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Modelling selectional super-flexibility*

Kristina Liefke
Ruhr University Bochum

Abstract The selectional flexibility of some attitude verbs (e.g. know, realize, report) between declarative and interrogative complements has been the subject of much recent work in formal semantics. However, little attention has been paid to verbs (e.g. see, remember, observe) that embed an even wider variety of complements (incl. subject-controlled gerundive small clauses and concrete object-denoting DPs). Since the familiar types of some of these complements resist an embedding in the type for questions [= sets of propositions], these verbs challenge Theiler, Roelofsen & Aloni's (2018) uniform interpretation strategy for the complements of declarative/interrogative-neutral verbs. The present paper answers this challenge by uniformly interpreting the different complements of selectionally super-flexible verbs like remember in a generalized type for questions, viz. as *parametrized centered questions*. It shows that the resulting semantics captures the intuitive entailment pattern of these verbs.

Keywords: responsive verbs, veridical experiential attitude verbs, complementation, cross-categorial entailment, inquisitive semantics

1 Introduction

Responsive verbs, i.e. verbs like know, realize, and report that are selectionally flexible between declarative (e.g. (1a)) and interrogative clauses (e.g. (1b)), have been at the center of much recent work in formal semantics (see e.g. Ciardelli, Roelofsen & Theiler 2017; Theiler, Roelofsen & Aloni 2018; 2019; Mayr 2019; Spector & Egré 2015; White & Rawlins 2016, 2020; Uegaki 2019; Uegaki & Sudo 2019).

(1) Ken knows
a. <u>that</u> Mary was wearing a crazy hat. (declarative clause)
b. <u>whether</u> Mary was wearing a crazy hat. (interrogative cl.)

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Responsive verbs are particularly interesting since their selectional flexibility cannot be attributed to an ambiguity between a declarative- and an interrogative-embedding use. Such attribution is excluded by the fact that declaratives can be coordinated with interrogatives in the complements of these verbs (see (2); following Groenendijk & Stokhof 1984: 93):

(2) Ken knows [that Mary was wearing a crazy hat] and [whether she bought it at the party supply store].

In formal semantics, interest in responsive verbs is further fuelled by the observation that their declarative and interrogative complements can stand in intuitive semantic inclusion relations to one another. Such relations validate the entailment from (3a) to (3b) and the equivalence of (4a) and (4b). They also account for the redundancy of reports like (4a). In particular, the redundancy of (4a) is due to the fact that all rainbow squid hats are crazy hats.

(3) a. Ken knows [that Mary was wearing a crazy hat (when she arrived)].
$\Rightarrow$ b. Ken knows [whether Mary was wearing a crazy hat (when she arrived)].

(4) a. #Ken knows [whether Mary was wearing a crazy hat] and [that she was wearing a rainbow squid hat]. (redundant)
$\equiv$ b. Ken knows [that Mary was wearing a rainbow squid hat].

On an intuitive level, the validity of entailments like (3) is ascribed to the observation that the semantic information content of the embedded interrogative in (3b) (i.e. 'Mary was or was not wearing a crazy hat') is contained in the information content of the embedded declarative in (3a) (i.e. 'Mary was wearing a crazy hat'). The redundancy – and attendant markedness – of the conjunction (4a) is due to the fact that the true answer to the question that is denoted by the first conjunct in the complement of (4a) (viz. 'Mary was wearing a crazy hat') is informationally contained in the content of the second conjunct in (4a) (viz. 'Mary was wearing a rainbow squid hat'), where rainbow squid hats are crazy hats.

The observed informational relations between embedded declaratives and interrogatives pose an important empirical constraint on any adequate semantics for responsive verbs. However, this constraint is not easily satisfied. This is so since declaratives and interrogatives are typically associated with objects of a different semantic type: while declaratives are commonly interpreted as *propositions* (analyzed as [characteristic functions of] sets of possible worlds, type[1] $(s;t)$; see Montague

1 To distinguish centered propositions from properties (see below), I will use multiary function types (see Tichý 1983; Orey 1959). The latter are types of the form $(\alpha_1 \times \ldots \times \alpha_n) \to \alpha_{n+1}$ that are associated with functions from n-tuples of objects of the types $\alpha_1, \ldots, \alpha_n$ to objects of type α_{n+1}. Following Tichý (1983), I write $(\alpha_1 \times \ldots \times \alpha_n) \to \alpha_{n+1}$ as $(\alpha_1 \ldots \alpha_n; \alpha_{n+1})$ and identify the type (α) with α.

1970; Karttunen 1977), interrogatives are interpreted as *questions* (analyzed as [characteristic functions of] sets of propositions, type $((s;t);t)$; see Hamblin 1976; Karttunen 1977; Ciardelli, Groenendijk & Roelofsen 2018). The different types of declaratives and interrogatives block an easy analysis of the relation between the complements in (3a) and (3b) as set-theoretic inclusion and disable the familiar interpretation of natural language and in (4a) as set intersection (see Partee & Rooth 1983).

Admittedly, one can enable the above-proposed analysis by 'lifting' propositions to questions through a variant of Partee's type-shifter *ident* (see Uegaki 2016). However, Theiler et al. have shown (in Theiler et al. 2018, 2019) that this move fails to capture informational inclusion relations like the inclusion of the semantic information content of that Mary was wearing a rainbow squid hat in the content of whether Mary was wearing a crazy hat (see (4)).

To answer this challenge, Theiler et al. (2018) propose that declaratives and interrogatives are uniformly interpreted in the type for questions, $((s;t);t)$. Interrogatives are then interpreted in their familiar type. Declaratives are interpreted through a type-shifter, $\lambda p^{(s;t)} \lambda q^{(s;t)} (\forall w^s)[q(w) \to p(w)]$, that sends sets of worlds p to their powersets $\mathscr{P}(p)$, i.e. to downward-closed sets of propositions (see also Ciardelli et al. 2017, 2018; Theiler et al. 2018). The downward closure of these sets effects that, if these sets include the familiar interpretation of the declarative p, they also include every informationally stronger proposition [= set of worlds] q, where $q \subset p$.[2]

The results of this type-shift meet the type-requirement (viz. type-identity) on entailment and coordination, and capture the intuitive inclusion relations between declarative and interrogative complements (Roelofsen 2013; Ciardelli et al. 2017). As a result, they straightforwardly account for the data in (3) and (4). My simplified account of this data (in (6), (7)) uses the semantics for know in (5), where $know := \lambda T^{((s;t);t)} \colon \underline{\exists q \in T\,[q(w)]}.\, \lambda w^s \lambda z^e . \exists p \in T\,[p(w) \wedge (\forall w'. \mathrm{DOX}_z^w(w') \to p(w'))]$ (see Uegaki 2016: 631).[3]

