Reasoning with an (Experiential) Attitude:
inference relations between same-type attitude reports

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Empirical Domain

Domain: grammatically different same-type attitude reports:

1. Ida imagined a penguin.
2. Ida imagined a penguin diving into the sea.
3. Ida imagined that a penguin dove/was diving into the sea

↩ we find most differences for **'experiential' attitude verbs:**

- epistemic verbs: remember, notice, ...
- counterfactual attitude verbs: imagine, dream, ...
- perception verbs: see, hear, feel, sense, ...

➥ these verbs ...
... accept nominal (❶) & clausal complements ([❷] ❸)
... have experiential (❶, ❷) & non-experiential readings (❸)

Objectives

Objective 1 (empirical)

Identify & classify inference relations b/w same-attitude reports:

(†) a. Ida imagined/saw a penguin dive into the sea.
$\overset{?}{\Rightarrow}$ b. Ida imag'd/saw that a penguin dove into the sea.

Note: for 'see', many of these rel's have been identified in situation semantics (Barwise 1981; B & Perry '83; Asher & Bonevac '85)

Hint: for 'imagine', these relations are different than for 'see'!

Objective 2 (formal)

- Give a simple (!) compositional semantics for imagination and vision reports that captures these differences

↩ **Strategy:** use a non-clausal syntax for bare infinitive/gerundive attitude reports; give it a situation-based semantics

Why do this?

1. Non-perception experiential attitude reports have been neglected in situation semantics (cf. Barwise-Perry, Kratzer, Cooper-Ginzburg)
2. Newer semantics for such reports (e.g. Stephenson 2010; cf. Zimmermann 1993, 2016) focus on certain grammatical forms

   ➥ they fail to capture inferences involving other forms:

(⋆) a. Ida imagined a penguin diving into the sea.
⇏ b. Ida imagined that a penguin was diving ...

(⋆⋆) a. Ida imagined a penguin diving into the sea.
⇏ b. Ida imagined a penguin.

The Plan

Sample Attitude Reports

❶ (A) Ida i. imagined / ii. saw a penguin.

(B) Ida i. imagined / ii. saw a **real-world** penguin [dive(ing) . . .]

❷ (C) Ida i. imagined / ii. saw a penguin **dive(ing)** into the sea.

(D) Ida i. imagined / ii. saw **an aquatic flightless bird** dive . . .

(E) **A penguin** is s.t. Ida i. imagined / ii. saw **it** dive into the sea.

❸ (F) Ida i. imagined / ii. saw **that** a penguin dove into the sea.

Combinatorics of Sample Reports

	A	B	C	D	E	F
A	≡					
B		≡				
C			≡			
D				≡		
E					≡	
F						≡

grey = 30 interesting pairs of attitude reports

Tests for Valid Inferences (Grice 1975; Blome-Tillmann 2013)

Test 1 (non-cancellability): If $X \Rightarrow Y$ is a valid inference, then 'X, but not Y' is a contradiction in any context (**general n.-c.**) or in some context (**contextual non-cancellability**)

(∗) #Ida imagined a real-world penguin, but not a penguin.

(‡) B.i. Ida imagined a real-world penguin.
⇒ A.i. Ida imagined a penguin.

Test 2 (non-reinforceability): If $X \Rightarrow Y$ is a valid inference, then 'X and (also) Y' is redundant/semantically deviant

(∗∗) ?Ida imagined a real-world penguin and (also) a penguin

Inference Classes

	A	B	C	D	E	F
A	≡	⇏/⇒	⇏	⇏	⇏	⇏
B	⇒	≡	⇒	⇏/⇒	⇏/⇒	⇒/⇏
C	⇒	⇏/⇒	≡	⇏/⇒	⇏/⇒	⇒/⇏
D	⇏/⇒	⇏/⇒	⇏/⇒	≡	⇏/⇒	⇏
E	⇒	⇏/⇒	⇒	⇏/⇒	≡	⇒/⇏
F	⇏	⇏	⇏	⇏	⇏	≡

white = 10 generally **in**valid inferences (⇏)

20 valid inferences:

green = 5 **generally** valid inferences (⇒)

grey = 15 '**lexical**' inferences (⇏/⇒, ⇒/⇏)

Introduction Inferences Background Modelling Conclusion

Inference Classes (cont'd)

	A	B	C	D	E	F
A	≡	⇏/⇒	⇏	⇏	⇏	⇏
B	⇒	≡	⇒	⇏/⇒	⇏/⇒	⇒/⇏
C	⇒	⇏/⇒	≡	⇏/⇒	⇏/⇒	⇒/⇏
D	⇏/⇒	⇏/⇒	⇏/⇒	≡	⇏/⇒	⇏
E	⇒	⇏/⇒	⇒	⇏/⇒	≡	⇒/⇏
F	⇏	⇏	⇏	⇏	⇏	≡

Class 1 (B–C, E ⇒ A, C)**:** generally valid inferences:

(1) C. Ida imagined/saw a penguin **dive into the sea**.
⇒ A. Ida imagined/saw a penguin.

