Embedded Questions are Exhaustive Alright, but…

Malte Zimmermann[1(✉)], Lea Fricke[2], and Edgar Onea[2]

[1] Universität Potsdam, 14476 Potsdam, Germany
mazimmer@uni-potsdam.de
[2] Karl-Franzens-Universität, 8010 Graz, Austria

Abstract. We present two novel diagnostics for gauging the exhaustivity level of German *wh*-interrogatives embedded under the predicates *wissen* 'know' and *überraschen* 'surprise'. The readings available in combination with the concessive particle combination *SCHON…aber* 'alright…but' and the Q-adverb *teilweise* 'partially' provide evidence that embedded *wh*-interrogatives under veridical and distributive *wissen* 'know' have a weakly exhaustive (WE) reading as their basic semantic interpretation [19]. The logically stronger strongly exhaustive (SE) reading is a pragmatic enrichment that can be cancelled by *SCHON…aber*. In our event-based analysis, *know* + *wh* expresses the maximal plurality of sub-events of knowing the individual answers to the question. Under the cognitive-emotive attitude verb *überraschen* 'surprise', which is not obligatorily distributive, *wh*-interrogatives allow for two types of WE-interpretations, distributive and non-distributive. The *SCHON…aber*-diagnostic shows the logically stronger distributive WE-reading to be a pragmatic enrichment. In view of (novel) experimental evidence that *surprise* + *wh* allows for SE-interpretations, we follow [12] and tentatively analyze *surprise* + *wh* as expressing a psychological state caused by a complex situation, or subparts or missing parts thereof.

Keywords: Embedded questions · Exhaustivity · Q-adverbs · Discourse particles · Pragmatic enrichment

This work was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), Priority Program SPP 1727 XPRAG.de, Project 'Exhaustiveness in embedded questions across languages' (Onea, Zimmermann). We would like to thank the audience at TbiLLC13 as well as two anonymous reviewers for valuable feedback. All remaining errors are our own.

A. Özgün and Y. Zinova (Eds.): TbiLLC 2019, LNCS 13206, pp. 173–194, 2022.
https://doi.org/10.1007/978-3-030-98479-3_9

1 Introduction

This paper takes a fresh look at the different exhaustivity levels of *wh*-interrogatives embedded under the veridical and distributive predicate *wissen* 'know', and under the cognitive-emotive and non-distributive *überraschen* 'surprise', cf. (1), (2).[1]

(1) Nino **weiß**, [wer getanzt hat].
'Nino **knows** who danced.'

(2) Es **überraschte** Nino, [wer getanzt hat].
'It **surprised** Nino who danced.'

The discussion will be based on two novel empirical diagnostics regarding the interaction of embedded *wh*-interrogatives with the concessive particle combination *SCHON…aber* 'alright…but' and the Q-adverb *teilweise* 'partially', as shown in (3).

(3) Nino weiß **SCHON/teilweise**, [wer getanzt hat].
'Nino knows who danced alright, Nino knows who danced alright.
/Nino knows in part who danced.'

A highly debated issue in question semantics is which of the observable surface readings of varying exhaustivity (strongly exhaustive [SE], intermediate exhaustive [IE], weakly exhaustive [WE]) are underlying semantic interpretations, and which ones are mere pragmatic inferences, if any. To this end, we will investigate the interpretive effect of particle combinations and Q-adverbs on the interpretation of interrogatives under *know* and *surpris*e. We will show that insertion of the particle combination *SCHON…aber* blocks the generation of some pragmatic implicatures. From this, we conclude that exhaustivity inferences of *wh*-interrogatives that are blocked by the presence of the particle combination are pragmatic inferences. The Q-adverb *teilweise* 'partially', by contrast, operates on truth-conditional semantic content proper. We conclude that exhaustivity inferences targeted by *teilweise* must be part of the truth-conditional semantic content of embedded *wh*-interrogatives. Applying the two diagnostics to *wh*-interrogatives embedded under *wissen* 'know' and *überraschen* 'surprise', we find the following: First, SE-readings under *wissen* 'know' are pragmatic inferences that are derived from a weaker semantic interpretation [19, 40] under an internal subject perspective [13, 39]. This internal perspective follows from the novel general pragmatic *Principle of Attitude Report Verification (PARV).* Second, the observable distributive readings with *überraschen* 'surprise' result from pragmatic strengthening of a relatively

[1] The distributivity of *wissen* 'know' is evidenced by the fact that knowledge of who danced in *s* will entail knowledge of every individual that danced in *s*: In a situation *s* with three individuals, Berit, Daniel and Malte, that danced, the truth of (1) entails that Nino knows that Berit danced and that Daniel danced and that Malte danced. By contrast, [24] was the first to show that *überraschen* 'surprise' is non-distributive, as one can be surprised by the composition of a group (e.g., that B and D and M and all danced together) without being surprised at the individual dancers; see §2 for more discussion of the semantics of *know* and *surprise.*

weak underlying semantic interpretation, which can be cast in terms of an existential WE-semantics [14, 34, 35], or by analyzing cognitive-emotive attitude verbs like *surprise* as predicates operating on facts/situations rather than propositions/questions [12].

The article is structured as follows: Sect. 2 provides background information on the exhaustivity of *wh*-interrogatives and the interpretive effects of *SCHON…aber* and *teilweise*. Section 3 presents the novel empirical findings for *wh*-interrogatives embedded under *wissen* 'know' (henceforth: *know* + *wh*), and it sketches an event-based analysis of *know* as operating over the plural sum of knowledge sub-events, effectively giving rise to a semantic WE-interpretation. Section 4 presents the novel empirical findings and a preliminary analysis of *wh*-interrogatives embedded under *überraschen* 'surprise'. Section 5 concludes.

2 Background: Exhaustive Force, Particles, and Q-Adverbs

This section provides background information on the variable interpretation of embedded *wh*-interrogatives as weakly or strongly exhaustive (Sect. 2.1), on the interpretive effects of the discourse particle *SCHON* 'alright' in combination with concessive *aber* 'but' (Sect. 2.2), and on the semantic import of the Q-adverb *teilweise* 'partially' (Sect. 2.3).

2.1 Different EXH-Force Under *Know* and *Surprise*: SE vs. WE

The surface interpretation of sentences with embedded *wh*-interrogatives can vary in the exhaustive force of the embedded interrogative, depending in part on the meaning of the embedding predicate. Consider (1) with *wissen* 'know' in a scenario with four individuals, Mary, Alex, Paul and Anna. Of these four, Mary and Alex danced, and Paul and Anna did not. The two readings of (1) of interest differ in how much information Nino must have regarding who did and who did not dance. On the strongly exhaustive reading [13], she must have complete information regarding the entire answer space, namely that Mary and Alex danced, and Paul and Anna did not. On the weakly exhaustive reading [19], it suffices for (1) to be true that Nino's information state is complete with respect to the positive answer space: She would only need to know that Mary and Alex danced. Moreover, non-exhaustive readings [41] with *know* are blocked by the inherent distributivity or homogeneity of this predicate [4, 24].[2]

[2] We focus on WE- and SE-readings in the discussion to come, in which we derive the SE-reading from the WE-reading, which we take to be the semantic basis of any semantic theory of embedded questions. The additional intermediate exhaustive reading (IE) is a strengthened WE-reading with the additional requirement that the subject have no false beliefs about individuals that are not in the extension of the embedded predicate. For (1), this would require that Nino does not (falsely) believe of Paul or Anna that they danced. We have nothing of substance to say about the IE-reading in this paper and will therefore remain silent on how it derives from the WE-reading. [40] derives IE-readings by applying an exhaustivity operator. Alternatively, there may be a *no-false belief* constraint as part of the semantics of the embedding verb *know*, which is veridical, i.e. truth-bound, so that the WE-reading with *know* is indistinguishable from the so-called IE-reading, as proposed by [36, 37] and [22] for other embedding predicates, such as *predict*. Throughout, we will continue to use the traditional label WE-reading in connection

