The Proper Treatment of Quantification in Ordinary English, Part 3: The Translation System, Part 2 [1]

Thus far, our discussion of the translation system in PTQ has assiduously avoided transitive verbs, and the whole issue of how the contrast between **seek** *and* **eat** *is to be approached…*

Before we can lay out Montague's solution, however, we need to get two other items on the table.

1. Quantifying In and the *De Re* / *De Dicto* Ambiguity

Rule T7 below will allow us to translate/interpret sentences like **John believes that Mary runs**.

(1) **Rule T7 (For Finite Complements of PA Verbs)**

If $\delta \in P_{IV/t}$ and $\beta \in P_t$, and δ, β translate into δ', β' respectively, then $F_6(\delta, \beta)$ translates into δ'(^β')

(2) **Illustration of Rule T7**

a. *Obtaining the Translation*

(i) **believe that** $\in P_{IV/t}$, **Mary runs** $\in P_t$ (S1, S4)
(ii) **believe that** translates into **believe that'** (T1)
(iii) **Mary runs** translates into [λP[P{*m*}]](^**run'**) (T1, T4)
(iv) F_6(**believe that**, **Mary runs**) translates into
believe that'([^[λP[P{*m*}]](^**run'**)]) (T7)
(v) **believe that Mary runs** translates into
believe that'([^[λP[P{*m*}]](^**run'**)]) (def. of F_6)
(vi) **John** $\in P_T$, **believe that Mary runs** $\in P_{IV}$ (S1, S7)
(vii) F_4(**John**, **believe that Mary runs**) translates into
[λP[P{*j*}]]([^**believe that'**([^[λP[P{*m*}]](^**run'**)])]) (T4)
(viii) **John believes that Mary runs** translates into
[λP[P{*j*}]]([^**believe that'**([^[λP[P{*m*}]](^**run'**)])]) (def. of F_4)

b. *Simplifying the Translation*

(i) [λP[P{*j*}]]([^**believe that'**([^[λP[P{*m*}]](^**run'**)])]) ⇔ (α-conversion)
(ii) [λP[P{*j*}]]([^**believe that'**([^[λQ[Q{*m*}]](^**run'**)])]) ⇔ (λ-conversion)
(iii) [^**believe that'**([^[λQ[Q{*m*}]](^**run'**)])]{*j*} ⇔ (CBN, DUC)
(iv) **believe that'**([^[λQ[Q{*m*}]](^**run'**)])(j) ⇔ (λ-conversion, CBN, DUC)
(v) **believe that'**([^**run'**(*m*)])(j)

[1] These notes are based upon material in Dowty *et al*. (1981) Chapter 7.

A major component of the overall PTQ system is the translation rule for structures formed by 'Quantifying In' (Rules S14-S16). It's none too different from the translation rule in our 'toy' PTQ system…

(3) **Rule T14 (For Translating 'Quantifying-In' Structures)**

If $\alpha \in P_T$, $\varphi \in P_t$, and α, φ translate into α', φ' respectively, then $F_{10,n}(\alpha, \varphi)$ translates into $\alpha'([\hat{}\lambda x_n\ \varphi'])$

Note: Again, following our general pattern, in the translation of $F_{10,n}(\alpha, \varphi)$, the translation of α takes as argument the *intension* of $[\lambda x_n\ \varphi']$.

(3) **Illustration of Rule T14**

a. *Obtaining the translation*

(i) **he₃** translates into $\lambda P[P\{x_3\}]$, **run** translates into **run'** (T1)

(ii) **he₃ runs** translates into $\lambda P[P\{x_3\}](\hat{}\mathbf{run'})$ (T4, def. of F_4)

(iii) **a man** translates into $\lambda P\ \bigvee x[\mathbf{man'}(x) \wedge P\{x\}]$ (T2, def. of F_2)

