

Two types of English non-manner 'how'-clauses

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Non-Interrogative Subordinate Wh-Clauses
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Diagnostics for Experiential Attitude Reports (ExAttRs) (cf. Stephenson 2010)

- ExAtt complements can be replaced by an event-denoting DP:

- (4) a. Ralph remembers Bill buying a sports car
 ≡ b. R. remembers **an event in which Bill was buying** ...

- the matrix verb in ExAttRs allows 'experiential' modification:

- (5) Ralph **vividly** remembers Bill buying a sports car/
 remembers Bill buying ... **in vivid/perfect detail**

- ExAttRs imply the truth of sentences that report the agent's direct witnessing of the event described by the complement:

- (6) a. Ralph remembers Bill buying a sports car
 ⇒ b. Ralph **has witnessed** Bill's purchase of a sports car

!! None of these holds for propositional [= *that*-clause] att. reports

Empirical Domain

Experiential attitude reports: describe an agent's direct mental or perceptual experience of a situation/event: (Stephenson '10)

- (1) Sam saw a penguin diving into the sea
(≡ Sam saw a scene in which a penguin was diving ...)
- (2) Ralph remembers Bill buying a sports car
(≡ Ralph remembers of a specific event in which Bill was buying a sports car)
- (3) Ida imagines a unicorn prancing in the sun
(≡ Ida imagines a mental scene in which a unicorn ...)

Experiential attitude verbs (ExAttVs):

- perception verbs: see, hear, feel, sense, ...
- cognitive factives: remember, notice, observe, ... } **factive**
- report verbs: report (on), describe, ... }
- fiction verbs: imagine, envision, dream (of), } **non-factive**

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Selectional Flexibility of ExAttRs

Observation 1: Experiential attitude verbs accept a **wide variety of complements**, incl. *how*-complements

- (7) Ralph remembers ...
- | | |
|---|--------------------|
| a. Bill | object-denoting DP |
| b. Bill buying a car | gerund |
| c. how Bill was buying a car | how-clause |
| d. that Bill bought a car | that-clause |
| e. the fact that Bill bought a car | content DP |
| f. a/the event in which Bill ... | event-denoting DP |

Observation 2: Experiential attitude reports with different complements enter into **entailment relations**

Objectives

Objective 1 (empirical)

Show that English has two types of non-manner 'how'-clauses: eventive *how*-clauses (Umbach et al.) & Legate-style *how*-clauses (Nye's (2012) *complementizer-'how' clauses, CHCs*)

Objective 2 (formal)

Give a compositional semantics for these two types of *how*-clauses

← **Strategy:** To get the right semantics for (reports with) these clauses, I will consider entailments between reports with different complements:

- (8) remembers **how_E** x was Fing ⇒ remembers x Fing
- (9) remembers **how_P** x Fed ⇏ remembers x Fing

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Two Types of Non-Manner *how*-Clauses: COCA examples

1 Eventive 'how'-clauses:

- I **saw** how her damaged hand was **searching** for sth. in the air
- I looked from Dad to Mom and **saw** how they were **staring** at each other
- [...] the Professor began to speak avidly, excitedly. His wife **saw** how he was **stroking** his whiskered jaws

2 Propositional 'how'-clauses:

- I **saw** how his gaze was **drawn inwards**
- he **saw** how the rice **was stained brown** with shoyu
- she **saw** how their mouths **were wide-open**, black and straining

3 Unclear cases:

- I **saw** how I was clearly **leading** them on (propositional?)
- he **saw** how his friends **hid** their bags **behind** their bodies (ev?)
- I **saw** how the other nurses' aides **would help** bring the residents to the table (eventive?)

