposition is that *every girl is in the domain of* f.

(34) $\begin{cases} \neg\exists x[\textbf{girl}_{@}(x) \wedge x \textbf{ submit}_{w'} f(x)] & \forall x[\textbf{girl}_{@}(x) \rightarrow x \in \textbf{dom}(f)] \\ \text{undefined} & \text{otherwise} \end{cases}$



Now we have a question nucleus which denotes a partial proposition. If we compose the rest of the *wh*-question using Engdahl's machinery, the result is a set of "partial" propositions, which vary across potentially partial functions f mapping individuals to pictures of themselves, and are defined iff every actual girl is in the domain of f.

The resulting question denotation:

(35) $\{ \lambda w' : \forall x[\textbf{girl}_{@}(x) \rightarrow x \in \textbf{dom}(f)] . \neg\exists x[\textbf{girl}_{@}(x) \wedge x \textbf{ submit}_{w'} f(x)] \mid \forall x[x \in \textbf{dom}(f) \rightarrow f(x) \textbf{ picture-of}_{@} x] \}$

As Heim (2012) observes, once we compute the question denotation, answers will never be partial propositions in a meaningful way.

Let's assume that the domain of $f_{\text{self-portrait}}$ is $\{ x \mid \textbf{girl}_{@}(x) \}$, and furthermore that f maps each girl to her unique *self-portrait*.

The resulting proposition in the answer set will be total, since the presupposition is satisfied:

(36) $\lambda w' : \forall x[\textbf{girl}_{@}(x) \rightarrow x \in \textbf{dom}(f_{\text{self-portrait}})] . \neg\exists x[\textbf{girl}_{@}(x) \wedge x \textbf{ submit}_{w'} f_{\textbf{self-portrait}}(x)]$

Now let's imagine a different function f_{selfie}, and the domain of f_{selfie} is $\{ x \mid \textbf{has-cellphone}_{@}(x) \}$; a set which only partially overlaps with the set of girls. f_{selfie} maps each individual in the domain to their unique selfie.

(37) $\lambda w' : \forall x[\textbf{girl}_{@}(x) \rightarrow x \in \textbf{dom}(f_{\text{selfie}})] . \ldots$

Since the presupposition is false, the resulting proposition will be undefined for every world in the domain.

Since every proposition is the resulting answer set is either total, or undefined for every world, we can rewrite the resulting question denotation as follows:

(38) $$\left\{ \lambda w' \,.\, \neg\exists x[\textbf{girl}_{@}(x) \wedge x\ \textbf{submit}_{w'}\ f(x)] \;\middle|\; \begin{array}{l} \forall x[\textbf{girl}_{@}(x) \rightarrow x \in \textbf{dom}(f)] \\ \wedge\, \forall x[x \in \textbf{dom}(x) \rightarrow f(x)\ \textbf{picture-of}_{@}\ x] \end{array} \right\}$$
$$\cup \{ \lambda w' \,.\, \# \}$$

As Heim (2012) points out, the presence of the pathological element makes no difference for how the resulting Hamblin set partitions worlds in the context set.[9]

[9] Once we tweak our algorithm for partitioning based on a Hamblin set, in light of the possibility of partial propositions, we can demand that two worlds w and w' are cell-mates iff they are defined at and return the same truth value for every proposition in the Hamblin set.

Disregarding the pathological element, the desired result is achieved — every answer in the question denotation involves a function whose domain includes all the girls in the actual world.

$$= \left\{ \begin{array}{c} \lambda w' \,.\, \neg\exists[\textbf{girl}_{@}(x) \wedge x\ \textbf{submit}_{w'}\ f_{\text{self-portrait}}(x)] \\ \lambda w' \,.\, \neg\exists[\textbf{girl}_{@}(x) \wedge x\ \textbf{submit}_{w'}\ f_{\text{caricature}}(x)] \\ \ldots \end{array} \right\}$$

$f_{\text{self-portrait}}$: a partial function whose domain is the actual girls, and which maps them all to their actual self-portraits; $f_{\text{caricature}}$: a partial function whose domain is the actual girls, and which maps them all to their actual caricatures...

Having clarified the role of partiality in Engdahl's analysis, the goal now will be to refine and reconstruct the analysis in terms of independently motivated mechanisms for interpreting copies, thereby eliminating **E**.