(iv) $F_{10,3}$(**a man**, **he₃ runs**) translates into
$\lambda P\ \bigvee x[\mathbf{man'}(x) \wedge P\{x\}]([\hat{}\lambda x_3[\lambda P[P\{x_3\}](\hat{}\mathbf{run'})]])$ (T14)

b. *Simplifying the Translation*

(i) $\lambda P\ \bigvee x[\mathbf{man'}(x) \wedge P\{x\}]([\hat{}\lambda x_3[\lambda P[P\{x_3\}](\hat{}\mathbf{run'})]])$ ⇔ (α-conversion)

(ii) $\lambda P\ \bigvee x[\mathbf{man'}(x) \wedge P\{x\}]([\hat{}\lambda x_3[\lambda Q[Q\{x_3\}](\hat{}\mathbf{run'})]])$ ⇔ (λ-conversion)

(iii) $\bigvee x[\mathbf{man'}(x) \wedge [\hat{}\lambda x_3[\lambda Q[Q\{x_3\}](\hat{}\mathbf{run'})]]\{x\}]$ ⇔ (CBN, DUC)

(iv) $\bigvee x[\mathbf{man'}(x) \wedge [\lambda x_3[\lambda Q[Q\{x_3\}](\hat{}\mathbf{run'})]](x)]$ ⇔ (λ-conversion)

(v) $\bigvee x[\mathbf{man'}(x) \wedge [\lambda Q[Q\{x\}](\hat{}\mathbf{run'})]\ ]$ ⇔ (λ-conversion)

(vi) $\bigvee x[\mathbf{man'}(x) \wedge [\hat{}\mathbf{run'}]\{x\}]$ ⇔ (CBN, DUC)

(vii) $\bigvee x[\mathbf{man'}(x) \wedge \mathbf{run'}(x)]$

With Rules T7 and T14 on the table, we can now capture the well-known 'de re / de dicto' ambiguity in a sentence like **John believes that a man runs.**

(4) **The De Dicto Reading**

a. **a man runs** translates into $[\lambda P \vee x[\mathbf{man'}(x) \wedge P\{x\}]]({}^\wedge\mathbf{run'})$ (T1, T2, T4)

b. **believe that a man runs** translates into
$\mathbf{believe\ that'}([{}^\wedge[\lambda P \vee x[\mathbf{man'}(x) \wedge P\{x\}]]({}^\wedge\mathbf{run'})])$ (T7)

c. **John believes that a man runs** translates into
$[\lambda P[P\{j\}]]([{}^\wedge\mathbf{believe\ that'}([{}^\wedge[\lambda P \vee x[\mathbf{man'}(x) \wedge P\{x\}]]({}^\wedge\mathbf{run'})])])$ (T4)

d. $[\lambda P[P\{j\}]]([{}^\wedge\mathbf{believe\ that'}([{}^\wedge[\lambda P \vee x[\mathbf{man'}(x) \wedge P\{x\}]]({}^\wedge\mathbf{run'})])])$
⇔ (α-conversion, λ-conversion, CBN, DUC)

e. $\mathbf{believe\ that'}([{}^\wedge[\lambda Q \vee x[\mathbf{man'}(x) \wedge Q\{x\}]]({}^\wedge\mathbf{run'})])(j)$
⇔ (λ-conversion, CBN, DUC)

f. $\mathbf{believe\ that'}([{}^\wedge\vee x[\mathbf{man'}(x) \wedge \mathbf{run'}(x)]])(j)$

<u>Note:</u>
Under this translation, **John believes that a man runs** ends up being true *iff* John stands in the **believe that'** relation to the proposition "there is a man who runs".

- Under the auxiliary assumption that *x* stands in the **believe that'** relation to *p iff p* is true in all of *x*'s belief worlds, we see that this translation garners us the so-called *de dicto* reading of the sentence:
  - I.e., in all of John's belief worlds, there is a man (in that world) who runs (in that world).