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Two Types of English Non-Manner *how*-Clauses

1 Eventive 'how'-clauses: (see Umbach et al., subm.)

- are licensed by **experiential attitude verbs**
- make a similar contribution to **gerund complements**
- denote an **event in progress**; are imperfective
- license activities and accomplishments, but not states

2 Propositional 'how'-clauses: (see Legate 2010; Nye 2012)

- are licensed by **factive verbs** and **verbs of saying**
- make the same semantic contribution as a content DP of the form 'the fact [C₀that ...]'
 - denote a **real-world fact**
- license negation and stative content (⇒ 'tooth fairy'-example)
- only occur in colloquial language use

License eventive <i>how</i> -clauses	License propositional <i>how</i> -clauses
see, remember, imagine	see, remember, tell

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Two Types of Non-Manner *how*-Clauses: ex (cont'd)

1 Eventive 'how'-clauses:

- She **remembered** how they were **walking** along the busy streets of Queens just chatting about school stuff
- Mike **remembered** how he was **sitting** in the kitchen looking directly at the front door, **waiting** for Becky to come home
- He **remembered** how she **fingered** the holes in the sleeves of her oversized school sweater

2 Propositional 'how'-clauses:

- She **remembered** how Mariela **had never wanted** to go out and play with the neighbor children
- Jack **remembered** how beavers **were sometimes killed** by the very tree they were cutting down
- Fay **remembered** how the old man had **kept** his CDs in a clearly marked folder

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Neither Type is a Manner *how*-Clause

(by the diagnostics from Umbach et al., submitted)

Test 1: Paraphrasability by 'the manner/way in which [_{TP}]'; Possible continuation by a specification of manner or method (manner: ✓; non-manner: X)

- (10) a. Anna saw *how_M* Berta packed her bag
 ≡ b. Anna saw *the manner/way in which* B. packed her bag,
 viz. very hastily / tennis shoes first, then some shirts (✓)
- (11) a. Anna saw *how_E* Berta was packing her bag
 ≠ b. Anna saw *the way in which* Berta was packing ... (X)
- (12) a. Mike remembered *how* he was sitting in the kitchen ...
 ≠ b. Mike remembered *the way in which* he was sitting (X)
- (13) a. Jack remembered *how* beavers were sometimes killed by
 the very tree they were cutting down
 ≠ b. Jack remembered *the way in which* beavers were... (X)

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Neither Type is a Manner *how*-Clause (cont'd)

(by the diagnostics from Umbach et al.)

Test 2: Admissible accenting of *how*; Possible follow-up by a manner clarification question (manner: ✓; non-m.: X)

- (14) a. Anna saw *how_M* Berta packed her bag
 b. – And *HOW* was she packing her bag? (✓)
 – Answer: Very hastily (manner) / Tennis shoes first, ...
- (15) a. Anna saw *how_E* Berta was packing her bag
 b. #– And *HOW* was she packing her bag? (X)
- (16) a. Mike remembered *how* he was sitting in the kitchen ...
 b. #– And *HOW* was sitting in the kitchen? (X)
- (17) a. Jack remembered *how* beavers were sometimes killed by
 the very tree they were cutting down
 b. #– And *HOW* are beavers (sometimes) killed ...? (X)

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Distinguishing the Two Types of Non-Manner *how*

(using a diagnostic from Umbach et al.)

Test 1 Possible follow-up by a question about why the event came about (eventive: ✓; non-event.: X)

- (18) a. Anna saw *how_E* Berta was packing her bag
 b. – What had happened? / How come? (✓)
 a. – Answer: She had had a fight with her sister
- (19) a. Anna saw *how_M* Berta packed her bag
 b. #– What had happened? / How come? (X)
- (20) a. Mike remembered *how* he was sitting in the kitchen ...
 b. – What had happened? / How come? (✓)
 a. – Answer: His father had just passed away ...
- (21) a. Jack remembered *how* beavers were sometimes killed by
 the very tree they were cutting down
 b. #– What had happened? / How come? (X)

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Distinguishing the Two Types of Non-Manner *how*

Observation: Stephenson's (2010) tests for 'experiential' (vs. propositional) attitude reports also identify eventive (vs. propositional) *how*-clauses:

Test 2 Modifiability of the matrix verb by *vividly* or *in perfect detail* (eventive: ✓; propositional: X)