(5) $[\![\text{know}]\!] = \lambda T^{((s;t);t)} \lambda w^s \lambda z^e\, [know_w(T)(z)]$

(6) a. $know_w\big(\lambda p \forall w'.\, p(w') \to (\exists x.\, crazy\text{-}hat_{w'}(x) \wedge wear_{w'}(x)(mary))\big)(ken)$

b. $\underline{(\forall T)(\forall w)(\forall z)[know_w(T)(z) \to (\forall T'.\, T \subseteq T' \to know_w(T')(z))]}$

$\Rightarrow$ c. $know_w\big(\lambda p.\, (\forall w'.\, p(w') \to (\exists x.\, crazy\text{-}hat_{w'}(x) \wedge wear_{w'}(x)(mary))) \vee$
$(\forall w'.\, p(w') \to \neg(\exists x.\, crazy\text{-}hat_{w'}(x) \wedge wear_{w'}(x)(mary)))\big)(ken)$

2 This differs from Alternative Semantics (Hamblin 1976), Possibility Semantics (Ciardelli et al. 2017), and Uegaki's (2016) semantics, which identify questions with the maximal elements in these sets (called *alternatives*). For reasons against this move, the reader is refereed to (Roelofsen 2013) and (Ciardelli et al. 2017, 2018).

3 For simplicity, we neglect tense and aspect of the matrix verb.

(7) a. $know_w\big(\lambda p.\,((\forall w'.\,p(w') \to (\exists x.\,crazy\text{-}hat_{w'}(x) \wedge wear_{w'}(x)(mary))) \vee$
$(\forall w'.\,p(w') \to \neg(\exists x.\,crazy\text{-}hat_{w'}(x) \wedge wear_{w'}(x)(mary)))) \wedge$
$(\forall w''.\,p(w'') \to (\exists x.\,squid\text{-}hat_{w''}(x) \wedge wear_{w''}(x)(mary)))\big)(ken)$

b. $\underline{(\forall x)(\forall w)[squid\text{-}hat_w(x) \to crazy\text{-}hat_w(x)]}$

$\Leftrightarrow$ c. $know_w\big(\lambda p \forall w'.\,p(w') \to (\exists x.\,squid\text{-}hat_{w'}(x) \wedge wear_{w'}(x)(mary))\big)(ken)$

In particular, (6) models the entailment in (3) through the inclusion of the powerset of the set of worlds in which Mary is wearing a crazy hat, $\mathscr{P}\big(\{w' \mid \exists x.\,crazy\text{-}hat_{w'}(x) \wedge wear_{w'}(x)(mary)\}\big)$, (see (6a)) in the union of the powerset of the set of worlds in which Mary is wearing a crazy hat, $\mathscr{P}\big(\{w' \mid \exists x.\,crazy\text{-}hat_{w'}(x) \wedge wear_{w'}(x)(mary)\}\big)$, and the powerset of the set of worlds in which Mary is not wearing a crazy hat, $\mathscr{P}\big(\{w' \mid \neg\exists x.\,crazy\text{-}hat_{w'}(x) \wedge wear_{w'}(x)(mary)\}\big)$ (see (6c)). Similar considerations hold for the equivalence in (4) (see (7)).

2 The Challenge from Experiential Attitude Verbs

Its merits notwithstanding, Theiler et al.'s semantics fails to capture the selectional flexibility of a particular, but salient, subclass of responsive verbs: veridical experiential attitude verbs (see Stephenson 2010b; Higginbotham 2003). The latter are verbs like see, remember, and observe that are selectionally much more flexible than 'standard' responsive verbs. Like their standard relatives, veridical experiential attitude verbs combine with declarative and interrogative complements (see (8a-b)). Like most responsive verbs, they also combine with content DPs, e.g. the fact that $[_{\text{TP}}\ ]$. However, they further combine with concrete object-denoting DPs (see e.g. (8e)) and with subject-controlled and non-controlled gerundive small clauses (e.g. (8d, c)). This particular selection behavior of experiential attitude verbs has been observed, e.g., by Higginbotham (2003), Anand (2011), and White & Rawlins (2020):

(8) Ron remembers

a.	that Mary was wearing a crazy hat.	$(s;t)$; generally: $\boldsymbol{(ss;t)}$
b.	whether Mary was wearing a crazy hat.	$((s;t);t)$
c.	Mary wearing a crazy hat.	$(s;t)$ or v (event)
d.	PRO wearing a crazy hat.	$\boldsymbol{(se;t)}$
e.	a (viz. Mary's) crazy hat.	$\boldsymbol{(s;((s;(e;t));t))}$

Like the complements of know in (3) and (4), the complements of the different occurrences of remember from (8) stand in semantic/informational inclusion relations to one another. These relations are exemplified in (9-11). They include – next to the familiar relations between declarative and interrogative complements (see (9)) – the entailment from (controlled and non-controlled) gerundive small clauses to that-clauses (e.g. (10); as argued by Umbach, Hinterwimmer & Gust 2021; Parsons

1997) and from gerundive small clauses to concrete object-denoting DPs (e.g. (11); as argued by Barwise 1981; Stephenson 2010b):

(9) a. Ron remembers [that Mary was wearing a rainbow squid hat].
$\Rightarrow$ b. Ron remembers [whether Mary was wearing a crazy hat].

(10) a. Ron remembers [i. PRO / ii. Mary wearing a crazy hat].
$\not\Leftarrow\Rightarrow$ b. Ron remembers [that there was a crazy hat (which i. he himself / ii. Mary was wearing)].

(11) a. Ron remembers [i. PRO / ii. Mary wearing a crazy hat].
$\not\Leftarrow\Rightarrow$ b. Ron remembers [a crazy hat].

