Knowing *whether* and Ignorance Inferences

Mathieu Paillé and Bernhard Schwarz

1. Introduction

The truth conditions of *know whether* reports – statements that feature the matrix predicate *know* embedding a polar question – have not been a matter of controversy (Karttunen 1977, Lewis 1982, Groenendijk & Stokhof 1982). It indeed seems obvious enough, for example, that sentence (1a) is true just in case the agent, Aisha, knows the true answer to the embedded question, that is, just in case either Ben is Canadian and Aisha knows that he is or Ben is not Canadian and Aisha knows that he isn't. Equating knowledge with true belief for simplicity, these truth conditions can be stated as in (1b).[1]

(1)   a.   Aisha knows whether Ben is Canadian.
        b. $(c \wedge B_a c) \vee (\neg c \wedge B_a \neg c)$

What does not seem to have been observed, however, is that negative *know whether* reports such as (2a) are judged to convey more information about the agent's beliefs than received wisdom leads one to expect. Sentence (2a) is expected to merely convey (2b), that is, that Aisha does not know the true answer to the embedded question. But (2a) is actually understood to more specifically convey (2c), that is, that Aisha is unopinionated, or ignorant, about which answer to the embedded question is true. Equivalently, in addition to conveying that Aisha does not know the true answer to the embedded question, the sentence is understood as implying that her beliefs do not entail the false answer, either.

(2)   a.   Aisha doesn't know whether Ben is Canadian.
        b. $\neg((c \wedge B_a c) \vee (\neg c \wedge B_a \neg c))$
        c. $\neg(B_a c \vee B_a \neg c)$

What is the source of such agent ignorance implications? An initially promising clue to pursue is the observation that *know whether* reports, whether affirmative or negative, routinely carry not only implications of agent ignorance, but also of *speaker* ignorance, i.e. the implication that the speaker is ignorant about which answer to the embedded question is true. Typical uses of (1a) and (2a), for example, suggest that the speaker is ignorant about whether or not Ben is Canadian. In discussions of this effect in the literature, it is suggested that this inference arises from pragmatic competition between an embedded polar question and embedded declaratives that express the answers to the question (Eckardt 2007, Egré 2008, Abenina-Adar 2018). This leads one to wonder whether agent ignorance implications, too, can be understood as arising from such competition.

Following this lead, one main objective of our paper is to spell out a possible neo-Gricean analysis of speaker ignorance implications of *know whether* reports as quantity implicatures, and to show that this analysis indeed permits a theoretically parsimonious extension that captures agent ignorance implications as well (sections 3 and 4). Another objective, however, is to show that, surprisingly, this analysis of agent ignorance is incorrect or insufficient. We demonstrate this by noting that agent ignorance inferences are more pervasive than the corresponding speaker ignorance implications, whereas

[1] Key: c := Ben is Canadian; $B_x p$:= x's beliefs entail p; a := Aisha.

the neo-Gricean account would at best be consistent with the opposite pattern (section 5). Establishing this negative result, our paper is an invitation to further investigate the source of ignorance implications of negative *know whether* reports.

To get started, we begin in section 2 by confirming the existence of the ignorance implications under investigation.

2. Ignorance inferences with *know whether*

We have noted that *know whether* reports, affirmative or negative, often suggest that the speaker is not opinionated about which answer to the embedded question is true, that is, that the speaker's beliefs do not entail either answer (Eckardt 2007, Egré 2008). For the examples in (1a) and (2a), repeated in (3), this implication is stated in (4).[2]

(3)   a.   Aisha knows whether Ben is Canadian.
      b.   Aisha doesn't know whether Ben is Canadian.

(4) $\neg B_s c \wedge \neg B_s \neg c$

Evidence for implications of speaker ignorance comes from Eckardt's (2007) observation that *know whether* reports are odd against prior contexts that are incompatible with these implications. The infelicity of B's reply in (5) serves to illustrate this.

(5)   A: Given that he {is/is not} Canadian, Ben is eligible to apply for this fellowship. He should definitely apply.
      B: #Aisha knows whether Ben is Canadian, so I am sure she has already told him what to do.

The speaker ignorance implication is also diagnosed by the oddness of examples where the speaker is unlikely to be unopinionated about the relevant content. For example, the perceived oddness of (6a) and (6b) in many contexts is intuited to stem from the fact that speakers are unlikely to be unopinionated about whether or not they are in bed.

(6)   a.   (#)Aisha knows whether I am in bed.
      b.   (#)Aisha doesn't know whether I am in bed.