4 *Heim's refinement*

4.1 *Background: the copy theory of movement*

Crucial assumption: the restrictor of the *wh*-expression may be interpreted *in-situ*.

There are two ways of cashing out this conjecture; Heim adopts the second:

- At Logical Form, *which*-phrases are interpreted *in-situ* as definite descriptions (Rullmann & Beck 1998).

- Movement leaves behind a *copy*, which is converted into a *bound definite description* at LF (Fox 1999).

Independent motivation for the Rullmann & Beck 1998 conjecture: *which*-phrases sub-extracted from intensional contexts can be interpreted *de dicto*.

(39) John believes that there is unicorn.
Which unicorn$_i$ does John think that Mary tried to catch the$_i$ unicorn?

Cf. projection behaviour of definite descriptions under attitude verbs (Heim 1992) (modulo proviso inferences):

(40) John believes that there is a unicorn and
John thinks that Mary tried to catch the unicorn.

In order to interpret lower copies, we need two type-shifters: Partee's (1986) THE and IDENT.

IDENT is essentially a concretely-typed variant of ?:

(41) **IDENT** $\coloneqq \lambda x \,.\, \lambda y \,.\, y = x$ $\langle \mathtt{e}, \mathtt{et} \rangle$

THE is a covert definite determiner:

(42) **THE** $\coloneqq \lambda k \;:\; \exists!x[k(x)] \,.\, \iota x[k(x)]$ $\langle \mathtt{et}, \mathtt{e} \rangle$

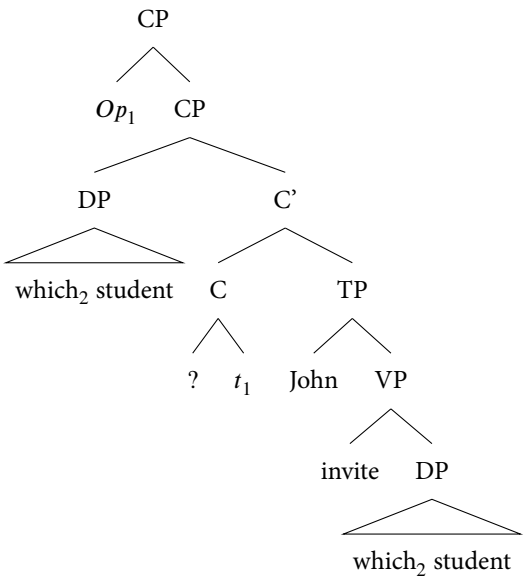
We'll also need to assume that *which* is interpreted as an *unrestricted* existential quantifier:

(43) $[\![\text{which}]\!] = \lambda k \,.\, \exists x[k(x)]$ $\mathtt{ett}$

The structure delivered by the narrow syntax for a simple question:

(44) Which student did John invite?

(45)



Schematic algorithm for trace converstion at LF:

(46) a. λp [which$_2$ student] ?(p) John invite [which$_2$ student]

b. λp [which student] λ_2 ?(p) John invite [which 2 student]

⇒ *insert binder and variable*

c. λp [which ~~student~~] λ_2 ?(p) John invite [~~which~~ 2 student]

