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# POSTPRINT

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# Misfits: On Unexpected German Ob-Predicates

**Abstract:** German subjectively veridical *sicher sein* 'be certain' can embed ob-clauses in negative contexts, while subjectively veridical *glauben* 'believe' and nonveridical *möglich sein* 'be possible' cannot. The Logical Form of *F isn't certain if M is in Rome* is regarded as the negated disjunction of two sentences  $\neg(c_f \sigma \lor c_f \neg \sigma)$  or  $\neg c_f \sigma \land \neg c_f \neg \sigma$ . *Be certain* can have this LF because  $\neg c_f \sigma$  and  $\neg c_f \neg \sigma$  are compatible and nonveridical. *Believe* excludes this LF because  $\neg bf \sigma$  and  $\neg bf \neg \sigma$  are incompatibile in a question-under-discussion context. It follows from this incompatibility and from the incompatibility of  $b_f \sigma$  and  $b_f \neg \sigma$  that  $b_f \neg \sigma$  and  $\neg b_f \sigma$  are equivalent. Therefore *believe* cannot be nonveridical. *Be possible* doesn't allow the LF either. Similar to *believe*,  $\neg p_f \sigma$  and  $\neg p_f \neg \sigma$  are incompatible. But unlike *believe*,  $p_f \sigma$  and  $p_f \neg \sigma$  are compatible.

Keywords: German interrogative embedding predicates, Contrary and complementary opposites, Neg-raising

# 1 Introduction

A glance into the ZAS data base of German clause embedding predicates shows that 666 out of 1795 clause embedding predicates embed *ob*-clauses 'whether/if-clauses' – cf. Stiebels et al. [19]. You find not only *fragen* 'ask', *wissen* 'know' and *bedenken* 'consider', which are more or less omnipresent when issues of interrogative embedding are discussed, but also unexpected verbs such as *sicher sein* 'be certain' – cf. (1) to (3). Such predicates account for nine percent of the *ob*-predicates. They only combine with an *ob*-clause if they are in the scope of a nonveridical operator – cf. (1) to (3). They are, so to speak, misfits among the *ob*-clause embedding predicates.

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(1)	a.	Frank fragt, ob Maria in Rom ist. 'Frank asks if Maria is in Rome.'
	b.	Frank fragt nicht, ob Maria in Rom ist. 'Frank doesn't ask if Maria is in Rome.'
(2)	a.	Frank weiß, ob Maria in Rom ist. 'Frank knows if Maria is in Rome.'
	b.	Frank weiß nicht, ob Maria in Rom ist. 'Frank doesn't know if Maria is in Rome.'
(3)	a.	#Frank ist sicher, ob Maria in Rom ist. 'Frank is certain if Maria is in Rome.'
	b.	Frank ist nicht sicher, ob Maria in Rom ist. 'Frank isn't certain if Maria is in Rome'.

The outsiders can be intuitively divided into four groups:

i. be certain-predicates. ausgehen 'expect', ausmachen 'realize', ausschließen 'exclude', begreifen 'comprehend', bekannt sein 'be known', beschwören 'conjure', bestätigen 'confirm', bewusst sein 'be aware', dementieren 'deny', einleuchten 'be clear', entsinnen 'recall', gewahr werden 'become aware', sicher sein 'be certain', verbergen 'conceal', verstehen 'understand', wahrnehmen 'perceive', übereinstimmen 'agree', überzeugt sein 'be convinced', vergessen 'forget', widerlegen 'refute', ...

- (4) a. Er ist "nicht sicher", ob der damals erzielte Überschuß von 307 Millionen wieder erreicht wird. ZDB 788: TIGER 'He is "not sure" whether the surplus of 307 million achieved at that time will be achieved again.'
  b. Inzwischen habe der Staatsschutz die Ermittlungen aufgenommen, da
  - Inzwischen nabe der Staatsschutz die Ermittungen aufgenommen, da nicht auszuschließen sei, ob die Anschläge mit Aktionen autonomer Gruppen zusammenhängen. DWDS 1284: DWDS BZ 1997
     'In the meantime, the state security authorities have started investigations, since it cannot be ruled out whether the attacks are connected with actions by autonomous groups.'

**ii.** *forsee*-**predicates.** absehen 'foresee', ahnen 'guess', hellsehen 'predict', voraussehen 'foresee', vorausahnen 'anticipate', ...

(5) Technik kann nicht vorausahnen, ob ein Kind auf dem Fahrrad gleich auf die Straße fährt – das kann nur der Mensch. ZDB 22906: DWDS nun 2012 'Technology cannot predict whether a child on a bicycle will ride straight onto the road – only humans can do that.'

iii. *determine*-predicates. einigen 'reach an agreement', garantieren 'guarantee', verantworten 'be accountable', versprechen 'promise', ... (6) Es will keine Angela Merkel, die sagt, ich kann nicht versprechen, ob ich es besser kann, aber ich will es versuchen. ZDB 8574: DWDS BZ 2005 'It doesn't want Angela Merkel saying I can't promise if I can do better, but I want to try.'

iv. concern-predicates. anfechten 'bother', auffallen 'notice', ausmachen 'care', interessieren 'interest', jucken 'care', kümmern 'care', stören 'bother', tangieren 'concern', ...

(7) Den Urlaubern macht es nichts aus, ob sie in Antalya oder Alicante am Strand liegen, ... ZDB 25700: DWDS Zeit 1999
 'It doesn't matter to the tourists whether they are on the beach in Antalya or Alicante.'

There are inherently negative predicates that can embed *ob*-clauses. They are partly opposites of *be certain-*, *determine-* or *concern-*predicates – cf. (8) and Sect. 4.5.

v. Inherently negative predicates. ausstehen 'be pending', entfallen 'slip so.'s mind', entgehen 'not recognize', ignorieren 'disregard', unklar sein 'be unclear', unsicher sein 'be uncertain', unterschlagen 'suppress', verbergen 'mask', vergessen 'forget', verheimlichen 'conceal', vernachlässigen 'disregard'.

 (8) Die Klage hat argumentiert, dass das Hinrichtungsprotokoll verfassungswidrig ist, weil das Lähmungsmittel für die Neuromuskulatur verbirgt, ob das Schlafmittel funktioniert ... ZDB 22008: DeWaC-5 P 257450634
 '... because the suppressant conceals whether the barbiturate is working.'

All these examples show that the matrix predicate is in the scope of a nonveridical operator. This does not always have to be a negation element. Nonveridical contexts are for example also modal verbs and polarity questions – cf. (9) and (10).

- Beide Partner sollten sich also ganz sicher sein, ob sie die gemeinsame Geburt wollen. ZDB 25375: DWDS BZ 1995
   'Both partners should therefore be quite sure whether they want the joint birth.'
- (10) Aber ist sie sicher, ob sie das wirklich will? DWDS 25678: DWDS Zeit 1998 'But is she sure she really wants this?'

