

German ‘*noch genau wissen*’: Uniform Semantics, Distinct Effects

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1. Introduction

1.1. Background and desiderata

German has two salient counterparts for the English verb ‘remember’: Apart from the obvious *sich erinnern* [‘REFL-remember/remind’], remembering can also be expressed through the complex predicate *noch wissen* [‘still know’], where *wissen* has the epistemic- (as opposed to the acquaintance-)sense of ‘know’ (Djäv 2022). Like *sich erinnern*, *noch wissen* can combine with a declarative *dass*- [‘that’-] clause (1a) or with an event-denoting *wie*- [‘how’-] free relative clause ((1b-i); Umbach et al. 2022):

- (1) a. *Mia weiß noch (aus der Schule), dass Juist eine Insel ist.*
Mia knows still (from the school) that Juist an island is FACT-ONLY
‘Mia remembers (from school) that Juist is an island.’
- b. *Mia weiß noch, {i. wie. ii. dass} Paul auf Juist im Meer geschwommen ist.*
Mia knows still {i. how, ii. that} Paul on Juist in-the sea swim is EXPERIENTIAL
‘Mia remembers {i. how, ii. that} Paul was swimming in the sea on Juist.’

The distinction between ‘*noch wissen, wie*’ and ‘*noch wissen, dass*’ is roughly parallel to the psychological/neuroscience distinction between experiential (or ‘episodic’) remembering (i.e. recall of a personally experienced past event) and fact-only (or ‘semantic’) remembering (see e.g. Tulving 1972). In particular, recent experimental work in semantics and psychology has found that ‘*noch wissen, wie*’- as well as ‘*sich erinnern, wie*’- constructions unambiguously report experiential remembering (see the data from Zöllner et al. 2022 and our studies with N=37 and N=57, Rosina & Liefke 2024a,b). In contrast, ‘*noch wissen, dass*’-/‘*sich erinnern, dass*’-constructions can be used to report either fact-only or experiential remembering. The possibility of using ‘*noch wissen, dass*’ to report both experiential and fact-only memory already suggests that the different occurrences of ‘*noch wissen*’ in (1a) and (1b) share a single lexical entry. This suggestion is further strengthened by the observation that *dass*-clauses allow coordination¹ with *wie*-free relative clauses in the complement of *noch wissen* (see (2); based on one of the ambiguity tests from Sadock & Zwicky 1975).

- (2) *Mia weiß noch, dass Juist eine Insel ist und wie Paul dort [auf Juist] im Meer geschwommen ist.*

A uniform semantics for ‘*noch wissen*’ – and, by extension, of memory predicated in general – is further supported by the need to explain why a wide variety of languages use the same predicate to report experiential and fact-only remembering (but, for example, not in the case of experiential imagination). Together with its ability to capture the properties of experiential remembering that will be sketched below, the above-listed combined support for a uniform semantics leads us to think that this semantics is preferable over accounts involving ambiguity or polysemy.

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¹ These coordinations are more acceptable if they share a common topic (in (2): Juist) due to pragmatic plausibility.

Some work in semantics and the philosophy of language has discussed fact-only remembering (see e.g. Kiparsky & Kiparsky 1970, Niiniluoto 2020). This work treats fact-only remembering as a propositional attitude, analogous to belief and desire (see Hintikka 1969). At first sight, experiential remembering resists such propositional treatment. This is due to the particular syntactic and semantic properties of experiential uses of ‘remember’. We close this subsection by identifying a number of desiderata for a good semantic account of (1b-i) that involve these properties. These include the ability to account for (i) the informationally rich contents of experiential remembering, for (ii) the intuition that remembering is grounded in the agent’s past experience, and for (iii) the observation that the *wie*-report in (1b-i) entails the *dass*-report in (1b-ii).² The informational richness of (1b-i) (see (i)) is supported by the intuitive paraphrase of (1b-i) as (3) (D’Ambrosio & Stoljar 2023) and by the possibility of modifying *noch wissen* in (1b-i) with the modifiers *lebhaft* [‘vividly’] and *bis ins letzte Detail* [roughly: ‘in perfect detail’]. Its experiential grounding (see (ii)) is supported by the validity of the inference to the truth of sentences that report the agent’s experience of the event described by the complement (see (4)). In Stephenson (2010), this inference is called the ‘direct witnessing requirement’.