- (22) a. Mike remembered *how* he was sitting in the kitchen ...
 ≡ b. Mike *vividly* remembered/remembered *in perfect detail*
 how he was sitting in the kitchen ... (✓)
- (23) a. Jack remembered *how* beavers were sometimes killed by
 the very tree they were cutting down
 ≠ b. ? Jack *vividly* remembered/remembered *in perfect detail*
 how beavers were sometimes killed by the very tree (X)

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Distinguishing the Two Types (cont'd)

Observation: Stephenson's (2010) tests for ExAttRs also identify *eventive how-clauses*:

Test 3 Entailment of the agent's direct experience or witnessing of the event/scene (eventive: ✓; proposition! ✗)

- (24) a. Mike remembered how he was sitting in the kitchen ...
 ⇒ b. Mike has experienced (/ witnessed himself) sitting in the kitchen ... (✓)
- (25) a. Jack remembered how beavers were sometimes killed by the very tree they were cutting down
 ✗ b. Jack has witnessed a beaver being killed by the very tree it was cutting down (✗)

⇒ *how_E*-clauses describe the contents of *experiential attitudes*;
how_P-clauses describe the contents of *non-experiential attitudes*

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Combinatorics of Sample Reports

For A–E, we identify 20 interesting pairs of reports (in grey):

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

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Sample Attitude Reports

Strategy: To get the 'right' semantics for the different types of non-manner *how*-clauses, we consider entailments between the following *sample reports*:

- (A) Ida i. remembers / ii. imagines *a penguin*
 (B) Ida i. remembers / ii. imagines *a penguin diving into the sea*
 (C) Ida i. remembers / ii. imagines *how_E a penguin was/is diving*
 (D) Ida i. remembers / ~~ii. imagines~~ *how_P a penguin dove/dives// was/is diving into the sea*
 (E) Ida i. remembers / ii. imagines *that a penguin dove/dives// was/is diving into the sea*

N.B.: For (D)–(E), we choose the *progressive/perfective form* depending on which one yields a *minimal pair*

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Testing for Entailments

(Grice 1975; Blome-Tillmann 2013)

We test these pairs for entailments via the usual tests:

Test 1 (non-cancellability): If $X \Rightarrow Y$ is an entailment, then 'X, but (it is) not (the case that) Y' is a contradiction

- (*) B.ii. Ida imagines *a penguin diving into the sea*
 ⇒ A.ii. Ida imagines *a penguin*

- (†) # Ida imagines *a penguin diving into the sea*, but she does not imagine *a penguin*

Test 2 (non-reinforceability): If $X \Rightarrow Y$ is an entailment, then 'X and, specifically, Y' is redundant/semantically deviant

- (‡) ?? Ida imagines *a penguin diving into the sea*;
 (more) specifically, she imagines *a penguin*

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Entailments

Tests 1 & 2 identify 9 interesting entailment relations:

	A	B	C	D	E
A	≡	≠	≠	≠/#	≠
B	⇒	≡	⇒/⇒	≠/#	⇒/⇒
C	⇒	⇒	≡	≠/#	⇒/⇒
D	≠/#	≠/#	≠/#	≡/#	⇒/#
E	≠	≠/⇒	≠/⇒	≠/#	≡

green = 3 general entailments (⇒)

grey = 4 'lexical' entailments: 1 holds only f. *remember* (⇒/#); 3 hold only for *imagine* (≠/⇒)

red judgements diverge dep. on whether *how_E*-complements are taken to be **epistemically positive** (cf. Dretske 1970)
 we follow Falkenberg 1989 (neutral), pace Umbach et al.