As to the use of the predicates of the classes *i* to *iv* and *v* imagine a path that begins with the question state of an individual  $\alpha$  and ends at best with  $\alpha$ 's knowledge state regarding the question – cf. Schwabe [16]. For  $\alpha$ 's question state it is characteristic that there is a question { $\sigma$ ,  $\neg \sigma$ } and that  $\alpha$  wants that  $\alpha$  knows that  $\sigma$  or  $\alpha$  knows that  $\neg \sigma$ . Question states can be related to by predicates like *sich fragen* 'wonder' or *argwöhnen* 'suspect'. A question state can be followed by  $\alpha$ 's question act which is addressed to  $\beta$  or by some mental activity of  $\alpha$ . A question act can be related to by predicates like *fragen* 'ask', *nachhaken* 'ask further questions', *bitten* 'ask' and *betteln* 'beg'. A mental activity can be denoted by *bedenken* 'ponder' or *beobachten* 'observe'. If  $\beta$  knows the answer and asserts it,  $\beta$  performs a proper response act. This act can be denoted by predicates like *ankündigen* 'announce' and *bestimmen* 'determine'.  $\alpha$ 's finding out the answer by

256

some mental activity can or be denoted by *herausfinden* 'find out' or *merken* 'notice'. If  $\alpha$  believes  $\beta$ 's true answer or what  $\alpha$  found out and  $\alpha$  is aware of the truth of it,  $\alpha$  knows the answer.

However, as reality shows,  $\beta$  often does not react in the intended way. The reason for this may be that  $\beta$  does not know the answer or simply does not want to give it. While  $\beta$ 's ignorance can be denoted by the negated predicates from the classes *i* to *iv* as well as from class v,  $\beta$ 's lack of interest in the answer can be expressed by negating predicates like *interessieren* 'interest' and by inherently negative predicates like *egal* sein 'not care'. Predicates like ankündigen 'announce', bestimmen 'determine', herausfinden 'find out' or merken 'notice' as well as the predicates of i to v belong to the class of responsive predicates, that is, to predicates that relate to the answers of a question - cf. Lahiri [13] and Spector and Égré [18]. If predicates like herausfinden 'find out' embed an *ob*-clause, they relate to the true answer to a question, that is, either  $\sigma$  or  $\neg \sigma$ . They embed question extensions in terms of Groenendijk and Stokhof [10] or they are objective-veridical in terms of Schwabe and Fittler [17]. Predicates like nicht sicher sein 'not be certain' refer to the possible answers to the question, that is, to both  $\sigma$  or  $\neg \sigma$ . According to Schwabe [16] *find out*-predicates are proper responsive predicates and be certain-predicates are improper ones. The latter have in common that they are not objective-veridical like herausfinden 'find out' or wissen 'know' and they are not potentially factive like bedauern 'regret'. They also share the ability to express an epistemic attitude of the matrix subject towards the embedded proposition and to occur in question-response contexts. But this also applies to predicates such as glauben 'believe' and *möglich sein* 'be possible'. That is,  $\beta$  can answer  $\alpha$ 's question (11a) with (11b) and also with (11c).

- (11) a. Is Maria going to Rome?
  - b. I think she's going to Rome.
  - c. It's possible for me she's going to Rome.

This raises the intriguing question of why predicates like *sicher sein* 'be certain' can embed *ob*-clauses in negative contexts, while predicates like *glauben* 'believe' and *möglich sein* 'be possible' cannot.

In Sect. 2, two approaches to this issue are briefly presented. The conclusion will be that Öhl's [15] suggestion that the embedding behavior of *be certain* is due to its characteristic of being subjective veridical is not sufficient. To better understand the semantic properties of the *be certain-*, *believe-* and *be possible-*predicates which are discussed in Sect. 4, Sect. 3 introduces the Logical Form of constructions with embedded *ob-*clauses.

# 2 Subjective Veridicality

Adger and Quer [1:109] distinguish between Q(uestion selecting)-predicates like *ask* and P(roposition selecting)-predicates like *tell*. The latter class includes the set of TF (true-false) predicates discussed by Ginzburg [9] like *assume*, *claim* and *maintain*. These predicates, according to Adger and Quer, indicate the subject's epistemic commitment to

the truth or falsity of the embedded proposition. Their semantics is incompatible with that of an *if*-clause [1:125]. According to Adger and Quer, the class of P-predicates also includes predicates like *admit*, *hear*, *say*, *be obvious* and *be clear*, a predicate class the predicates of which embed *if*-clauses in negative but not in affirmative contexts. They are suggested to lack the lexical specification to be incompatible with questions.

With Adger and Quer the following is not clear: there's no reason why *be certain* predicates shouldn't be TF predicates in affirmative contexts. Why then can they embed *ob*-questions in negative contexts? Öhl [15] encounters a similar problem. He adapts Giannakidou's [8] concept of subjectively veridical predicates, which is briefly summarized here for the purposes of the paper.

- (12) Veridicality and Nonveridically (Definition 1 in Giannakidou [7]) a. A propositional operator F is veridical iff Fp entails or presupposes that p is true in some individual's model M (i). P is true in M (i) iff M (i)  $\subseteq$ p, i.e. if all worlds in M (i) are p-worlds.
  - b. Otherwise, F is nonveridical.

#### Epistemic model of an individual i

An epistemic model  $M(i) \in M$  is a set of worlds associated with an individual *i* representing worlds compatible with what *i* believes or knows.

#### *Truth in an epistemic model* (= full commitment)

A proposition p is true in an epistemic model M (i) iff M (i)  $\subseteq$  p:  $\forall w [w \in M (i) \rightarrow w \in \{w' | p(w')\}]$ .

By replacing "epistemic model M(i)" by "information state W(i)", Giannakidou can distinguish between *veridical*, *antiveridical* and *nonveridical* information states and ultimately between *veridical*, *antiveridical* and *nonveridical* propositional operators. Unbiased questions, so Giannakidou, convey typical nonveridical information states.

- (13) (Non)veridicality and (Non)homogeneity (Definition 3 in Giannakidou [8])
  - a. An information state (a set of worlds) W(i) relative to an epistemic agent *i* is *veridical* with respect to a proposition *p* iff all worlds in W(i) are *p*-worlds. (*Positively homogeneous state*).
  - b. An information state W(i) relative to an epistemic agent *i* is *antiveridical* with respect to a proposition *p* iff all worlds in W(i) are  $\neg p$ -worlds. (Negatively homogeneous state).
  - c. An information state W(i) relative to an epistemic agent *i* is *nonveridical* with respect to a proposition *p* iff W(i) is partitioned into *p* and  $\neg p$ -worlds. (*Nonhomogeneous state*).

Öhl makes the property of subjective veridicality responsible for the ability of predicates like *be clear* or *be certain* to embed *if*-clauses. However, if one takes into account predicates such as *accept* and *believe* that are subjectively veridical according to (12) and that do not allow questions in negative contexts, one quickly sees that this property is not sufficient. The following will show that predicates such as *be clear* and *be certain*, which are subjectively veridical in affirmative contexts, are able to convey nonveridical

information states in negative contexts. Predicates like *be possible* are not able to do this. Although they are nonveridical in affirmative contexts, they cannot connect with questions. The reason for this results from the Logical Form of constructions with responsive predicates and *ob*-clauses. It will also be shown why predicates like *believe*, when they occur in negative contexts, are not able to convey nonveridical states.

## 3 Logical Form of Responsive Ob-Constructions

With regard to the predicate *sicher sein* 'be certain', the initial situation is as follows: On the one hand there is its argument structure as shown in (14) and the embedded question (15). The latter is represented in the manner of Adger and Quer [1] or Hamblin [11], respectively. On the other hand there is the embedding construction (16). How do the predicate and the question come together?