The cognitive-emotive attitude predicate *überraschen* 'surprise' differs semantically from *wissen* 'know' in several ways. This has repercussions for the interpretation of embedded *wh*-interrogatives. For one, *surprise* is not obligatorily distributive [24]. So, (2) could still be true if Nino did not expect both Mary and Alex to dance at the same party (because they are rivals and never dance if the other does) even though she is not surprised by Mary's dancing per se, nor by Alex's. Given non-distributivity, *surprise* + *wh* may give rise to different readings than *know* + *wh* in the above scenario. The different readings will crucially depend on Nino's prior expectations. On the distributive WE-reading (WE_dist), Nino didn't expect Mary nor Alex to dance, so that her surprise is complete with respect to the positive answer space of *Who danced?*. A non-distributive WE-reading (WE_nondist; cf. [14, 34, 35]) obtains if it's just Alex that Nino didn't expect to dance. Now her surprise is directed at the positive answer space in a non-distributive manner. In addition, there may be two SE-readings with *surprise*, which make reference to the full logical answer space including the non-dancers: the non-distributive SE-reading (SE_nondist) obtains if Nino is not surprised by the actual dancers, but she did expect Anna to dance as well, contrary to fact. Finally, the distributive SE-reading (SE_dist) would require Nino to be surprised by everybody who danced and by everybody who didn't (= complete counter-expectation).

Notice that *know* and *surprise* also exhibit different entailment patterns [32, 40], i.a. *Know* is upward entailing so that SE entails WE: If Nino knows who was and who was not at the party (SE), it follows that she knows who was at the party (WE). The same entailment does not hold for *surprise*: If it surprises Nino who did and who did not dance (SE), it does not follow that she is surprised by who actually danced (WE). The surprise may be directed exclusively at the non-dancers.

The literature offers different views on the available interpretations of *wh*-interrogatives under *know*. In [13], all embedded *wh*-interrogatives denote propositions inducing a full partition of the entire logical space. In this partitioning question semantics, all embedded *wh*-interrogatives are predicted to be strongly exhaustive. For [17], the SE-reading with interrogatives under *know* follows from the lexical partitioning semantics of the matrix predicate, such that (1) will be true iff Mary knows the complete answer to who was at the party, and that this is the complete answer. Differences aside, both accounts only predict SE-readings for *know* + *wh*. This strong position is problematic on at least two counts: Firstly, whereas SE-readings are indeed prominent with *know*, other embedding verbs such as *predict*, *tell*, or *announce* allow for weaker interpretations, which cannot be modelled in a partition semantics [4, 17]. Secondly, recent experimental work has found the weaker IE/WE-readings (i.e. to know the complete positive answer and nothing more) to be readily available with an acceptability rate of >90% even with English *know* and French *savoir* 'know' [6, 8]. In addition, [7] provide experimental evidence for both WE_nondist and SE_nondist-readings with interrogatives under *surprise*. The experiments in [6] and [7] involved picture matching and acceptability judgments with an external, participant-centered perspective.

with *know* and *surprise*, where it should be understood as (empirically) equivalent to the label IE-reading in the case of *know*, as in [40] modulo our non-commitment regarding the derivation of IE.

Novel Experimental Evidence. In two experiments with novel setups, we were able to replicate to some extent these findings for German *wissen* 'know' and *überraschen* 'surprise'. In a contradiction experiment [10], we tested for the obligatoriness of SE-readings with *wissen* 'know' predominantly from the internal perspective of the attitude holder. Participants had to judge the contradictoriness of discourse sequences, such as (4) (in italics), in which the SE-reading is explicitly negated in the final clause.

(4) Context: [Anna, Beth, Chloe, Doro, Emma and Franzi share a flat in Berlin.] On the long weekend, they organized a games night. [Their former flatmate] Jannick was there as well. During games night, they mixed drinks.
Jannick knows who out of the flatmates mixed a cocktail, but he doesn't know that Emma and Franzi did not mix a cocktail.

If only SE-readings were available under *wissen*, such sequences should be systematically judged as contradictory. Conversely, if participants judge them as non-contradictory, this constitutes evidence for the WE/IE-reading. The results show that more than 25% of all cases were judged as non-contradictory, indicating that WE/IE-readings are available to some extent.

The second experiment was carried out for a range of matrix predicates in German, including *wissen* 'know' and *überraschen* 'surprise' [11]. Target sentences were objects of bets, and compensation was performance based, so that participants were actively engaged through a financial incentive. Again, the linguistic items and contexts were designed such that target sentences had to be judged from the internal perspective of the attitude holder, while the external perspective of the addressee had to be taken into account as well. This design targets the optimal reading from a communication-oriented perspective; see [11] for details on the experimental setup. The descriptive results for the two predicates of interest are as follows: For *wissen*, there was evidence for a WE/IE-reading in 46% of all cases, as opposed to a ceiling 100% for SE. For *überraschen*, there was evidence for the two WE-readings (WE_dist: 100%, WE_nondist: 96%), but, interestingly, also for the SE_nondist-reading at a robust level of 58%. The availability of SE_nondist will play a crucial role in the analysis of *überraschen* in Sect. 4.

Previous Analyses of Flexible SE/WE-Interpretations. There is ample evidence from introspection and experiments that the interpretation of *wh*-interrogatives is flexible between SE and WE under *wissen* 'know', and variable between three surface interpretations under *überraschen* 'surprise'. The literature offers different ways to account for this flexibility, with different sources for the observed variability in exhaustive force. [3] derive the variability from two covert answer operators *ANS1* (giving rise to WE) and *ANS2* (deriving SE), which both operate on an unconstrained interpretation of the interrogative in terms of Hamblin-alternatives [16]. [22] postulate covert EXH-operators either in the embedded interrogative (deriving SE) or in the matrix clause (deriving WE/IE). [40] derives an IE-interpretation as the only available semantic reading by placing covert EXH in the matrix clause. SE-readings are derived as a pragmatic enrichment via a hearer-based (excluded middle) competence assumption. Finally, [39] posit

a lexical ambiguity in the attitude verb *know* as expressing an internal perspective (SE-reading) or external perspective (WE/IE-reading), respectively. Our analysis of *know* + *wh* in Sect. 3 will incorporate core ingredients from the last two accounts.

2.2 The Interpretive Effect of *SCHON…Aber*: Implicature Blocking

According to [42], the German discourse particle *schon* 'alright' is a modal comparative degree operator that commits the speaker to the truth of the prejacent proposition *p*, after weighing the circumstantial evidence in favor of *p* against the evidence for its polar counterpart $\neg p$. In general, the presence of *schon* indicates that there may be some reason to doubt the validity of *p*. Because it expresses polar comparison, *schon,* and accented *SCHON* in particular, are commonly found in verum focus contexts [18]. In combination with the (implicit) concessive particle *aber* 'but' in a subsequent clause, accented *SCHON* has an additional effect on interpretation: It consists in the blocking of pragmatic implicatures based on prototypicality or relevance.[3] Consider (5A), which gives rise to the relevance-based implicature that *Levan is not hungry* in the absence of *SCHON*. With *SCHON*, this implicature is blocked. Likewise, B's implicit question in (6) is whether she can get petrol, so that A's response without *SCHON* would give rise to the relevance-based conversational implicature that the petrol station is open and sells petrol. This implicature is blocked in the presence of *SCHON*, thereby indicating that the implicit question is answered in the negative: no petrol available.