Finally, speaker ignorance implications can be credited for the deviance, in many contexts, of affirmative first-person *know whether* reports such as (7). In such cases, the sentence's assertion contradicts the speaker ignorance inference, conveying that the speaker *does* have a (correct) opinion as to which answer to the embedded question is true.[3]

(7)   (#)I know whether Ben is Canadian.

We now turn to the implication of agent ignorance with negative *know whether* reports. As noted above, sentence (3b) is not merely intuited to convey that Aisha fails to know the true answer to the question whether Ben is Canadian, but also that Aisha's beliefs do not entail the false answer, either. Hence (3b) conveys that Aisha is ignorant as to which answer to the question is true, an implication that can be stated as in (2c) or, equivalently, (8).

(8) $\neg B_a c \wedge \neg B_a \neg c$

One natural diagnostic for implications of agent ignorance is the infelicity of negative *know whether* reports in contexts that are incompatible with these implications. In applying such a diagnostic, though, we must take care to steer clear of any conflict with *speaker* ignorance implications as a confounding

---

[2]   Key: s := the speaker.
[3]   We do not wish to claim that these examples are infelicitous in all contexts. We can certainly think of certain (perhaps unusual) contexts where such examples could sound perfectly natural in actual conversation. We will return to this point in section 5.

factor. The examples below are designed to meet this constraint. Consider first the minimal pair in (9), whose members both include (3b).

(9)   a.   Given that she forgot to ask him about the outcome of his citizenship application,
                 Aisha doesn't know whether Ben is Canadian.
        b.   #Given that he lied to her about the outcome of his citizenship application,
                 Aisha doesn't know whether Ben is Canadian.

In (9a), the *given that* adjunct suggests that Aisha is ignorant about whether Ben is Canadian, and expectedly is felicitous as a modifier of (3b). In contrast, the adjunct in (9b) suggests that Aisha believes the false answer to the embedded question. The fact that, as shown, (3b) is judged infelicitous in the context of this adjunct, is evidence for the existence of the agent ignorance inference.

The minimal pair in (10) makes much the same point as (9). It shows that (3b) can be responded to felicitously by suggesting that Aisha is ignorant about whether Ben is Canadian, but not by implying that she believes the false answer to this question. Once again this signals the presence of agent ignorance as an implication of (3b).

(10)   a.   A: Aisha doesn't know whether Ben is Canadian.
               B: That's right. Unfortunately, she forgot to ask him yesterday.
        b.   A: Aisha doesn't know whether Ben is Canadian.
               B: #That's right. She thinks he is Ontarian/Peruvian.

Finally, we note that presence of the agent ignorance inference can be detected by the possibility of it serving as the target of disagreement. The observed felicity of B's denial in (11) requires the assumption that A's utterance of (3b) implies that Aisha is ignorant about whether Ben is Canadian.

(11)   A: Aisha doesn't know whether Ben is Canadian.
        B: No, actually, she thinks he is Ontarian/Peruvian.

In sum, we have established that affirmative and negative *know whether* reports can carry speaker ignorance implications, and that negative *know whether* reports in addition carry agent ignorance implications. We now turn to investigating the sources of these effects, starting with speaker ignorance.

3. Speaker ignorance implications from primary implicatures

In this section, we will demonstrate that speaker ignorance implications can be made to fall out as quantity implicatures under neo-Gricean assumptions. We intend this demonstration to be read as a mere proof of concept. That is, while the assumptions that we will be making in spelling out the neo-Gricean account have all been motivated in previous work for independent reasons, we do not wish to argue here that they are necessary, or superior to possible alternatives. Our goal is just to establish that a neo-Gricean quantity based account of the relevant speaker ignorance implications is viable. We begin with a few assumptions about the semantics of polar questions and of embedding polar questions under *know* (section 3.1) and then turn to the neo-Gricean derivations in the affirmative and negative case (sections 3.2 and 3.3).

3.1. Syntax and semantics for know whether reports

Following Larson (1985) and Guerzoni & Sharvit (2014), we will assume that embedded polar questions are covertly disjunctive, to be parsed as alternative questions with *or not*, reduced by ellipsis. The embedded question in our running examples in (3), again repeated in (12), is assigned the logical form in (13), where the strike-out marks elided structure.

(12)   a.   Aisha knows whether Ben is Canadian.
        b.   Aisha doesn't know whether Ben is Canadian.