(14) sicher sein 'be certain'
 λp λx λe [certain (p, x, e)]

(15) 
$$\lambda p [p = \sigma \lor p = \neg \sigma]$$
  
 $\lambda p [p = Maria is in Rome \lor p = \neg Maria is in Rome]$ 

(16) Frank ist nicht sicher, ob Maria in Rom ist. 'Frank isn't certain whether M is in Rome.'

F is not certain that M is in R and F is not certain that she is not in R.

 $\forall p \ \forall e \ [\neg (certain (p, f, e) \land (mr = p)) \land \neg (certain (p, f, e) \land (\neg mr = p))]$ abbreviated:  $\neg c_f \sigma \land \neg c_f \neg \sigma$ 

Adapting Adger and Quer's [1] Logical Form of constructions with unselected *if*-clauses, we suggest a polarity sensitive operator (17i) that takes the *ob*-clause (15), thus yielding the Operator Phrase (17ii). The latter, on its part, applies to an objective or polarity sensitive matrix predicate (14) and creates (17iii). If (17iii) is combined with the subject and then with the negation operator, the final Logical Form [[NegP]] (17v, vi) obtains.

(17) Frank ist nicht sicher, ob Maria in Rom ist.  
'Frank isn't certain whether M is in Rome.'  
[... not ... 
$$[VP[VP Frank ... [VP[V] [OP O t_{CP}] sicher ist]]] [CP ob M in R ist]]]$$
  
i.  $[[O]] = \lambda R \lambda P_{P \in OVP \cup PSP} \lambda x \exists p \exists e [(P (p, x, e)) \land R (p)]$   
ii.  $[[OP]] = \lambda P_{P \in OVP \cup PSP} \lambda x \exists p \exists e [(P (p, x, e)) \land ((mr = p) \lor (\neg mr = p))]$   
iii.  $[[V']] = \lambda x \exists p \exists e [c (p, x, e) \land ((mr = p) \lor (\neg mr = p))]$   
iv.  $[[VP]] = \exists p \exists e [(c (p, f, e) \land (mr = p)) \lor (c (p, f, e) \land (\neg mr = p))]$   
v.  $[[NegP]] = \neg \exists p \exists e [(c (p, f, e) \land (mr = p)) \lor (c (p, f, e) \land (\neg mr = p))]$   
vi.  $= \forall p \forall e [\neg (c (p, f, e) \land (mr = p)) \land \neg (c (p, f, e) \land (\neg mr = p))]$ 

'F is not certain that M is in Rome and he is not certain that she is not in Rome.'

The equivalent representations (17v, vi) show that there is a disjunction or conjunction of two sentences, both sharing the matrix predicate but differinh with respect to their complementary propositions. This disjunction or conjunction can be regarded as the reduction of the structure 'Frank is not certain if Maria is in Rome'. Additionally, this operator existentially binds the variable *p* contributed by the question and the predicate as well as the eventuality variable *e* provided by the verb.

# 4 Intranegative Opposites

As shown in 2, Ohl [15] sees the subjective veridicality of predicates like sicher sein 'be certain' as the only reason for their ability to embed *ob*-clauses in a polarity environment. It was also pointed out that this condition cannot be sufficient since glauben 'believe' is subjectively veridical too but is always incompatible with ob-clauses. This section examines why among the subjectively epistemic predicates like sicher sein 'be certain' and glauben 'believe' only predicates like sicher sein embed *ob*-clauses in polarity contexts. Predicates like *sicher sein* will be defined as contrary positive intranegative opposites. It will be suggested that these predicates can embed *ob*-clauses in a polarity context because this context turns them into subjectively nonveridical predicates. It will be shown that glauben 'believe' in a question context does not become subjectively nonveridical when negated. It will be defined as a complementary intranegative opposite. Finally, it will be questioned why predicates like *möglich sein* 'be possible', which are originally subjectively nonveridical, cannot embed *ob*-clauses. It will turn out that a subjectively epistemic predicate embeds an *ob*clause only if it is subjectively nonveridical in a polarity context. This condition is fulfilled for sicher sein 'be certain' but not for glauben and möglich sein.

#### 4.1 Positive Contrary Intranegative Opposites: The Be Certain Case

If an individual  $\alpha$  addresses a question like *Is Maria in Rome*? {mr,  $\neg$ mr} to an individual  $\beta$ , then  $\alpha$  believes that  $\beta$  knows that Maria is in Rome or that  $\beta$  knows that Maria is not in Rome. If  $\beta$  doesn't know if Maria is in Rome but is willing to react to the question, he or she can do so – depending on his or her epistemic attitude – by means of a predicate like *sicher sein* 'be certain'. This can be reported by expressions as given in (18a-e):

(18)	a.	Frank ist sicher, dass Maria in Rom ist. 'Frank is certain that Maria is in Rome.'	c <sub>f</sub> mr
	b.	Frank ist sicher, dass Maria nicht in Rom ist.	c <sub>f</sub> →mr
	c.	Frank ist nicht sicher, dass Maria in Rom ist.	¬c <sub>f</sub> mr
	d.	Frank ist nicht sicher, dass Maria nicht in Rom ist.	$\neg c_f \neg mr$
	e.	Frank ist nicht sicher, ob Maria in Rom ist. 'Frank isn't certain whether Maria is in Rome.'	$\neg c_f mr \land \neg c_f \neg mr$

The Logical Form for (18e) is given in Sect. 3 - cf. (17v, vi). It consists of the disjunction of two complex propositions, both sharing the matrix predicate and differing in their complementary embedded propositions. The complementarity of the embedded propositions contributes to the fact that *sicher sein* 'be certain' is intranegative when it embeds an *ob*-clause. All complex propositions as given with (18a-e) represent epistemic states of Frank. The relationships between all these states can be visualized with the help of the Figs. 1 and 2. Figure 1 shows two inverse epistemic scales, one hosting Frank's epistemic evaluation grades for  $\sigma$  and the other one with his epistemic evaluation grades for  $\neg \sigma$ . At the rightmost pole of the  $\sigma$ -scale, there is 'Frank knows that Maria is in Rome' or kn<sub>f</sub>  $\sigma$ , just followed by c<sub>f</sub>  $\sigma$ . And at the leftmost pole of the  $\neg \sigma$ -scale, there is kn<sub>f</sub>  $\neg \sigma$  and c<sub>f</sub>  $\sigma$  and c<sub>f</sub>  $\sigma$ . The converse is also true: the degrees kn<sub>f</sub>  $\neg \sigma$  and c<sub>f</sub>  $\neg \sigma$  are also followed by their negations.



Fig. 1. Epistemic scales: sicher sein 'be certain'

Figure 1 illustrates that the negation phases  $\neg c_f \sigma$  and  $\neg c_f \neg \sigma$  overlap. It is important to underline that the overlaps involve other epistemic attitudes of the epistemic subject towards  $\sigma$  and  $\neg \sigma$ . This is just the case that is denoted by expressions like *Frank ist nicht sicher, ob Maria in Rom ist* 'Frank isn't certain whether Maria is in Rome'. Such an expression is compatible, as we will see below, with *Frank hält es für möglich, dass Maria in Rom ist*. 'Frank considers it possible that Maria is in Rome'.