The modelling of the above relations is impeded by the observation that some of the above complements (viz. the ones with the bold-printed types in (8)) resist an interpretation as type-$((s;t);t)$ questions. This holds especially for concrete object-denoting DPs (see (8e)) and for subject-controlled complements (see (8d)). Surprisingly, this resistance even holds for some occurrences of embedded declaratives (see (8a)). The particular challenges that are posed by these kinds of complements are discussed in some detail below:

2.1 Challenge 1: concrete-object DPs

Most contemporary formal semantics interpret the direct object DPs of intensional transitive verbs as intensional generalized quantifiers (type $(s;((s;(e;t));t))$; see e.g. Montague 1970; Moltmann 1997) or as properties of individuals (type $(s;(e;t))$; see e.g. Zimmermann 1993, 2016). In particular, these semantics interpret (8e) as (12a) respectively as (12b), where the complement is over- or underbraced. Since remember takes different-type arguments in these two interpretations, it is interpreted through different non-logical constants, viz. *remember′* (which takes a quantifier-argument) and *remember″* (which takes a property-argument). Below, *crazy-hat* is a non-logical constant of type $(s;(e;t))$:

(12)
$$[\![(8\mathrm{e})]\!] \begin{cases} \text{a.} & remember'_w(\overbrace{\lambda w'\lambda P^{(s;(e;t))}\exists x.\,crazy\text{-}hat_{w'}(x)\wedge P_{w'}(x)}^{\text{type }(s;((s;(e;t));t))})(ron) \\ \text{b.} & remember''_w(\underbrace{crazy\text{-}hat}_{\text{type }(s;(e;t))})(ron) \end{cases}$$

Noticeably – depending on the size of the domain of worlds, D_s, and of individuals, D_e –, already the ‘simpler’ (= lower-type) interpretation of the DP a crazy hat (in (12b)) can have a larger cardinality than the domain of questions Q $(:= D_{((s;t);t)})$.

As a result, there is no true, information-preserving embedding of properties in the domain of questions. But embeddability (or injectivity) is a necessary requirement on any admissible type-shift (van Benthem 1991; Zimmermann 2020).

2.2 Challenge 2: parasitic complements

Surprisingly, even declaratives like (8a) cannot always be represented as questions (see Maier 2015; Ninan 2008; Blumberg 2018, 2019). This is the case when one or more constituents of the declarative are referentially dependent (or *parasitic*) on other attitudes, i.e. when their intuitive interpretation requires their contents to be evaluated at worlds other than the evaluation world (w) and the alternatives (w') that are introduced by the matrix attitude verb. Such evaluation is prompted either by the presence of other attitude predicates (in (13) and (14): *see* resp. *dream*; inspired by Ninan 2012; Blumberg 2019) or by the lack of adequate truth-conditions in the absence of these predicates (as is the case in (15a), inspired by Blumberg's (2018) 'burgled Bill'-scenario):

(13) Ralph remembers [that the man whom <u>he has seen</u> sneaking around on the waterfront was wearing a hooded sweater].

(14) John remembers [that the woman who threatened him <u>in his dream</u> last night is swimming in the sea].

In particular, in (15a), the evaluation of she [= some/the female tattoo model] at the relevant scene from Fred's dream is triggered by the observation that – given the context in (15) – (15a) is false on its *de re*-reading (which gives the DP she a specific interpretation; in (16a), paraphrased by (15a-i)) and is contradictory on its *de dicto*-reading (in (16b), paraphrased by (15a-ii)):

(15) *Context:* Fred has been dreaming of some female tattoo model (no particular one that he has come across in real life).

a. Now, he falsely (!) remembers [that she had clear (= untattooed) skin].

$\not\equiv$ i. *de re:* There is a certain tattoo model of whom Fred remembers that she had clear skin.

$\not\equiv$ ii. *de dicto:* Fred remembers an inconsistent situation (in which a model simultaneously did and did not have tattoos).

$\equiv$ b. Fred remembers [that the tattoo model <u>from his dream</u> had clear skin].

The interpretation of she in (15a) at Fred's oneiric scene is then prompted by the observation that (15a) has plausible truth-conditions on a 'parasitic' reading (viz. (16c), paraphrased in (15b)) that interprets she at some other world/attitudinal alternative[4] (different from w and from Fred's mnemonic alternatives, w'). In (16c), this alternative is denoted by $\boldsymbol{X}$:

(16) a. [the model-in-w] [$\lambda t.$ Fred remembers-in-w [$\lambda w'.$ t has-clear-skin-in-w']]

b. Fred remembers-in-w [$\lambda w'.$ the model-in-w' has-clear-skin-in-w']

c. Fred remembers-in-w [$\lambda w'.$ the model-in-$\underline{\boldsymbol{X}}$ has-clear-skin-in-w']

To capture the dependence of the constituents in (15a) on different attitudinal alternatives, we posit distinct variables for the alternatives that are introduced by the matrix [= parasite] attitude verb (here: remember; below: w_2) and for the alternatives that are introduced by the host attitude verb (here: dream; below: w_1). This move has been proposed by Blumberg (2018, 2019). In line with the above naming pattern, the variable for the evaluation world (previously: w) will hereafter be named 'w_0'.

The reading (16c) (on which (15a) is true) then has the interpretation in (17). In this interpretation, *remember‴* takes as arguments (characteristic functions of) sets of ordered pairs of worlds (type $(ss;t)$). The first element in these pairs is a host attitudinal alternative (above: one of Fred's oneiric alternatives); the second element is a parasite/matrix attitudinal alternative (one of Fred's mnemonic alternatives). In (Blumberg 2018), such sets are called *paired propositions*.[5]

(17) $$[\![(15)]\!]^{w_0} = \; remember'''_{w_0}(\underbrace{\lambda \langle w_1, w_2 \rangle\, \exists x.\, model_{w_1}(x) \wedge clear\text{-}skin_{w_2}(x)}_{\text{type } (ss;t)})(fred)$$

Since the domain of paired propositions has a larger cardinality than Q – and since embedded interrogatives can, themselves, be parasitic on other attitudes (see below) –, there is no true embedding from paired propositions into questions.

2.3 Challenge 3: *de se*-complements

Another challenging case for the question-interpretation of experiential attitude complements is posed by subject-controlled gerundive small clauses (e.g. (8d)): Following Chierchia (1989), the latter are obligatorily interpreted *de se*, viz. as (characteristic functions of) sets of centered worlds (type $(se;t)$; see (18)), called *centered propositions*. The members of such sets are commonly analyzed as world/individual-pairs $\langle w, y \rangle$, where y is the experiential-perspectival center of w (see Lewis 1979; Stephenson 2010a).

4 In this paper, I use *alternative* in the sense of 'attitudinal alternatives' (see Hintikka 1969).

5 Since Blumberg's framework only has *unary* function types, it analyzes paired propositions as functions from worlds to propositions (i.e. as objects of type $(s;(s;t))$).