(5) **The De Re Reading, Part 1: Obtaining the Translation**

a. **he$_3$ runs** translates into $\lambda P[P\{x_3\}]({}^\wedge\mathbf{run'})$ (T1, T4)

b. **believe that he$_3$ runs** translates into
$\mathbf{believe\ that'}([{}^\wedge[\lambda P[P\{x_3\}]({}^\wedge\mathbf{run'})]])$ (T7)

c. **John believes that he$_3$ runs** translates into
$[\lambda P[P\{j\}]]([{}^\wedge\mathbf{believe\ that'}([{}^\wedge[\lambda P[P\{x_3\}]({}^\wedge\mathbf{run'})]])])$ (T1, T4)

d. $F_{10,3}$(**a man**, **John believes that he$_3$ runs**) translates into (T2, T14)
$[\lambda P \vee x[\mathbf{man'}(x) \wedge P\{x\}]]$
$([{}^\wedge\lambda x_3[\lambda P[P\{j\}]]([{}^\wedge\mathbf{believe\ that'}([{}^\wedge[\lambda P[P\{x_3\}]({}^\wedge\mathbf{run'})]])])])$

e. **John believes that a man runs** translates into (def. of $F_{10,3}$)
$[\lambda P \vee x[\mathbf{man'}(x) \wedge P\{x\}]]$
$([{}^\wedge\lambda x_3[\lambda P[P\{j\}]]([{}^\wedge\mathbf{believe\ that'}([{}^\wedge[\lambda P[P\{x_3\}]({}^\wedge\mathbf{run'})]])])])$

(6) **The De Re Reading, Part 2: Simplifying the Translation**

Note that the 'simplification' below proceeds in an 'inside-out' fashion:

a. $[\lambda P\ \vee x[\mathbf{man'}(x) \wedge P\{x\}]]$
$([\hat{}\lambda x_3[\lambda P[P\{j\}]]([\hat{}\mathbf{believe\ that'}([\hat{}[\lambda P[P\{x_3\}](\hat{}\mathbf{run'})]])])])$ ⇔ (λ-conversion, CBN, DUC)

b. $[\lambda P\ \vee x[\mathbf{man'}(x) \wedge P\{x\}]]$
$([\hat{}\lambda x_3[\lambda P[P\{j\}]]([\hat{}\mathbf{believe\ that'}([\hat{}\mathbf{run'}(x_3)])])])$ ⇔ (λ-conversion, CBN, DUC)

c. $[\lambda P\ \vee x[\mathbf{man'}(x) \wedge P\{x\}]]$
$([\hat{}\lambda x_3\ \mathbf{believe\ that'}([\hat{}\mathbf{run'}(x_3)])(j)])$ ⇔ (λ-conversion)

d. $\vee x[\mathbf{man'}(x) \wedge [\hat{}\lambda x_3\ \mathbf{believe\ that'}([\hat{}\mathbf{run'}(x_3)])(j)]\{x\}]$ ⇔ (CBN, DUC)

e. $\vee x[\mathbf{man'}(x) \wedge [\lambda x_3\ \mathbf{believe\ that'}([\hat{}\mathbf{run'}(x_3)])(j)](x)]$ ⇔ (λ-conversion) [2]

f. $\vee x[\mathbf{man'}(x) \wedge \mathbf{believe\ that'}([\hat{}\mathbf{run'}(x)])(j)]$

Note:
Under this translation, **John believes that a man runs** ends up being true *iff* there is a particular man *x* such that John stands in the **believe that'** relation to the proposition "*x* runs."

- Thus, assuming that *y* **believe that'** *p* holds *iff p* is true in all of *y*'s belief worlds, this translation garners us the so-called *de re* reading fot he sentence:
  - It needn't be the case that in all (or any) of John's 'belief worlds' there is a man running…
    - All that is required is that in all John's belief worlds, *x* runs, where x in the actual (evaluation) world is some man.