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Noteworthy Entailments

- general**
- (1) C: I. remembers/imagines **how_E** a penguin was/is diving
 exper'ty of *how_E* ⇒ B: Ida remembers/imagines a penguin diving
- 'lexical' ↓**
- (2) D: Ida i. remembers / ii. imagines **how_P** a penguin dove
 epist.+ of *how_P* ⇒ E: Ida remembers **that** a penguin dove into the sea
- (3) E: Ida i. remembers **that** a penguin dove into the sea
 'richness' of *how_P* ⇒ D: Ida remembers / imagines **how_P** a penguin dove ...
- (4) B: Ida i. remembers / ii. imagines a penguin diving ...
 epist.+ of *imagine* ⇒ E: Ida **that** i. remembers / ⇒ ii. imagines **that** a penguin was/is diving
- (5) E: I. remembers/imagines **that** a penguin was/is diving
 exper'ty of *imagine* ⇒ B/C: **that** i. remembers / ⇒ ii. imagines a penguin diving/
how_E a penguin was diving

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Important Observations

- how_E*-clauses describe the contents of **experiential** attitudes (1); *how_P*-clauses do **not** describe the contents of **exp.** attitudes

C: I. remembers/imagines **how_E** a penguin was/is diving ...
 ⇒ B: Ida remembers/imagines a penguin diving ...
 D: I. remembers/imagines **how_P** a penguin was diving ...
 ≠ B: Ida remembers a penguin diving into the sea

- imagine*- (unlike *remember*-) reports are always **experiential** (5)

E: I. remembers/imagines **that** a penguin was/is diving
 B/C: **that** i. remembers / ⇒ imagines (**how_E**) a penguin (was) diving

- all *imagine*-reports are **epistemically positive** (4)

B: Ida i. remembers / ii. imagines a penguin diving ...
 E: Ida **that** i. remembers / ⇒ imagines **that** a penguin was/is ...

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Important Observations (cont'd)

- how_P* effects the **epistemic positiveness** of its complements (2)

D: Ida i. remembers / ii. imagines **how_P** a penguin dove ...
 E: ⇒ Ida remembers **that** a penguin dove into the sea

- how_P*-clauses have 'richer' content than *that_P*-clauses (3)

(Nye 2012: "CHCs [...] contribute something additional [to the interpretation of factive *that*-clauses]")

E: Ida i. remembers **that_P** a penguin dove into the sea
 D: **that** i. remembers / imagines **how_P** a penguin dove ...

- how_P* – but not *how_E* – (or verbs that license it) **presupposes the truth** of its complement (see the distribution of *how_P*)

D: Ida i. remembers / ii. imagines **how_P** a penguin dove ...

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Capturing the Observations

To capture the different entailment patterns of *remember* and *imagine*, we adopt a **3-part strategy**:

Strategy

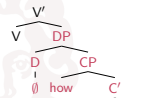
- 1 Assume that how_E - and how_P -clauses have the same syntax, but a **diff. semantics** (due to the semantics of how_E vs. how_P)
- 2 how_E has the semantics of interrogative manner $how_{(M)}$; how_P is interpreted as a factive complementizer (= Kratzer's *that_F*)
 - ↳ this captures the factivity (3), non-experientiality (1), and epistemic positiveness (2) of how_P -complements
- 3 *remember* is polysemous b/w 'experiential' uses (that select for $how_{E/P}$) and 'propositional' uses (that select for *that_F*) (cf. Tuvving 1972); *imagine* is always used 'experientially'
 - ↳ captures the positiveness (4) & experientiality of *imagine* (5)

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On ①: the syntax of non-manner *how*-clauses

Assumption: non-manner *how*-complements are free 'relative clauses' in which *how* is base-generated in its surface position; (see Legate 2010; cf. Umbach et al., submitted)

↳ this explains their DP-like behavior: (see Legate 2010)



- *how*-clauses can be coordinated w. (content/non-content) DPs
- *how*-clauses can be the complement of a preposition
- *how*-clauses occur in the PP of CP/PP-neutral predicates
- *how*-clauses cannot appear in positions that are not assigned case
- ...