(18) $$[\![(8\text{d})]\!] = remember''''_{w_0}(\underbrace{\lambda\langle w_2,y\rangle\,\exists x.\, crazy\text{-}hat_{w_2}(x)\wedge wear_{w_2}(x)(y)}_{\text{type }(se;t)})(ron)$$

Admittedly, the domain of centered propositions, $D_{(se;t)}$, potentially has a smaller cardinality than the domains of questions, Q. However, since there is no principled connection between D_e and D_t $(:=\{0,1\})$, there is still no good embedding of $D_{(se;t)}$ in Q.

The absence of a suitable embedding of semantic *de se*-complements in the domain of questions is made even more apparent by the observation that – like their 'non-*de se*'-relatives – self-directed experiential attitudes can themselves parasitically depend on other attitudes. Such dependence is assumed by the remember-report in (19a), which presupposes the context from (15).[6] To capture the parasitic *de se*-nature of this report, its complement requires an interpretation in the type $(\boldsymbol{s};(se;t))$ (i.e. as a set of pairs of worlds whose second (world-)element is centered; see (19b)). I will hereafter call objects of this type *parametrized centered propositions*.

(19) a. Fred$_i$ remembers [PRO$_i$ being scared by the model (from his dream)].
($\equiv$ Fred remembers [that he himself was being scared by the model ...])
b. $$remember'''''_{w_0}(\underbrace{\lambda w_1\lambda\langle w_2,y\rangle\,\exists x.\, model_{w_1}(x)\wedge scare_{w_2}(y)(x)}_{\text{type }(s;(se;t))})(fred)$$

Aggravating the above, interrogatives can also be parasitic and *de se* (see (20a)). Complements of this form require an interpretation in the even higher-rank type, viz. $(s\,(se;t);\boldsymbol{t})$:

(20) a. Fred remembers [whether he himself was being scared by the model (from his dream)].
b. $$remember''''''_{w_0}\big(\underbrace{\lambda\langle w_1,C^{(se;t)}\rangle[(\forall w_2.(\forall y.C(w_2,y)\rightarrow(\exists x.\, model_{w_1}(x)\wedge scare_{w_2}(y)(x))))\vee(\forall w_2.(\forall y.C(w_2,y)\rightarrow\neg(\exists x.\, model_{w_1}(x)\wedge scare_{w_2}(y)(x))))]}_{\text{type }(s\,(se;t);t)}\big)(fred)$$

The interpretation of the occurrences of remember from (12) and (17-20) suggests that remember is polysemous between different lexical entries that take different-type arguments. However, this assumption makes it difficult to model the semantic relations from (9-11).

6 For reasons of simplicity, I (naïvely) assume that gerundive small clauses (e.g. the complement in (19a), i.e. PRO being scared by the model from his dream) make the same semantic contribution as finite declarative clauses (here: that he himself was being scared by the model from his dream). For a sophisticated account of the semantics of gerundive small clauses, the reader is referred to (Stephenson 2010b; Liefke 2020a, 2021).

3 A Uniform Type for Parasitic and *de se*-Complements

I propose to answer the above challenge by generalizing Theiler et al.'s 2018 type for questions, $((s;t);t)$, to the type for *parametrized centered questions* $(s\,(se;t);t)$ (abbr. 'PCQ'; inspired by Liefke & Werning 2018 resp. by Coppock & Wechsler 2018). Objects of this type are (characteristic functions of) sets of ordered pairs of worlds (type s) and centered propositions (type $(se;t)$). The first element of such pairs, w_1, is a 'host' attitudinal alternative (in (15a): a world that is compatible with what Fred has been dreaming). The second element, C, is a centered content that is associated with the content of the 'parasite'/matrix attitude (in (15a): what Fred is remembering).

(21) $$\Big\{\langle \overbrace{w_1}^{\text{'host' attitudinal alternative}}, \underbrace{C}_{\text{content of the matrix attitude}} \rangle \mid \forall w_2.\,(\forall y.\,C(w_2,y) \rightarrow (\exists x.\,woman_{w_1}(x) \wedge scare_{w_2}(y)(x)))\Big\}$$

Below, I will show that the different semantic objects from Section 2 all have a true embedding in the domain of PCQs which captures the intuitive entailments from (9-11). However, before I do so, I want to make a caveat about the role of PCQ-embeddings in my proposed semantics:

Importantly, while the remainder of this paper will be formulated in terms of type-shifts, the aim of my proposal is *not* to individually lift each of the familiar complement-denotations to PCQs. Rather, I propose to interpret complements *directly as PCQs*, analogously to Theiler et al. (2018). This strategy has an effect on the compositional interpretation of nearly all syntactic constituents (see Ciardelli et al. 2017). In particular, in my proposed semantics, common nouns would no longer be interpreted as (type-$(e;(s;t))$, or type-$(e;((s;t);t))$) functions from individuals to propositions (or to questions), but as (type-$(e;(s\,(se;t);t))$) functions from individuals *to PCQs*. Analogous observations hold for transitive verbs, which would receive an interpretation in the type $(e;(e;(s\,(se;t);t)))$.

Alternatively to the above, one could interpret TPs in their usual type, $(s;t)$, and lift declaratives, interrogatives etc. to PCQs through a special interpretation of the complementizer. On such approach, the complementizer that would then be interpreted as a function, $\lambda q\,\lambda\langle w_1,C\rangle[\forall w_2.\,(\forall y.\,C(w_2,y)) \rightarrow q(w_2)]$, from propositions to PCQs. A likely drawback of this alternative is that it would block a semantic Theiler et al.-style explanation of selectional restrictions (see Sect. 5).

With the above in place, I return to the PCQ-embeddability of the semantic objects from Section 2. I start by showing that my account preserves the results from Theiler et al., i.e. that there is a true PCQ-embedding of propositions and questions:

3.1 Embedding simple questions and propositions

I have assumed above that 'simple' interrogatives (i.e. non-parasitic, non-*de se* interrogative clauses like (8b)) are interpreted in the type $((s;t);t)$, where 's' is associated with the worlds/alternatives that are introduced by the matrix attitude verb. This assumption suggests that, in PCQ-representations of questions, the 'host' attitudinal alternative (below: w_1) and the individual center (y) of the matrix attitudinal alternatives are semantically 'inert'. My question-to-PCQ type-shifter (in (22)) reflects this inertness by assuming that its value is independent[7] of w_1, and by universally quantifying over the individual centers in all (centered world-)members of C. To capture the type of its arguments, we call this type-shifter 'E-INQ' (for *inquisitive* [or *interrogative*] *Embedder*):

(22) $\text{E-INQ} := \lambda T^{((s;t);t)} \lambda \langle w_1, C^{(se;t)} \rangle [T(\lambda w_2.(\forall y.\, C(w_2,y)))]$

In the formulation of this type-shifter, universal quantification over the type-e elements in C is motivated by the wish to identify sets of centered worlds with semantically inert centers as *boring centered propositions* (following Egan 2006). The latter are characteristic functions of sets of centered worlds whose value does *not* depend on the worlds' center, s.t. $(\forall w_2)(\forall x)(\forall y)[C(w_2,x) \leftrightarrow C\,(w_2,y)]$ (see Ninan 2010: 553). This is the case if $C := \lambda \langle w_2, y \rangle [p^{(s;t)}(w_2)]$, where p is a non-logical constant.