- (3) *Mia weiß noch, wie das war, als Paul im Meer geschwommen ist: (er trug blaue Shorts, sein Körper wurde von den Wellen hin und her geworfen . . .)*
 ‘Mia remembers what it was like when Paul was swimming in the sea: (he was wearing blue shorts, his body was being tossed about by the waves . . .)
- (4) a. *Mia weiß noch, wie Paul auf Juist im Meer geschwommen ist.*
 ⇒ b. Mia has (perceptually) experienced Paul swimming in the sea on Juist.

It is an open – though possibly empirically uninformative – question whether (1b-ii) is still a case of experiential remembering: Under one possible interpretation, ‘*noch wissen, dass*’ can report both experiential and fact-only remembering (then understood as scenarios in which the sentence can be true). Under an alternative interpretation, ‘*noch wissen, dass*’ just IS fact-only remembering. On the second view, the entailment from ‘*noch wissen, wie*’ to ‘*noch wissen, dass*’ is then due to additional demands of experiential remembering.

1.2. Preview and structure

This paper argues for a propositionalist semantics for experiential and fact-only ‘*noch wissen*’ that interprets embedded *wie*- and *dass*-clause complements uniformly as (type-⟨*s, t*⟩) propositions (see Liefke 2023b). The paper centrally motives this semantics through its ability to account for the informational richness of ‘*noch wissen*’-complements (see (i)) and for the entailment from *wie*- to *dass*-complements (see (iii)), which is a natural by-product of this richness. It proposes (contra Stephenson 2010) that experiential grounding (i.e. the inference to (4-b), see (iii)), is only a common pragmatic inference.³ (We will stick with the common terminology of ‘experiential remembering’ to refer to the pre-theoretic phenomenon, even though this feature of our account renders it not the best fit.)

To support our proposed semantics, we will show that it yields the intuitively different interpretations of the modifier *genau* [roughly: ‘exactly’] in *genau wissen, dass* (reliability) and *genau wissen, wie* (vividness) under a single semantic entry for *genau* (based on Wurm 2020; see Sect. 3). Specifically, we analyze ‘*noch genau wissen, wie p*’ as retained extra-justified knowledge of the informationally rich proposition denoted by ‘*wie p*’, with the constituent structure $[_{DP}\Delta [_{CP}w_{ie}_M [_{C'}\emptyset [_{TP}p]]]]$ (Liefke 2023d, Umbach et al. 2022). We assume that *wie* only adds informational richness in the experiential case (see Sect. 2.1). In Section 2.2, we show how *wissen* contributes factivity and evidentiality. *genau* optionally increases the standard for justification, as shown in Section 3. In Section 4, we show that *noch* semantically effects past-directed retention of evidential knowledge. It is only at this point that remembering differs from other forms of knowledge. Section 5 concludes and addresses some open issues. The structure of

² For a detailed discussion of these properties, the reader is referred to Liefke (2023a).

³ This paper focuses on the truth-conditional semantics of ‘*noch wissen*’-reports. Some informal motivation of this pragmatic account is given in footnotes 6 and 9. For further discussion and tentative experimental support, the reader is referred to Rosina (2024) and, respectively, to Rosina & Liefke (2024a).

our (de-)compositional semantics for ‘*noch genau wissen, wie*’ is given below, with the numbered circles re-appearing in the title of the corresponding sections:

$$(5) \quad \underbrace{[_{VP} \text{noch}]}_{\textcircled{4}} \underbrace{[_{v} \text{wissen}]}_{\textcircled{3}} \underbrace{[_{DP} \Delta]}_{\textcircled{2}} \underbrace{[_{CP} \text{wie}_{\mathcal{M}}]}_{\textcircled{1}} \underbrace{[_{C'} \emptyset]}_{\textcircled{1}} \underbrace{[_{TP} p]}_{\textcircled{1}} \underbrace{]}_{\textcircled{1}}$$

Note that our semantics for the individual ingredients from (5) is neither novel nor specific to memory reports. In particular, the ingredient semantics for non-manner *wie*-complements is due to Umbach et al. (2022) (see Liefke 2023d). The semantics for *wissen* is based on Lewis (1996) and Kiparsky & Kiparsky (1970). Our semantics for *genau* and *noch* are due to Wurm (2020) and, respectively, to Löbner (1990). Our contribution then only lies in combining these entries into a complex semantics for ‘*noch genau wissen, wie*’, viz. by showing that this semantics captures the intuitive truth- (and use-)conditional contribution of the verb ‘remember’ – suggesting an extension of our semantics to a cross-linguistic core –,⁴ and by demonstrating how this semantics captures desiderata (i)–(iii) from Section 1.1. The above notwithstanding, we believe that these contributions will greatly help advance semantic work on reports of experiential attitudes (other examples of which include imagining, hallucinating, and dreaming).