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Inference Classes (cont'd)

	A	B	C	D	E	F
A	≡	⇏/⇒	⇏	⇏	⇏	⇏
B	⇒	≡	⇒	⇏/⇒	⇏/⇒	⇒/⇏
C	⇒	⇏/⇒	≡	⇏/⇒	⇏/⇒	⇒/⇏
D	⇏/⇒	⇏/⇒	⇏/⇒	≡	⇏/⇒	⇏
E	⇒	⇏/⇒	⇒	⇏/⇒	≡	⇒/⇏
F	⇏	⇏	⇏	⇏	⇏	≡

Class 2 (A, C–E ⇒ B)**:** DP-veridicality inferences for 'see'

(2) A. Ida i. imagined / ii. saw a penguin.
B. Ida ⇏ i. imag'd / ⇒ ii. saw a **real-world** penguin.

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Inference Classes (cont'd)

	A	B	C	D	E	F
A	≡	⇏/⇒	⇏	⇏	⇏	⇏
B	⇒	≡	⇒	⇏/⇒	⇏/⇒	⇒/⇏
C	⇒	⇏/⇒	≡	⇏/⇒	⇏/⇒	⇒/⇏
D	⇏/⇒	⇏/⇒	⇏/⇒	≡	⇏/⇒	⇏
E	⇒	⇏/⇒	⇒	⇏/⇒	≡	⇒/⇏
F	⇏	⇏	⇏	⇏	⇏	≡

Class 3 (B–C, E ⇔ D)**:** DP-substitution infer's for 'see'

(3) C. Ida i. imagined / ii. saw a penguin dive . . .
D. Ida ⇏ i. imagined / ⇒ ii. saw **an aquatic flightless bird** dive . . .

Inference Classes (cont'd)

	A	B	C	D	E	F
A	≡	⇏ / ⇒	⇏	⇏	⇏	⇏
B	⇒	≡	⇒	⇏ / ⇒	⇏ / ⇒	⇒ / ⇏
C	⇒	⇏ / ⇒	≡	⇏ / ⇒	⇏ / ⇒	⇒ / ⇏
D	⇏ / ⇒	⇏ / ⇒	⇏ / ⇒	≡	⇏ / ⇒	⇏
E	⇒	⇏ / ⇒	⇒	⇏ / ⇒	≡	⇒ / ⇏
F	⇏	⇏	⇏	⇏	⇏	≡

Class 4 (B–D ⇒ E)**:** DP-specificity inferences for 'see'

(4) C. Ida i. imagined / ii. saw a penguin dive . . .
E. **A penguin** is s.t.
Ida ⇏ i. imagined / ⇒ ii. saw **it** dive . . .

Inference Classes (cont'd)

	A	B	C	D	E	F
A	≡	⇏ / ⇒	⇏	⇏	⇏	⇏
B	⇒	≡	⇒	⇏ / ⇒	⇏ / ⇒	⇒ / ⇏
C	⇒	⇏ / ⇒	≡	⇏ / ⇒	⇏ / ⇒	⇒ / ⇏
D	⇏ / ⇒	⇏ / ⇒	⇏ / ⇒	≡	⇏ / ⇒	⇏
E	⇒	⇏ / ⇒	⇒	⇏ / ⇒	≡	⇒ / ⇏
F	⇏	⇏	⇏	⇏	⇏	≡

Class 5 (B–C, E ⇒ F)**:** epistemic positivity for 'imagine'

(5) C. Ida i. imagined / ii. saw a penguin dive . . .
F. Ida ⇒ i. imagined / ⇏ ii. saw **that** a penguin was diving . . .

Epistemic Positivity ≠ (Experiential) Indirectness

(5) C. Ida i. imagined / ii. saw a penguin dive . . .
F. Ida ⇒ i. imagined / ⇏ ii. saw **that** a penguin . . .