Fig. 2. Epistemic square of sicher sein 'be certain'

Figure 2 shows *i*. that  $c_f \sigma$  and  $\neg c_f \sigma$ , on the one hand, and  $c_f \neg \sigma$  and  $\neg c_f \neg \sigma$ , on the other, are negatives of each other,<sup>1</sup> *ii*. that  $c_f \neg \sigma$  and  $c_f \sigma$  are incompatible, and *iii*. that  $\neg c_f \sigma$  and  $\neg c_f \neg \sigma$  are compatible. It follows from the incompatibility of  $c_f \sigma$  and  $c_f \neg \sigma$  that  $c_f \sigma$  entails  $\neg c_f \neg \sigma$  and that  $c_f \neg \sigma$  entails  $\neg c_f \sigma$ . With these terminological clarifications it is now possible to define the notion positive contrary intranegative opposite.<sup>2</sup>

**Definition 1: positive contrary intranegative opposites.** Let q and q' be operators with a predicate type argument. Let the predicate domains of q and q' be such that q yields a truth value for a predicate expression  $\sigma$  iff q' yields a truth value for the negative opposite of  $\sigma$ . q and q' are *positive contrary intranegative opposites* to each other iff: for any predicate expressions  $\sigma$  or  $\sigma'$  eligible as operands of q and q': if  $\sigma$  NEG  $\sigma'$ , then q $\sigma$  INCOMP q' $\sigma'$  and  $\neg q\sigma$  COMP  $\neg q'\sigma'$ .

The property to be a contrary positive intranegative opposite that becomes nonveridical in the scope of a nonveridical operator enables predicates like *sicher sein* 'be certain' to embed *ob*-clauses. Something similar can be shown for objectiveveridical predicates like *wissen* 'know'. And it's certainly not hard to show even for *forsee-* and *determine-*predicates that they are positive intranegative opposites.

As we will see in the subsequent sections, *glauben* 'believe' and *möglich sein* 'be possible' do not meet the condition of being a contrary positive intranegative opposite.

#### 4.2 Complementary Intranegative Opposites: The Believe Case

This paragraph seeks to examine why a predicate like *glauben* 'believe' does not accept an *ob*-clause if it is in the scope of a nonveridical operator. This is a quite pertinent question because *glauben* is subjectively veridical just as *sicher sein* 'be certain' is. The reason why *glauben* fails is that it is a complementary intranegative opposite and not a contrary one like *sicher sein* 'be certain'. What does this mean and entail?

Similar to *sicher sein* 'be certain', *glauben* 'believe' is related to two epistemic states:  $b_f \sigma$  and  $b_f \neg \sigma$  as well as their negations  $\neg b_f \sigma$  and  $\neg b_f \neg \sigma$ .



Fig. 3. Epistemic scales: glauben 'believe'

 $<sup>\</sup>frac{1}{c_f \sigma}$  and  $-c_f \sigma$  are negatives of each other because they yield opposite truth values – cf. Löbner [14:485].

<sup>&</sup>lt;sup>2</sup> The formulation of the following definition is based on that of Löbner [14:486] for dual operators.

A comparison between Figs. 1 and 3 reveals that  $\neg b_f \sigma$  and  $\neg b_f \neg \sigma$  do not overlap unlike  $\neg c_f \sigma$  and  $\neg c_f \neg \sigma$  did. The reason for this is that in the context of the question  $\{\sigma, \neg\sigma\}$ , the epistemic subject either believes  $\sigma$  or  $\neg\sigma$ , which means that  $\neg b_f \sigma$  and  $\neg b_f \neg \sigma$  are mutually exclusive. Similar to the negative *be certain*-states  $\neg c_f \sigma$ ,  $\neg c_f \neg \sigma$ and  $\neg c_f \sigma \land \neg c_f \neg \sigma$ ,  $\neg b_f \sigma$  and  $\neg b_f \neg \sigma$  involve other epistemic attitudes of Frank towards  $\sigma$  and  $\neg \sigma$ .

As shown in Fig. 4,  $b_f \sigma$  and  $b_f \neg \sigma$  on the one hand, and  $\neg b_f \sigma$  and  $\neg b_f \neg \sigma$ , on the other, are incompatible or yield opposite truth values. In terms of Löbner [14:485], they are in a negative relation NEG to each other. As for *sicher sein* 'be certain', recall that  $c_f \sigma$  and  $c_f \neg \sigma$  were incompatible and  $\neg c_f \sigma$  and  $\neg c_f \neg \sigma$  were compatible.



Fig. 4. Epistemic square: glauben 'believe'

Figure 4 and (19) show that the negativity relation of  $b_f \sigma$  and  $b_f \neg \sigma$  entails that  $\neg b_f \sigma$  and  $b_f \neg \sigma$  are equivalent. The same applies for  $b_f \sigma$  and  $\neg b_f \neg \sigma$ .

$$\begin{array}{ll} (19) & \left[ (b_{\rm f} \, \sigma \lor b_{\rm f} \neg \sigma) \land \neg (b_{\rm f} \, \sigma \land b_{\rm f} \neg \sigma) \right] & \Leftrightarrow \\ & \left[ (b_{\rm f} \, \sigma \lor b_{\rm f} \neg \sigma) \land (\neg b_{\rm f} \, \sigma \lor \neg b_{\rm f} \neg \sigma) \right] & \Leftrightarrow \\ & \left[ (\neg b_{\rm f} \, \sigma \Rightarrow b_{\rm f} \neg \sigma) \land (b_{\rm f} \, \sigma \Rightarrow \neg b_{\rm f} \neg \sigma) \right] & \Leftrightarrow \\ & \left[ (\neg b_{\rm f} \, \neg \sigma \Rightarrow b_{\rm f} \, \sigma) \land (b_{\rm f} \, \neg \sigma \Rightarrow \neg b_{\rm f} \, \sigma) \right] & \Leftrightarrow \\ & \left[ (\neg b_{\rm f} \, \sigma \Leftrightarrow b_{\rm f} \neg \sigma) \land (b_{\rm f} \, \sigma \Leftrightarrow \neg b_{\rm f} \, \neg \sigma) \right] & \Leftrightarrow \end{array}$$

Provided that  $\neg b_f \sigma$  and  $b_f \neg \sigma$  are equivalent, the disjunction ' $b_f \sigma \lor b_f \neg \sigma'$ , which would result if *glauben* 'believe' embedded an *ob*-clause, is tautological. It should be emphasized that the equivalence relationships presuppose that the matrix subject believes either  $\sigma$  or  $\neg \sigma$  in a question-under-discussion context. We will return to this issue in Sect. 4.6. First, however, we want to define what is meant by a "complementary intranegative opposite".

**Definition 2: complementary intranegative opposites.** Let q and q' be operators with a p-type argument. Let the p-domains of q and q' be such that q yields a truth value for a predicate expression  $\sigma$  iff q' yields a truth value for the negative opposite of  $\sigma$ . q and q' are *complementary intranegative opposites* or *intranegative negatives* iff: for any p-expressions  $\sigma$  or  $\sigma'$  eligible as operands of q and q': if  $\sigma$  NEG  $\sigma'$ , then  $q\sigma$  NEG  $q'\sigma'$ .

This complementarity property applies, for instance, for *denken* 'think', *erwarten* 'expect', *hoffen* 'hope', *meinen* 'think', *wollen* 'want' and *wahrscheinlich sein* 

<sup>&</sup>lt;sup>3</sup> This definition corresponds to Löbner's [14:486] definition of dual opposites.