(5) Q: Is Levan hungry? Has he had breakfast?
A: Er hat (**SCHON**) gefrühstückt (, **aber**…)
'He's had breakfast (**alright**, **but** ...)'

(6) Context: B tells A that she needs petrol and asks about a petrol station nearby.
A: Es gibt hier (**SCHON**) eine Tankstelle (, **aber** …)
'There is a petrol station (**alright**, **but** ...)'

Crucially, *SCHON…aber* does not block scalar implicatures. In (7), its presence does not rescue the impending contradiction between the implicature (*not all*) and its contradiction in the subsequent clause (*all*).

(7) #Cleo hat **SCHON** *einige* Kekse gegessen, **aber** eigentlich hat sie *alle* gegessen.
'Cleo has eaten *some* cookies **alright**, **but** actually she's eaten *all* of them.'

[3] How exactly this blocking of implicatures should be modelled is an open question. It seems to us that the presence of *SCHON* in a sentence is understood by the hearer as a cue suggesting that (a certain type of) implicatures should not be derived in the first place. However, for the purposes of this paper a somewhat weaker formulation would also suffice: *SCHON* is licit in contexts in which certain types of implicatures are cancelled with an upcoming *aber* ('but') construction. We will use the stronger claim in this paper for explicitness.

We speculate that the insensitivity to scalar implicatures follows from the polar comparative nature of modal *SCHON* [42], and from the fact that the scalar alternative (*C ate **all** the cakes*) logically entails the literal meaning *p* (*C ate **some** cakes*): Adding implicature-blocking *SCHON* to a proposition *p* normally constitutes a reason for doubting *p*, but in the case of the scalar *not-all* implicature in (7) the validity of the unblocked alternative (*all the cakes*) casts no doubt on the entailed *p* (*some cakes*). For this reason, the presence of *SCHON* is unmotivated as there is no contradiction.

Moreover, modal *SCHON* does not resolve lexical ambiguities, as shown for the German homonym *Bank* ('bench' or 'bank') in (8). (8) can only be understood in jest (☺) as a play of words, i.e., at a meta-linguistic level.

(8) Ich kenne **SCHON** eine *Bank* hier in der Nähe, die Deutsche *Bank*, **aber** auf der kannst du nicht bequem sitzen. ☺
'I know a bank nearby **alright**, Deutsche *Bank*, **but** it's not comfy to sit on.'

Finally, *SCHON…aber* does not affect truth-conditional semantic content. Its presence in (9) does not lead to a rejection of the claim that at least five beers were drunk:

(9) #Ich habe **SCHON** fünf Bier getrunken, **aber** eigentlich nur drei.
'I drank five beers alright, but actually only three.'

The insensitivity of *SCHON…aber* to semantic content will play an important role in our semantic analysis of *wh*-interrogatives under *know* and *surprise*. In particular, we can conclude that any inferences blocked by the presence of *SCHON…aber* are not semantic entailments, but mere pragmatic implicatures triggered by considerations of prototypicality or relevance. Pragmatically, the presence of *SCHON…aber* indicates that a prototypical default does not obtain, which in turn casts doubt on the truth of the prejacent *p* by the semantic meaning of *SCHON* as a modal degree operator.

2.3 The Meaning of *Teilweise* 'Partially': Quantifying Over Pluralities

In contrast to *SCHON…aber*, the Q-adverb *teilweise* 'partially, in parts' is a quantificational modifier operating on truth-conditional semantic content. For the purposes of this paper, there are three important aspects to the meaning of *teilweise*:

Firstly, *teilweise* affects the truth-conditions. Whereas Nino must have eaten all of the (contextually salient) Khachapuris for (10) to be true, (11) will already be true if Nino ate only a subset of them. More generally, sentences with *teilweise* are true if a subpart of the theme-related eventualities in question are instantiated.

(10) Nino hat die Khachapuris gegessen.
'Nino ate the Khachapuris.'

(11) Nino hat die Khachapuris **teilweise** gegessen.
'Nino ate the Khachapuris **partially**.'

Secondly, we assume that *teilweise* only excludes maximal eventualities in the pragmatics, as (11) will also be true in situations in which Nino ate all of the Khachapuris. Having said this, we concede that it is quite misleading to use *teilweise* in a situation in which Nino ate all of the Khachapuris, but there is good evidence for the assumption that the partiality associated with *teilweise* is a pragmatic effect. (12) will be true if Ninos granny is pleased with Nino eating some or (even better!) all of the Khachapuris. Moreover, there is a clear contrast between *teilweise* vs. *nur teilweise*, as shown in (13).

(12) Wenn Nino die Khachapuris **teilweise** gegessen hat, ist ihre Oma zufrieden.
'If Nino ate the Khachapuris **partially**, her granny will be pleased.'

(13) Nino hat die Khachapuris **nur teilweise** gegessen.
'Nino ate the Khachapuris **only partially**.'

Thirdly, *teilweise* only operates on pluralities of discrete eventualities, which must be tied to atomic entities in the individual domain, as expressed by plural count NPs. As a result, *teilweise* in (14) cannot be used to express that Nino ate only part of the soup, unlike the part-whole modifier *zum Teil* 'in part'. The only felicitous reading of (14) is one in which Nino ate the soup in discrete portions (possibly together with others).

(14) #Nino hat die Suppe **teilweise** gegessen.
'#Nino **partially** ate the soup.'

(11) and (14) show that *teilweise* is not lexically connected to question embedding, but to plural eventualities. Most importantly, all these requirements can only be fulfilled if the atomic pluralities are targeted by *teilweise* in the process of semantic composition.

There are several conceivable ways to implement the semantics of *teilweise.* An obvious possibility would be to follow [4] or [24] in assuming that *teilweise* is a run-of-the-mill adverbial quantifier that takes individuals, propositions, or eventualities as its arguments. An alternative would be to implement *teilweise* as a quantifier that takes a plurality as argument and returns a part of that plurality for the further compositional procedure, [2]. Here, we opt for an event-semantic analysis, though, in which *teilweise* operates on mereological part-whole structures. Providing arguments in support of our analysis goes beyond the scope of this paper. For its core arguments, not much hinges on the particular choice of analysis for *teilweise*, as long as it accounts for the three main empirical observations. For this reason, the present analysis should be considered a mere handy tool for formally implementing the essential points viz. the semantics of embedded questions. For the same reason, we refrain from a detailed compositional analysis. Most of what follows could be restated in any analysis that takes questions to denote a Hamblin/Karttunen style set of alternatives.

For explicitness, we analyze the Q-adverb *teilweise* as a quantificational part-whole modifier of a verbal projection that operates over plural mereological sub-event structures. We assume that a clause with *teilweise* will be true iff there exists some sub-event *e* of a complex plural event *e'*. In (11), this plural event is the maximal eating event of a contextually given maximal set of khachapuris, which is formally derived by the

sum-formation operator ⊕. The Neo-Davidsonian event-semantic representation of (11) is shown in (15), with *TH* = *Theme*; see also [2, 26], i.a.

(15) $\exists e.e \sqsubseteq e' \wedge e' = \bigoplus\{e|eat(e) \wedge TH(e) \in \bigoplus\{x|khachapuri(x)\}\} \wedge AG(e,N)$

To conclude, the meaning parts targeted by *teilweise* constitute semantic content proper. Any inferences that are not affected by *teilweise* must be considered pragmatic implicatures. In Sect. 3, we will employ this diagnostic to show that SE-readings with *know* + *wh* must be pragmatic implicatures, and not semantic entailments!