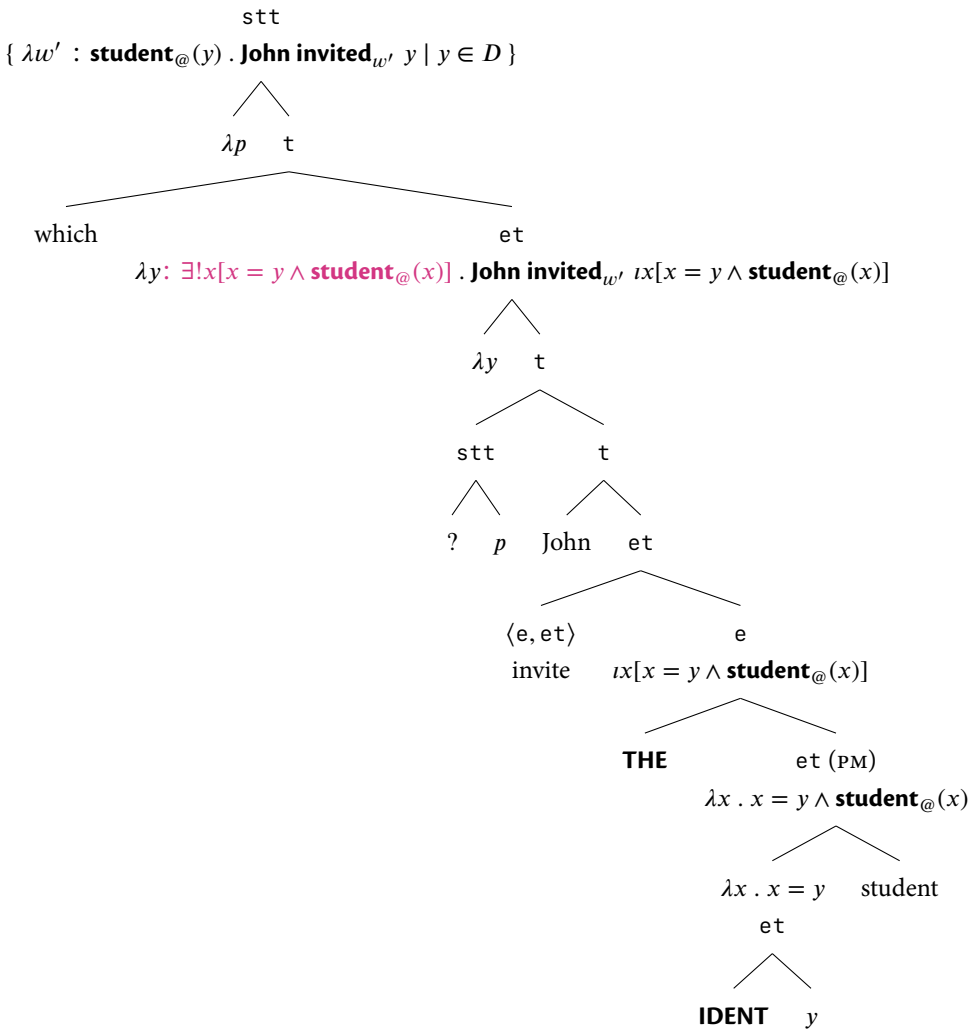
⇒ *delete higher restrictor and lower determiner*

d. λp which λ_2 ?(p) John invite [**THE** [**IDENT** 2] student]

⇒ *Rescue lower copy using type-shifters*

The resulting LF can now be interpreted; LF of the *which*-question post trace conversion:

(47)



Since the restrictor of the *which*-phrase is interpreted *de re*, the resulting propositions in the question denotation are not really partial; rather, they are either *total* propositions, if *y* is a student in @, or the unique proposition undefined for any world.

(48) { λw′ : **student**$_{@}$(y) . **John invited**$_{w'}$ y | y ∈ D }

This is equivalent to:

(49) { λw′ . **John invited**$_{w'}$ y | **student**$_{@}$(y) } ∪ { λw . # }

As acknowledged by Heim, the proposal here is not obviously compatible with the *scope theory of intensionality*; the restrictor in the lower copy is interpreted *de re*, despite occurring within the scope of ?.

4.2 Functional readings via complex copies

(50) Which picture of herself did no girl submit?

The plan: generalize the basic theory to functional readings. We'll need to adopt polymorphic entries for *which*, and the type-shifters responsible for interpreting lower copies, as well as mechanisms for constructing something analogous to layered traces.

Which is a polymorphic existential quantifier, which will allow *which* to quantify over skolem functions.

(51) $[\![\text{which}]\!] \coloneqq \lambda k \,.\, \exists x[k(x)]$ $\sigma\mathtt{tt}$

IDENT takes any value, and returns the (characteristic function of) the singleton set containing that value.

(52) **IDENT** $\coloneqq \lambda x \,.\, \lambda y \,.\, y = x$ $\langle \sigma, \sigma\mathtt{t} \rangle$

THE is a polymorphic definite determiner.

(53) **THE** $\coloneqq \lambda k \;:\; \exists! x[k(x)] \,.\, \iota x[k(x)]$ $\langle \sigma\mathtt{t}, \sigma \rangle$

We'll also need to allow for insertion of covert pronouns, in order to derive something corresponding to a *layered trace*.