By applying E-INQ to the familiar interpretation of the polar interrogative from (8b) (see (6c)), we yield the PCQ-representation in (23). This representation is a characteristic function of sets of ordered pairs of worlds and centered propositions. The second element in these pairs is a subset of the set of centered worlds in which Mary was wearing a crazy hat or of the set of centered worlds in which Mary was *not* wearing a crazy hat. This interpretation is similar to Theiler et al.'s interpretation of interrogative complements:

(23)
$$
\begin{aligned}
&\text{E-INQ}\big([\![\text{whether Mary was wearing a crazy hat}]\!]\big)\\
&\equiv \text{E-INQ}\big(\lambda p.\,(\forall w'.\, p(w') \to (\exists x.\, \textit{crazy-hat}_{w'}(x) \wedge \textit{wear}_{w'}(x)(\textit{mary}))) \vee \\
&\qquad\qquad (\forall w'.\, p(w') \to \neg(\exists x.\, \textit{crazy-hat}_{w'}(x) \wedge \textit{wear}_{w'}(x)(\textit{mary})))\big)\\
&= \lambda \langle w_1, C \rangle [(\forall w_2.\,(\forall y.\, C(w_2,y)) \to (\exists x.\, \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(\textit{mary}))) \vee \\
&\qquad (\forall w_2.\,(\forall y.\, C(w_2,y)) \to \neg(\exists x.\, \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(\textit{mary})))]
\end{aligned}
$$

Since propositions can be represented as questions (through the function $\lambda q \lambda p$ $(\forall w)[p(w) \to q(w)]$; see Sect. 1), one would expect that E-INQ also provides a true PCQ-embedding of *propositions*. This is indeed the case, as is evidenced by (24) for the interpretation of that Mary was wearing a crazy hat (see (8a)). In particular,

7 The 'curried' version this shifter, i.e. $\lambda w_1 \lambda C\,[T(\lambda w_2 \forall y.\, C(w_2,y))]$, is constant for w_1.

the PCQ-representation of (8a) interprets this declarative as the set of ordered pairs whose second member is a subset of the set of centered worlds in which Mary was wearing a crazy hat:

(24) $\text{E-INQ}\big(\lambda q \lambda p[\forall w.\, p(w) \to q(w)]\big(⟦\text{that Mary was wearing a crazy hat}⟧\big)\big)$
$\equiv \text{E-INQ}\big(\lambda p[\forall w.\, p(w) \to (\exists x.\, \mathit{crazy\text{-}hat}_w(x) \wedge \mathit{wear}_w(x)(\mathit{mary})]\big)$
$= \lambda\langle w_1, C\rangle[\forall w_2.\, (\forall y.\, C(w_2,y)) \to (\exists x.\, \mathit{crazy\text{-}hat}_{w_2}(x) \wedge \mathit{wear}_{w_2}(x)(\mathit{mary}))]$

As desired, the PCQ-representation of the complements in (8a) and (8b) preserves the intuitive informational relation between declarative and interrogative complements. Since it uses Ciardelli et al.'s analysis of questions as downward-closed sets of propositions (see the uni-directional material conditional in (23) and (24)), my semantics also straightforwardly captures the informational inclusion relation between the complements in (9) (see (25)):

(25) a. $\text{E-INQ}\big(\lambda q \lambda p[\forall w.\, p(w) \to q(w)]\big(⟦\text{that Mary was wearing a squid hat}⟧\big)\big)$
$= \lambda\langle w_1, C\rangle[\forall w_2.\, (\forall y.\, C(w_2,y)) \to (\exists x.\, \mathit{squid\text{-}hat}_{w_2}(x) \wedge \mathit{wear}_{w_2}(x)(\mathit{mary}))]$

$\subseteq$ b. $\text{E-INQ}\big(⟦\text{whether Mary was wearing a crazy hat}⟧\big)$
$= \lambda\langle w_1, C\rangle[(\forall w_2.\, (\forall y.\, C(w_2,y)) \to (\exists x. \mathit{crazy\text{-}hat}_{w_2}(x) \wedge \mathit{wear}_{w_2}(x)(\mathit{mary})))$
$\vee (\forall w_2.\, (\forall y.\, C(w_2,y)) \to \neg(\exists x.\, \mathit{crazy\text{-}hat}_{w_2}(x) \wedge \mathit{wear}_{w_2}(x)(\mathit{mary})))]$

3.2 Embedding paired propositions

Above, I have identified the first element in world/centered proposition-pairs with a host attitudinal alternative. My type-shifter E-PARA (in (26)) – which provides PCQ-representations of paired propositions – makes use of this identification. To capture the non-*de se* status of simple paired propositions, this shifter treats C in its range as a boring centered proposition (analogously to E-INQ). To associate the 'second' world in paired propositions with matrix alternatives, it identifies these boring propositions with (characteristic functions of) subsets of $\{\langle w_2, y\rangle \mid R(w_1, w_2)\}$:

(26) $\text{E-PARA} := \lambda R^{(ss;t)} \lambda\langle w_1, C\rangle[\forall w_2.\, (\forall y.\, C(w_2,y)) \to R(w_1,w_2)]$

By applying E-PARA to Blumberg's semantics for the parasitic declarative complement in (15b) (see (17)), we obtain the PCQ in (27). The latter is a set of ordered world/centered proposition-pairs whose first element is one of Fred's oneiric alternatives and whose second element is a set of (oneirically dependent) 'boring' centered worlds that constitute Fred's mnemonic alternatives.