2. Knowing how *p*

2.1. Informationally rich propositions, ❶

The intuition that even experiential remembering is a form of retained knowledge, viz. of knowledge obtained through ones personal experiences, receives philosophical support from Hörl (2022). We want to link this idea concretely to memory *predicates* in natural language and the desiderata (i)–(iii) in Sect. 1.1 and provide it with a compositional-semantic implementation. On our account, requirement (i), i.e. informational richness, results from Umbach et al.’s (2022) semantics for non-manner (\mathcal{M}) *wie*- [‘how’-] complements (given in Liefke’s (2023) compositional version in (6)). This semantics assumes that $wie_{\mathcal{M}}$ is interpreted as interrogative manner (\mathcal{M}) *wie*, i.e. as a function from propositions *p* (analyzed as sets of possible worlds/situations) to a set of proper subsets of *p* whose members represent a particular manner (cf. Ciardelli et al. 2017). In (6), ‘M(anner)’ denotes the set of manners, where manners are modelled as similarity classes of events⁵ (see Umbach & Gust 2014).

$$(6) \quad \llbracket \text{wie}_{\mathcal{M}} \rrbracket = \llbracket \text{wie}_{\mathcal{M}} \rrbracket = \lambda p \lambda q. q \subseteq p \wedge M(q)$$

On Umbach et al.’s account, non-manner *wie*-clauses are similar to manner free relatives (see Fig. 1): like $wie_{\mathcal{M}}$ -complements, $wie_{\mathcal{M}}$ -complements are DPs that are headed by a silent determiner, Δ (see Liefke 2023d; following Kastner 2015). The only difference between these two *wie*-clause DPs lies in the internal structure of the embedded CP – especially in the base position of *wie*: while *wie* moves from a TP-internal position in $wie_{\mathcal{M}}$ -complements, leaving a trace (Caponigro 2003; see Fig. 1a), it is base-generated in its surface position in $wie_{\mathcal{M}}$ -clauses, where it serves as specifier of the CP (Umbach et al. 2022; see Fig. 1b). In the semantics of *wie*-complements, Δ is interpreted as a choice function, *f*, that chooses a member of the set that serves as the (type- $\langle\langle s, t \rangle, t \rangle$) denotation of the *wie*-clause. This function has a reading, $\Delta_{\mathcal{M}}$, that generates manners/event types (see Fig. 1a: (7b)) and a reading, Δ_s , that generates type- $\langle s, t \rangle$ representations of situations/event tokens (see Fig. 1b: (7a)). The fact that the interpretation of Δ_s , i.e. f^s (abbreviated ‘*f*’), only chooses the representation of a particular situation that exemplifies some manner (rather than a set of situations that exemplifies this manner) then explains why $wie_{\mathcal{M}}$ -complements can be interpreted as a superset of $wie_{\mathcal{M}}$ -complements (see the inclusion relation in (7)). For example, this superset could include different real-world events in which Paul was swimming in the same (particular) way, rather than just Mia’s perceived real-world event in which Paul was swimming in this way.

⁴ While we will not argue for this claim in detail, we think that it is supported by the parallel distribution of German ‘*noch wissen*’, ‘*sich erinnern*’ and English ‘*remember*’ in our experiments (Rosina & Liefke 2024a,b). The cross-linguistic, cross-structural claim is, however, limited to stative uses of memory predicates and cannot, in its current form, yet capture eventive ‘is remembering right now’ uses that some of these predicates have in addition.

⁵ $M := \lambda p (\exists e)(\exists F)[p = (\lambda e'. \text{SIM}(e', e, F))]$ (Umbach et al. 2022), where *F* is a contextual parameter that includes the relevant dimensions of comparison and SIM is a similarity relation that compares events w.r.t. this parameter.