The structure of the question (under the functional reading) delivered by the narrow syntax:

(54) λp [which picture of herself$_y$]$_2$
?(p) no girl λy y submit [which$_2$ picture of herself$_y$]

Post TC:

(55) λp which λf
?(p) no girl λy y submit [**THE** [**IDENT** f] picture of herself$_y$]

Recue via insertion of covert pronoun:

(56) λp which λf
?(p) no girl λy y submit [**THE** [**IDENT** $f(pro_y)$] picture of herself$_y$]

Note immediately that the reflexive is *semantically bound* by *no girl*; the reflexive in the higher copy is simply deleted, along with the rest of the restrictor.

A PREDICTION(?): functional readings of questions should *always* feed condition C violations.

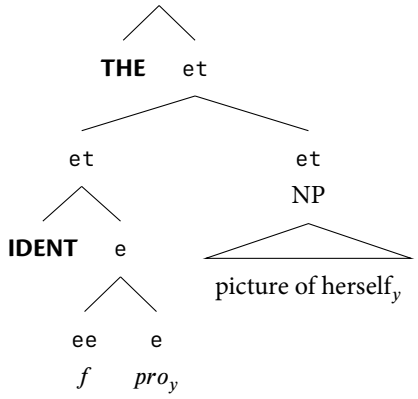
(57) Which picture of John did he show no girl?
a. ?The one she wanted to see the most.

Since, post TC:

(58) λp which λf
?(p) no girl λy he show [**THE** [**IDENT** $f(pro_y)$] picture of John]

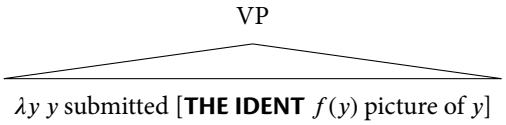
The structure of the lower copy, post trace conversion + insertion of covert pronouns; pro_y will eventually be semantically bound by the quantificational subject.

(59)
$$\begin{cases} g_f(g_y) & g_y \in \textbf{dom}(g_f) \wedge g_f(g_y)\ \textbf{picture-of}_@\ g_y \\ \text{undefined} & \text{otherwise} \end{cases}$$



As composition proceeds, abstraction over y yields a partial function:

(60) $\lambda y : y \in \textbf{dom}(f) \wedge f(y)\ \textbf{picture-of}_@\ y\ .\ y\ \textbf{submitted}_{w'}\ f(y)$



The presupposition projects universally through *no girl*:

(61)

$$\begin{cases} \neg\exists y[\textbf{girl}_{@}(y) \wedge y \textbf{ submitted}_{w'} f(y)] & \forall y[\textbf{girl}_{@}(y) \rightarrow y \in \textbf{dom}(f) \wedge f(y) \textbf{ picture-of}_{@} y] \\ \text{undefined} & \text{else} \end{cases}$$

TP

No girl submitted [**THE IDENT** $f(y)$ picture of y]

Again, because the restrictor is interpreted *de re*, the propositions in the answer set are never partially defined.

(62) $\{ \lambda w' . \neg\exists y[\textbf{girl}_{@}(y) \wedge y \textbf{ submitted}_{w'} f(y)] \mid \forall y[\textbf{girl}_{@}(y) \rightarrow y \in \textbf{dom}(f) \wedge f(y) \textbf{ picture-of}_{@} y] \} \cup \{ \lambda w' . \# \}$

4.3 Comparison with Engdahl

One of the main differences between Heim 2012 and Engdahl 1986 is that, on Heim's approach, the reflexive in the restrictor really is (semantically) bound by its antecedent; on Engdahl's approach, the reflexive is *indirectly* bound by **E**.

Evidence for *direct* binding: ϕ-feature transmission (examples from Heim 2012: p. 12):

(63) Which picture of himself/*herself did no boy submit.
(64) Which relative of theirs did most people complain about?
(65) Which mistake that we have made will none of us ever forgive ourselves?

N.b., as Heim acknowledges, the force of this argument depends on the assumption that ϕ-features on bound pronouns/reflexives are determined configurationally (*feature transmission*; Kratzer 2009).

5 Next week

Depending on preferences, we may cover the following topics:

- Extensions of Heim's theory, and implications for relative clauses.
- Heim's theory and *de re*/*de dicto* readings.

- Paycheck pronouns, and functional readings without copies (Jacobson 2000, Charlow 2019a).

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