(13)   [whether [Ben is Canadian] ~~or not[Ben is Canadian]~~]

Aligned with Alonso-Ovalle (2006), we assume that the clausal disjuncts denote singleton sets of propositions, which are unioned by the disjunction particle *or*. Also assuming that *whether* is semantically vacuous, the embedded question in (12) will receive as its denotation the intended set of propositions $\{c, \neg c\}$.

With regard to embedding under *know*, the logical forms for the examples in (12) that are shown in (14) follow Lahiri (2002) in assuming that the embedded interrogative raises covertly, leaving behind a proposition-type trace for *know* to compose with. As shown in (15), we identify the meaning of *know* with the meta-language belief operator B employed above, expressing doxastic necessity (Hintikka 1969), plus a factive presupposition, encoded as a condition on the domain of the relevant function.

(14) a. [whether [Ben is Canadian] ~~or not[Ben is Canadian]~~] λp [Aisha knows p]
      b. not[whether [Ben is Canadian] ~~or not[Ben is Canadian]~~] λp [Aisha knows p]

(15) $\llbracket$ know $\rrbracket = \lambda p_{st}.\lambda x_e.\lambda w_s: p(w)=1. \, B_{x,w}p$

Furthermore, we follow a suggestion in George (2011) by taking the raised interrogative to serve as the argument of a covert existential operator $\exists$, forming a generalized quantifier over propositions. Fleshing out (14) accordingly, we arrive at the complete logical forms in (16).

(16) a. $\exists$[whether [Ben is Canadian] ~~or not[Ben is Canadian]~~] λp [Aisha knows p]
      b. not $\exists$[whether [Ben is Canadian] ~~or not[Ben is Canadian]~~] λp [Aisha knows p]

Finally, translating a proposal in Spector & Egré (2015) into the present setting, we assume that presuppositions project existentially from under the generalized quantifier that $\exists$ forms. To encode this assumption, we assign $\exists$ the denotation in (17). If $\exists$ is restricted by *whether p or ¬p*, a factive presupposition triggered in its scope will then effectively disappear, projecting as the tautology $p \vee \neg p$.

(17) $\llbracket \exists \rrbracket = \lambda Q_{(st)t}. \, \lambda P_{(st)(st)}. \, \lambda w_s: \exists p[Q(p)=1 \wedge w \in dom(P(p))]. \, \exists p[Q(p)=1 \wedge P(p)(w)=1]$

As the reader is invited to confirm, the above assumptions derive for our running examples (12a) and (12b) the intended truth conditions, stated again in (18a) and (18b), respectively.

(18) a. $(c \wedge B_a c) \vee (\neg c \wedge B_a \neg c)$
      b. $\neg((c \wedge B_a c) \vee (\neg c \wedge B_a \neg c))$

3.2. Speaker ignorance implications: affirmative case

For the affirmative case (12a), we will now demonstrate that the syntactic and semantic assumptions laid out above support a neo-Gricean derivation of the speaker ignorance implication in (19) as a quantity implicature.

(19) $\neg B_s c \wedge \neg B_s \neg c$

To begin, under Katzir's (2007) complexity-based notion of alternatives for quantity implicature, deletion of one or the other disjunct in the logical form (16a) yields the pair of alternative logical forms in (20). Since in these alternatives the restrictor of $\exists$ is a singleton set of propositions, the existential projection encoded in the entry in (17) lets the factive presupposition triggered in the scope (here c or $\neg c$) project unaltered. Encoding those factive presupposition as conjuncts in the meta-language description, the resulting meanings of the logical forms in (20) are then as shown in (21).

(20) a. $\exists$[Ben is Canadian] λp [Aisha knows p]
      b. $\exists$[~~not[Ben is Canadian]~~] λp [Aisha knows p]

(21) a. $c \wedge B_a c$
      b. $\neg c \wedge B_a \neg c$

We note that these are suitable meanings for the examples with embedded *that* clauses in (22). So the analysis effectively lets *know whether* compete with *know that*, as proposed in Eckardt (2007), Egré (2008), Mayr (2017), and Abenina-Adar (2018).

(22)   a.   Aisha knows that Ben is Canadian.
           b.   Aisha knows that Ben is not Canadian.

Let us now suppose, following Schlenker (2012) and Leahy (2016), that presuppositional content contributes to informativity for the purposes quantity implicature.[4] Under this assumption, each of the alternative meanings in (21) is stronger than the asserted meaning (18a). Under a neo-Gricean standard algorithm for quantity implicature (Sauerland 2004, Geurts 2011), the pair of alternative meanings in (21) therefore gives rise to a pair of primary implicature in the sense of Sauerland (2004), shown in (23).