'be likely'. Whereas wahrscheinlich sein is always a complementary intranegative opposite, predicates like glauben 'believe', hoffen 'hope', meinen 'think', denken 'think' and wollen 'want' have this property only in question-under-discussion contexts. This property prevents the just mentioned predicates from embedding ob-clauses in the scope of a nonveridical operator. Let us remember, for a subjectively veridical predicate it is necessary to be subjectively nonveridical when taking an ob-clause. Predicates like sicher sein 'be certain' become nonveridical if they are in the scope of a nonveridical operator. The negated disjunction ' $\neg$  (c<sub>f</sub>  $\sigma \lor c_f \neg \sigma$ )' they form when combined with a question and a nonveridical operator is well-formed because  $\neg c_f \sigma$ and  $\neg c_f \neg \sigma$  are compatible. Imagine a predicate like *glauben* 'believe' combined with a question and being negated. The resulting negated disjunction  $\neg$  (b<sub>f</sub>  $\sigma \lor b_f \neg \sigma$ ) would be inadmissible. The reason for this is that the negated disjunction would contradict the condition that  $b_f \sigma$  and  $b_f \neg \sigma$  are disjoint and incompatible or in a NEG-relationship or complementary, respectively – see Fig. 4. Another reason is that, assuming that  $\neg b_f \sigma$ and  $b_f \neg \sigma$  are equivalent, the contradiction ' $\neg b_f \sigma \land b_f \sigma$ ' would result. In the next section, we will see why a nonverdical predicate like *möglich sein* 'be possible' cannot combine with a question and a nonveridical operator.

#### 4.3 Negative Contrary Intranegative Opposites: The Be Possible Case

As already mentioned above, a predicate like *möglich sein* 'be possible' never embeds *ob*-clauses. The predicates  $poss_f \sigma$  and  $poss_f \neg \sigma$  are subjectively nonveridical while their negatives are antiveridical in terms of Giannakidou [8]. The subjectively nonveridical  $poss_f \sigma$  and  $poss_f \neg \sigma$  enable an overlap as illustrated in Fig. 5.



Fig. 5. Epistemic scales: sicher sein 'be certain', möglich sein 'be possible'

Figure 6 below shows the compatibility properties of *möglich sein* 'be possible'. It illustrates that the positive intranegatives  $poss_f \sigma$  and  $poss_f \neg \sigma$  are compatible, unlike the positive intranegatives  $c_f \sigma$  and  $c_f \neg \sigma$  and that the negative intranegatives  $\neg poss_f \sigma$  and  $\neg poss_f \neg \sigma$  are incompatible.

It follows from the incompatibility of  $\neg poss_f \sigma$  and  $\neg poss_f \neg \sigma$  that  $\neg poss_f \sigma$  entails  $poss_f \neg \sigma$  and that  $\neg poss_f \neg \sigma$  entails  $poss_f \sigma$ . The definition of a contrary negative intranegative opposite is as follows:



Fig. 6. Epistemic square: möglich sein 'be possible'

**Definition 3: contrary negative intranegative opposites.** Let q and q' be operators with a predicate type argument. Let the predicate domains of q and q' be such that q yields a truth value for a predicate expression  $\sigma$  iff q' yields a truth value for the negative opposite of  $\sigma$ . q and q' are *contrary negative intranegative opposites* to each other iff: for any predicate expressions  $\sigma$  or  $\sigma'$  eligible as operands of q and q': if  $\sigma$  NEG  $\sigma'$ , then q $\sigma$  COMP q' $\sigma'$  and  $\neg q\sigma$  INCOMP  $\neg q'\sigma'$ .

The compatibility properties of *sicher sein* 'be certain', *glauben* 'believe' and *möglich sein* 'be possible' specified in the individual definitions can be formulated as the following syntactically relevant compatibility restrictions.

- (20) a. sicher sein 'be certain':  $\neg (c_{\alpha} \sigma \wedge c_{\alpha} \neg \sigma)$ b. glauben 'believe':  $(b_{\alpha} \sigma \vee b_{\alpha} \neg \sigma) \wedge \neg (b_{\alpha} \sigma \wedge b_{\alpha} \sigma \neg \sigma)$ 
  - c. *möglich sein* 'be possible':  $(p_{\alpha} \sigma \lor p_{\alpha} \neg \sigma)$

The compatibility restriction of *sicher sein* 'be certain' does not exclude the combination  $\neg c_{\alpha} \sigma \land \neg c_{\alpha} \neg \sigma$  which is the Logical Form of *Frank is not certain if Maria is in Rome.* And the compatibility restriction of *möglich sein* 'be possible' does not exclude the combination  $p_{\alpha} \sigma \land p_{\alpha} \neg \sigma$ .

Figures 5 and 7 reveal that the sentences *Frank is certain that Maria is in Rome* and *It is not possible for Frank that Maria is not in Rome* are equivalent.<sup>4</sup> If you take the epistemic squares of *be certain* and *be possible* and rotate the square of *be possible* horizontally by 180°, you get the following picture:



Fig. 7. Epistemic squares: sicher sein 'be certain', möglich sein 'be possible'

The equivalence of  $\neg c_f \sigma \land \neg c_f \neg \sigma'$  and  $\neg poss_f \sigma \land poss_f \neg \sigma'$  raises the question of why *be certain* allows question embedding in a polarity context and *be possible* does

<sup>&</sup>lt;sup>4</sup> Löbner [14:494] demonstrates that *be certain* is the dual of *be possible*. The duality relationship implies that  $c_f \sigma$  and  $\neg p_f \neg \sigma$  are equivalent. Horn [12:325) points out that  $\neg c_f \sigma$  and  $p_f \neg \sigma$  are equivalent.

not. The reason for this can be found by combining the question *if Maria is in Rome* with the matrix predicates *sicher sein* 'be certain' and *möglich sein* 'be possible' – cf. the derivation (17) of *sicher sein* in Sect. 3.

(21) 
$$\llbracket VP \rrbracket = \exists p \exists e [((cert (p, f, e)) \land (mr = p)) \lor ((cert (p, f, e)) \land (\neg mr = p))]$$
  

$$c_{f} \sigma \lor c_{f} \neg \sigma$$
  
(22) 
$$\llbracket VP \rrbracket = \exists p \exists e [((poss (p, f, e)) \land (mr = p)) \lor ((poss (p, f, e)) \land (\neg mr = p))]$$
  

$$poss_{f} \sigma \lor poss_{f} \neg \sigma$$

Sentences with Logical Forms like (21) and (22) prohibit themselves for pragmatic reasons. A question embedding would simply be trivial. However, while (21) can be saved by negation as we have seen in Sect. 3, this is not possible with (22). The reason for this is is simply the compatibility restriction of *be possible*, which cannot be negated. That is,  $\neg poss_f \sigma$  and  $\neg poss_f \neg \sigma$  is always excluded, which implies that *möglich sein* 'be possible' cannot be polarity sensitive and thus, unlike *sicher sein* 'be certain', not copatible with questions – cf. (17).

#### 4.4 Implications and Horn-Scales

Figure 8 summarizes the relationship of *wissen* 'know', *sicher sein* 'be certain', *glauben* 'believe' and *möglich* sein 'be possible' to the epistemic scales. It illustrates the possible equivalences and implications and the strength of the implicative potential.



