# On the semantic contribution of the German discourse particle *wohl* embedded under attitudes

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**Abstract**

This paper proposes a unified semantics for the German discourse particle *wohl* in both root and embedded clauses in the framework of inquisitive semantics (Ciardelli et al. 2019). According to the proposal, *wohl* modifies the result of sentence type indicators INT/DECL applied to the sentence radical, introducing a stereotypical ordering for an information state whose "best" part is used to evaluate clauses with *wohl*. The analysis captures not only *wohl*'s wide scope over question meanings (Zimmermann 2004) and its inferential-evidential meaning (Göbel 2018, Eckardt 2018), but also its embedding in complement clauses, whether declarative or interrogative, which is difficult (if not impossible) to handle in previous approaches which make use of a speech act–level machinery.

## 1 Introduction

There are intensive discussions in formal linguistics literature on the syntax and semantics of the German discourse particle *wohl*[1], which signals epistemic uncertainty about the proposition expressed by the rest of the clause in which it occurs.[2]

(1) Hein ist wohl auf See.
Hein is PRT at sea

'Hein is WOHL at sea.' [Zimmermann (2004:254)[3]]

(2) Ist Hein wohl auf See?
is Hania PRT at sea

'Is Hein WOHL at sea?' [Zimmermann (2004:263)]

The seminal work by Zimmermann (2004) argues that *wohl* is syntactically located in SpecForceP and semantically functions as a sentence type– (force-) modifier, taking scope over the proposition or set of propositions denoted by the rest of the sentence. While there are now several proposals to implement this idea in a more formal setting designed to capture discourse moves (Farkas 2017), relatively little focus has been placed on what *wohl* semantically contributes in embedded environments, which seems to be a somewhat unbalanced situation given the syntactic investigations attesting its possible occurrences in embedded clauses (e.g. Coniglio 2011). In this talk, I will attempt to fill this gap by proposing a semantics of *wohl* which captures its semantic contribution not only in the matrix clauses but also when it occurs embedded under attitude predicates. More specifically, the focus is on cases where *wohl* is embedded under rogative predicates (in the sense of Lahiri 2002) such as *sich fragen* (*wonder*) as well as doxastic predicates such as *glauben* (*believe*).

Building on Eckardt's (2018) proposal that *wohl* is an inferential evidential marker encoding stereotypicality, I propose a unified semantics for *wohl* in both root and embedded clauses in the framework of inquisitive semantics (Ciardelli et al. 2019). According to the proposal, *wohl* modifies the result of sentence type–indicators INT/DECL applied to the sentence radical, introducing a stereotypical ordering for an information state whose "best" part is used to evaluate clauses with *wohl*; in embedded case, such an information state is provided by an attitude predicate.

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[1]In this paper, only the unstressed variant of *wohl* is treated. It is distinguished from other uses – the stressed variant *WOHL* and the adverbial *wohl* (corresponding roughly to the English adverb *well*) – in that the former, unlike the latter, can signal a weaker commitment of the speaker to the rest of the clause in declarative sentences. See e.g. Zimmermann (2004) for discussions on the possibility of a unified account.

[2]Abbreviations in the glosses are: KI = Konjunktiv I, PRT = particle, REFL = reflexive.

[3]The glosses and translation are the present author's. This holds for all the other examples from Zimmermann (2004) and Doherty (1987).

The rest of this paper is structured as follows. Section 2 introduces the main observations about *wohl* to be explained: its scope over question meanings (§2.1), its logical strength (§2.2), and its distribution under attitude predicates (§2.3). Section 3 proposes an analysis of *wohl* which covers these observations in an inquisitive semantics framework. Section 4 makes a short comparison with previous approaches to the semantics of *wohl* and concludes the paper.