(7) **Remark**

- Thus, the syntactic-semantic analysis in PTQ holds to the 'scope theory' of the *De Re / De Dicto* ambiguity…

- Thus, it is also subject to all the problems that we saw the scope theory is subject to in LING 620…

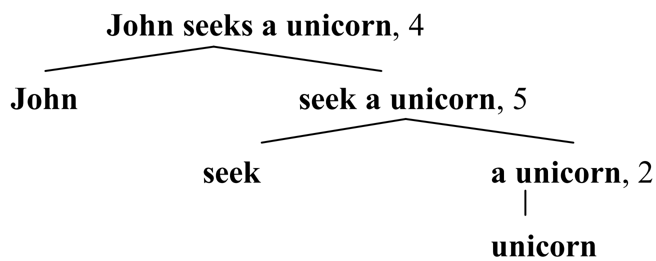
[2] Recall that we're able to do λ-conversion into the scope of '^' here because 'x' is a variable, and so will have the same across in all possible worlds/times.

2. The *De Re / De Dicto* Ambiguity with *Seeks*

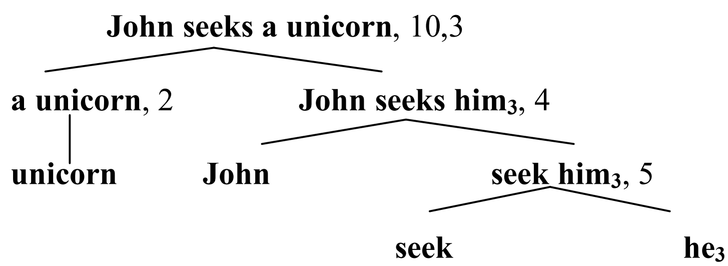
Recall that, just like the sentence **John believes that a man runs**, the sentence **John seeks a unicorn** is also syntactically ambiguous in our English fragment.

(8) **The Syntactic Ambiguity of *John seeks a unicorn***

a. <u>Derivation / Analysis One</u>



b. <u>Derivation / Analysis Two</u>



In this section, we will see that this similar syntactic ambiguity also leads to a similar semantic ambiguity:

- Under the derivation in (8a), **John seeks a unicorn** receives a *de dicto* reading (where there need be no actual unicorns)
- Under the derivation in (8b), **John seeks a unicorn** receives a *de re* reading (where there exists a particular, actual unicorn x such that John seeks x)

(9) **Rule T5 (Translation Rule for TVs and Direct Objects)**

If $\delta \in P_{TV}$ and $\beta \in P_T$, and δ, β <u>translate into</u> δ', β' respectively, then $F_5(\delta, \beta)$ <u>translates into</u> δ'(^β')

<u>Note:</u> Again, following our general pattern, in the translation of $F_5(\delta, \beta)$, the translation of δ takes as argument the *intension* of the translation of β.

(10) **Illustration of Rule T5 (The De Dicto Reading of *John seeks a unicorn*)**

a. *Obtaining the Translation*

(i) **seek** <u>translates into</u> **seek’** (T1)

(ii) **a unicorn** <u>translates into</u> λP Vx[**unicorn’**(x) ∧ P{x}] (T2)

(iii) F_5(**seek**, **a unicorn**) <u>translates into</u>
seek’([^λP Vx[**unicorn’**(x) ∧ P{x}]]) (T5)

(iv) **John** <u>translates into</u> [λP[P{*j*}]] (T1)

(v) **John seeks a unicorn** <u>translates into</u>
[λP[P{*j*}]](^**seek’**([^λP Vx[**unicorn’**(x) ∧ P{x}]])) (T4)

b. *Simplifying the Translation*

(i) [λP[P{*j*}]](^**seek’**([^λP Vx[**unicorn’**(x) ∧ P{x}]])) ⇔ (α-conversion)
(ii) [λQ[Q{*j*}]](^**seek’**([^λP Vx[**unicorn’**(x) ∧ P{x}]])) ⇔ (λ-conversion)
(iii) [^**seek’**([^λP Vx[**unicorn’**(x) ∧ P{x}]])]{j} ⇔ (CBN, DUC)
(iv) **seek’**([^λP Vx[**unicorn’**(x) ∧ P{x}]])(j)