Note: C.i is **direct** (i.e. contains a non-finite gerundive constructn) and is epistemically **positive** (i.e. resists DP-substitution)

↩ This goes against Barwise (cf. Dretske 1970) and Kratzer, who associate epistemic **positiveness** with **in**directness!

➥ **Problem/question:**

- How can we ensure that direct imagination reports are epistemically positive, but direct vision reports are epist'y neutral?

Strategy

➥ **Problem/question:**

- How can we ensure that direct imagination reports are epistemically positive, but direct vision reports are epist'y neutral?

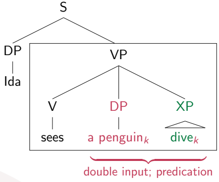
Strategy

- Assign a non-clausal syntax to bare infinitive/gerundive attitude reports (see Williams 1983; vs. Barwise 1981)
  - ↩ This gives us a better handle on the scope of the embedded DP!
- **Show:** this syntax can be given a situation-based semantics! (see Barwise 1981; cf. Kratzer 2002; Liefke & Werning 2018)

Non-Clausal Syntax (Williams 1983, 2010)

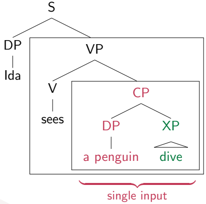
Assumption (predication theory): the complement in C (D–E) is a non-constituent element of a ternary branching VP:

↩ This gives us a better handle on the scope of the embedded DP



Comparison: Small Clause Syntax (Stowell 1981; s. Barwise 1981)

Assumption (small clause theory): the complement in C (D–E) forms a constituent small clause:



Syntax-Semantics Interface: interpreting non-clausal 'see'

Ida [$_{\text{VP}}$sees [$_{\text{DP}}$a penguin]$_k$ [$_{\text{XP}}$dive into the sea]$_k$]

Attempt 1: $[\![\text{see } [_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i = \lambda\mathcal{Q}\,\lambda P \lambda z\,[\mathit{see}'''_i(z, \mathcal{Q}_i, P)]$

(↩ predication?)

Attempt 2: $= \lambda\mathcal{Q}\,\lambda P \lambda z\,[\mathcal{Q}_i(\lambda j \lambda y.\ \mathit{see}''_j(z, y, \lambda k.\, P_k(y)))]$

$\simeq [\![\text{find } [_{\text{DP}}]]\!]^i = \quad \lambda\mathcal{Q}\,\lambda z\,[\mathcal{Q}_i(\lambda j \lambda y.\ \mathit{find}_j(z, y))]$ (↩ redundant y?)

Attempt 3: $= \lambda\mathcal{Q}\,\lambda P \lambda z\,[\mathcal{Q}_i(\lambda j \lambda y.\ \mathit{see}'_j(z, \lambda k.\, P_k(y)))]$

(↩ a proposition; ? better: a situation)

Evidence for Situation Arguments (see Stephenson 2010)

Observation: A–E have an 'experiential' reading, i.e. their complements denote a **situation**/informationally incomplete world-part

↩ **Support:**

- the matrix verb in A–E allows for 'experiential' modification:

  (○) Ida vividly imagined (/saw) a penguin.

- A–E can be rephrased with an eventive *how*-complement:

  (●) Ida imagined/saw how a penguin was diving ...

↩ **Proposal:** turn the proposition-argument of *see′* in **Attempt 3** into a situation:

(van der Does 1991: "Adopting [Williams'] syntactic structure does not force one to reject Barwise's semantics")

Situations & Non-Clausal 'See'

Attempt 3: $= \lambda\mathcal{Q}\lambda P\lambda z[\mathcal{Q}_i(\lambda j\lambda y.\, see'_j(z, \overbrace{\lambda k.\, P_k(y)}^{\text{a proposition}}))]$

$\Downarrow$

Attempt 4: (final) $= \lambda\mathcal{Q}\lambda P\lambda z[\mathcal{Q}_i(\lambda j\lambda y.\, see_j(z, \underbrace{f_c(\lambda k.\, P_k(y))}_{\text{a situation}}))]$

Above, f is an event-dependent choice function (v. Heusinger '13):

- f selects a situation from a given set of situations $\lambda k[\ldots]$
- f depends on a parameter, c, for the described attitudinal event (here: $c := (\iota e)[\text{see}_j(e) \wedge \text{AGENT}_j(e) = z]$, i.e. the event of z's seeing in j)