Fig. 8. Epistemic scales: wissen 'know', sicher sein 'be certain', glauben 'believe', möglich sein 'be possible'

Both  $\neg kn_f \sigma$  and  $\neg kn_f \neg \sigma$  as well as  $\neg c_f \sigma$  and  $\neg c_f \neg \sigma$  overlap. The same is true for  $p_f \sigma$  and  $p_f \neg \sigma$ . The predicates involved are subjectively nonveridical. *Glauben* 'believe' doesn't allow such overlaps provided it is used in a question under discussion context. From the previous section, we know that only the overlaps formed by negated predicates, that is, by subjectively nonveridical predicates, are compatible with *ob*-clauses.

The subjectively nonveridical predicates  $\neg c_f \sigma$  and  $\neg c_f \neg \sigma$  as well as their equivalent pendants  $p_f \neg \sigma$  and  $p_f \sigma$  allow only one implication each. That is, both  $\neg c_f \sigma$  and  $p_f \neg \sigma$  imply  $\neg kn_f \sigma$ . And  $\neg c_f \neg \sigma$  and  $p_f \sigma$  entail  $\neg kn_f \neg \sigma$ . These predicates can be described as small implication triggers. In comparison, the complementary subjectively veridical *glauben* 'believe' is a medium implication trigger because  $b_f \sigma$  implies  $\neg c_f \neg \sigma$ , which in turn implies  $\neg kn_f \neg \sigma$ . And  $b_f \neg \sigma$  implies  $\neg c_f \sigma$  which implies  $\neg kn_f \sigma$ . The subjectively veridical predicates  $c_f \sigma$  and  $c_f \neg \sigma$  and their equivalent antiveridical pendants  $\neg p_f \sigma$  are large implication triggers since each of them allows three implications. Thus,  $c_f \sigma$  or  $\neg p_f \neg \sigma$  entails  $b_f \sigma$ , which in turn entails  $p_f \sigma$  and  $\neg kn_f \neg \sigma$ . And  $c_f \neg \sigma$  or  $\neg p_f \sigma$ , respectively, implies  $\neg b_f \sigma$  which implies  $\neg c_f \sigma$  and  $\neg kn_f \sigma$ .

The division into small, medium and large predicates corresponds to that of Horn [12:325] into weak, middle and strong predicates. He places these predicates on two vertical scales. One scale is for positive verbs like *be certain*, *be likely* and *be possible*, the other is for their negatives. The weak verbs are at the bottom of each scale. Instead of *believe* Horn has *be likely* as a medium verb. The reason for this is that he, contrary to what is assumed here, does not consider  $b_f \sigma$  and  $b_f \neg \sigma$  to be disjunctive – cf. (20b). Figure 9 shows a version of Horn's [12] scales slightly adapted to this paper. Horn's predicates are indicated by indices, as are the ones discussed by Löbner.



Fig. 9. Slightly adapted Horn Scales

It is easy to see that Horn's positive predicates of the left scale have negative equivalents and that his negative predicates of the right scale have positive equivalents. At the top of the scales are the contrary, subjectively veridical  $c_f \sigma$  and  $c_f \neg \sigma$  as well as their equivalent antiveridical pendants  $\neg p_f \neg \sigma$  and  $\neg p_f \sigma$ . Their veridicality or antiveridicality, respectively, prevents them from embedding *ob*-clauses. The medium predicates are in the middle of each scale. They include  $l_f \sigma$  as well as  $\neg l_f \sigma$  according

to Horn but also  $b_f \sigma$  as well as  $\neg b_f \sigma$  according to Löbner and this paper. The weak predicates *möglich sein* 'be possible' and *nicht sicher sein* 'not be certain' are at the bottom of the scales. Both are, as we have seen in the previous sections, nonveridical. That is, the truth values of their embedded propositions  $\sigma$  or  $\neg \sigma$  are not decided. This indecisiveness is a prerequisite for a question. However, we know that only *nicht sicher sein* can embed an *ob*-clause. *Möglich sein* 'be possible' fails because a sentence with it and an *ob*-clause is uninformative and it becomes antiveridical if it is negated.

### 4.5 Lexical Opposites and Their Intranegative Opposites

So far, we have been dealing with contrary and complementary intranegative opposites like, *be certain, be possible* and *believe* that have the syntactically formed negatives *not be certain, not be possible* and *not believe*. Apart from these, there are also lexical opposites. So we distinguish between lexically complementary opposites (LC) like *certain* and *uncertain*, on the one hand, and lexically contrary opposites like *deny* and *confirm* (Lc). As far as the LC-opposites are concerned, there are those who have complementary intranegative opposites (LCC) and those whose intranegative opposites are contrary (LCC). Lc-opposites always have contrary intranegative opposites (Lcc).

**LCC.** Lexical complementary opposites with complementary intranegative opposites are *wahr sein* 'be true' and *falsch sein* 'be false' as well as *wahrscheinlich sein* 'be likely' and *unwahrscheinlich sein* 'be unlikely'. They are not interesting for our purposes, as they do not allow the embedding of questions. Why don't they do this? Let's look at the opposites *wahr sein* 'be true' and *falsch sein* 'be false'. Both are in a NEG-relation to each other because false<sub>f</sub>  $\sigma$  is equivalent to  $\neg$ true<sub>f</sub>  $\sigma$ . Just as with *believe*,  $\neg$ true<sub>f</sub>  $\sigma$  and  $\neg$ true<sub>f</sub>  $\neg \sigma$  as well as false<sub>f</sub>  $\sigma$  and false<sub>f</sub>  $\neg \sigma$  are in a NEG-relation to each other. However, as we have seen in Sect. 4.1, the embedding of an *ob*-clause requires predicates that are contrary positive intranegative opposites. It is obvious that LCC verbs do not meet this condition.

LCc. Lexical complementary opposites with contrary intranegative opposites include, for instance, *erinnern* 'recall' and *vergessen* 'forget', *sicher sein* 'be certain' and *unsicher sein* 'be uncertain' as well as *zeigen* 'show' and *verbergen* 'conceal'. Predicates like *vergessen* 'forget', *unsicher sein* 'be uncertain', and *verbergen* 'conceal' belong to the predicate class we called inherently negative predicates in Sect. 1. They all embed *ob*-clauses like their negated opposites *nicht erinnern* 'not recall' and *nicht zeigen* 'not show', and *nicht sicher sein* 'not be certain' cf. (23a, b).

- (23) a. Frank hat vergessen, ob er einen Pass besitzt. ( $f_f \sigma$ ) 'Frank forgot if he had a passport.'
  - b. Frank kann sich nicht erinnern, ob er einen Pass besitzt.  $(r_f \sigma)$ 'Frank can't remember if he has a passport.'

The compatibility restrictions of *erinnern* 'recall' and *vergessen* 'forget' in (24a, b) as well as Fig. 10 illustrate that *erinnern* is a positive contrary intranegative opposite like *sicher sein* 'be certain' and that *vergessen* is a contrary negative intranegative opposite like *möglich sein* 'be possible' – cf. (20a, c).