(27) $\text{E-PARA}\big(⟦\text{that the model (from Fred's dream) has clear skin}⟧\big)$
$\equiv \text{E-PARA}\big(\lambda w_1 \lambda w_2.\, (\exists x.\, \mathit{model}_{w_1}(x) \wedge \mathit{clear\text{-}skin}_{w_2}(x))\big)$
$= \lambda\langle w_1, C\rangle[\forall w_2.\, (\forall y.\, C(w_2,y)) \to (\exists x. \mathit{model}_{w_1}(x) \wedge \mathit{clear\text{-}skin}_{w_2}(x))]$

I will show below that the type-shifter E-PARA is easily generalized to parametrized *centered* propositions (e.g. the familiar denotation of the complement in (19a)). Following my treatment of centered propositions (in Sect. 3.3), I will also show that my PCQ-representation of paired propositions captures intuitive entailment relations between parasitic declarative and interrogative complements.

3.3 Embedding (simple and parametrized) centered propositions

My earlier considerations have associated the individual elements in PCQs with the center of the matrix attitudinal alternatives (in (8d)/(18): the center of Ron's mnemonic alternatives). To preserve this association, my type-shifter for centered propositions, E-DESE, (in (28)) identifies the second element, C, of all ordered pairs in a PCQ with a subset of the represented centered proposition:

(28) $\text{E-DESE} := \lambda G^{(se;t)} \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y) \rightarrow G(w_2, y))]$

By applying this type-shifter to Chierchia's semantics for the complement in (8d) (see (18)), we yield the PCQ in (29). This PCQ is a set of ordered world/centered proposition-pairs whose second element is a set of centered worlds that constitute Ron's mnemonic alternatives:

(29) $\text{E-DESE}\big([\![\text{PRO wearing a crazy hat}]\!]\big)$
$\equiv \text{E-DESE}\big(\lambda\langle w_1, y\rangle . \mathit{wear}_{w_1}(\mathit{crazy\text{-}hat})(y)\big)$
$= \lambda\langle w_1, C\rangle[\forall w_2. (\forall y. C(w_2, y) \rightarrow (\exists x. \mathit{crazy\text{-}hat}_{w_2}(x) \wedge \mathit{wear}_{w_2}(x)(y)))]$

The attentive reader may have noticed that – like the values of the type-shifter E-INQ – the values of E-DESE do not depend on the 'host attitude'-world w_1. While this is desirable for a PCQ-representation of the semantic complement in (8d), this non-dependence blocks an adequate interpretation of parasitic *de se*-complements like the one in (19a). To give a suitable PCQ-semantics for such complements, we use a combination of the type-shifters E-DESE and E-PARA. The resulting shifter, E-PA/SE, (in (30)) sends parametrized centered propositions S (type $(s;(se;t))$) to sets of world/centered proposition-pairs whose first element is the parameter of S (below: the world w_1) and whose second element is a subset of S's value at w_1:

(30) $\text{E-PA/SE} := \lambda S^{(s;(es;t))} \lambda\langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y) \rightarrow S(w_1)(w_2, y))]$

The type-shifter E-PA/SE enables a suitable PCQ-interpretation of the complement in (19a), as expected (see (31)). The latter is PCQ whose first element is one of Fred's oneiric alternatives and whose second element is a set of (oneirically dependent) centered worlds that constitute Fred's mnemonic alternatives.

Complement	Input	Name	Definition
interrogative	$((s;t);t)$	E-INQ	$\lambda T \lambda \langle w_1, C\rangle [T(\lambda w_2. (\forall y. C(w_2, y)))]$
declarative/ non-contr. SC	$(s;t)$	—— E-DECL	$\lambda q.[\text{E-INQ}(\lambda p.(\forall w.\, p(w) \to q(w)))]$ $\equiv \lambda q \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y)) \to q(w_2)]$
parasitic decl.	$(ss;t)$	E-PARA	$\lambda R \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y)) \to R(w_1, w_2)]$
controlled SC	$(se;t)$	E-DESE	$\lambda G \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y) \to G(w_2, y))]$
para.contr. SC	$(s;(se;t))$	E-PA/SE	$\lambda S \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y) \to S(w_1)(w_2, y))]$
de se-interrog.	$((se;t);t)$	-INQ/SE	$\lambda Q \lambda \langle w_1, C\rangle [Q(C)]$ (see Sect. 3.4)
object DP	GQ	E-QTF	$\lambda \mathscr{Q} \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y)) \to \mathscr{Q}_{w_2}(E)]$
object DP	$(s;(e;t))$	E-PTY	$\lambda P.[\text{E-QTF}(\lambda w_2 \lambda P'. (\exists x. P_{w_2}(x) \wedge P'_{w_2}(x)))]$

Table 1 'Familiar denotation'-to-PCQ type-shifters.

(31) $\text{E-PA/SE}\big([\![\text{PRO being scared by the model (from his dream)}]\!]\big)$
$\equiv \text{E-PA/SE}\big(\lambda w_1 \lambda \langle w_2, y\rangle\, \exists x. \mathit{model}_{w_1}(x) \wedge \mathit{scare}_{w_2}(y)(x)\big)$
$= \lambda \langle w_1, C\rangle [\forall w_2. (\forall y.\, C(w_2, y) \to (\exists x. \mathit{model}_{w_1}(x) \wedge \mathit{scare}_{w_2}(y)(x)))]$

The different type-shifters that are required for a uniform (i.e. PCQ-)interpretation of the diverse experiential attitude complements are summarized in Table 1. In this table, the type-shifters from Sections 3.1 to 3.3 are printed in black. Type-shifters that will be introduced in subsequent sections are printed in grey.

3.4 Embedding centered questions

I have shown above that the black-printed type-shifters in Table 1 enable the PCQ-embedding of more complex objects than the familiar propositions or questions. Unsurprisingly, this is also the case for centered questions (see Coppock & Wechsler 2018). The latter are sets of centered propositions (type $((se;t);t)$) that are denoted e.g. by interrogative clauses with a reflexive subject (e.g. by the complement in (32)).

(32) Ron remembers [whether he himself was wearing a crazy hat].