Attempt 4′ (event-semantic version):

$\lambda\mathcal{Q}\lambda P\lambda z[\mathcal{Q}_i(\lambda j\lambda y\exists e.\, \text{see}_j(e, z, f_e(\lambda k.\, P_k(y))))]$

$\text{AGENT}_j(e)\uparrow$ $\quad\uparrow \text{THEME}_j(e)$

Situations & Non-Clausal 'See' (cont'd)

Note: the parameterizing event constrains the choice of situation

➡ f's dependence on vision events ensures the factivity of 'see':

$[\![\text{see}\ [_{DP}\ ][_{XP}\ ]]\!]^i \equiv \lambda\mathcal{Q}\lambda P\lambda z[\mathcal{Q}_i(\lambda j\lambda y.\, see_j(z, f_c(\lambda k.\, P_k(y) \wedge \boldsymbol{k \leq j})))]$

Below: $E_k(y)$:= 'y exists in k'; $j \leq i$:= 'i contains all info of j':

The semantics of 'see'

$[\![\text{see}\ [_{DP}\ ][_{XP}\ ]]\!]^i = \lambda\mathcal{Q}\lambda P\lambda z[\mathcal{Q}_i(\lambda j\lambda y.\, see_j(z, f_c(\lambda k.\, P_k(y))))]$

$[\![\text{see}\ [_{DP}\ ]]\!]^i = \lambda\mathcal{Q}\lambda z[\mathcal{Q}_i(\lambda j\lambda y.\, see_j(z, f_c(\lambda k.\, E_k(y))))]$

$[\![\text{see}\ [_{CP}\ ]]\!]^i = \lambda p\lambda z[see_i(z, \lambda j.\, p_j \wedge j \leq i)]$

!! situations need not be spatio-temporally located/anchored

⬅ we represent situations by sets of anchored situations

visual scenes := singletons containing an anchored situation

imagined situations := sets of qualitatively identical anchored sit's

➡ we can use *see* to interpret all above occurrences of 'see'!

Interpreting Bare Infinitive Vision Reports

$[\![\text{see}\ [_{DP}\ ][_{XP}\ ]]\!]^i = \lambda\mathcal{Q}\lambda P\lambda z[\mathcal{Q}_i(\lambda j\lambda y.\, see_j(z, f_c(\lambda k.\, P_k(y))))]$

$[\![\text{Ida sees}\ [_{DP}\text{a penguin}]\ [_{XP}\text{dive}]]\!]^i$

$= \lambda\mathcal{Q}\lambda P\lambda z[\mathcal{Q}_i(\lambda j\lambda y.\, see_j(z, f_c(\lambda k.\, P_k(y))))]$
$\quad(\lambda l\lambda P'(\exists x)[penguin_l(x) \wedge P'_l(x)], dive, ida)$

$\overset{!}{\equiv} (\lambda P(\exists x)[penguin_i(x) \wedge P_i(x)])$
$\quad(\lambda j\lambda y.\, see_j(ida, f_c(\lambda k.\, dive_k(y))))$

$\equiv (\exists x)[penguin_i(x) \wedge see_i(ida, f_c(\lambda j.\, dive_j(x)))]$

$= [\![[_{DP}\text{a penguin}]\ [\lambda_1[\text{Ida}\ [_{VP}\text{sees}\ t_1\ [_{XP}\text{dive}]]]]]\!]^i$

(4) C. Ida i. imagines / ii. sees a penguin dive.

E. A penguin is s.t. Ida $\not\Leftarrow$ i. imagines / $\Rightarrow$ ii. sees it dive.

Against the 'Small Clause'-Approach

$[\![\text{see}\ [_{DP}\ ][_{XP}\ ]]\!]^i = \lambda\mathcal{Q}\lambda P\lambda z[\mathcal{Q}_i(\lambda j\lambda y.\, see_j(z, f_c(\lambda k.\, P_k(y))))]$

Alternative (?): $[\![\text{see}\ [_{CP}\ ]]\!]^i = \lambda p\lambda z[see_i(z, f_c(p))]$

⬅ But: $[\![\text{Ida sees}\ [_{CP}\text{a penguin dive}]]\!]^i$

$= \lambda p\lambda z[see_i(z, f_c(p))](\lambda j(\exists x)[penguin_j(x) \wedge dive_j(x)], ida)$