# 2   Observations to be explained

## 2.1   *Wohl*'s scope over question meanings:   modalized answers to *wohl*-interrogatives

As we saw in (2), *wohl* can occur in interrogative sentences. In the literature, it is reported that *wohl*-interrogatives can be paraphrased in such a way that the uncertainty meaning of *wohl* scopes over the alternatives introduced by the question formation. Zimmermann (2009: 206), for example, paraphrases (2) as: "Tell me (granted a degree of uncertainty) whether Hein is at sea or not," rather than "Tell me whether you assume that Hein is at sea." This intuition is supported by the fact that (2) cannot be answered by the German equivalent of "No, I don't assume that Hein is at sea," while modalized negative answers such as *vermutlich nein* ("presumably no") are felicitous.   This is the main support for Zimmermann's (2004) argument that *wohl* scopes over question meanings.

More generally, answers to questions with *wohl* are expected to be modalized ones (e.g. *vermutlich (ja/nein)* ("presumably (yes/no)"), *wahrscheinlich (ja/nein)* ("probably (yes/no)"), *ich denke ja/nein* ("I think so/not")) rather than plain *ja/nein* (Asbach-Schnitker 1977, Zimmermann 2004; 2009).

## 2.2   On *wohl*'s logical strength

Although it is common in the literature to regard *wohl* as signaling uncertainty of someone about the truth of its prejacent (e.g. Zimmermann 2004, 2009), it is recently pointed out that *wohl* does tolerate the speaker's certainty in declarative sentences under certain circumstances (Göbel 2018): Its use is felicitous when the speaker's certainty is based on his/her inference. This is illustrated by the following example, where Pascal, the speaker, is fully certain that he was wrong, which is clear from the infelicity of modal adverbs such as *wahrscheinlich* "probably" and *möglicherweise* "perhaps."

(3)   [Context: Pascal and Mordecai, bored during the soccer break, are playing a guessing game.
Mordecai: Guess how much Tianjin Quanjian is offering Aubameyang.
Pascal: 20 million?
M: You are wrong, it's 34 million!]

P: Hm, da    lag ich wohl   /#wahrscheinlich /#möglicherweise falsch.
P  well there lay I   WOHL /probably         /perhaps          wrong

'Well, I was WOHL wrong.' ≈ 'Well, looks like I was wrong.' [Adapted from Göbel (2018:78)]

This observation amounts to a desideratum on an analysis of *wohl* that it should predict *wohl*'s compatibility with the known truth of its prejacent.

On the other hand, it is observed that *wohl p* is incompatible even with the possibility of the prejacent's being false ($\neg p$): *wohl p but perhaps not p* is infelicitous, as the following example shows.

(4)   #Es regnet wohl, aber vielleicht regnet es nicht.
it    rains  wohl but  perhaps rains  it not
[Eckardt (2018:16)]

This fact, too, should be captured by a plausible analysis of *wohl*.

## 2.3   Embedded occurrences of *wohl*

It has long been noticed that *wohl* can occur not only in matrix but also in embedded clauses (e.g. Doherty 1987, Zimmermann 2004, Coniglio 2011), whether their mood is declarative or interrogative, as is exemplified below:[4]

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[4]We assume that the complementizer signals the mood of an embedded clause: *ob* "if/whether" indicates the interrogative mood whereas *dass* "that" is an indicator of non-interrogative moods (the declarative mood is involved in (5)).

(5) Maria vermutet, dass Hein wohl auf See ist.
    Maria suspects   that Hein PRT at sea is

    'Maria suspects that Hein is WOHL at sea' [Zimmermann (2004:266)]

(6) Lily fragt sich,   ob      Konrad wohl verreist ist.
    Lily ask   herself whether Konrad PRT away   is

    'Lilly wonders whether Konrad WOHL is away.' [Doherty (1987:119)]

Furthermore, observations have been made as to which predicates can and cannot embed declarative *dass*-clauses with *wohl*:[5] Among predicates which allow complements with *wohl* are doxastic predicates such as *glauben* "believe," *denken* "think," and *vermuten* "suspect" as well as verbs of saying such as *sagen* "say" and *erzälen* "tell" whereas (semi-)factive predicates such as *wissen* "know" do not tolerate *wohl* in their complement.