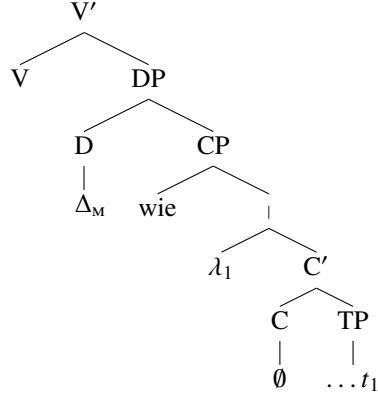


Figure 1a: Manner *wie*-complements.

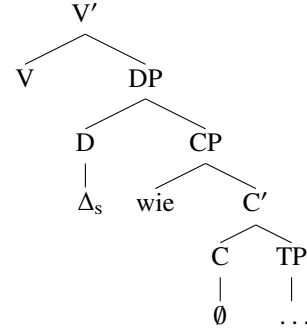


Figure 1b: Non-manner *wie*-complements.

$$(7) \quad \begin{aligned} \text{a. } & \llbracket [\text{DP} \Delta_S [\text{CP} \text{wie}_{(M)} [\text{C}' \emptyset [\text{TP} p]]]] \rrbracket^c = f_c^{(s)}(\lambda q. q \subseteq p \wedge M(q)) \\ \subseteq \text{b. } & \llbracket [\text{DP} \Delta_M [\text{CP} \text{wie}_{(M)} [\lambda_1 [\text{C}' \emptyset [\text{TP} p \ t_1]]]]] \rrbracket^c = f_c^M(\lambda q. q \subseteq p \wedge M(q)) \end{aligned}$$

To ensure that $f^{(s)}$ identifies the ‘right’ (contextually salient) member, its choice proceeds in dependence on the utterance context, c . Δ_S is interpreted as $\lambda T^{(s,t),t} [f_c(T)]$. \emptyset is interpreted as $\lambda p \lambda j. p_j$, where the variable j ranges over situations. The semantics of the $\text{wie}_{(M)}$ -complement from (1b-i) is given in (8):

$$(8) \quad \llbracket [\text{DP} \Delta_S [\text{CP} \text{wie}_{(M)} [\text{C}' \emptyset [\text{TP} \text{PAST} [\text{PERF} [\text{Paul} \text{schwimmen}]]]]]] \rrbracket^c = f_c(\lambda q. q \subseteq (\lambda j. t_j \prec t_{@} \wedge \text{swim}(j, \text{paul})) \wedge M(q))$$

In contrast to *wie*, *dass* [‘that’] is commonly given a semantically vacuous interpretation (in (9a)), based on Kratzer’s (2006) ‘trivial complementizer’, that_T . The resulting semantics for the specific *dass*-clause from (1b-ii) (in (10)) ensures that (8) is properly included in (10).

$$(9) \quad \begin{aligned} \text{a. } & \llbracket [\text{dass}] \rrbracket = \lambda p \lambda j. p_j & \text{b. } & \llbracket [\text{CP} \text{dass} [\text{C}' \emptyset [\text{TP} p]]] \rrbracket = \lambda j. p_j \\ (10) & \llbracket [\text{CP} \text{dass} [\text{C}' \emptyset [\text{TP} \text{PAST} [\text{PERF} [\text{Paul} \text{schwimmen}]]]]] \rrbracket = \lambda j. t_j \prec t_{@} \wedge \text{swim}(j, \text{paul}) \end{aligned}$$

2.2. Evidential knowledge, w

To obtain the intuitive semantics for ‘*noch wissen, wie*’, we assume that (7a) combines with an evidence-based variant of the standard presuppositional factive semantics for ‘know’ (based on Lewis 1996, Kiparsky & Kiparsky 1970). This semantics defines knowledge of a proposition p in terms of the attitude holder’s evidence for p (in (11)). It captures a weak Gettier-style (1963) justification requirement on knowledge by replacing the doxastic alternatives of an agent x in $@$ by the set of worlds, $\text{EVI}_{x,@}$, that are compatible with x ’s evidence in $@$ and that are considered relevant in the context c , i.e. $\text{CONS}_{@,c}$.

$$(11) \quad \llbracket [\text{wissen}] \rrbracket^{@,c} = \lambda p : \underline{p}_{@} \cdot \lambda x. (\text{CONS}_{@,c} \cap \text{EVI}_{x,@}) \subseteq p$$