$\equiv see_i(ida, f_c(\lambda j\exists x.\, penguin_j(x) \wedge dive_j(x)))$

$\not\equiv (\exists x)[penguin_i(x) \wedge see_i(ida, f_c(\lambda j.\, dive_j(x)))]$

$= [\![[_{DP}\text{a penguin}]\ [\lambda_1[\text{Ida}\ [_{VP}\text{sees}\ t_1\ [_{XP}\text{dive}]]]]]\!]^i$

(Problematic) **Remedy:** Adopt the ff. quantifier exportation rule:

(Q-Exp) $(\forall z)(\forall Q)(\forall P)[see_i(z, f_c(\lambda j\exists x.\, Q_j(x) \wedge P_j(x)) \rightarrow$
$\quad(\exists y)[Q_i(y) \wedge see_i(z, f_c(\lambda j.\, P_j(y)))]$

Capturing 'See'-Inferences: Class 3

(3) C. Ida i. imagines / ii. sees a penguin dive into the sea.
D. Ida $\not\Rightarrow$ i. imag's / $\Rightarrow$ ii. sees an **aquatic flightless bird** . . .

Note: the DP-argument of 'see' has an **extensional** interpret'n:

$[\![\text{Ida sees a penguin} \ldots]\!]^i = (\exists x)[penguin_i(x) \wedge see_i(\ldots)]$

➥ granted (Ext), C.ii ⇒ D.ii is a valid inference:

a. $[\![\text{C.ii}]\!]^i = (\exists x)[penguin_i(x) \wedge see_i(ida, f_c(\lambda j.\, dive_j(x)))]$

(Ext). $(\forall x)[penguin_i(x) \leftrightarrow aquatic\text{-}flightless\text{-}bird_i(x)]$

$\equiv$ b. $[\![\text{D.ii}]\!]^i = (\exists x)[aquatic\text{-}flightless\text{-}bird_i(x) \wedge see_i(ida, f_c(\lambda j.\, dive_j(x)))]$

Note: the XP-argument of 'see' stays **intensional**

(see Asher & Bonevac 1985)

Interpreting 'Objectual' Vision Reports

$[\![\text{see } [_{DP}\ ]]\!]^i = \lambda \mathcal{Q} \lambda z\, [\mathcal{Q}_i(\lambda j \lambda y.\, see_j(z, f_c(\lambda k.\, E_k(y))))]$

$[\![\text{Ida sees } [_{DP}\text{a penguin}]]\!]^i$

$= \lambda \mathcal{Q} \lambda z\, [\mathcal{Q}_i(\lambda j \lambda y.\, see_j(z, f_c(\lambda k.\, E_k(y))))]$
$(\lambda l \lambda P (\exists x)[penguin_l(x) \wedge P_l(x)], ida)$

$\equiv (\exists x)[penguin_i(x) \wedge see_i(ida, f_c(\lambda j.\, E_j(x)))]$

$\equiv (\exists x)[penguin_i(x) \wedge see_i(ida, f_c(\lambda j.\, E_j(x) \boldsymbol{\wedge j \leq i}))]$

$=$ [[Ida sees [$_{DP}$a penguin] [being there (in the real world)]]]^i

$\overset{!}{\equiv}$ [[Ida sees [$_{DP}$a <u>real-world</u> penguin]]]^i (↑see Parsons 1997)

(1) A. Ida i. imagines / ii. sees a penguin.
B. Ida $\not\Rightarrow$ i. imagines / $\Rightarrow$ ii. sees a **real-world** penguin.

Capturing 'See'-Inferences: Class 1

(1) C. Ida i. imagines / ii. sees a penguin **dive into the sea**.
$\Rightarrow$ A. Ida i. imagines / ii. sees a penguin.

Note: 'see' in A.ii and C.ii has the same(-type) translation:

[[see a penguin]]^i $\equiv$ [[see a penguin existing/being there]]^i

➥ granted (Gen), C.ii ⇒ A.ii is valid: (analogously for 'imagine')

(1) a. $[\![\text{C.ii}]\!]^i = (\exists x)[penguin_i(x) \wedge see_i(ida, f_c(\lambda j.\, dive_j(x)))]$

(Gen). $(\forall j)(\forall x)[dive_j(x) \rightarrow E_j(x)]$

$\Rightarrow$ b. $[\![\text{A.ii}]\!]^i = (\exists x)[penguin_i(x) \wedge see_i(ida, f_c(\lambda j.\, E_j(x)))]$