A combination of the type-shifters E-INQ and E-DESE (in (33)) allows us to represent the semantic complement in (32) as the PCQ in (34). This representation is an ordered world/centered proposition-pair whose second element is a non-boring centered question:

(33) $\text{E-INQ/SE} := \lambda Q^{((se;t);t)} \lambda \langle w_1, C\rangle [Q(C)]$

(34) $\text{E-INQ/SE}\big([\![\text{whether he himself was wearing a crazy hat}]\!]\big)$
$\equiv \text{E-INQ/SE}\big(\lambda C \forall w_2.(\forall y. C(w_2, y) \to \mathit{wear}_{w_2}(\mathit{crazy\text{-}hat})(y))\big)$
$= \lambda \langle w_1, C\rangle [(\forall w_2. (\forall y.\, C(w_2, y) \to (\exists x. \mathit{crazy\text{-}hat}_{w_2}(x) \wedge \mathit{wear}_{w_2}(x)(y)))) \vee$
$(\forall w_2. (\forall y.\, C(w_2, y) \to \neg(\exists x. \mathit{crazy\text{-}hat}_{w_2}(x) \wedge \mathit{wear}_{w_2}(x)(y))))]$

Like its non-centered counterpart (see (25)), the PCQ-representation in (34) captures the intuitive semantic inclusion relation between the complements of the reports in a *de se*-analogue of (9) (see (35)):

(35) a. ⟦(that he himself was) wearing a rainbow squid hat⟧
$= \lambda\langle w_1, C\rangle[\forall w_2.(\forall y. C(w_2, y) \rightarrow (\exists x. \textit{squid-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y)))]$

$\subseteq$ b. ⟦whether he himself was wearing a crazy hat⟧
$= \lambda\langle w_1, C\rangle[(\forall w_2.(\forall y. C(w_2, y) \rightarrow (\exists x. \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y)))) \vee (\forall w_2.(\forall y. C(w_2, y) \rightarrow \neg(\exists x. \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y))))]$

This entailment is explained by the inclusion of the set $\mathscr{P}(\{\langle w_2, y\rangle \mid \exists x. \textit{squid-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y)\})$ in the union of the sets $\mathscr{P}(\{\langle w_2, y\rangle \mid \exists x. \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y)\})$ and $\mathscr{P}(\{w_2 \mid \neg\exists x. \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y)\})$. Similar observations hold for the intuitive entailment between remember-reports with parasitic *de se*-declarative and interrogative complement clauses (e.g. (36); see (19b) resp. (20b)). (36) differs from (35) only with respect to the PCQ's non-trivial dependence on a set of 'host' attitudinal alternatives w_1.

(36) a. ⟦that he himself was scared by the model (from his dream)⟧
$= \lambda\langle w_1, C\rangle[\forall w_2.(\forall y. C(w_2, y) \rightarrow (\exists x. \textit{model}_{w_1}(x) \wedge \textit{scare}_{w_2}(y)(x)))]$

$\subseteq$ b. ⟦whether he himself was scared by the model (from his dream)⟧
$= \lambda\langle w_1, C\rangle[(\forall w_2.(\forall y. C(w_2, y) \rightarrow (\exists x. \textit{model}_{w_1}(x) \wedge \textit{scare}_{w_2}(y)(x)))) \vee (\forall w_2.(\forall y. C(w_2, y) \rightarrow \neg(\exists x. \textit{model}_{w_1}(x) \wedge \textit{scare}_{w_2}(y)(x))))]$

4 A PCQ-Interpretation of Concrete-Object DPs

4.1 Embedding intensional generalized quantifiers

I have shown above that PCQs enable a true embedding of paired and/or centered propositions and questions. This success notwithstanding, it *prima facie* seems that my uniform type for experiential attitude complements, $(s(se;t);t)$, blocks an adequate semantic representation of concrete-object DPs. This is due to the fact that, on certain assumptions about the cardinality of D_s and D_e, intensional generalized quantifiers do not have a true embedding in the domain of questions (see Sect. 2.1). One could try to solve this problem by explicitly using the 'host' parameter w_1 and the individual center of the matrix attitudinal alternatives y in the representation, such that w_1 and y would no longer be semantically inert (a similar observation is made in Zimmermann 2017). A problem with this strategy is that giving up inertness results in the inability to capture relations between concrete object-denoting DPs (e.g. a crazy hat) and subject-controlled gerundive small clauses (e.g. PRO wearing a crazy hat) that have this DP in complement object position (see (11-i)).

The above notwithstanding, concrete DP complements of remember still allow for a representation in the type for PCQs. This is due to the intuitive equivalence of embedded object DPs with gerundive small clauses of the form 'there being $[_{\text{DP}}\ ]$ (in the subject's remembered scene)' (see Stephenson 2010b; Liefke 2020b; based on Parsons 1997: 375–37):

(37) a. Ron remembers [a crazy hat].

$\equiv$ b. Ron remembers [a crazy hat being there (in Ron's contextually relevant remembered event/scene)].

My quantifier-to-PCQ shifter E-QTF (in (38)) exploits this equivalence. This shifter sends intensional generalized quantifiers $\mathscr{Q}$ to sets of world/centered proposition-pairs whose second element is a subset of the set of 'boring' centered worlds in which $\mathscr{Q}$ has a type-*e* referent. In (38), E is a world-relative existence predicate (see Liefke 2014: 117 ff.).

(38) $\text{E-QTF} := \lambda \mathscr{Q}^{(s;((s;(e;t));t))} \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y)) \rightarrow \mathscr{Q}_{w_2}(E)]$

By applying E-QTF to the intensional quantifier-interpretation of the DP *a crazy hat* in (8e) (see (12a)), we obtain the PCQ in (39). The last line of (39) uses the assumption that any object that is a crazy hat in some world exists in (i.e. 'inhabits') this world:

(39)
$$\begin{aligned}
&\text{E-QTF}\big([\![\text{a crazy hat}]\!]\big)\\
&\equiv \text{E-QTF}\big(\lambda w \lambda P \exists x. \textit{crazy-hat}_w(x) \wedge P_w(x)\big)\\
&= \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y)) \rightarrow (\exists x. \textit{crazy-hat}_{w_2}(x) \wedge E_{w_2}(x))]\\
&\equiv \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y)) \rightarrow (\exists x. \textit{crazy-hat}_{w_2}(x))]
\end{aligned}$$

Granted the availability of a type-shifter from properties to intensional generalized quantifiers (viz. an intensional version of Partee's (1987) type-shifter *BE*, aka *existential closure*, $\exists$-CLOS; in (40)), E-QTF also enables the PCQ-representation of property-based semantics for object DPs (see (12b)). This representation (in (42); see (41)) is exactly the PCQ in (39), as desired.