3 *Wissen* 'Know' + *Wh*: Data and Analysis

This section presents novel empirical data on the interpretation of *wh*-interrogatives embedded under *wissen* 'know'. In Sect. 3.1, we present evidence from the interpretation of such interrogatives in combination with *SCHON…aber* and with *teilweise* that shows that their basic semantic interpretation is the WE-reading. We will put forward an event-based semantic analysis of *know* + *wh* in Sect. 3.2. The SE-reading, in turn, is not an independent semantic reading, but derived from the WE-reading by way of pragmatic enrichment. Our analysis in Sect. 3.3 will take up ideas by [40] and [39], but we will put the ingredients together in a different manner.

3.1 Novel Evidence on *Know* + *Wh*: IE is Semantic, but SE is Pragmatic!

Looking first at the interpretive effect of *teilweise*, we find that this Q-adverb only ranges over the positive alternatives in the question, i.e. the complete set of true answers constituting the WE-reading [19]. The semantic effect of *teilweise* is to turn this WE-interpretation into a non-exhaustive question interpretation. Consider (16) and recall from Sect. 2.3 that *teilweise* only operates on truth-functional semantic content. (16) will be true if Nino knows for only part of the dancers that they danced, i.e., her knowledge is non-exhaustive regarding the WE-interpretation. As a result, the follow-up in (16a) is licit. Crucially, the alternative follow-up in (16b), in which Nino's knowledge is shown to be incomplete regarding the entire answer space including negative answers (= SE), is NOT felicitous. But it should be if SE-readings were bona fide semantic entailments, thus making (16) semantically ambiguous. The infelicity of (16b) thereby constitutes negative evidence against the analysis of SE as a semantic entailment.

(16) Nino weiß nur **teilweise**, wer getanzt hat, weil sie nicht weiß, …
'Nino knows only **partially** who danced because she doesn't know…'
a. …, dass Levan getanzt hat.
'… that Levan danced.
b. # …, dass David **nicht** getanzt hat.
'… that David **didn't** dance.'

Next, consider the effect of *SCHON…aber* in (17). Here, the particle combination indicates that the SE-inference blocked. This is compatible with the felicitous follow-up in (17b), which is directed at the negative answer space (= part of the SE-denotation),

and which improves significantly in the presence of *SCHON…aber* as opposed to its counterpart without. In contrast, as *SCHON…aber* cannot operate on the semantic content of the clause, cf. (9), it cannot be used to turn the underlying WE-reading into a non-exhaustive reading, viz. the infelicity of (17a), which marks Nino's knowledge as incomplete regarding the WE-denotation.

(17) Nino weiß **SCHON**, wer getanzt hat, **aber** sie weiß nicht, …
'Nino knows who danced **alright**, **but** she doesn't know…'
a. #…, dass Levan getanzt hat.
'… that Levan danced.'
b. …, dass David **nicht** getanzt hat.
'… that David didn't dance.'

In sum, the infelicity of (17a) constitutes negative evidence that the WE-reading is the underlying semantic interpretation of *know* + *wh*, whereas the felicity of (17b) constitutes positive evidence that SE is a mere pragmatic implicature. The data in (18) and (19) illustrate the same point (follow-ups in English for reasons of space):

(18) Nino weiß **teilweise** wer getanzt hat,
'Nino knows partially who danced,
a. # … but she doesn't know that this is all. (SE violation #)
b. … but she doesn't know of all dancers that they danced. (WE violation OK)

(19) Nino weiß **SCHON** wer getanzt hat, **aber**
'Nino knows who danced alright, but
a. … she doesn't know that this is all. (SE violation OK)
b. # … she doesn't know of all dancers that they danced. (WE violation #)

3.2 An Event-Semantic Analysis of WE-Readings with *Wissen* 'Know'

In our event-semantic account of the basic semantic WE-reading of *know* + *wh*, completeness of the answer is aspectually derived via event summation. We suggest the lexical entry in (20) for *wissen* 'know', using event composition with knowledge events and content arguments, as suggested by [29] and [26]. According to (20), for x to know (the answer to) Q means that x is in an attitudinal state e that is composed of the maximal sum of K(nowledge) substates e' that have the individual positive answers p to Q as their content.[4]

(20) $[\![wissen]\!]^w = \lambda Q.\lambda x.\lambda e.\, e = \oplus\{e' | p \in Q \wedge K_w(e') \wedge Content_w(e', p)\} \wedge AttitudeHolder_w(e, x)$

We also assume that the denotation Q of *wh*-interrogative clauses is the set of Hamblin-alternatives [16]. Given the veridicality and factivity of the knowledge attitude, we moreover assume that only true propositions can be known, i.e., that only true propositions in w

[4] We assume that K is a primitive *knowledge* predicate over eventualities.

can form the content of a knowledge eventuality; in other words $K_w(e') \wedge Content_w(e', p)$ can only be true iff $w \in p$. Finally, we assume that the $\oplus$-operator is part of the lexical aspect of *wissen*, making e the maximal possible knowledge eventuality concerning the question Q. This derives weak exhaustiveness for Q as an aspectual phenomenon, thereby eliminating the need for a covert ANS-operator [3, 17]: $\oplus$ sums in e the sub-states of knowledge of all true propositions in Q. For (1), this results in an event predication over the stative eventuality of x knowing the complete list of dancers, or rather the complete list of true propositions of the form *y danced*, as shown in (21) for the world of evaluation w. Further application of (21) to the denotation of *Nino* and subsequent existential closure over events will yield the complete meaning of (1).

(21)
$$\lambda x.\lambda e.e = \oplus\{e' | p \in \{\lambda v.dance(y,v) | y \in Human_w\} \wedge K_w(e') \wedge Content_w(e', p)\} \wedge AttitudeHolder_w(e, x)$$

The analysis in (20) and (21) directly extends to *know* + *that* when *that*-CPs are modelled as singleton sets of sets of worlds ($\langle\langle s, t\rangle, t\rangle$) [5]. Notice, too, that the event maximality imposed by $\oplus$ makes the eventuality bounded, which explains the old puzzle of why stative verbs of knowledge are crosslinguistically marked as perfective/telic, such as e.g. in Finnish [21] or in Hausa [27].

Applying the Q-adverb *teilweise* 'partially' to (21), and following the logic from Sect. 2.3, we derive the meaning of (18) in (22). (22) specifies a sub-event e of the maximal knowledge eventuality *e'* regarding the question *Who danced?*, and x is the attitude holder of this knowledge sub-eventuality *e*.

(22)
$$\lambda x.\lambda e.e \sqsubseteq e' \wedge e' = \oplus\{e' | p \in \{\lambda v.dance(x,v) | x \in Human\} \wedge K_w(e') \wedge Content_w(e', p)\} \wedge AttitudeHolder_w(e, x)$$

Feeding in the subject meaning and existential closure over events yields the correct meaning for (18). In sum, combining *teilweise* and *know* + *wh* results in a non-exhaustive semantic interpretation. We turn to pragmatic strengthening from WE to SE next.

3.3 Pragmatics: Strengthening to SE

As mentioned in Sect. 2.1, the SE-reading of *know* + *wh* does not only entail knowledge of the complete answer to the question, but also the knowledge that this is the complete answer [17]. In other words, *to know*-SE entails not only that the attitude holder knows the complete answer, but also that she knows that this is the complete answer, cf. [17]. In the event-semantic reformulation of *know* + *wh* in (23), this is represented in terms of two conjoined knowledge eventualities, where the second eventuality *e*" captures the missing component that turns the formula into a valid representation of SE-knowledge.