(11) **Remarks**

a. Note that no further simplification can take place to the formula in (10b,iv).
- In our translation, **seek’** is a constant of type <<s,<<s,<e,t>>,t>>, <e,t>>
- Thus, it takes as argument (i) and (ii) to yield an expression of type t
  - (i) the intension of a generalized quantifier expression, and
  - (ii) an entity

b. Thus, under the syntactic derivation in (8a), **John seeks a unicorn** receives a translation which is true iff:
John stands in the **seek’** relation to the intension of **a unicorn**

c. Finally, let us assume that *x* stands in the **seek’** relation to $\mathcal{P}$ iff in all the world-times <w’,t’> where x’s desires are met, $\mathcal{P}$(w’,t’)(λy : x has y in w’ at t’)

- Thus, John stands in the **seek’** relation to the intension of **a unicorn** *iff* in all the world-times <w’,t’> where John’s desires are met:
There is an x such that x is a unicorn in w’ and t’ at John has x in w’ at t’

d. We see, then, that the translation we generate for parse (8a) amounts to the *de dicto* reading of **John seeks a unicorn.**

Now let's see what happens when we derive the sentence along the lines in (8b):

(11) **Obtaining the De Re Reading**

a. *Obtaining the Translation*

(i) **seek** translates into **seek'**, **he$_3$** translates into $\lambda P[P\{x_3\}]$ (T1)

(ii) F_5(**seek**, **he$_3$**) translates into **seek'**$(\hat{}\lambda P[P\{x_3\}])$ (T5)

(iii) **seek him$_3$** translates into **seek'**$(\hat{}\lambda P[P\{x_3\}])$ (def. of F_5)

(iv) **John** translates into $[\lambda P[P\{j\}]]$ (T1)

(v) **John seeks him$_3$** translates into $[\lambda P[P\{j\}]](\hat{}$**seek'**$(\hat{}\lambda P[P\{x_3\}]))$ (T4)

(vi) **a unicorn** translates into $\lambda P\ Vx[$**unicorn'**$(x) \wedge P\{x\}]$ (T2)

(vii) **John seeks a unicorn** translates into
$[\lambda P\ Vx[$**unicorn'**$(x) \wedge P\{x\}]]$
$(\hat{}\lambda x_3[[\lambda P[P\{j\}]](\hat{}$**seek'**$(\hat{}\lambda P[P\{x_3\}]))])$ (T14, def. of $F_{10,3}$)

b. *Simplifying the Translation*

(i) $[\lambda P\ Vx[$**unicorn'**$(x) \wedge P\{x\}]](\hat{}\lambda x_3[[\lambda P[P\{j\}]](\hat{}$**seek'**$(\hat{}\lambda P[P\{x_3\}]))])$
$\Leftrightarrow$ (λ-conversion, CBN, DUC)

(ii) $[\lambda P\ Vx[$**unicorn'**$(x) \wedge P\{x\}]](\hat{}\lambda x_3\,[$**seek'**$(\hat{}\lambda P[P\{x_3\}])(j)])$
$\Leftrightarrow$ (λ-conversion, CBN, DUC)

(iii) $Vx[$**unicorn'**$(x) \wedge$ **seek'**$(\hat{}\lambda P[P\{x\}])(j)]$

(12) **Remarks**

a. Thus, under the syntactic derivation in (8b), **John seeks a unicorn** receives a translation which is true iff:

There is an x such that x is a unicorn, and John stands in the **seek'** relation to the GQ-intension $\hat{}\lambda P[P\{x\}]$

b. Again, let us assume that *x* stands in the **seek'** relation to $\mathcal{P}$ iff in all the world-times <w',t'> where x's desires are met, $\mathcal{P}$(w',t')(λy : x has y in w' at t')

Thus, John stands in the **seek'** relation to $\hat{}\lambda P[P\{x\}]$ *iff* in all the world-times <w',t'> such that John's desires are met, John has x.

c. We see, then, that the translation we generate for parse (8b) amounts to the *de re* reading of **John seeks a unicorn.**