(23)   a. $\neg B_s(c \wedge B_a c)$
           b. $\neg B_s(\neg c \wedge B_a \neg c)$

The alternative meanings in (21) are not only stronger than the actual meaning in (18a), but moreover are symmetric relative to (18a) in the sense of Fox (2007). That is, (18a) entails the disjunction (21a) and (21b). By a logic familiar from Sauerland (2004), this symmetry guarantees that the primary implicature in (23), together with the quality implicature in (24), entail the pair of possibility implicatures in (25).

(24) $B_s((c \wedge B_a c) \vee (\neg c \wedge B_a \neg c))$

(25)   a. $\neg B_s \neg (c \wedge B_a c)$
           b. $\neg B_s \neg (\neg c \wedge B_a \neg c)$

We now observe that a possibility statement $\neg B_s \neg p$ is upward entailing in the position of p. So each possibility implicature in (25) entails a corresponding possibility statement about one of the answers, c or $\neg c$. That is, (25a) and (25b) entail (26a) and (26b), respectively.

(26)   a. $\neg B_s \neg c$
           b. $\neg B_s c$

The conjunction of the statements in (25) is the intended implication of speaker ignorance in (19), the implication that the speaker's beliefs fail to entail either answer to the embedded question. This completes our analysis of the affirmative case (12a). We now turn to its negative counterpart in (12b).

3.3. Speaker ignorance implication: negative case

For the negative case (12b), given the logical form in (16b), Katzir's (2007) algorithm again delivers two alternatives, which are shown in (27). Assuming that *not* is a presupposition hole in the sense of Karttunen (1973), the factive presupposition, c or $\neg c$, projects globally in these alternatives, so that effectively negation only applies to the belief statement. Once again encoding the factive presuppositions as conjuncts, the logical forms in (27) therefore have the meanings in (28).

(27)   a.   not ∃[Ben is Canadian] λp [Aisha knows p]
           b.   not ∃[~~not[Ben is Canadian]~~] λp [Aisha knows p]

---

[4] Without this assumption, an alternative conceivable route to speaker ignorance implications (suggested by the exposition in Abenina-Adar 2018), appeals to the principle of Maximize Presupposition (Heim 1991, Sauerland 2008). We have no arguments against this alternative approach, but we note that it must be suitably fleshed out so as to derive inferences about the speaker's belief state, and not merely inferences about common knowledge (Chemla 2008, Rouillard & Schwarz 2017, in press). On the other hand, for reasons that emerge from Meyer (2013), a standard neo-Gricean approach leaves us without a complete understanding of the oddness effects employed to diagnose speaker ignorance implications in section 2, while an analysis on terms Maximize Presupposition avoids this problem. However, as Meyer (2013) observes, such oddness effects are a general problem for neo-Gricean accounts, and we hope that any proper solution to this general problem (e.g., Meyer 2013, Lauer 2014) will apply correctly to the data in this paper.

(28) a. $c \wedge \neg B_a c$
      b. $\neg c \wedge \neg B_a \neg c$

These are suitable meanings for the negated *know that* reports in (29). So under negation, too, the analysis effectively lets *whether know* statements compete with the relevant *know that* statements.

(29) a. Aisha doesn't know that Ben is Canadian.
      b. Aisha doesn't know that Ben is not Canadian.

It is now helpful to observe that the truth conditions for (12b) that we gave in (18b) can be restated equivalently as in (30). Given that (30) is the disjunction of the alternatives (28a) and (28b), it emerges that just like affirmative *know whether* reports, negated *know whether* reports have two stronger symmetric alternatives. It follows that for the purposes of the neo-Gricean standard algorithm for quantity implicature, the negative case is completely parallel to the affirmative case.

(30) $(c \wedge \neg B_a c) \vee (\neg c \wedge \neg B_a \neg c)$

So, the standard algorithm delivers the pair of primary implicatures in (31), and therefore, in conjunction with the quality implicature (32), the pair of possibility implicatures in (33). These possibility implicatures entail the statements in (34), whose conjunction is the speaker ignorance implication in (19) that we were aiming to derive.