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The Syntax of Our Example Attitude Complements

DP complements:

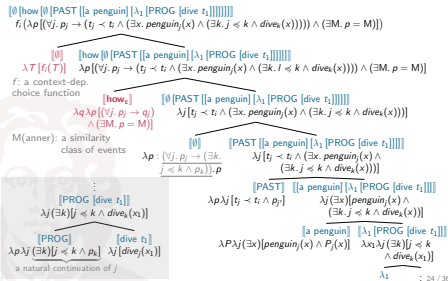
- **eventive 'how'-complements:** how a penguin was diving
 $[_{DP} \emptyset [_{CP} how_E [_{C'} \emptyset [_{TP} PAST [[a \text{ penguin}] [\lambda_1 [PROG [dive \ t_1]]]]]]]]]$
- **propositional 'how'-complements:** how a penguin dove
 $[_{DP} \emptyset [_{CP} how_P [_{C'} \emptyset [_{TP} PAST [[a \text{ penguin}] [\lambda_1 [PERF [dive \ t_1]]]]]]]]]$
- **direct object complements:** a penguin
 $not: [_{CP} \emptyset [_{TP} PAST [[a \text{ penguin}] [\lambda_1 [INF [dive \ t_1]]]]]]]$ (cf. Parsons 1997)

CP complements:

- **gerund complements:** a penguin diving (not in German)
 $[_{CP} \emptyset [_{C'} \emptyset [_{TP} [[a \text{ penguin}] [\lambda_1 [PROG [dive \ t_1]]]]]]]$
- **'that'-clause complements:** that a penguin dove
 $[_{CP} that [_{C'} \emptyset [_{TP} PAST [[a \text{ penguin}] [\lambda_1 [PERF [dive \ t_1]]]]]]]$

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On ②: the semantics of eventive *how*-clauses



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Complement Semantics: key ingredients

- the TP denotes a proposition [= a set of situations/events]

$$\llbracket_{\text{TP}} \text{PAST} [\llbracket \text{a penguin} \rrbracket [\lambda_1 [\text{PROG} [\text{dive } t_1]]]] \rrbracket \\ = \lambda j [t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge (\exists k. j \preccurlyeq k \wedge \text{dive}_k(x)))]$$

- $\text{how}_E (= \text{how}_M)$ denotes a fct. from propositions to questions, where $M(\text{anner}) := \lambda j (\exists j') (\exists \mathcal{F}) [\text{SIM}(j, j', \mathcal{F})]$

$$\llbracket \text{how}_E \rrbracket = \lambda q^{(s,t)} \lambda p^{(s,t)} [(\forall j^s. p_j \rightarrow q_j) \wedge (\exists M. p = M)]$$

- how_P is a **factive complementizer** that sends a proposition to the set of its minimal exemplifiers (see Kratzer 2002, 2006)

$$\llbracket \text{how}_P \rrbracket \equiv \llbracket \text{that}_P \rrbracket = \lambda p^{(s,t)} \cdot p_i. [\Pi(p)], \text{ where} \\ \Pi := \lambda q \lambda j [q_j \wedge (\forall k. (q_k \wedge k \leq j) \rightarrow k = j)]$$

- this captures the **factivity** (p_i), **non-experimentality** (1), & **epistemic positiveness** (2) of how_P -complements (see Π)

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The Semantics of Experiential Attitude Verbs

- Proposal 1:** To capture E (*that*) \nrightarrow D (how_P), we assume that *remember* is polysemous between 'experiential' and 'propositional' uses: (cf. Tulving 1972)

- (26)
- a. $\llbracket \text{remember}_{\text{PROP}} \rrbracket^i = \lambda p^{(s,t)} \lambda z^e [\text{remember}_i(z, \lambda j. p_j \wedge t_j \prec t_i)]$ a classical proposition
- b. $\llbracket \text{remember}_{\text{EXP}} \rrbracket^i = \lambda p \lambda z^e [\text{remember}_i(z, C_i(\lambda j. p_j \wedge t_j \prec t_i))]$ a (propositionally coded) event/situation

- C** selects a subset (= isomorphic situations) from a set of situations in dependence on the attitude event i (cf. von Stechow 1999)