3. Transitive Verbs that Don't Seem to Create Opaque Contexts

(13) **Interim Summary**
Our translation system generates two different translations for **John seeks a unicorn**

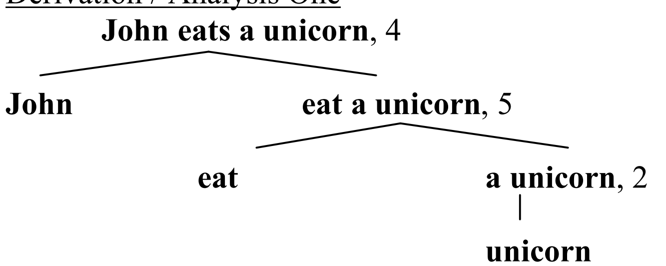
a. Under one translation (reading), the sentence *does not entail that any unicorns actually exist* (the *de dicto* reading)

b. Under another translation (reading), the sentence *does entail that unicorns exist*. (the *de re* reading)

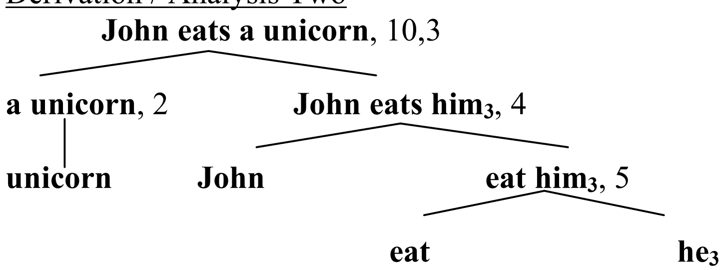
(14) **An Immediate Problem: Parallel Ambiguity for *John eats a unicorn*.**

- Note that in our English fragment, the sentence **John eats a unicorn** has the same structural ambiguity as **John seeks a unicorn.**

a. <u>Derivation / Analysis One</u>



b. <u>Derivation / Analysis Two</u>



- Furthermore, recall that – due to our category-to-type mapping – the English transitive verb **eat** is also translated as a type <<s,<<s,<e,t>>,t>>, <e,t>> predicate.

- Consequently, our translation system predicts that **John eats a unicorn** will be ambiguous in the same way as **John seeks a unicorn**.
  - That is, **John eats a unicorn** will receive two translations, one logically equivalent to (14c), and the other equivalent to (14d).

c. <u>Translation One:</u> **eat'**([^λP Vx[**unicorn'**(x) ∧ P{x}]])(*j*)

d. <u>Translation Two:</u> Vx[**unicorn'**(x) ∧ **eat'**(^λP[P{x}])(*j*)]

(15) **The Acute Empirical Problem: No Perception of Ambiguity**

Contrary to the predictions above, English speakers don't perceive an ambiguity in **John eats a unicorn**, akin to that in **John seeks a unicorn.**

- More acutely, under the translation in (14c), **John eats a unicorn** can be true without there being any actual unicorns (just like with (10b))
- However, English speakers universally agree that **John eats a unicorn** entails that there does exist some unicorn (which John is eating).
- That is, of the two translations in (14c,d), only (14d) seems to align with the truth-conditional judgments of English speakers.

(16) **The Key Idea Towards a Solution**
Suppose it were the case that the 'lexical semantics' of **eat** entailed that (16a) is true *iff* (16b) is true.

a. $\mathbf{eat'}(\mathcal{P})(x)$

b. $[^{\vee}\mathcal{P}]([\hat{}\lambda x_0\ [\mathbf{eat'}(\hat{}\lambda P[P\{x_0\}])(x)]])$

As the computation below shows, it would predict that translation (14c) will be logically equivalent to translation (14d).

c. (i) $\mathbf{eat'}([\hat{}\lambda P\ \vee x[\mathbf{unicorn'}(x) \wedge P\{x\}]])(j)$ ⇔ (by assumption (16))