(31) a. $\neg B_s(c \wedge \neg B_a c)$
      b. $\neg B_s(\neg c \wedge \neg B_a \neg c)$

(32) $B_s((c \wedge \neg B_a c) \vee (\neg c \wedge \neg B_a \neg c))$

(33) a. $\neg B_s \neg (c \wedge \neg B_a c)$
      b. $\neg B_s \neg (\neg c \wedge \neg B_a \neg c)$

(34) a. $\neg B_s \neg c$
      b. $\neg B_s c$

What we have established, then, is that speaker ignorance implications for both affirmative and negative *know whether* reports are derivable as quantity implicatures under neo-Gricean assumptions. We are now ready to turn our attention to agent ignorance implications.

4. Agent ignorance implications from secondary implicatures

Are agent ignorance inferences, too, amenable to a neo-Gricean derivation? Recall that for our example (12b), repeated here once more in (35a), we hope to derive the agent ignorance inference (8), repeated in (35b). We are asking whether this implication can be made to fall out under neo-Gricean assumptions.

(35) a. Aisha doesn't know whether Ben is Canadian.
      b. $\neg B_a c \wedge \neg B_a \neg c$

To address this question, we return to the possibility implications in (33) that we saw the standard algorithm delivers for our negative *know whether* report (35a). Notice that parallel to the pair of entailments in (34), the possibility implications in (33) also have, by the same logic, the pair of entailments in (36).

(36) a. $\neg B_s B_a c$
      b. $\neg B_s B_a \neg c$

The neo-Gricean standard algorithm for quantity implicature (as spelled out in Sauerland 2004) posits an "epistemic step" that strengthens any primary implicature $\neg B_s p$ to the corresponding "secondary implicature" $B_s \neg p$, provided this strengthening is consistent. (A listener's taking this epistemic step amounts to their making the assumption that the speaker is opinionated about p, that

is, the assumption $B_sp \lor B_s\neg p$.) In the case at hand, the epistemic step can indeed be taken consistently, and so the implicatures in (36) are expected to be strengthened into those in (37).

(37)   a. $B_s\neg B_ac$
        b. $B_s\neg B_a\neg c$

The neo-Gricean standard algorithm also posits that listeners routinely take speakers to be reliable in the sense of assuming that the speaker's beliefs that have inferred are indeed true. In the case at hand, given the inferences in (37), making this speaker reliability assumption will lead the listener to furthermore draw the pair of inferences in (38).

(38)   a. $\neg B_ac$
        b. $\neg B_a\neg c$

The conjunction of (38a) and (38b) is the intended agent ignorance implication (35b). So we have shown that given a derivation of speaker ignorance implications, the neo-Gricean standard algorithm provides a straightforward account of agent ignorance implications of negative *know whether* reports.

5. The unexpected pervasiveness of agent ignorance implications

Since on the analysis stated above, the necessary premises for the derivation of agent ignorance implications include speaker opinionatedness (which supports the epistemic step) and speaker reliability, they form a proper superset of the assumptions needed to derive speaker ignorance inferences. We will refer to this feature of the analysis as the *superset property*. Suppose now that a given manipulation removes one of the premises that our neo-Gricean derivation of speaker ignorance implications relies on, and that this manipulation has the expected effect of obviating speaker ignorance implications. Because of the superset property, the analysis formulated above then predicts that the same manipulations will eliminate agent ignorance implications as well. Surprisingly, as we will now show, this prediction is incorrect. We will report that while removing either the maxim of quantity (section 5.1) or symmetry between the alternatives (section 5.2) makes the relevant speaker ignorance implications disappear, agent ignorance implications turn out to persist under these manipulations.

5.1. Removing the maxim of quantity

Employing a manipulation suggested in Fox (2014), imagine a game show where the host is known to routinely withhold relevant information, suspending the maxim of quantity. In this setting, speaker ignorance inferences based on neo-Gricean quantity reasoning are predicted to be absent. For the speaker ignorance implications of both affirmative and negative *know whether* reports, the intuited felicity of the examples in (39) shows this prediction to be correct.

(39)   Game show host to candidate:
        a.   Aisha knows whether Ben is Canadian, and so do I.
              Now I want *you* to find out whether he is.
        b.   Aisha doesn't know whether Ben is Canadian, although I do.
              Now I want *you* to find out whether he is.

Given the superset property, the above neo-Gricean analysis of agent ignorance implications of negative *know whether* reports therefore predicts that in the game show setting, those inferences are likewise preempted. The infelicity of (40) shows this prediction to be incorrect.

(40)   Game show host to candidate:
        Aisha doesn't know whether Ben is Canadian.
        #Your task is to determine whether she was misled about Ben's nationality.