Interpreting Clausal Vision Reports

$[\![\text{see } [_{CP}\ ]]\!]^i = \lambda p \lambda z\, [see_i(z, \lambda j.\, p_j \wedge j \leq i)]$

$[\![\text{Ida sees } [_{CP}\text{that a penguin dives}]]\!]^i_{de\ dicto}$

$= \lambda p \lambda z\, [see_i(z, \lambda j.\, p_j \wedge j \leq i)]$
$(\lambda k (\exists x)[penguin_k(x) \wedge dive_k(x)], ida)$

$\equiv see_i(ida, \lambda j \exists x.(\boldsymbol{penguin_j}(x) \wedge dive_j(x)) \wedge j \leq i)$

$\overset{!}{\not\equiv} (\exists x)[penguin_i(x) \wedge see_i(ida, f_c(\lambda j.\, dive_j(x) \wedge j \leq i))]$

$=$ [[[$_{DP}$a penguin] [λ_1[Ida [$_{VP}$sees [$_{CP}$that t_1 [$_{XP}$dives]]]]]]]^i

$\equiv$ [[Ida sees [$_{DP}$a penguin] [$_{XP}$dive]]]^i

(5) C. Ida i. imagines / ii. sees a penguin dive into . . .
F. Ida $\Rightarrow$ i. imagines / $\not\Rightarrow$ ii. sees **that** a penguin dives . . .

Interpreting (Gerundive) Imagination Reports

Note: the DP-argument of 'imagine' (unlike 'see') is **intensional**

↩ two strategies for capturing this:

Strategy 1 (s. Montague 1973; cf. Quine 1956): lexically decompose 'imagine' into '■ to see', where ■ is an intensional operator:

$[\![\text{imagine } [_{\text{DP}}\ ]]\!]^i$
$= \lambda\mathcal{Q}\lambda z\,[■_i(z, \lambda j.\, \mathcal{Q}_j(\lambda k\lambda y.\, see_k(z, f_c(\lambda l.\, E_l(y)))))]$
$\simeq [\![\text{seek}]\!]^i = \lambda\mathcal{Q}\lambda z\,[try_i(z, \lambda j.\, \mathcal{Q}_j(\lambda k\lambda y.\, find_k(z, y)))]$

▶ **Strategy 2** (see Montague 1970; cf. Moltmann 1997): interpret 'imagine' as a quantifier low scope-version of 'see':

$[\![\text{imagine } [_{\text{DP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda z\,[imagine_i(z, f_{c'}(\lambda j.\, \mathcal{Q}_j(E)))]$
$\simeq\ [\![\text{seek } [_{\text{DP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda z\,[seek_i(z, \mathcal{Q})]$

Semantics of 'Imagine'

Below: $c' :=$ the event of z's imagining in i

The semantics of 'imagine'

$[\![\text{imagine } [_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda P\lambda z\,[imagine_i(z, f_{c'}(\lambda j.\, \mathcal{Q}_j(P)))]$
$[\![\text{imagine } [_{\text{DP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda z\,[imagine_i(z, f_{c'}(\lambda j.\, \mathcal{Q}_j(E)))]$
$[\![\text{imagine } [_{\text{CP}}\ ]]\!]^i = \lambda p\lambda z\,[see_i(z, \lambda j.\, p_j)]$

Note: 'imagine' is counterfactual/non-verid'l (no conjunct '$j \leq i$') (we can also imagine what is not there)

The semantics of 'see'

$[\![\text{see } [_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda P\lambda z\,[\mathcal{Q}_i(\lambda j\lambda y.\, see_j(z, f_c(\lambda k.\, P_k(y))))]$
$[\![\text{see } [_{\text{DP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda z\,[\mathcal{Q}_i(\lambda j\lambda y.\, see_j(z, f_c(\lambda k.\, E_k(y))))]$
$[\![\text{see } [_{\text{CP}}\ ]]\!]^i = \lambda p\lambda z\,[see_i(z, \lambda j.\, p_j \wedge j \leq i)]$

Capturing 'Imagine'-Inferences: Class 4

(4) C. Ida i. imagines / ii. sees a penguin dive.
E. A penguin is s.t. Ida $\not\Rightarrow$ i. imagines / $\Rightarrow$ ii. sees it dive.