(24) a. erinnern 'recall':  $\neg (r_{f} \sigma \wedge r_{f} \neg \sigma)$ sicher sein 'be certain':  $\neg (c_{\alpha} \sigma \wedge c_{\alpha} \neg \sigma)$ b. vergessen 'forget':  $(f_{f} \sigma \vee f_{f} \neg \sigma)$ möglich sein 'be possible':  $(p_{\alpha} \sigma \vee p_{\alpha} \neg \sigma)$ 



Fig. 10. epistemic squares: sich erinnern 'remember' and vergessen 'forget'

As for the epistemic square of *forget* in Fig. 11, its original rectangle is rotated 180° vertically.



Fig. 11. Epistemic squares: sich erinnern 'remember' and vergessen 'forget'

Unlike *möglich sein* 'be possible', *vergessen* can embed an *ob*-clause – cf. (23a). The reason for this is that it is inherently negative.

Lcc. There are a few lexical contrary opposites with contrary intranegative opposites in German. They include the epistemic predicates *bestätigen* 'confirm' and *dementieren* 'deny' or *widerlegen* 'deny' – see (25a, b). And we also find these contrary predicates with respect to *concern*-predicates like *helfen* 'help' and *schaden* 'harm' or *begeistern* 'impress' or *stören* 'bother'. As shown in (25a, b), lexical contrary opposites can be conjoined in a nonveridical context.

- (25) a. ¬conf<sub>f</sub> σ ∧ ¬deny<sub>f</sub> σ
   Die Bankgesellschaft wollte am Sonntag weder bestätigen noch dementieren, dass der Vorstand Feddersen … mit einem Mandat betraut habe. DWDS BZ 2001
   'On Sunday, the bank company neither wanted to confirm nor deny that the board had entrusted Feddersen with a mandate ….'
  - b. ¬conf<sub>f</sub>¬σ ∧ ¬deny<sub>f</sub>¬σ
    Doch wollte man bei dem Unternehmen weder bestätigen noch dementieren, dass die Kreditlinien ... nicht verlängert werden sollen. DWDS TS 2002
    'However, the company neither wanted to confirm nor deny that the credit lines ... were not to be extended.'

(26a, b) illustrate that the verbs, taken alone, are exactly like *sicher sein* 'be certain' positive contrary intranegative opposites. Therefore, they can embed *ob*-clauses.

- (26) a. ¬conf<sub>f</sub> σ ∧ ¬conf<sub>f</sub> ¬σ
   Er muss dann bestätigen, ob er diese Dienste weiter nutzen oder diese Nummern sperren lassen will. ZDB 24083: DWDS TS 2003
   'He must then confirm whether he wants to continue using these services or have these numbers blocked.'
  - b. ¬denyf σ ∧ ¬denyf ¬σ
    Als sogar Helmut Kohl nicht ganz eindeutig dementierte, ob er ... im Waldspaziergang nun ein "akzeptables Ergebnis" erkenne, war höchste Alarmstufe erreicht: ... ZDB 25511: DWDS Zeit 1983
    'When even Helmut Kohl did not quite clearly deny whether ... he recognized an "acceptable result" during the walk in the woods, the highest alarm level was reached: ...

As shown in (27a, b) to (29) and Figs. 12 and 13 below, lexical contrary predicates can embed *ob*-clauses when they seem coordinated.

- (27) a. Bracht wollte nicht *bestätigen*, aber auch nicht *dementieren*, ob die Bürgschaft .... beim DFB angekommen sei. ZDB 3004: DWDS BZ 1994
   'B neither wanted to confirm nor to deny whether the DFB received the security.'
  - b. ..., weder begeistert noch stört es mich, ob Palin aus religiösen Gründen eine Abtreibung ablehnt ... ZDB 24121: DWDS Zeit 2008
    'It neither thrills nor does it disturb me whether Palin opposes abortion for religious reasons.'

At this point, we only discuss structures like (27a). Its rough syntactic representation (28) shows the conjunction of two complex sentences where the embedded *ob*-clauses are raised to the right and the subject in the second conjunct is elided. (28) Frank hat nicht bestätigt, und nicht dementiert, ob Maria in Rom ist.
 'Frank didn't confirm, and didn't deny, whether Maria is in Rome.'
 [ConjP [ConjP [CP1 Frank ... [NegP ... nicht [VP tFrank ... [v [ORP tCP] bestätigt]]]]
 [Conj<sup>T</sup> und [CP2 Frank ... [NegP ... nicht [VP tFrank ... [v [ORP tCP] dementiert]]]]]
 [CP ob Maria in Rom ist]]

The derivation of the Logical Form of (28) takes place in a similar way as the derivation of the Logical Form of 'Frank is not certain whether Maria is in Rome.' – see (17).

 $\begin{array}{ll} (29) & \forall p \; \forall e \; [[\neg \; (confirm \; (p, \, f, \, e)) \land (mr = p)] \land [\neg \; (confirm \; (p, \, f, \, e)) \land (\neg mr = p)] \\ & \land [\neg \; (deny \; (p, \, f, \, e)) \land (mr = p)] \land [\neg \; (deny \; (p, \, f, \, e)) \land (\neg mr = p)]] \\ & ((F \; has \; not \; confirmed \; that \; mr) \; and (F \; has \; not \; confirmed \; that \; not \; mr)) \; and \\ & ((F \; has \; not \; denied \; that \; mr) \; and (F \; has \; not \; denied \; that \; not \; mr)) \\ & (\neg conf_f mr \land \neg conf_f \neg mr) \land (\neg deny_f mr \land \neg deny_f \neg mr) \end{array}$ 

Figure 12 illustrates the four descriptions of response events as well as the overlaps of their negations enabled by *confirm* and *deny*.



Fig. 12. Epistemic scales: bestätigen 'confirm' and dementieren 'deny'

Figure 12 illustrates that the following propositions are each equivalent to one another:  $conf_f \sigma$  and  $deny_f \neg \sigma$ ,  $deny_f \sigma$  and  $conf_f \neg \sigma$ ,  $\neg deny_f \sigma$  and  $\neg conf_f \neg \sigma$ , as well as  $\neg conf_f \sigma$  and  $\neg deny_f \sigma$ . There are eight compatible combinations: *i*.  $\neg conf_f \sigma \land \neg conf_f \neg \sigma$ , *ii*.  $\neg deny_f \sigma \land \neg deny_f \neg \sigma$ , *iii*.  $\neg conf_f \sigma \land \neg deny_f \sigma$ , *iv*.  $\neg conf_f \neg \sigma \land \neg deny_f \neg \sigma$ , *v*.  $\neg conf_f \sigma \land \neg deny_f \neg \sigma$ , *vi*.  $\neg conf_f \neg \sigma \land \neg deny_f \sigma$ , and *vii*.  $\neg conf_f \sigma \land \neg deny_f \neg \sigma \land \neg deny_f \sigma \land \neg deny_f \sigma \land \neg deny_f \sigma \land \neg deny_f \neg \sigma$ . The last combination corresponds to the Logical Form (29). All combinations are equivalent because  $conf_f \sigma$  and  $deny_f \neg \sigma$  are equivalent. And they are all exemplified in the ZAS database. As to the epistemic square of *deny* in Fig. 13, its original rectangle is rotated 180° horizontally and vertically.