In contrast to *dass*-clauses, embedded interrogative *ob*-clauses with *wohl* have received relatively less attention except for ones embedded under *sich fragen* "wonder" (see (6) above). A corpus search reveals, however, that there is a plenty of predicates which allow *ob*-clauses with *wohl*:

(7) a. es wurde eifrig   diskutiert, ob      sich   das Wetter   wohl halte
       it was   eagerly discussed   whether REFL the weather PRT  hold.KI

       'It was eagerly discussed whether the weather WOHL will hold.'
       [DeReKo, A10/AUG.01952 St. Galler Tagblatt, 03.08.2010, S. 32; Helvetisierung im Toggenburg]
    b. Man überlegt, ob      die Gäste wohl Vegetarier   sind, Fisch-Fans oder Fleischtiger,
       one  considers whether the guests PRT vegetarians  are  fish-fans   or    meat-eaters

       'They are considering whether the guests are vegetarians, fish-fans, or meat-eaters.'
       [DeReKo, BVZ08/SEP.03291 Burgenländische Volkszeitung, 24.09.2008, S. 21]

This means that a plausible analysis of *wohl* should be general enough to cover cases with various embedding predicates.

Finally, the following remarks have been provided in the literature (Zimmermann 2004, Döring 2013) as to the interpretation of embedded *wohl*: (i) the relevant epistemic agent for the interpretation of *wohl* is shifted to the subject referent of the embedding predicate and (ii) second order attitude ascription is prohibited. Take (5), for example, it is compatible with the speaker's knowledge that Hein is at sea based on direct perceptual evidence since the relevant epistemic agent is shifted to Maria. Moreover, (5) cannot be paraphrased as "Maria$_i$ suspects that she$_i$ assumes (with a certain degree of uncertainty/based on inferential evidence) that Hein is at sea." The proposal of this paper provides explanations for these data, too.

## 3   The analysis

The analysis proposed in this paper is formulated in an inquisitive semantic framework (see Ciardelli et al. (2019) for an introduction). Inquisitive semantics enables an integrated treatment of both declarative and interrogative clauses by letting them denote the same kind of objects (i.e., a set of sets of worlds), which is a desirable feature to capture *wohl*'s occurrences in both types of clauses.

Following Zimmermann (2004), we assume that *wohl* is located in the specifier position of ForceP at LF; the epistemic agent who has uncertainty/inferential evidence in *wohl*-sentences is provided by Force head (DECL/INT) via specifier-head agreement: In the case of matrix declaratives, the epistemic agent is the speaker; in the case of matrix interrogatives, it is the hearer; in embedded cases, it is bound by the subject of the embedding predicate.

With regard to *wohl*'s semantics, we follow Eckardt (2018) in referring to the notion of stereotypicality, although, unlike Eckardt (2018), our formulation is based on Kratzerian ordering semantics (Kratzer 2012). In words, *wohl* takes an (inquisitive) proposition $\mathcal{P}$ and an epistemic agent $x$ as its arguments; an information state $s$ supports wohl$_x(\mathcal{P})$ iff for any world $w$ in $s$, the best part of $s$[6], which consists of the most stereotypical worlds from the viewpoint of $[\![x]\!]$ in $w$, supports $\mathcal{P}$, i.e., is a member of $[\![\mathcal{P}]\!]$.

**Definition 1** $\leq_{stereo}(x, w)$ is a partial order on $W$ (the set of possible worlds in a model) which orders worlds according to the degree to which they are stereotypical from the viewpoint of an epistemic agent $x$ in $w$.

**Definition 2** Best$(s, \leq) = \{w \in s | \neg \exists v \in W(v \leq w)\}$

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[5]See Zimmermann (2004), Coniglio (2011), and Döring (2013) among others.
[6]For simplicity, we are making the limit assumption that there always exist best worlds (Lewis 1973).