$[\![\text{Ida imagines } [_{\text{DP}}\text{a penguin}]\ [_{\text{XP}}\text{diving}]]\!]^i_{de\ dicto}$
$= \lambda\mathcal{Q}\lambda P\lambda z\,[imagine_i(z, f_{c'}(\lambda j.\, \mathcal{Q}_j(P)))]$
$\quad (\lambda k\lambda P'(\exists x)[penguin_k(x) \wedge P'_k(x)], dive, ida)$
$\equiv imagine_i(ida, f_{c'}(\lambda j \exists x.\, penguin_j(x) \wedge dive_j(x)))$
$\overset{!}{\not\equiv} (\exists x)[penguin_i(x) \wedge imagine_i(ida, f_{c'}(\lambda j.\, dive_j(x)))]$
$= [\![[_{\text{DP}}\text{a penguin}]\ [\lambda_1[\text{Ida } [_{\text{VP}}\text{imagines } t_1\ [_{\text{XP}}\text{diving}]]]]]\!]^i$
$\equiv [\![[_{\text{DP}}\text{A penguin}] \text{ is s.t. Ida imagines it } [_{\text{XP}}\text{diving}]]\!]^i$

N.B.: the *de re*-cases are analogous to the resp. 'see'-inference

Capturing 'Imagine'-Inferences: Class 3

(3) C. Ida i. imagines / ii. sees a penguin dive into the sea.
D. Ida $\not\Rightarrow$ i. imagines / $\Rightarrow$ ii. sees an aquatic flightless bird dive.

Note: the DP-arg. of 'imagine' can have an **intensional** interpr'n:

$[\![\text{Ida imagines a penguin} \ldots]\!]^i = imagine_i(ida, f_{c'}(\lambda j \exists x.\, \ldots))$

➥ even with (Ext), C.i $\Rightarrow$ D.i is not a valid inference:

(3) a. $[\![\text{C.i}]\!]^i = imagine_i(ida, f_c(\lambda j \exists x.\, penguin_j(x) \wedge dive_j(x)))$
(Ext). $(\forall x)[penguin_i(x) \leftrightarrow aquatic\text{-}flightless\text{-}bird_i(x)]$
$\not\Rightarrow$ b. $[\![\text{D.i}]\!]^i = imagine_i(ida, f_c(\lambda j \exists x.\, aquatic\text{-}flightless\text{-}bird_j(x) \wedge dive_j(x)))$

Interpreting 'Objectual' Imagination Reports

$[\![\text{imagine } [_{\text{DP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda z[imagine_i(z, f_{c'}(\lambda j.\mathcal{Q}_j(E)))]$

$[\![\text{Ida imagines } [_{\text{DP}}\text{a penguin}]]\!]^i_{de\ dicto}$
$= \lambda\mathcal{Q}\lambda z[imagine_i(z, f_{c'}(\lambda j.\mathcal{Q}_j(E)))]$
$(\lambda k\lambda P(\exists x)[penguin_k(x) \wedge P_k(x)], ida)$
$\equiv imagine_i(ida, f_{c'}(\lambda j\exists x.penguin_j(x) \wedge E_j(x)))$
$= [\![\text{Ida imagines } [_{\text{DP}}\text{a penguin}]\ [\text{being there (in her imag'd situation)}]]\!]^i$
(see Parsons 1997; Liefke, accepted)
$\overset{!}{\not\equiv} [\![\text{Ida imagines } [_{\text{DP}}\text{a \underline{real-world} penguin}]]\!]^i$
$= imagine_i(ida, f_{c'}(\lambda j\exists x.penguin_j(x) \wedge E_{\underline{i}}(x)))$

(2) A. Ida i. imagines / ii. sees a penguin.
B. Ida ⇏ i. imagines / ⇒ ii. sees a **real-world** penguin.

Interpreting Clausal Imagination Reports

(5) C. Ida i. imagines / ii. sees a penguin diving into ...
F. Ida ⇒ i. imagines / ⇏ ii. sees that a penguin dives ...