(23)
$$\exists e.\, e = \oplus\{e' | p \in \{\lambda v.\, dance(y, v) | y \in Human\} \wedge K_w(e') \wedge Content_w(e', p)\} \wedge AttitudeHolder_w(e, Nino) \wedge \exists e''[K_w(e'') \wedge Content_w(e'', \lambda v.\, e = \oplus\{e' | p \in \{\lambda w.\, dance(y, w) | y \in Human\} \wedge K_v(e') \wedge Content_v(e', p)\}) \wedge AttitudeHolder_w(e'', Nino)]$$

In view of the evidence for the blocking of pragmatic implicatures and SE-readings with *SCHON…aber* presented in Sect. 2.3 and Sect. 3.1, we propose to analyze the strengthened SE-reading in (23) as a pragmatic enrichment of (22). This enrichment follows from a hearer-based pragmatic preference for interpreting 3rd person attitude reports from the *internal* 1st person-perspective of the attitude holder. To capture this preference, we propose the novel general pragmatic principle PARV in (24).

(24) PRINCIPLE OF ATTITUDE REPORT VERIFICATION (PARV): In lack of further evidence, assume that if the utterance "S has the attitude X" is true, S is in a state of mind that allows her to truthfully utter: "I have the attitude X".

With PARV, the SE-reading of (1) (*Nino weiß, wer getanzt hat* 'Nino knows who danced') is derived from its underlying semantic WE-interpretation in (21) by the defeasible assumption that Nino is able to confirm (1) by uttering (25), i.e. that she knows that she knows the WE-reading, and not just part of it. Crucially, such 1st person knowledge reports are always SE, as is evidenced by the infelicity of the subsequent follow-up, which contradicts the 1st person SE-knowledge. The obligatory SE-construal with 1st person attitude reports follows from the fact that the reporting 1st person attitude holder must know that the summed (WE) knowledge eventuality is the complete knowledge state regarding *Q*, for else she cannot rule out that her knowledge is incomplete. In the formula in (24), this is captured in the occurrence of the second event *e''*.

(25) Nino: Ich weiß, wer getanzt hat…
'Nino: I know who danced…'
…but I don't know everybody who danced.

Notice that (24) is mute on negative embedders, such as *keine Ahnung haben* 'be unaware' in (26), in which case the speaker cannot commit to the embedded content. Such predicates trigger logical scale reversal, such that the SE-interpretation is no longer an independent and logically stronger entailment, but rather entailed by semantic WE. If Nino is already unaware of the complete list of dancers in *w* (WE), it follows that she is also unaware of the complete list of dancers and non-dancers (SE).

(26) Nino hat keine Ahnung, wer getanzt hat.
'Nino is unaware who danced.'

Although not semantic in nature, the PARV-driven SE-reading is the default surface interpretation of *know* + *wh* in the absence of further evidence, which makes it difficult to cancel in the absence of context information or explicit discourse marking. This is evidenced, for instance, by the fact that SE-violations with *know* + *wh* were rated as contradictory in almost 75% of all cases in the contradiction experiment in [10] reported in Sect. 2.1. However, same as other prototypicality-based implicatures (Sect. 2.2), the default pragmatic SE-enrichment can be blocked by the particle combination *SCHON…aber*, as illustrated in (17) in Sect. 3.1.

More generally, PARV captures the implicit hearer-based assumption that attitude holders will normally be reported to have an attitude X if they are *de se* aware of having X. In such cases, they could explicitly commit to X in the form of a 1st person report. Presumably, the PARV-driven preference for evaluating attitude reports from the internal perspective of the attitude holder is due to the fact that attitudes are mental objects located in the holder's mind, for which the best or most reliable kind of evidence is a commitment by the attitude holder in the form of a 1st person report. If so, PARV would be connected to more general cognitive mechanisms associated with Theory of Mind [30]. Importantly, PARV in (24) is best considered a general interpretive principle that is not tied to questions per se, but which is also active, for instance, in the resolution of *de re/dicto*-ambiguities: In full parallel to SE-readings with *know* + *wh*, DPs contained in 3rd person attitude reports receive *de dicto* readings by default, and they must be *de dicto* in 1st person reports, cf. (27). In particular, the *de re* reading of (27a) is verified by a situation in which Rico owns a ruby which he falsely believes to be a worthless glass stone. The speaker may use the term *a ruby* to refer to that ruby, and correctly report that Rico knows that he owns that object. Crucially, Rico cannot report of himself that he owns a ruby, as long as he is not aware of the fact that this stone is in fact a ruby, cf. (27b). The contrast can be replicated with definite descriptions, too.

(27) a. Rico knows that he owns a ruby, but he is not aware it's a ruby.
3rd person: cancelled default reading = *de dicto*

b. Rico: #I know that I own a ruby, but I am not aware it's a ruby.
1st person: obligatory *de dicto*

Likewise, *de se*-pronouns as commonly found with logophoric construals [20, 28] are also tied to the internal perspective of the attitude holder. Given these observations, the pragmatic SE-enrichment with *wh*-interrogatives under *know* appears to be just another instance of perspective-dependent interpretation in natural language.

Our proposal to derive SE-readings by way of pragmatic enrichment is similar in spirit to the account in [40], but it differs in how the enrichment is triggered. [40] derives SE-readings from IE-readings via a hearer-based (excluded middle) competence assumption (CA). However, this is problematic, as the exact content of CA is unclear. On the formulation in (28a), CA is already equivalent to the SE-reading of (1), resulting in circularity. The formulation in (28b) does not generalize to other SE-compatible verbs, such as the verbs of saying *predict* or *tell*, as predictions or statements do not follow from beliefs. Another issue with the analysis of [40] is that it assumes a NEG-raising like

property of predicates like *know*,[5] even though no evidence exists to this assumption – in fact, it seems that exactly the contrary is supported by facts.

(28) *Competence assumption (CA) by addressee of (1):*
a. Nino knows for everybody whether they danced or not.
b. Nino has some belief about everybody whether they danced or not.

This being said, there are some valid concerns as to whether PARV can also handle speech act verbs correctly. After all, PARV is limited to verbs of propositional attitude. For speech act verbs, it no longer holds true that the main evidence for their truth is in fact in the mind of the subject, as speech act verbs have public effects. But then again, (i.) speech act verbs tend to have less of a bias towards SE-readings; (ii.) even with speech act verbs it is essential what the subject meant when making her utterance, cf. the *de re*/*de dicto* ambiguities in (29); and (iii.) there are no sufficient empirical data for teasing apart the attitude component and the quotational aspects of speech act verbs [37] as would be necessary for an in-depth evaluation of PARV.

(29) Nino predicted that the winner will be the spy.
a. Nino: "The winner will be the spy." *De dicto*
Nino: "I predicted that the winner will be a spy."
b. Nino: "The winner will be Rico." (incidentally, Rico is a spy!) *De re*
Nino: "??I predicted that the winner will be a spy but I was not aware of it."

In deriving SE-readings as an effect of assuming an internal perspective, we adopt a core idea of [39], first traces of which are already found in [13]. [39] also link the weaker WE- (for them: IE) and the SE-reading to the external and internal perspectives of speaker and attitude holder, respectively. They do so, however, by treating the attitude predicate *know* as semantically ambiguous between [± internal perspective]. Their account in terms of a lexical ambiguity clashes with the above argument against semantic SE, though, and in particular with the observation that *SCHON…aber* cannot be exploited for disambiguating semantic ambiguities, cf. (8). Moreover, the availability of WE- and SE-readings with other question-embedding verbs (*predict*, *tell*…) [6, 11, 22]) would necessitate the assumption of a systematic WE/SE-ambiguity in the lexicon of such verbs, an undesirable consequence. In view of these findings, and given the observable parallels to other perspective-dependent phenomena in 1st and 3rd person reports, we consider our pragmatic account superior.