**Definition 3** $s \models \text{wohl}_x(\mathcal{P})$ iff $\forall w \in s(\text{Best}(s, \leq_{stereo}(x, w)) \in \llbracket\mathcal{P}\rrbracket)$

Remember that *wohl* is syntactically located in the specifier position of ForceP. Accordingly, *wohl*'s propositional argument is provided by the rest of ForceP. We locate Ciardelli et al.'s (2019) DECL and INT, which are used for eliminating and ensuring inquisitiveness respectively, in the Force head.
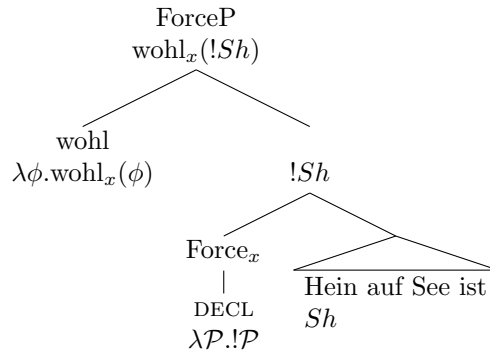
**Definition 4**
a. DECL $\rightsquigarrow \lambda\mathcal{P}.!\mathcal{P}$
b. INT $\rightsquigarrow \lambda\mathcal{P}.\langle?\rangle\mathcal{P}$

**Definition 5**
$\llbracket!\mathcal{P}\rrbracket = \wp(\bigcup(\llbracket\mathcal{P}\rrbracket))$
$\llbracket?\mathcal{P}\rrbracket = \llbracket\mathcal{P}\rrbracket \cup \llbracket\mathcal{P}\rrbracket^*$ where $P^* = \{s|s \cap t = \emptyset \text{ for all } t \in P\}$
$\llbracket\langle?\rangle\mathcal{P}\rrbracket = \llbracket?\mathcal{P}\rrbracket$ if $\llbracket\mathcal{P}\rrbracket$ is non-inquisitive; $= \llbracket\mathcal{P}\rrbracket$ otherwise
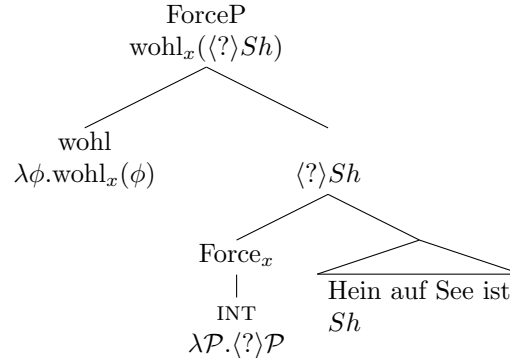
The whole structure of ForceP is illustrated by the following examples, where $S^{\downarrow}$ is an abbreviation for $\{t \subseteq s | s \in S\}$.

(8) **wohl in declaratives**



$\llbracket Sh \rrbracket = \llbracket !Sh \rrbracket = \{\{w|\text{Hein is at sea in } w\}\}^{\downarrow}$

(9) **wohl in interrogatives**



$\llbracket\langle?\rangle Sh\rrbracket = \llbracket?Sh\rrbracket = \{\{w|\text{Hein is at sea in } w\}, \{w|\text{Hein is not at sea in } w\}\}^{\downarrow}$

Now let us see how this analysis captures the observations in Section 2.

First, *wohl*'s scope over question meanings in interrogative cases is directly reflected in the semantic calculation. $\text{wohl}_x(\langle?\rangle Sh)$ is, for example, supported by a state $s$ iff $s$'s best part is a member of $\{\{w|\text{Hein is at sea in } w\},$ $\{w|\text{Hein is not at sea in } w\}\}^{\downarrow}$, which means that the best part supports either $Sh$ or $\neg Sh$. The modalized answers like *Wahrscheinlich ja/nein* "Probably yes/no" arguably express a similar meaning: A set of information states whose best part supports the prejacent/the negation of the prejacent, hence their legitimate answerhood to *wohl*-questions.