Fig. 13. Epistemic squares: bestätigen 'confirm' and dementieren 'deny'

What distinguishes the individual combinations? Let us begin with *vii*. Its Logical Form (29) is pleonastic, considering that  $conf_f \sigma$  and  $deny_f \neg \sigma$  are equivalent. However, a glance at the syntactic structure (28) shows that it contains two negated different contrary opposites which can be contrasted. Furthermore, the truth value of  $\sigma$  is not fixed. The different contrary opposites distinguish *vii* from *i* and *ii* – cf. (25a, b). The unspecified truth value differentiates it from *iii* and *iv* – cf. (26a, b). The combinations *v* and *vi* are not exemplified because each is tautological in itself.

#### 4.6 Additions to the Believe-Case

**Apparent Equivalence.** Section 4.2 showed that  $b_f \sigma$  and  $b_f \neg \sigma$  are complementary intranegative opposites in question-under-discussion contexts because  $b_f \sigma$  and  $b_f \neg \sigma$  as well as  $\neg b_f \sigma$  and  $\neg b_f \neg \sigma$  are incompatible in these contexts. *Glauben* thus has the compatibility properties ( $b_f \sigma \lor b_f \neg \sigma$ )  $\land \neg (b_f \sigma \land b_f \neg \sigma)$  from which it follows that  $\neg b_f \sigma$  and  $b_f \neg \sigma$  are equivalent. Assuming an Excluded Middle (EM) as a pragmatic presupposition, Bartsch [2] shows that the equivalence of  $b_f \neg \sigma$  and  $\neg b_f \sigma$  follows from  $b_f \sigma \lor b_f \neg \sigma$  and  $\neg b_f \sigma$  to id disjunctive syllogism. Collins and Postal [3:9] call this an "apparent equivalence". However, the compatibility restrictions of *glauben* 'believe' show that the assumption of this disjunctive syllogism is not necessary. The equivalence of  $b_f \neg \sigma$  and  $\neg b_f \sigma$  follows already from the property of *believe* of being a complementary intranegative opposite in a question-under-discussion context.

**Neg-Raising or Equivalence.** There is a broad discussion as to whether  $\neg b_f \sigma$  is syntactically derived from  $b_f \neg \sigma$  via neg-raising or whether  $\neg b_f \sigma$  and  $b_f \neg \sigma$  are generated independently of each other and are linked semantically by an equivalence relationship. According to Crowley [4] and Collins and Postal [3], the approaches can be divided into three classes: the pure syntactic accounts (e.g. Fillmore [5] and possibly Horn [12]), the pure semantic-pragmatic accounts (e.g. Bartsch [2], Gajewski [6, 7]), and the mixed accounts (Collins and Postal [3]). Collins and Postal argue that negraising only makes sense if there is a syntactic reason for it. As for the cases examined in this paper, there were no syntactic reasons for raising the negation element from the embedded to the matrix clause. Additionally, similar to English, there are many constructions in German that can hardly be explained by neg-raising.

- (30) a. Aber es ist eine Illusion zu glauben, dass jemals alle Flächen frei von Kampfmitteln sein werden. DWDS BZ 2001
   'But it's an illusion to believe that all surfaces will ever be free of weaponry.'
  - b. Glauben Sie daran, dass sich jemals etwas zwischen oben und unten, Arm und Reich ändern wird? DWDS Zeit 2008
    'Do you believe that anything will ever change between above and below, rich and poor?'

Especially the polar matrix clause in (30b) seems to be an insurmountable hurdle for the neg-raising approach. This, as well as the fact that there is no syntactic reason to raise the negation element for the above examples, makes neg-raising obsolete.

## 5 Summary

The paper focused on the following questions: Why can subjectively veridical predicates like *sicher sein* 'be certain' embed *ob*-clauses in negative contexts, while subjectively veridical predicates like *glauben* 'believe' cannot? And why can't *möglich sein* 'be possible', which is nonveridical, embed *ob*-questions either?

i. Adapting Adger and Quer's [1] Logical Form of constructions with unselected *if*-clauses, constructions like *Frank isn't certain if Maria is in Rome* are represented as the negated disjunction of two sentences, both sharing the matrix predicate but differing with respect to their complementary propositions:

$$\neg c_f \sigma \land \neg c_f \neg \sigma$$
.

The non-negated disjunctions of all three predicates ' $c_f \sigma \lor c_f \neg \sigma$ ', ' $b_f \sigma \lor b_f \neg \sigma$ ' and ' $p_f \sigma \lor p_f \neg \sigma$ ' cannot be expressed with the help of an *ob*-clause because *be certain, believe* and *be possible* are not objective-veridical.

ii. Predicates like *sicher sein* are regarded as positive contrary intranegative opposites because  $c_{\alpha} \sigma$  and  $c_{\alpha} \neg \sigma$  are incompatible and  $\neg c_{f} \sigma$  and  $\neg c_{f} \neg \sigma$  are compatible. This behavior is summarized with the following compatibility restriction:

$$\neg (c_{\alpha}\sigma \wedge c_{\alpha}\neg\sigma).$$

This restriction does not exclude the combination  $\neg c_{\alpha} \sigma \wedge \neg c_{\alpha} \neg \sigma$  which corresponds to the the Logical Form or *Frank is not certain if Maria is in Rome* – cf. (17). The restriction enables predicates like *be certain* to embed *ob*-clauses in polarity contexts. These contexts turn them into nonveridical predicates.

iii. *Believe* is defined as a complementary intranegative opposite because  $b_{\alpha} \sigma$  and  $b_{\alpha} \neg \sigma$  as well as  $\neg b_{f} \sigma$  and  $\neg b_{f} \neg \sigma$  are incompatible. The negated disjunction  $\neg (b_{\alpha} \sigma \lor b_{\alpha} \neg \sigma)$  would be ruled out by the compatibility restrictions of *believe*:

$$(b_{\alpha}\sigma \lor b_{\alpha}\neg\sigma) \land \neg (b_{\alpha}\sigma \land b_{\alpha}\sigma\neg\sigma).$$

The feature ' $b_{\alpha} \sigma \lor b_{\alpha} \neg \sigma$ ' is equivalent to ' $\neg (\neg b_{\alpha} \sigma \land \neg b_{\alpha} \neg \sigma)$ ', which shows that  $\neg b_{\alpha} \sigma$  and  $\neg b_{\alpha} \neg \sigma$  are incompatible. The compatibility restrictions of *believe* imply that  $b_{\alpha} \neg \sigma$  and  $\neg b_{\alpha} \sigma$  are equivalent. Thus neg-raising – a syntactic derivation with the effect that  $\neg b_{\alpha} \sigma$  implies  $b_{\alpha} \neg \sigma$  – is superfluous. However, the assumption of equivalence is a pragmatic presupposition or implication that always takes place in a question-under-discussion context.

iv. As for *be possible*, it is a negative contrary intranegative opposite. Its compatibility restriction prohibits question embedding since  $\neg p_{\alpha} \sigma$  and  $\neg p_{\alpha} \neg \sigma$  are incompatible:

$$(p_{\alpha}\sigma \vee p_{\alpha}\neg\sigma).$$

- v Due to their implication behavior, predicates like *be certain* and *not be possible* were characterized as strong implication triggers, predicates like *believe* as medium ones and predicates like *not be certain* and *be possible* as weak ones.
- vi. Lexically complementary or contrary intranegative opposites like *recall* and *forget* or *confirm* and *deny* were discussed. The latter can appear coordinated on the surface and embed an *ob*-clause in a nonveridical context because they are contrary opposites. The Logical Form of the coordinated structure is pleonastic, but the syntactic structure allows the expression of contrast.

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