[5] According to [40], NEG-raising is the crucial step for deriving the SE-reading from underlying IE. The IE-reading guarantees that for any false alternative *p*, the subject does not believe *p*. By NEG-raising, now we move from the proposition that the subject does not believe *p* to the proposition that the subject does in fact believe *not p*. In other words, NEG-raising transforms the non-belief of false alternatives into a positive belief that false alternatives are false.

3.4 Conclusion on *Wissen* 'know' + *Wh*

In this section, we presented two novel diagnostics shedding light on the underlying semantic interpretation of *wh*-interrogatives under the veridical and homogeneous/distributive attitude verb *wissen* 'know'. The combination of such interrogatives with the Q-adverb *teilweise* 'partially' and the particle combination *SCHON…aber* 'alright…but' shows that their underlying semantic interpretation is WE, whereas the SE-reading is a pragmatic enrichment. In Sect. 3.3, we argued that this pragmatic enrichment is triggered by a default tendency to interpret 3rd person attitude reports from the attitude holder's 1st person internal perspective. We also suggested that the same enrichment process is at work in the derivation of *de dicto* readings and logophoricity effects.

4 *Überraschen* 'Surprise' + *Wh*: Data and Analysis

This section presents novel empirical data on the interpretation of *wh*-interrogatives embedded under the cognitive-emotive attitude verb *überraschen* 'surprise'. In Sect. 4.1, we consider the interpretation of *surprise* + *wh* in combination with *SCHON…aber* and *teilweise*. Our findings provide novel evidence for the claim in [34, 35], and [14] that they come with a fairly weak non-distributive, or non-homogeneous semantic WE_nondist interpretation, which can be pragmatically strengthened to WE_dist. Again, such pragmatic strengthening is blocked in the presence of *SCHON…aber*. Sect. 4.2 discusses the interpretation of *surprise* + *wh* from a theoretical perspective. We discuss a shortcoming of the existential WE-interpretation à la [14], and we end by sketching a tentative analysis of *überraschen* 'surprise' and other cognitive-emotive attitude verbs as denoting a cognitive-emotive attitude towards a fact, or a proposition-dependent or proposition-exemplifying situation à la [12, 25], and [1].

4.1 Novel Evidence: WE_nondist is Semantic, but WE_dist is Pragmatic!

Recall from Sect. 2.1 that *wh*-interrogatives under *überraschen* 'surprise' allow for two WE-construals of different logical strength. In (2), the attitude holder Nino may be surprised by each and every individual in the positive answer space of dancers (= WE_dist). Alternatively, she may be surprised by just some of the dancers (WE_nondist), cf. [14, 34]. WE_dist logically entails WE_nondist.

If we add the concessive particle combination *SCHON…aber*, we find that it blocks the logically stronger WE_dist interpretation, which involves surprise at each individual answer. This is evidenced by the felicitous follow-up in (30a) vs. (30b), in which the presence of *SCHON…aber* does not serve to cancel a semantic entailment.

(30) Es hat Nino **SCHON** überrascht, wer getanzt hat, …
'It surprised Nino alright who danced …'
a. …**aber** es hat sie nicht bei jedem Tänzer überrascht
'… but she wasn't surprised at every dancer.'
b. #…**aber** sie war gar nicht überrascht.
'… but she wasn't surprised at all.'

Secondly, the Q-adverb *teilweise* 'partially' is difficult to interpret with *surprise* + *wh*, if not outright degraded, in the absence of other suitable plural expressions, cf. (31). This combination is also not readily attested in corpora:

(31) ??Es überrascht Nino **teilweise**, wer getanzt hat.
??'It partially surprises Nino who danced.'

As *teilweise* operates over plural events only, cf. (14), it is conceivable that the deviant status of (31) is due to the absence of such event pluralities with *surprise* + *wh.*

4.2 Towards a Non-propositional Analysis of *Surprise* + *Wh*

A classic way of deriving WE_nondist-readings for *surprise* + *wh* would consist in adopting an existential analysis with weak exhaustive force à la [34, 35], and [14]. *Überraschen* 'surprise' would take the WE-set of minimal (believed to be) true answers *Q* as its complement and map these to true iff there is at least one proposition *p* in this set such that the attitude holder did not expect this proposition to be true in *w*, cf. [14]:

(32) $[\![\textit{surprise}]\!]^w(Q)(z)$ = True iff for all worlds w' compatible with z's past expectations in w, there is at least one $p \in \{q: q \in Q \wedge w \in p\}$ such that $w' \notin p$; defined if for all $p \in \{q: q \in Q \wedge w \in p\}$, z believes p in w.

Pragmatic strengthening to WE_dist would formally amount to replacing the existential quantifier in (32) with the universal quantifier. Informally, such pragmatic strengthening is licit as the strengthened readings still entail the truth of the underlying semantic entailment. They just depict particular ways of making (32) true. This is entirely parallel to what we find in the domain of adnominal quantifier scope in (33), in which the surface ∀∃-reading (*all the students watched a movie*) can be pragmatically strengthened to an inverse ∃∀-pseudoscope reading (*there is a movie that all the students watched*), which is again just a specific way of making the semantic ∀∃-reading true [31]:

(33) All the students have watched a/some movie.

Finally, the deviant status of (31) with *teilweise* may simply follow from semantic redundancy, as the underlying WE_nondist semantics already captures the incompleteness or subpart requirement of *teilweise.*

Alternatively, the deviant status of (31) may also follow from the inability of *teilweise* to access the subparts of individual situations with complex non-atomic substructure [23]. And indeed, there is some reason to believe so, as *surprise* can also give rise to SE_nondist-readings, which are not accounted for at all on the WE-analysis in (32) [7, 9, 11]. There is indeed some experimental evidence that the target of the surprise in cases of SE_nondist is not from the set of positive true answers that are accessed in (32). For

illustration, consider the following example from the betting experiment [9, 11]. In the betting experiment, participants could decide to cash in a betting slip, or not, depending on how they interpreted the meaning of a sentence with a *wh*-interrogative embedded under *surprise*, cf. (34a). The truth-value judgment underlying participants' choices is made on the basis of a 1st person report of the attitude holder (here: Tiffany), cf. (34b), and of information about the circumstantial facts, cf. (34c).

(34) a. BET: Tiffany war überrascht, wer von den Teilnehmerinnen und Teilnehmern in der Sendung eine Heuschrecke gegessen hat.
'It surprised Tiffany who of the participants ate a grasshopper on the show.'

b. Tiffany: "I often think about the show, in which Freddy and Alessa bravely ate a grasshopper and the other three refused to do it. I expected that Carlo and Sophie would also eat a grasshopper on the show. After all, the two of them are generally quite flexible when it comes to food."

c. Facts: Alessa Carlo Freddy Mara Sophie ate a grasshopper.
YES NO YES NO NO

In the setting in (34bc), the surprise of Mary is directed at the negative answer space: What is unexpected is that Carlo and Sophie did NOT eat the grasshopper. Crucially, the WE-based lexical entry for *surprise* in (32) predicts the bet to be false in this SE_nondist-setting, so that participants should not cash it in. This prediction stands in stark contrast to participants' behavior, who opted for cashing in in 58% of all cases, where cashing in is equivalent to judging (34a) true in the SE_nondist setting (34bc).