$[\![\text{Ida imagines } [_{\text{CP}}\text{that a penguin is diving}]]\!]^i_{de\ dicto}$
$= \lambda p\lambda z[imagine_i(z, \lambda j.p_j)]$
$(\lambda k(\exists x)[penguin_k(x) \wedge dive_k(x)], ida)$
$\equiv imagine_i(ida, \lambda j\exists x.penguin_j(x) \wedge dive_j(x))$

➥ granted (M↑), C.i ⇒ F.i is a valid inference:

(5) a. $[\![\text{C.i}]\!]^i = imagine_i(ida, \mathbf{f_{c'}}(\lambda j\exists x.penguin_j(x) \wedge dive_j(x)))$
(M↑). $(\forall p)(\forall z)[imagine_i(z,p) \rightarrow (\forall q.p \subseteq q \rightarrow imagine_i(z,q))]$
⇒ b. $[\![\text{F.i}]\!]^i = imagine_i(ida, \lambda j\exists x.penguin_j(x) \wedge dive_j(x))$

Comparison with Other Approaches

$[\![\text{imagine } [_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda P\lambda z[imagine_i(z, f_{c'}(\lambda j.\mathcal{Q}_j(P)))]$

Stephenson 2010 (simplified to center-less situations)

$[\![\text{imagine } [_{\text{CP}}\ ]]\!]^i_{vivid} = \lambda p\boldsymbol{\lambda j}\lambda z[p_{\mathbf{j}} \wedge vivid\text{-}imagine_i(z,\mathbf{j})]$,
where $vivid\text{-}imagine_i(z,j) = 1$
iff z forms a mental image of j as if by directly witnessing it

Problems:

- Which expression (if any) contributes the imag'd situation j?
- How do we explain inferential diff's b/w 'see' and 'imagine'?
- How do we interpret vivid/non-vivid coordinations?

(‡) Ida imagined a penguin and that it was diving into the sea.

Prospects

Note:

- Our interpretations of 'see' and 'imagine' give the embedded DP **maximal** wide resp. narrow **scope**

$[\![\text{see } [_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda P\lambda z[\mathcal{Q}_i(\lambda j\lambda y.see_j(z, f_c(\lambda k.P_k(y))))]$
$[\![\text{imagine } [_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i = \lambda\mathcal{Q}\lambda P\lambda z[imagine_i(z, f_{c'}(\lambda j.\mathcal{Q}_j(P)))]$

- intermediate-scope interpretations are also possible & could be used to capture the inferential behavior of other verbs:

Conjecture ???

$[\![\text{remember } [_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i$ (intensionality + factivity)
$= \lambda\mathcal{Q}\lambda P\lambda z[remember_i(z, f_{c''}(\lambda j.\mathcal{Q}_j(\lambda k\lambda y.P_k(y) \wedge (\mathbf{k \leq i \wedge k \prec i}))))]$
$[\![\text{(non-veridical) see } [_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i$ (extensionality + positivity)
$= \lambda\mathcal{Q}\lambda P\lambda z(\exists x)[E_i(x) \wedge see_i(z, f_{c'}(\lambda j.\mathcal{Q}_j(\lambda k\lambda y.P_k(y) \wedge x = y)))]$
⬅ Szabó's (2010) rule 'split QR'

Prospects (cont'd)

$[\![$remember $[_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i$ (intensionality + factivity)

$= \lambda\mathcal{Q}\lambda P\lambda z\,[remember_i(z, f_{c''}(\lambda j.\,\mathcal{Q}_j(\lambda k\lambda y.\,P_k(y) \wedge (\boldsymbol{k \leq i \wedge k \prec i})))))]$

$[\![$(non-veridical) see $[_{\text{DP}}\ ][_{\text{XP}}\ ]]\!]^i$ (extensionality + positivity)

$= \lambda\mathcal{Q}\lambda P\lambda z\,(\boldsymbol{\exists x})[\boldsymbol{E_i(x)} \wedge see_i(z, f_{c'}(\lambda j.\,\mathcal{Q}_j(\lambda k\lambda y.\,P_k(y) \wedge x = y))))]$

↩ Szabó's (2010) rule 'split QR'

Support:

(†) a. Ida remembers a penguin (diving into the sea).
⇒ b. Ida remembers a **real-world** penguin (diving ...).
⇏ c. Ida remembers a **currently existing** penguin (diving).

(‡) a. Ida (non-veridically) sees a penguin dive into the sea.
⇒ b. **Something** (in i) is s.t. Ida sees **it** dive into the sea.
⇏ c. **A penguin** (in i) is s.t. Ida sees **it** dive into the sea.

Wrap-Up

We have provided a new semantics for imagination and vision reports that ...

... assigns a non-clausal syntax to gerundive attitude reports

... assumes that nominal, gerundive & *that*-clause complements are uniformly interpreted in the type of (coded) situations

The resulting semantics ...

... is compositional

... captures the different inferential behavior of imagination & vision reports

... obviates the need for 'external' lexical-semantic axioms (e.g. quantifier exportation)

➡ is (comparatively) simple

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