(ii) $[^{\vee}[\hat{}\lambda P\ \vee x[\mathbf{unicorn'}(x) \wedge P\{x\}]]]([\hat{}\lambda x_0\ [\mathbf{eat'}(\hat{}\lambda P[P\{x_0\}])(j)]])$
⇔ (CBN, DUC)

(iii) $[\lambda P\ \vee x[\mathbf{unicorn'}(x) \wedge P\{x\}]]([\hat{}\lambda x_0\ [\mathbf{eat'}(\hat{}\lambda P[P\{x_0\}])(j)]])$
⇔ (λ-conversion)

(iv) $\vee x[\mathbf{unicorn'}(x) \wedge [\hat{}\lambda x_0\ [\mathbf{eat'}(\hat{}\lambda P[P\{x_0\}])(j)]]\{x\}]$ ⇔ (CBN, DUC)

(v) $\vee x[\mathbf{unicorn'}(x) \wedge [\lambda x_0\ [\mathbf{eat'}(\hat{}\lambda P[P\{x_0\}])(j)]](x)]$ ⇔ (λ-conversion)

(vi) $\vee x[\mathbf{unicorn'}(x) \wedge \mathbf{eat'}(\hat{}\lambda P[P\{x\}])(j)]$

If this were the case, then, we wouldn't perceive an ambiguity in **John eats a unicorn**, since the two translations (readings) would be truth-conditionally equivalent.

- Furthermore, both translations end up entailing that *there are unicorns.*

In the PTQ system, we have a mechanism for encoding such aspects of 'lexical semantics' into our analysis: the meaning postulates!

(17) **The Solution: Meaning Postulate for 'Non-Intensional' Verbs**
In a 'logically possible' interpretation for IL, the following formulae are true (at all worlds and times): [3]

$\Lambda x \Lambda \mathcal{P} \Box [\, \delta(\mathcal{P})(x) \leftrightarrow [{}^{\vee}\mathcal{P}]([{}^{\wedge}\lambda x_0\, \delta({}^{\wedge}\lambda P[P\{x_0\}])(x)])$
where δ translates any member of B_{TV} other than **seek** or **conceive**

(18) **Remark**
If we restrict the interpretations of IL to only those that are 'logically possible', it will follow (as shown in (16)) that translation (14c) is logically equivalent to (14d).
We will also predict the univocality of such sentences as:

a. **John finds a unicorn**. b. **John loses a unicorn.**
c. **John loves a unicorn.** d. **John dates a unicorn.**

(19) **A General Summary of the Overall Story Regarding Transitive Verbs**

a. We know that **seek** must receive a translation/meaning where it takes as argument the *intension* of its complement.

b. Thus, the need for a category-to-type correspondence in the PTQ (and UG) framework entails that *all* transitive verbs must take as argument the *intension* of their complement.

c. Thus, even the translation/meaning of **eat** is a relation between an entity and the *intension of some GQ*.

d. This, of course, raises the question of what the 'lexical semantics' of **eat** are. *When should we say that the* ***eat*** *relation holds between an entity and some GQ intension?*

e. Well, suppose we say that **eat** holds between x and $\mathcal{P}$ exactly when $[{}^{\vee}\mathcal{P}]$ holds of the following crazy property: $([{}^{\wedge}\lambda x_0\, [\mathbf{eat'}({}^{\wedge}\lambda P[P\{x_0\}])(x))$
- That's what the meaning postulate in (17) says…

f. As shown above, the resulting system correctly predicts that – while **John seeks a unicorn** doesn't entail the existence of unicorns – **John eats a unicorn** does.

[3] Note that the actual formula used by Montague in PTQ is slightly different from the one in (17). However, as the student can confirm, they amount to the same condition (see Dowty *et al.* (1981), pp. 219-227).

(20) **One Final Note**
In PTQ, Montague extends the general strategy in (16)-(19) above to other categories besides TV. In this way, the PTQ system is also able to capture the observed contrasts between (i) **rapidly** vs. **allegedly**, and (ii) **in** vs. **about**.