The availability of SE_nondist readings for *surprise* + *wh* casts some serious doubt on the adequacy of the WE-meaning representation in (32). For this reason, we would like to raise the possibility that *überraschen* 'surprise', and other cognitive-emotive attitude verbs, such as *be glad*, *be happy*, *be worried* etc., differ from *know* (and other epistemic attitude verbs) in a more fundamental way. Following [12], we would like to propose that such predicates do not select for a set of propositions (a question meaning), but rather for – what [12] call – a fact, or an exemplified or situated proposition [1, 25]. On this line of thought, the attitude of surprise may be conceptualized as a psychological state that is caused by potentially complex situations and their overall constitution or make-up, including missing subparts.[6] Put differently, we think of the meaning of *surprise* and of other emotive-cognitive factives as lexically decomposable into a causing eventuality and a primitive emotional state (here: surprisal) caused by the eventuality.

It is important to see that this means that the actual states of *surprisal* or happiness or worry etc. are primitive neuropsychological or emotional states, as typically assumed in language processing [15]. They are not phenomenologically intentional in that they do not have a propositional attitude argument. The impression of intentionality, i.e., the directedness towards a proposition or situation, is the result of associating the causing propositional attitude or cognitive attitude towards a situation with the resulting state.

[6] This is reminiscent of [38]'s notion of surprise as being directed at the overall size and constitution of the answer, except that the propositional notion of answer is replaced with a directly observable situation with unexpected subparts or unexpectedly missing subparts.

The general pattern for the meaning of cognitive-emotive factives is formally captured in (35), where the causing stimulus *s* could stand for a situation or a fact; see above.

(35) *s* surprises *X* = *X*'s acquaintance with *s* causes *X* to experience surprisal

The surprisal is then not caused by a belief in the truth of a proposition, but more directly by becoming acquainted with some situation or fact. In this vein, surprise can also be triggered non-verbally, e.g., by the content of pictures and photographs, or by the absence of content on such pictures, which are visual representations of complex situations. The famous picture of Lenin giving a speech in front of a revolutionary crowd in Sverdlov Square, Moscow, which was later purged of Trotzki's presence, constitutes a striking example of surprise by the absence of content. As a result, there are different ways of making (36) true:

(36) The Communist Party members were surprised by [what the picture showed].
i. by what it showed (WE: surprise at visible content, e.g. Lenin)
ii. by what it didn't show (SE_nondist: surprise at missing content: Trotzki)

There are other kinds of evidence pointing towards a different semantic status of epistemic and cognitive-emotive attitude verbs. *Surprise* can take situation-referring DPs or depictive DPs as arguments (37a), whereas *wissen* 'know' cannot (37b).

(37) a. *Der Krach/Das Bild* überraschte Nino.
'*The noise/the picture* surprised Nino.'

b. *Nino weiß *den Krach/das Bild*.
'Nino knows #*the noise/the picture*.'

Secondly, the situation argument is directly expressed with the mandatory pronoun *es* 'it' with *überraschen* in (38a), whereas such a pronominal reference is at best optional with *wissen* 'know' in (38b).

(38) a. ***(Es$_7$)** überrascht Nino, wer getanzt hat.
'It surprised Nino who danced.'

b. Nino weiß (??**es$_7$**), wer getanzt hat.
'Nino knows it who danced.'

The empirical differences in (37) and (38) motivate a different semantic analysis for *überraschen* and other cognitive-emotive verbs in which they do not operate directly on the propositional content of the *wh*-interrogative. Following ideas in [12], and in particular [1] on the cognitive-emotive attitude predicate *interesting*, *überraschen* 'surprise' can be analyzed as directly selecting for a situation *s* such that *s* is a stimulus situation or fact that is part of a larger situation *s'* that (fully) resolves the *wh*-interrogative meaning

Q, and s causes a surprisal e of x in w, as tentatively shown in (39). For a situation to resolve a *wh*-question meaning, the situation must contain sufficient information for allowing at least for a partial answer to the *wh*-question.

(39) $[\![surprise]\!]^w = \lambda Q.\lambda x.\lambda s.\exists e \exists s'.\mathrm{s} \sqsubseteq \mathrm{s}' \wedge resolves(s', Q) \wedge cause(s, \mathrm{e}) \wedge surprisal(\mathrm{e}) \wedge holder(\mathrm{e}, x)$

Importantly, our theory of *surprise* naturally predicts that *surprise* has both a stative and an achievement reading, as shown in (40). For the stative reading (40a), the aspectual modification targets the resulting surprisal state whereas the achievement reading (40b) focuses on the causation event.

(40) a. I am surprised that… b. It surprises me that…

Given that a situation can cause surprisal by its size or by its general make-up or constitution [38], the denotation in (39) is general enough to be compatible with WE_dist, WE_nondist and SE_nondist readings alike. In the default case, this underspecified interpretation will be pragmatically enriched to the strongest logical reading, namely WE_dist, which expresses surprisal at all relevant subparts of the situation. Same as with *wissen* 'know', such pragmatic enrichment is blocked in the presence of *SCHON…aber*. Finally, the Q-adverb *teilweise* can only operate on semantically plural sums of eventualities, but not on the internal subparts (or lumps, [23]) of a complex situation, cf. the soup-eating situation by Nino in (14) above. This accounts for the observed infelicity of *teilweise* in combination with *surprise* + *wh*, where the surprise is directed at a complex situation. In order to express partial surprise, i.e., surprise at the subparts of a complex situation, we require the part-whole modifier *zum Teil* 'in part', which CAN operate on the material subparts of individual situations:

(41) Nino ist **zum Teil** überrascht, wer getanzt hat.
'It surprises Nino in part who danced.'

We postpone a more detailed situation-based analysis of *überraschen* 'surprise' to another occasion, and we conclude by pointing the interested reader to a recent analysis in [25] of depictive verbs like *imagine* as taking proposition-dependent situations as complements. As *imagine* can select for *wh*-interrogatives, too, it is tempting to aim at a unified analysis of different situation-selecting attitude verbs.

5 Conclusions and Theoretical Implications

In this paper, we investigated the interpretation of *wh*-interrogative clauses embedded under the attitude predicates *wissen* 'know' and *überraschen* 'surprise' in interaction with the particle combination *SCHON…aber* 'alright…but' and the Q-adverb *teilweise* 'partially'. We have shown that *SCHON…aber* does not operate on semantic content,

but rather blocks the emergence of pragmatic implicatures based on considerations of relevance or prototypicality. The Q-adverb *teilweise*, by contrast, operates on semantic content by presenting an event as a mereological subpart of some plural sum event. Applying these novel empirical diagnostics to *know* + *wh*, we found that SE-inferences with *know* + *wh* are pragmatic in nature, whereas the logical weaker WE-inferences are semantic in nature. Applying the same diagnostics to *surprise* + *wh*, we found that the WE_dist reading under *surprise* is pragmatic and the result of default pragmatic strengthening. We also saw that the existence of both WE_dist and WE_nondist readings with *surprise* is accounted for on an existential WE-analysis à la [19] and [14], but the unexpected emergence of SE_nondist-readings is not! This led us to tentatively propose a fact- or situation-based reanalysis of cognitive-emotive attitude verbs like *überraschen* 'surprise' à la [12], on which the denotation of *surprise* does not operate on a set of propositions, i.e. the set of true answers in *w*, but on a fact that is situated or exemplified by the Karttunen-meaning of the *wh*-interrogative.