Our semantics for ‘*wissen, wie*’ and ‘*wissen, dass*’ is given in (12), where $p' := f_c(\lambda q. q \subseteq p \wedge M(q))$.

$$(12) \quad \begin{aligned} \text{a. } & \llbracket [\text{Mia} [\text{VP} \text{weiß}, [\text{DP} \Delta_S [\text{CP} \text{wie}_{(M)} [\text{C}' \emptyset [\text{TP} p]]]]]] \rrbracket^{@,c} = \underline{p'}_{@} \cdot (\text{CONS}_{@,c} \cap \text{EVI}_{\text{Mia},@}) \subseteq p' \\ \Leftrightarrow \text{b. } & \llbracket [\text{Mia} [\text{VP} \text{weiß}, [\text{CP} \text{dass} [\text{C}' \emptyset [\text{TP} p]]]]] \rrbracket^{@,c} = \underline{p}_{@} \cdot (\text{CONS}_{@,c} \cap \text{EVI}_{\text{Mia},@}) \subseteq p \end{aligned}$$

The adoption of an evidence-based semantics for ‘know’ has three advantages over a semantics based on doxastic alternatives: Firstly, it in principle allows for knowledge without conscious belief (as in “Come on, you know it!”), without forcing a commitment to subconscious belief. Secondly, it allows us to use the negation ‘ x weiß nicht, dass p ’ to negate the evidential status in Gettier cases, where belief and truth of p are given. Thirdly, it is compatible with the observation that something is considered good evidence for a proposition can be contested from the position of an outside interlocutor who may hold different standards

of evidence than the agent. As a result, it correctly predicts faultless disagreement over knowledge and, thus, over memory ascriptions.

We have already mentioned above that $EVI_{x,@}$ is restricted by the set of contextually relevant worlds, $CONS_{@,c}$. Our entries in (12) explain the non-validity of the inference from ‘*wissen, dass p*’ to ‘*wissen, wie_M p*’ by the inclusion of $p' := f_e(\lambda q. q \subseteq p \wedge M(q))$ in p . The observation that, in (1b-ii), ‘*wissen, dass*’ can be used to report experiential remembering results from this inference. Fig. 2 illustrates this observation through a model where the agent knows p (i.e. ‘*dass p*’), but does not know p' (which we identify with ‘*wie p*’). In this figure, the proper inclusion of p' in p (see w_1) effects that $CONS_{@,c} \cap EVI_{Mia,@}$ (i.e. the dark gray area) is only a subset of p , but not of p' . For example, this is the case when Paul *did* swim in the sea in w_1 , but under circumstances that conflict with ‘how things were’ when he did in $@$. By default, Mia cannot exclude this possibility when her evidence is indirect, e.g. hearsay – $@$ and w_1 are indistinguishable for Mia. In the experiential case, Mia’s personal experience of Paul swimming restricts $EVI_{Mia,@}$ further than in the model in Fig. 2 and typically warrants exclusion of worlds like w_1 , such that the dark gray area becomes a subset of p' . This is the first part of the pragmatic inference to (4b).⁶

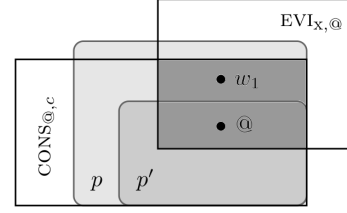


Figure 2: x knows p , but not p' .

3. Exact knowledge and vivid recall, ③

German speakers’ memory reports (see the data in Zöllner et al. 2022) suggest that (*noch*) *wissen* is commonly modified by *genau*, [‘exactly’], intuitively increasing reliability in ‘*genau wissen, dass*’ and vividness in ‘*genau wissen, wie_M*’. By adopting a version of Wurm’s (2020) semantics for *genau*, we can explain both intuitions. Specifically, we follow Wurm’s (2020) idea that *genau* makes us consider more – previously ignored – worlds, building on Lewis’ (1996) notion of context-dependent ‘properly ignored’ worlds. *genau* then extends $CONS_{@,c}$ by a set of previously ignored worlds G_c that needs to be additionally considered to meet the new, higher standards for knowledge (see (13)). The effect of *genau* is thus similar to switching to a context in which deceit and epistemic fallibility are made salient. These cases would, however, be modelled via the context variable directly manipulating $CONS$, while G_c can still be added on top. Options for making $CONS_{@,c}$ accessible to $[[genau]]^{@,c}$ include externalizing $CONS_{@,c}$ as a covert argument or allowing for intervention at the level of morphology (a context-independent root of (11) is separated from the manipulated $CONS_c^{@}$).⁷

$$(13) \quad [[genau\ wissen]]^{@,c} = \lambda p : \underline{p}_@ . \lambda x. (CONS_{@,c} \cup G_c) \cap EVI_{x,@} \subseteq p$$