- different remembering events have different contents

- !! since *remember* is **factive**, **C** in (b) chooses a **singleton**

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Complement Semantics: key ingredients (cont'd)

- the silent determiner selects a proposition from a question:

$$\llbracket \text{D } \emptyset \rrbracket = \lambda T^{(s,t)} \llbracket f_i(T) \rrbracket, \text{ where } f_i \text{ is an } i\text{-dep't choice fct.}$$

- this resolves the **type mismatch** between CP and V

- how_E -clauses denote a **manner** (!)

$$\llbracket \emptyset [\text{how}_E [\emptyset [\text{PAST} [\llbracket \text{a penguin} \rrbracket [\lambda_1 [\text{PROG} [\text{dive } t_1]]]]]] \rrbracket \rrbracket \\ = f_i \lambda p [(\forall j. p_j \rightarrow (t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge (\exists k. j \preccurlyeq k \wedge \text{dive}_k(x))))) \wedge (\exists M. p = M)] \\ \equiv \lambda j [t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge \dots) \wedge (\exists j' \exists \mathcal{F}. \text{SIM}(j, j', \mathcal{F}))]$$

- how_P -clauses denote a **set of isomorphic facts**

$$\llbracket \emptyset [\text{how}_P [\emptyset [\text{PAST} [\llbracket \text{a penguin} \rrbracket [\lambda_1 [\text{PROG} [\text{dive } t_1]]]]]] \rrbracket \rrbracket \\ = \Pi(\lambda j [t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge (\exists k. j \preccurlyeq k \wedge \text{dive}_k(x)))])$$

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[[remember that_P]] vis-à-vis [[remember how_P]] (Cl. (2), (3))

- Proposal 2:** $\text{remember}_{\text{PROP}}$ selects that_P ; $\text{remember}_{\text{EXP}}$ how_P

- (27) $\llbracket E.i \rrbracket^i \equiv \llbracket \text{Ida} [\text{VP remembers} [\text{CP that}_P [\text{TP a penguin dove}]]] \rrbracket^i \\ \equiv \llbracket \text{remember}_{\text{PROP}} \rrbracket^i (\llbracket \text{Ida} \rrbracket, \llbracket \text{that}_P \text{ a penguin dove} \rrbracket) \\ = \text{remember}_i(\text{Ida}, \Pi(\lambda j. t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge \text{dive}_j(x))))$ a set of isomorphic different-world facts

- See Nye's semantics for CHCs (a singleton set representing) a fact in i

- (28) $\text{remember}_i(\text{Ida}, C_i(\Pi(\lambda j. t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge \text{dive}_j(x)))) \\ \equiv \llbracket \text{remember}_{\text{EXP}} \rrbracket^i (\llbracket \text{Ida} \rrbracket, \llbracket \text{how}_P \text{ a penguin dove} \rrbracket) \\ \equiv \llbracket D.i \rrbracket^i \equiv \llbracket \text{Ida} [\text{VP remembers} [\text{CP how}_P [\text{TP a penguin dove}]]] \rrbracket^i_{\text{de dicto}}$

- !! Since $C_i(\Pi(\lambda j. \dots)) \subseteq \Pi(\lambda j. \dots)$, $D.i \Rightarrow E.i$ (2), but $E.i \nrightarrow D.i$ (3)

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[[remember how_E]] vis-à-vis [[remember how_P]]