(40) $\exists\text{-CLOS} := \lambda P^{(s;(e;t))} \lambda w \lambda P' (\exists x)[P_w(x) \wedge P'_w(x)]$

(41)
$$\begin{aligned}
\text{E-PTY} &:= \lambda P^{(s;(e;t))}[\text{E-QTF}(\exists\text{-CLOS}(P))]\\
&\equiv \lambda P \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y)) \rightarrow (\exists x. P_{w_2}(x) \wedge E_{w_2}(x))]
\end{aligned}$$

(42) $\text{E-PTY}(\textit{crazy-hat}) = \lambda \langle w_1, C\rangle [\forall w_2. (\forall y. C(w_2, y)) \rightarrow (\exists x. \textit{crazy-hat}_{w_2}(x))]$

4.2 Capturing semantic relations between different-category complements

The uniform representation of the different semantic complements of remember straightforwardly captures the semantic relations in (10-11). In particular, the semantic inclusion relation between the complements in (11-i) takes the form of a set-theoretic containment of the powerset $\mathscr{P}\big(\{\langle w_2, y\rangle \,|\, \exists x.\, \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)\ (y)\}\big)$ in $\mathscr{P}\big(\{\langle w_2, y\rangle \,|\, \exists x.\, \textit{crazy-hat}_{w_2}(x)\}\big)$ (see (43)). This containment is due to the inclusion of the set $\{\langle w_2, y\rangle \,|\, \exists x.\, \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y)\}$ in the set $\{\langle w_2, y\rangle \,|\, \exists x.$ $\textit{crazy-hat}_{w_2}(x)\}$. In virtue of this inclusion, any subset of the former is also a subset of the latter.

(43) a. E-DECL$\big(⟦\text{PRO wearing a crazy hat}⟧\big)$
$= \lambda\langle w_1, C\rangle[\forall w_2.\, (\forall y.\, C(w_2, y) \rightarrow (\exists x.\, \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y)))]$

$\subseteq$ b. E-QTF$\big(⟦\text{a crazy hat}⟧\big)$
$= \lambda\langle w_1, C\rangle[\forall w_2.\, (\forall y.\, C(w_2, y)) \rightarrow (\exists x.\, \textit{crazy-hat}_{w_2}(x))]$
$\equiv \lambda\langle w_1, C\rangle[\forall w_2.\, (\forall y.\, C(w_2, y)) \rightarrow (\exists x.\, \textit{crazy-hat}_{w_2}(x) \wedge E_{w_2}(x))]$
$=$ E-DECL$\big(⟦\text{a crazy hat being there}⟧\big)$

Notably – in line with our intuitions – my uniform semantics for remember-complements does <u>not</u> predict the obtaining of a semantic inclusion relation between the complements in (44). This is due to the fact that the powerset $\mathscr{P}\big(\{\langle w_2, y\rangle \,|\, \exists x.$ $\textit{crazy-hat}_{w_2}(x)\}\big)$ is <u>not</u> contained in the union of the powersets $\mathscr{P}\big(\{\langle w_2, y\rangle \,|\, \exists x.\, \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y)\}\big)$ and $\mathscr{P}\big(\{\langle w_2, y\rangle \,|\, \neg\exists x.\, \textit{crazy-hat}_{w_2}(x) \wedge \textit{wear}_{w_2}(x)(y)\}\big)$.

(44) a. Bill remembers [<u>*whether*</u> *he himself was wearing* a crazy hat].
$\not\Rightarrow$ b. Bill remembers [a crazy hat].

5 Future Work

In this paper, I have focused on the (type-)uniform interpretation of the different syntactic *complements* of remember. Arguably, to provide a fully explanatory account of the entailment relations in (9-11), we would also need to specify the (lexical and) compositional semantics of the verb remember itself. The previous sections suggest that such specification can proceed analogously to the interpretation of responsive verbs in (Theiler et al. 2018), resulting in a single, type-$((s\,(se;t);t);(e;(s;t)))$, interpretation of the verb remember. However, this interpretation fails to account for the difference between the complements in (45a) and (45b) (assuming that non-controlled gerundive small clauses commonly receive the same interpretation as that-clauses; see my footnote 6).

(45) a. Ron remembers [that Mary was wearing a crazy hat].
(≡ Ron remembers [*the fact* that Mary was wearing a crazy hat])

$\not\Rightarrow$ b. Ron remembers [Mary wearing a crazy hat].
(≡ Ron remembers [*a (specific) event* in which Mary was wearing a crazy hat])

To capture the semantic difference between (45a) and (45b), I have proposed (in Liefke 2021) to distinguish two same-type lexical entries for remember that are associated with semantic [≈ propositional] memory (e.g. (45a)) and with episodic [≈ event-]memory (e.g. (45b); see Tulving 1972; Stephenson 2010b). I leave the transfer(-to-PCQ) of these ideas as a project for future work.

I close this paper with a comment on the selection behavior of *non-veridical* experiential attitude verbs (e.g. imagine, dream, hallucinate): The possibility of representing the different semantic complements of experiential attitude verbs as PCQs suggests that the complements of other (incl. non-veridical) experiential attitude verbs can also be uniformly interpreted in this type. However, such interpretation would wrongly predict the ability of these verbs to combine with interrogative complements (see e.g. (46b)):

(46) Ida imagines
- a. that Mary is wearing a crazy hat.
- b. ??whether Mary is wearing a crazy hat.
- c. Mary wearing a crazy hat.
- d. PRO wearing a crazy hat.
- e. a crazy hat.

To provide an explanatory account of the anti-rogativity of non-veridical experiential attitude verbs, it does not suffice to stipulate a type-difference (viz. $(s\,(se;t);t)$ vs. $(s;(se;t)))$ between the complements of veridical and non-veridical experiential attitude verbs (see Theiler et al. 2019; Uegaki & Sudo 2019). Rather, such account requires reference to independently observable lexical-semantic properties of these verbs. I conjecture that relevant properties will include the presence (for veridical experiential attitude verbs) resp. absence (for non-veridical experiential attitude verbs) of a 'decidability'-presupposition on the verb's complement. This presupposition assumes the existence of a fact of the matter that determines whether the complement is true at the evaluation world. This move is, in some respects, similar to Uegaki & Sudo's (2019) account of the anti-rogativity of non-veridical *preferential* verbs (e.g. wish, hope, fear). It remains to be seen whether this account can be s used to explain the anti-rogativity of non-veridical *representational* verbs like imagine.

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Kristina Liefke
Department of Philosophy II
Ruhr University Bochum
Universitätsstraße 150
44780 Bochum, Germany
Kristina.Liefke@ruhr-uni-bochum.de
https://www.ruhr-uni-bochum.de/phil-inf/