Note here that $\text{wohl}_x(\phi)$ does not denote a proposition in the standard inquisitive sense since it is not downward-closed: Even if $s$ supports $\text{wohl}_x(\phi)$, it is not always the case that each of $s$'s subset supports it. For example, if $s$ contains some non-$\phi$ worlds, sets consisting only of non-$\phi$ worlds cannot support $\text{wohl}_x(\phi)$. The existence of non-downward-closed sets of states means a departure from the basic inquisitive semantics InqB (Ciardelli et al. 2019), but such a move is not uncommon: Inquisitive semantics with attentive content (Ciardelli et al. 2014) and suppositional inquisitive semantics (Aher and Groenendijk 2015, Groenendijk and Roelofsen 2015) both do not require downward closure of propositions to handle the semantics of *might* or conditionals.

Although we leave it to future research to investigate which extension of inquisitive semantics is more suitable to integrate the analysis of *wohl* into, a potential empirical support for letting *wohl* denote a non-canonical object comes from the relatively degraded felicity of answers with plain *ja/nein*. If we assume that these answer particles are propositional anaphors (Krifka 2013, Roelofsen and Farkas 2015) which only target downward-closed propositions, they can pick up *wohl*'s prejacent but not the entire clause modalized by *wohl*. Though what the prejacent denotes is an answer to the corresponding *wohl*-interrogative, it is not expected by the questioner that the answerer is so certain about the truth of the prejacent (otherwise the questioner would use a simpler plain interrogative without *wohl*). This unexpectedness could be the source of the relative infelicity of using plain *ja/nein*.

Second, *wohl*'s logical strength is also explained. Its compatibility with the known truth of the prejacent in matrix declarative cases is not a problem at all, since nothing in the semantics prohibits the speaker's knowing the prejacent. The inferential evidentiality of *wohl* pointed out by Göbel (2018) and Eckardt (2018) is reflected in the stereotypical ordering, which refers to the viewpoint of an epistemic agent.

The infelicity of *wohl p, but vielleicht not p*, too, receives a straightforward explanation under the assumption that *vielleicht* "perhaps" also refers to the stereotypically best part of an information state—more specifically, *vielleicht not p* asserts that there is a non-*p* world in the best part. Then, the sequence *wohl p, but vielleicht not p* makes a contradictory claim that the best part of a state contains no non-*p* worlds and some non-*p* worlds at the same time, hence the infelicity.

Finally, our proposal is applicable to *wohl*'s embedding under various predicates. In embedded cases, an information state relevant to the evaluation of *wohl*-clauses is provided by the embedding predicate. The following are lexical entries of representative attitude predicates *denken* "think" and *sich fragen* "wonder" and relevant support conditions:

**Definition 6** denken $\rightsquigarrow \lambda\phi\lambda x.B_x\phi$

**Definition 7** $s \models B_x\phi$ iff $\forall w \in s(Bel_{[\![x]\!]}(w) \models \phi)$, where $Bel_a(w)$ is the set of worlds compatible with $a$'s belief at $w$.

**Definition 8** sich fragen $\rightsquigarrow \lambda\phi\lambda x.E_x\phi$ [7]

**Definition 9** $s \models E_x\phi$ iff $\forall w \in s, \forall t \in \mathbf{alt}(\Sigma_{[\![x]\!]}(w))(t \models \phi)$, where $\Sigma_a(w)$ is the inquisitive state of $a$ at $w$ (a non-empty downward closed set of information states); $\mathbf{alt}(\mathcal{P}) = \{s | s \in \mathcal{P} \ \& \ \forall t(t \in \mathcal{P} \ \& \ s \subseteq t \rightarrow t = s)\}$ [8]

(10) below illustrates how the embedded *wohl* contributes its meaning under attitude predicates. The resulting support condition ensures that this is a first-order report about the subject referent's belief: Maria's belief is such that its best part consists of worlds where Hein is at sea.