$$\begin{aligned}
 (29) \quad & \llbracket \text{remember}_{\text{EXP}} \rrbracket^i (\llbracket \text{Ida} \rrbracket, f_i(\llbracket \text{how}_E \text{ a penguin was diving} \rrbracket)) \\
 & \quad \text{(a representation of) a manner} \\
 = & \text{remember}_i(\text{Ida}, C_i(f_i(\lambda p. [\forall j. p_j \rightarrow (t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge \\
 & \quad (\exists k. j \preccurlyeq k \wedge \text{dive}_k(x)))))) \wedge (\exists M. p = M)]))) \\
 \equiv & \text{remember}_i(\text{Ida}, \text{!! } C \text{ selects a singleton } \uparrow \\
 & \quad C_i(\lambda j. t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge (\exists k. j \preccurlyeq k \wedge \text{dive}_k(x)))))) \\
 & \quad \text{(a rep. of) an event in } i \text{ [= a maximally specific manner!]} \\
 & \quad \text{IU} \\
 & \quad \text{(a singleton set representing) a fact in } i \\
 (32) \quad & \text{remember}_i(\text{Ida}, C_i(\Pi(\lambda j. t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge \text{dive}_j(x)))))) \\
 = & \llbracket \text{remember}_{\text{EXP}} \rrbracket^i (\llbracket \text{Ida} \rrbracket, \llbracket \text{how}_P \text{ a penguin was diving} \rrbracket) \\
 \text{!! Since } & C_i(\Pi(\lambda j. \dots)) \not\subseteq C_i(\lambda j. \dots), C.i \not\rightarrow D.i \text{ and } D.i \not\rightarrow C.i
 \end{aligned}$$

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How_P-reports and fiction verbs

Note: Our semantics also explains why fiction verbs do not license how_P-clauses:

$$\begin{aligned}
 (30) \quad & \llbracket * \text{Ida} [\text{VP imagines} [\text{CP how}_P \text{ TP a unicorn canters}]] \rrbracket^i \text{ de dicto} \\
 \equiv & \llbracket \text{imagine}_{\text{EXP}} \rrbracket^i (\llbracket \text{Ida} \rrbracket, \llbracket \text{how}_P \text{ a unicorn canters} \rrbracket) \\
 = & (\exists j) [j \leq w_i \wedge (\exists x. \text{unicorn}_j(x) \wedge \text{canter}_j(x))] \\
 & \quad \text{imagine}_i(\text{Ida}, C_i(\Pi(\lambda j. \exists x. \text{unicorn}_j(x) \wedge \text{canter}_j(x)))) \\
 \equiv & \text{imagine}_i(\text{Ida}, C_i(\Pi(*))) \equiv * \\
 & \quad \uparrow \text{undefined, since } \neg(\exists j) [j \leq w_i \wedge (\exists x. \text{unicorn}_j(x))]
 \end{aligned}$$

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The Semantics of our Sample remember-Reports

Experiential 'remember'-reports:

$$\begin{aligned}
 (C) \quad & \llbracket \text{Ida remembers how}_E \text{ a penguin was diving} \rrbracket^i \text{ de dicto} \\
 = & \text{remember}_i(\text{Ida}, C_i(\lambda j. t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge (\exists k. j \preccurlyeq k \wedge \text{dive}_k(x)))))) \\
 & \quad \text{(a representation of) an event in } i \\
 \equiv (B) \quad & \llbracket \text{Ida remembers a penguin diving} \rrbracket^i \text{ de dicto} \quad (\text{see (1)})
 \end{aligned}$$

Propositional 'remember'-reports:

$$\begin{aligned}
 (D) \quad & \llbracket \text{Ida remembers how}_P \text{ a penguin dove} \rrbracket^i \text{ de dicto} \\
 = & \text{remember}_i(\text{Ida}, C_i(\Pi(\lambda j. t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge \text{dive}_j(x)))))) \\
 & \quad \text{(a representation of) a fact in } i \\
 (E) \quad & \llbracket \text{Ida remembers that a penguin dove} \rrbracket^i \text{ de dicto} \\
 = & \text{remember}_i(\text{Ida}, \Pi(\lambda j. t_j \prec t_i \wedge (\exists x. \text{penguin}_j(x) \wedge \text{dive}_j(x)))) \\
 & \quad \text{a set of isomorphic different-world facts}
 \end{aligned}$$

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The Semantics of imagine-Reports (p.c. Ede Zimmermann)

Observation: *imagine*-reports are always experiential & epistemic-ally positive (see (4), (5))