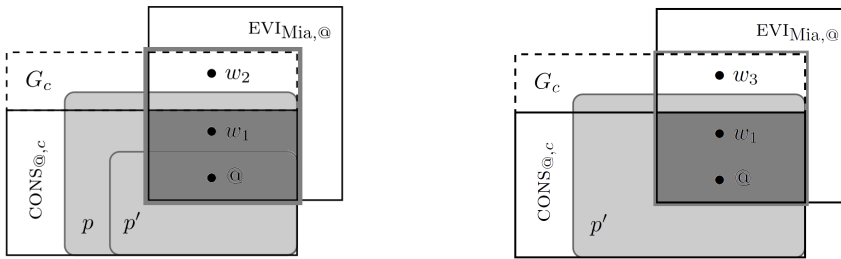


Figure 3a: Mia knows p , but not *genau*. Figure 3b: Mia knows *wie p*, but not *genau*.

For an informationally poor proposition, p , denoted by ‘*dass p*’, (13) effects that x ’s evidence might no longer suffice to exclude all relevant ‘not- p ’ worlds. This would be the case for a world w_2 in which a

⁶ For the pragmatic inference to go through, we have to assume a corresponding folk psychological reasoning on the listener’s side: “If Mia has good evidence for the way things were when Paul was swimming in the sea (not just the fact that he was), then she must have been there.” For the methodological relation between actual cognition, our semantics put forth here, our experiments (Rosina & Liefke 2024a), and philosophical debates, see Rosina (2024).

⁷ We thank Jan Köpping for discussing these options with us.

friend who told Mia about Paul’s swimming was trying to mislead her: While it is okay for Mia to ignore this possibility for *wissen* (thus yielding the dark gray filled area in Fig. 3a), *genau wissen* implements higher standards (that, e.g., force Mia to check with Paul himself; yielding the larger, dark gray bordered area). This straightforwardly explains the intuitive translation of *genau* in ‘*genau wissen, dass*’ as ‘for sure’, increasing reliability (understood as robustness across further worlds).

For an informationally rich proposition p' (denoted by ‘ $wie_M p'$ ’), the modified evidence supports the concrete circumstances of Paul’s swimming: Recalling further details about this event amounts to being able to exclude additional ‘not- p' ’ worlds, increasing the intuitive vividness. Thus, in the model in Fig. 3b, Mia’s (typically experiential) evidence initially supports knowledge of the informationally rich proposition p' : She can exclude worlds like w_1 , where Paul was swimming in the sea under completely different circumstances than in @, because she was there when it happened. Whether or not she can exclude recalling some little detail (like the color of Paul’s swimming trunks, the weather on that day, ...) inaccurately (e.g. due to fading memory) is irrelevant for the unmodified sentence in most contexts, because these worlds – like w_3 – are ‘properly ignored’ (i.e. are not elements of $CONS_{@,c}$). Like in the case of *genau* modifying knowledge of p in Fig. 3a, more such worlds have to be excluded for ‘*genau wissen, wie p'*’. A recall that is based on a personal experience but with fading details years after the event might no longer suffice. Recalling more details equals being able to exclude more not- p' worlds like w_3 , which explains the intuitive translation of *genau* as ‘[for sure because] vividly’ in these cases.

Since *genau* intervenes between *wissen* and *noch* (s.t. [$noch$ [$genau$ [VP weiß, [DP Δ [CP $wie_{(M)}$ [C' ∅ [TP p]]]]]]]), what *noch* – introduced in the next section – retains is x ’s highly justified knowledge of p . ‘*noch genau wissen, wie_M*’ thus leads to the strongest truth-conditions of all cases discussed here.