(10)　a. Maria denkt, dass Hein wohl auf See ist. 'Maria thinks that Hein is WOHL at sea.'
$\rightsquigarrow B_m(\text{wohl}_m(!Sh))$

　　b. $s \models B_m(\text{wohl}_m(!Sh))$ iff $\forall w \in s(Bel_{[\![x]\!]}(w) \models \text{wohl}_m(!Sh))$
iff $\forall w \in s(\forall w' \in Bel_{[\![m]\!]}(w)(\text{Best}(Bel_{[\![m]\!]}(w), \leq_{stereo} (m, w')) \in \{\{w \mid \text{Hein is at sea in } w\}\}^{\downarrow}))$

Note, however, that this kind of semantics cannot prevent *wissen* "know" from embedding *wohl*-declaratives (see §2.3) since it, too, provides an information state to evaluate the embedded clause (i.e., the epistemic state of the subject referent). At the moment, we have to resort to the syntactic solution by Coniglio (2011): The complement of (semi-)factive predicates have no ForceP projection in which *wohl* could be located, which is independently supported by lack of root phenomena in factive complements (see ibid. for details).

As for embedded *wohl*-interrogatives, too, the semantic calculation is possible without any further stipulation, as (11) below shows. The resulting support condition amounts to saying that the subject referent's inquisitive state is such that each of its maximal elements supports either *wohl p* or *wohl not p*. Thus, in embedded cases, too, *wohl*'s scope over question meaning is preserved.

(11)　a. Maria fragt sich, ob Hein wohl auf See ist. 'Maria wonders whether Hein is WOHL at sea.'
$\rightsquigarrow E_m(\text{wohl}_m(\langle?\rangle Sh))$

　　b. $s \models E_m(\text{wohl}_m(\langle?\rangle Sh))$ iff $\forall w \in s, \forall t \in \mathbf{alt}(\Sigma_{[\![m]\!]}(w))(t \models \text{wohl}_m(\langle?\rangle Sh)))$
iff $\forall w \in s, \forall t \in \mathbf{alt}(\Sigma_{[\![m]\!]}(w))(\forall w \in t(\text{Best}(t, \leq_{stereo} (x, w)) \in \{\{w \mid \text{Hein is at sea in } w\}, \{w \mid \text{Hein is not at sea in } w\}\}^{\downarrow}))$

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[7] This is a simplification disregarding the ignorance component of wondering. See Ciardelli et al. (2019) for details.

[8] Note that this is somewhat different from the original formulation in Ciardelli et al. (2019) in that this version refers only to the alternatives (= maximal elements) in the inquisitive state of an epistemic agent $a$. This is due to the failure of downward closure of what *wohl*-sentences denote, but does no harm to ordinary inquisitive propositions since they are downward closed.

# 4    Concluding remarks

This paper proposed an inquisitive semantic analysis of *wohl* which is applicable to both root and embedded clauses, regardless of whether they are declarative or interrogative. We conclude the paper with a brief comparison to other approaches First, the unified nature of our approach has an advantage over existing accounts which make use of a speech act–level machinery. Farkas (2017), for example, analyzes *wohl* in interrogatives as triggering a special discourse effect to capture a weaker commitment expected on the addressee. However, such an approach would have to assume a non-actual discourse to cope with embedded cases, This might be a plausible move for predicates expressing discourse moves such as *sagen* "say" and *diskutieren* "discuss" (cf. Anand and Hacquard 2009), but it is not clear how it deals with other kinds of predicates such as *überlegen* "consider." Our approach is, in contrast, general enough to cover these cases, as such predicates all seem to provide some relevant information state. Second, our analysis is more concrete about the semantics of embedded *wohl*-interrogatives than others that also takes into consideration the shift of the relevant epistemic agent in interrogative and/or embedded cases (e.g. Krifka 2017, Eckardt 2018). Finally, the proposed analysis has in common with Eckardt (2018) that it gives clauses with *wohl* a special kind of meaning: while we make them non-downward-closed, Eckardt (2018) make them denote Kaplanian characters to capture the interrogative flip fact. Type theoretically, what we do is less eccentric since the type of propositions is always $\langle\langle s, t\rangle, t\rangle$ whereas Eckardt would have to assume that attitude predicates have multiple entries corresponding to complements of different types (ordinary propositions and Kaplanian characters). Therefore, the type-theoretic parsimony might be a further advantage of our analysis.

# Corpus

Das Deutsche Referenzkorpus DeReKo, http://www.ids-mannheim.de/kl/projekte/korpora/,
   am Leibniz-Institut für Deutsche Sprache, Mannheim

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