The general theoretical repercussions of our endeavor are as follows. We have presented novel empirical evidence that the meaning of embedded *wh*-interrogatives is indeed underspecified in the form of a set of Hamblin-alternatives, cf. [3]. Moreover, the observation that there is no inherent distributivity or homogeneity component built into the meaning of such *wh*-clauses argues against the obligatory presence of a max-operator in *wh*-clauses, pace [33]. Likewise, we have argued that the exhaustivity effects frequently observed with embedded questions are not located in the denotation of the *wh*-interrogatives themselves, for instance in the form of covert ANS(wer)- or EXH-operators. Instead, they follow from the aspectual semantics of the embedding attitude predicates. As a result, some attitude verbs such as cognitive-emotive *surprise* only come with very weak exhaustivity requirements, whereas the complete WE-interpretation with epistemic *know* is the result of sum formation over knowledge sub-events. The corresponding SE-inferences are not semantically derived. Finally, we tentatively suggested that cognitive-emotive attitude verbs may express a relation not to sets of propositions, but to proposition-dependent situations or facts, which may also be expressed in the form of plain nominal DPs.

References

1. Abenina-Adar, M.: Interesting interrogatives. In: Franke, M., et al. (eds.) Proceedings of Sinn und Bedeutung 24, pp. 1–16. Open Journal Systems, Konstanz (2020)
2. Beck, S., Sharvit, Y.: Pluralities of questions. J. Semant. **19**, 105–157 (2002)
3. Beck, S., Rullmann, H.: A flexible approach to exhaustivity in questions. Nat. Lang. Semant. **7**, 249–298 (1999)
4. Berman, S.: On the semantics and logical form of wh-clauses. Ph.D. thesis, University of Massachusetts at Amherst (1991)
5. Ciardelli, I., Groenendijk, J., Roelofsen, F.: Inquisitive Semantics. Oxford University Press, Oxford (2018)
6. Cremers, A., Chemla, E.: A psycholinguistic study of the exhaustive readings of embedded questions. J. Semant. **33**, 49–85 (2016)
7. Cremers, A., Chemla, E.: Experiments on the acceptability and possible readings of questions embedded under emotive-factives. Nat. Lang. Semant. **25**, 223–261 (2017)

8. Cremers, A., Tieu, L., Chemla, E.: Children's exhaustive readings of questions. Lang. Acquis. **24**(4), 343–360 (2017)
9. Fricke, L., Blok, D.: Exhaustiveness in embedded questions. An experimental comparison of four predicates of embedding. Talk Presented at XPrag.de, Berlin (2019)
10. Fricke, L., Bombi, C., Blok, D., Zimmermann, M.: The pragmatic status of strong exhaustive readings of embedded questions. Poster presented at DGfS 42, Hamburg (2020)
11. Fricke, L., Blok, D., Zimmermann, M., Onea, E.: The pragmatics of embedded questions. An experimental comparison of four predicates of embedding. Manuscript (2020)
12. Ginzburg, J., Sag, I.: Interrogative investigations: the form, meaning and use of English interrogatives. CSLI, Stanford (2000)
13. Groenendijk, J., Stokhof, M.: Studies on the semantics of questions and the pragmatics of answers. Ph.D. thesis, University of Amsterdam (1984)
14. Guerzoni, E., Sharvit, Y.: A question of strength: on NPIs in interrogative clauses. Linguist. Philos. **30**(3), 361–391 (2007)
15. Hale, J.: A probabilistic early parser as a psycholinguistic model. In: Proceedings of the 2nd Meeting of the North American chapter of the Association for Computational Linguistics on Language Technologies, pp. 1–8 (2001)
16. Hamblin, C.: Questions in Montague English. Found. Lang. **10**, 41–53 (1973)
17. Heim, I.: Interrogative semantics and Karttunen's semantics for know. In: Buchalla, R., Mittwoch, A. (eds.) Proceedings of the Ninth Annual Conference and the Workshop on Discourse of IATL, pp. 128–144. Academon, Jerusalem (1994)
18. Höhle, T.: Über Verum-Fokus im Deutschen. In: Jacobs, J. (ed.) Informationsstruktur und Grammatik, pp. 112–141. Springer, Wiesbaden (1992). https://doi.org/10.1007/978-3-663-12176-3_5
19. Karttunen, L.: Syntax and semantics of questions. Linguist. Philos. **1**, 3–44 (1977)
20. Kiemtoré, A.: Issues in Jula complementation: structure(s), relation(s), and matter(s) of interpretation. Ph.D. thesis, Universität Stuttgart (2022)
21. Kiparsky, P.: Partitive case and aspect. In: Butt, M., Geuder, W. (eds.) The Projection of Arguments. Lexical and Compositional Features, pp. 265–317. CSLI, Stanford (1998)
22. Klinedinst, N., Rothschild, D.: Exhaustivity in questions with non-factives. Semant. Pragmatics **4**(2), 1–23 (2011)
23. Kratzer, A.: An investigation of the lumps of thought. Linguist. Philos. **12**(5), 607–653 (1989)
24. Lahiri, U.: Questions and Answers in Embedded Contexts. Oxford University Press, Oxford (2002)
25. Liefke, K.: A propositionalist semantics for imagination and depiction reports. In: Franke, M., et al. (eds.) Proceedings of Sinn und Bedeutung 24, pp. 515–532. Open Journal Systems, Konstanz (2020)
26. Moulton, K.: Natural selection and the syntax of clausal complementation. Ph.D. thesis, UMass Amherst (2009)
27. Newman, P.: The Hausa Language. Yale University Press, New Haven (2000)
28. Pearson, H.: The sense of self: topics in the semantics of de se expressions. Ph.D. thesis, Harvard University (2013)
29. Pietroski, P.M.: On explaining that. J. Philos. **97**, 655–662 (2000)
30. Premack, D., Woodruff, G.: Does the chimpanzee have a theory of mind? Behav. Brain Sci. **1**(4), 515–526 (1978)
31. Reinhart, T.: Quantifier scope. How labor is divided between QR and choice functions. Linguist. Philos. **20**, 335–397 (1997)
32. Romero, M.: Surprise-predicates, strong exhaustivity and alternative questions. In: Proceedings of SALT, vol. 25, pp. 225–245 (2015)
33. Rullmann, H.: Maximality in the semantics of wh-constructions. Ph.D. thesis, UMass Amherst (1995)

34. Sharvit, Y.: Embedded questions and 'de dicto' readings. Nat. Lang. Seman. **10**, 97–123 (2002)
35. Sharvit, Y., Guerzoni, E.: Reconstruction and its problems. In: Proceedings of the 14th Amsterdam Colloquium, pp. 205–210. Universiteit van Amsterdam, Amsterdam (2003)
36. Spector, B.: Exhaustive interpretations: what to say and what not to say. Unpublished paper, presented at the LSA Workshop on Context and Content, Cambridge, 15 July 2005 (2005)
37. Spector, B.: Aspects de la pragmatique des opérateurs logiques. Université Paris Diderot dissertation, Paris (2006)
38. Theiler, N.: A multitude of answers. Embedded questions in typed inquisitive semantics. MSc thesis, University of Amsterdam (2014)
39. Theiler, N., Roelofsen, F., Aloni, M.: A uniform semantics for declarative and interrogative complements. J. Semant. **35**(3), 409–466 (2018)
40. Uegaki, W.: Interpreting questions under attitudes. Ph.D. thesis, MIT (2015)
41. Xiang, Y.: Interpreting questions with non-exhaustive answers. Ph.D. dissertation, Harvard University (2006)
42. Zimmermann, M.: Wird schon stimmen! A degree operator analysis of schon. J. Semant. **35**(4), 687–739 (2018)