4. Past-directedness, ④

Importantly, nothing we have discussed after the introduction up to this point is specific to memory reports. While the modification by *noch* [‘still’] as introduced in this section is very common in German and helps lift the semantics of ‘*wissen, wie*’ to the meaning of experiential ‘remember’, knowledge of an informationally rich *wie*-proposition can also be attributed without *noch*. For example, this is the case in evidentially supported present-time imagination:

- (14) a. Having watched the neighbors snap at each other and storm into their house:
 b. *Ich weiß (genau/schon/ja/#noch), wie die jetzt (wieder) aufeinander losgehen.*
 I know (exactly/PART/PART/still) how these now (again) at-each-other attack
 ‘I know (exactly) how these two are fighting (again) right now.’

The evidential requirement and the informational richness in (14b) are both as described for (1b-i). What makes only (1b-i) a memory report is the temporal particle *noch*. (14b) with *noch* is infelicitous in scenario (14-a), but becomes acceptable when the scene is placed in a TV series that the attitude holder has watched several times. We claim that this is because *noch* has nothing to do (directly) with whether or not the ‘known event’ is a past event – it is the evidence that must have been there already long before the utterance. In (14), only the combination of the current visual perception and previous experience with similar situations puts the attitude holder in a position to claim to have good evidence for what is happening behind closed doors. In contrast, in the scenario underlying (1b-i), Mia already had all the evidence for ‘how Paul was swimming in the sea’ the day before the sentence was uttered. The temporal particle *noch* [‘still’], which modifies ‘*wissen, dass/wie p'*’ in (1), captures this past-directedness of memory. On our simplified version of Löbner 1990 in (15) (cf. Beck 2020; Krifka 2000), ‘*noch p'*’ asserts that p is true at the actual time $t_{@}$ and presupposes that p was true at some time, t , preceding $t_{@}$ (‘ $< t_{@}$ ’) (or time interval starting before $t_{@}$).⁸ To integrate this analysis with (12), we understand ‘worlds’ as time-slices of worlds, analyzed as world-time pairs, $\langle w, t \rangle$, where $w_{@}$ is the actual world.

⁸ We are being intentionally vague because we are uncommitted with respect to the concrete temporal relation that has to hold for *noch wissen*. Intuitive counter-examples to any concrete proposal we know can be constructed (e.g., do I ‘still know’, if I had forgotten for an hour yesterday?), However, the same holds for *noch regnen* [‘still rain’]. The inheriting of general problems with the semantics of *noch* can even be seen as further evidence that this is indeed the same element.

$$(15) \quad \llbracket \text{noch} \rrbracket = \lambda p : \underline{(\exists t)[(t \prec t_{@}) \wedge p_{\langle w_{@}, t \rangle}]} \cdot P_{\langle w_{@}, t_{@} \rangle}$$

By the above, ‘*x weiß noch, dass p*’, presupposes that *x* has known *p* for a while. For the informationally rich proposition denoted by ‘*wie p*’, satisfaction of this presupposition usually demands first-hand experience. The retainment of evidence for this proposition suggests a causal link between the experience and knowledge. (This is the second part of the pragmatic inference to (4).⁹) Combining negated *noch* (see Löbner 1990, Krifka 2000) with *wie_M* leads to the correct prediction that ‘*nicht mehr wissen, wie p*’ [‘not anymore know how *p*’] amounts to having forgotten how *p* – previous rich knowledge is still presupposed, previous experience inferred. This is compatible with ‘*noch wissen, dass p*’.

This completes our compositional account of ‘*noch genau wissen, wie/dass p*’. We close the main part of this paper by showing (16) that the informational richness of the *wie*-complement (see (i)) and entailment of the corresponding *dass*-sentence (see (iii)) are preserved in our semantics of the full clause.