← **Strategy:** Assume that *imagine* only has an experiential use:

$$(31) \quad \llbracket \text{imagine}_{\text{EXP}} \rrbracket^i = \lambda p. \lambda z^e [\text{imagine}_i(z, C_i(p))]$$

Experiential 'imagine'-reports:

$$\begin{aligned}
 (C) \quad & \llbracket \text{Ida imagines how}_E \text{ a penguin is diving} \rrbracket^i \text{ de dicto} \\
 = & \text{imagine}_i(\text{Ida}, C_i(\lambda j. \exists x. \text{penguin}_j(x) \wedge (\exists k. j \preccurlyeq k \wedge \text{dive}_k(x)))) \\
 & \quad \text{(a representation of) an event} \\
 \equiv (B) \quad & \llbracket \text{Ida imagines a penguin diving} \rrbracket^i \text{ de dicto} \quad (\text{see (1)}) \\
 \equiv (E) \quad & \llbracket \text{Ida imagines that a penguin is diving} \rrbracket^i \text{ de dicto} \\
 & \quad \text{! this event can be 'informationally poor'}
 \end{aligned}$$

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A Conjecture

	(minimal) facts	non-minimal events
located in <i>i</i>	<i>how_P</i> -clause	gerund / <i>how_E</i> -clause
located s'where	factive <i>that</i> -clause	non-factive <i>that</i> -clause

Question 1: Why do some languages have *how_P*?

– **Answer 1:** It fills an otherwise unoccupied structural position

Question 2: Why do languages have *how_E*?

– **Answer 2:** It makes it possible to express relations to actual events in languages (e.g. German) that do not allow for gerund complements

Question 3: Why use the 'manner'-denotation of *how* for *how_E*?

– **Answer 3:** Semantic uniformity + It captures entailments between ExAttRs with *how_E*- and *how_M*-complements

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Wrap-Up

We have ...

- ... shown that English has **two types of non-manner 'how'-clauses**: eventive (cf. Umbach et al.) and propositional clauses (Legate 2010; Nye 2012)
- ... identified the **entailment relations** between attitude reports with embedded *how_{E/P}*-clauses and other complements
- ... given a **compositional semantics for *how_{E/P}*-clause reports** that captures these relations
- Future work:** there's a lot to do still ...

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(Non-)Interrogative Manner *how*-Clauses

(32) $\llbracket \text{Ida imagines } [_{DP} \emptyset [_{CP} [\text{how}_M] [\lambda_1 [\emptyset [_{TP} \text{Berta is packing } t_1]]]]] \rrbracket^i$
 $\equiv \llbracket \text{imagine} \rrbracket^i (\llbracket \text{Ida} \rrbracket, f_i (\llbracket \text{how}_M \rrbracket (\lambda_1. \llbracket \text{Berta is packing } t_1 \rrbracket)))$
 $= \text{imagine}_i(\text{ida},$
 $C_i(f_i(\lambda p[(\forall j. p_j \rightarrow (\exists k. j \preccurlyeq k \wedge \text{pack}_k(\text{berta})) \wedge (\exists M. p = M)])))$
 a representation of a (single) manner

Question: Do fiction verbs embed interrogative *how_M*-clauses?

(33) $\llbracket \text{Ida imagines } [_{CP} [\text{how}_M] [_{C'} Q [\lambda_1 [\emptyset [_{TP} \text{Berta is packing } t_1]]]]] \rrbracket^i$
 $\equiv \llbracket \text{imagine} \rrbracket^i (\llbracket \text{Ida} \rrbracket, \llbracket \text{how}_M \rrbracket (\lambda_1. \llbracket \text{Berta is packing } t_1 \rrbracket))$
 $= \text{imagine}_i(\text{ida},$
 $\lambda p[(\forall j. p_j \rightarrow (\exists k. j \preccurlyeq k \wedge \text{pack}_k(\text{berta})) \wedge (\exists M. p = M)]])$
 a representation of a **set of (different) manners**
 $\approx \llbracket \text{Ida considers } [\text{alternative manners in which B. might be packing}] \rrbracket^i$

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