$$(16) \quad \begin{aligned} \text{a. } & \llbracket \text{Mia} [\text{v}_p \text{noch} [\text{genau} [\text{v} \text{weiß}]], [\text{DP} \Delta_s [\text{CP} \text{wie}_{(M)} [\text{c}' \emptyset [\text{TP} \text{PAST} [\text{PERF} [\text{Paul} \text{schwimmen}]]]]]]]] \rrbracket^{@,c} \\ & = \frac{f_c(\lambda q. q \subseteq (\lambda j. t_j \prec t_{@} \wedge \text{swim}(j, \text{paul})) \wedge M(q))(@)}{((\text{CONS}_{@,c} \cup G_c) \cap \text{EVI}_{\text{Mia},@}) \subseteq f_c(\lambda q. q \subseteq (\lambda j. t_j \prec t_{@} \wedge \text{swim}(j, \text{paul})) \wedge M(q))} \\ \Leftrightarrow \text{b. } & \llbracket \text{Mia} [\text{v}_p \text{noch} [\text{genau} [\text{v} \text{weiß}]], [\text{CP} \text{dass} [\text{c}' \emptyset [\text{TP} \text{PAST} [\text{PERF} [\text{Paul} \text{schwimmen}]]]]]] \rrbracket^{@,c} \\ & = \underline{\exists j. t_j \prec t_{@} \wedge \text{swim}(j, \text{paul})}. ((\text{CONS}_{@,c} \cup G_c) \cap \text{EVI}_{\text{Mia},@}) \subseteq (\lambda j. t_j \prec t_{@} \wedge \text{swim}(j, \text{paul})) \end{aligned}$$

5. Conclusion and open issues

In this paper, we have proposed a (de-)compositional semantics for German ‘remember’ that analyzes ‘*noch genau wissen, wie p*’ as retained extra-justified knowledge of an informationally rich proposition. In this semantics, *wissen* (relative to a contextual standard of relevant indices) contributes factivity, and justification via evidentiality. *genau* increases the relevance standard, *wie* adds informational richness, *noch* past-directed retention.

All of these elements can be dropped or replaced individually. Thus, ‘*wissen, wie*’ without *noch* still entails ‘*wissen, dass*’ qua informational richness; informationally rich *wie*-complements also appear in imagination reports a.o. *noch* [‘still’] is the same entry as in ‘*it’s still raining*’ and can be replaced by *wieder* [‘again’] or negated as *nicht mehr* [‘not anymore’] with the predicted temporal relations between times at which evidence is and is not given. ‘*nicht mehr wissen, wie*’ [‘not anymore know how’] amounts to having forgotten how things were when *p*, and is entailed by ‘*nicht mehr wissen, dass*’, as predicted for negation. The place of *genau* can be taken by *lebhaft* [‘vividly’] or ‘*bis ins letzte Detail*’ [roughly: ‘in perfect detail’] only in experiential cases (see Stephenson 2010), because these arguably do not (just) manipulate CONS but require informational richness. While *genau* is independently motivated by Wurm (2020), its relation to numeral-modifying ‘exactly’ (‘exactly 200 people’) remains to be explained.

An intuitive way of understanding our proposed truth-conditions for ‘*noch (genau) wissen, wie*’ is an interplay of three factors: The more informationally rich a proposition is, the harder it is to be known. The more possible worlds we consider (in dependence of the context and of possible modification), the more unrestricted CONS gets, and the harder it is to know *p*. The better our evidence, the more EVI is restricted and the easier it is to know *p*. Hence, if the proposition becomes informationally richer (because *dass p* is replaced with *wie p*), or if CONS is extended (because we are in an epistemology context or because of *genau*-modification), this can be ‘compensated for’ by gaining better (typically direct) evidence.

We did not have the space to discuss the pragmatic relation between evidence and experience or the nature of EVI in detail. Doing so will be necessary to make our work fruitful for the more general investigation of evidentiality in attitude reports (Ünal & Papafragou 2018). For an initial such discussion, the reader is referred to Rosina (2024). Furthermore, we only mentioned our empirical work as support. For a discussion of it, see Rosina & Liefke (2024a). When we go beyond *wie*- and *dass*-complements and investigate DP-complements and different infinitival and small clauses, we will have to re-evaluate the

⁹ Like for part 1, footnote 6, we have to assume a certain folk psychological reasoning for this to be plausible – in this case, roughly: “It’s (almost) impossible to retain evidence for the exact way things were when Paul was swimming in the sea over such a long time span just by recalling a list of facts about it, so Mia must have retained a scenic representation of a personally experienced event.” Cf. Rosina & Liefke (2024a) and Rosina (2024).

attitudinal propositionalism (see Liefke 2023c) we have been arguing for here. The applicability of our account to other attitude verbs, first and foremost to ‘imagine’, has to be tested. Liefke (2024) contains a discussion of parallels and differences that would have to be captured. Finally, we leave for future work the extension to eventive uses of memory predicates (‘is remembering right now’), and a typological investigation of the morphological makeup of memory predicates that could be insightful, e.g. for the question whether ‘know’ is a common element of such predicates.

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