In (40), the show host's second sentence, which suggests that Aisha might believe the false answer to the question whether Ben is Canadian, is intuited to be incompatible with the first sentence, which

is apparently understood as conveying that Aisha is unopinionated, not believing either answer to this question. This is so despite the fact that (in our scenario) the game show host is trying to withhold information about whether or not Aisha is opinionated. We conclude that even with the maxim of quantity deactivated in the game show setting, agent ignorance implications of negative *know whether* reports persist.

5.2. Removing symmetry

The second manipulation we consider here removes the assumption that the alternatives for quantity implicature are symmetric. Consider the *know whether* report in (41), where *know whether* is in the scope of a negative indefinite subject, and where the complement clause contains a pronoun that is to be read as bound by that negative quantifier.

(41)   No woman knows whether she passed.

With (41) so understood, received wisdom assigns to the sentence the truth conditions in (42), which states that there is no woman who either passed and knows that she did or did not pass and knows that she didn't.[5]

(42) $\neg\exists x[w(x) \wedge ((p(x) \wedge B_x p(x)) \vee (\neg p(x) \wedge B_x \neg p(x)))]$

To determine the predictions of the neo-Gricean approach explicated above, we bypass matters of implementation that we attended to in section 3, and focus directly on the underlying commitment that *know whether* reports compete with the corresponding *know that* reports. The *know that* reports that the account takes (41) to compete with are shown in (43).

(43)   a.   No woman knows that she passed.
         b.   No woman knows that she didn't pass.

Aligned with Chemla's (2009) finding that a presupposition triggered in the scope of a quantifier headed by *no* projects universally, the sentences in (43) are judged to suggest that every woman passed, and didn't pass, respectively. Encoding presuppositional content as conjuncts as before, the meanings of the *know that* reports in (43) are accordingly as given in (44), conveying that every woman passed but none of them believes that she did, or that no woman passed but none of them believes that she didn't.

(44)   a. $\forall x[w(x) \rightarrow p(x)] \wedge \neg\exists x[w(x) \wedge B_x p(x)]$
         b. $\forall x[w(x) \rightarrow \neg p(x)] \wedge \neg\exists x[w(x) \wedge B_x \neg p(x)]$

We now observe that even though each of the statements in (44) is stronger than (42), they are not symmetric relative to (42). This is so because the disjunction of the statements in (44), in virtue of entailing that either all or none of the women passed, is stronger than (42). Due to this lack of symmetry, the neo-Gricean standard algorithm does not derive possibility implicatures or speaker ignorance implicatures parallel to those derived for our running examples in (12). Given the superset property, this entails that it does not derive agent ignorance implications, either.

Are these predictions correct? With regard to speaker ignorance implications, we submit that they are. If some but not all women passed, we take it that (41) can be used felicitously by a speaker who has full knowledge of which women passed and didn't pass, including in scenarios where the speaker is taken to abide by the maxim of quantity. This indicates that (41) indeed does not carry an implication of speaker ignorance.

In contrast, however, with regard to agent ignorance implications, the prediction of the neo-Gricean account is clearly incorrect. In parallel to the minimal pair in (9) above, the contrast in (45) establishes that (41) carries an implication of agent ignorance. Specifically, it is understood to convey that no woman believes either answer to the question whether she passed the exam.

---

[5]   Key: $w(x) :\Leftrightarrow x$ is a woman; $p(x) :\Leftrightarrow x$ passed.

(45) a. Given that Ben refused to divulge any information about the results of the oral exam, no
          woman knows whether she passed.
      b. #Given that Ben lied to some women about the results of their oral exam and refused to
          divulge any information to the others, no woman knows whether she passed.

We observe, then, that in the absence of symmetry between alternatives, where speaker ignorance implications are expectedly obviated, agent ignorance implications persist.

Speaker and agent ignorance implications come apart in a similar way in (certain) cases of embedded wh-questions. As Eckardt (2007) reports, speaker ignorance ignorance are generally absent with embedded wh-questions. This assessment is confirmed by the felicity of (46a) and (46b), where the speaker ignorance implication, conveying that the speaker is unsure about the identity of their spouse, would be implausible.

(46) a. Aisha knows who I'm married to.
      b. Aisha doesn't know who I'm married to.

In this case, too, the absence of speaker ignorance implications is naturally credited to the assumption that there are no symmetric alternatives.[6] The neo-Gricean account then predicts agent ignorance implications to be absent as well. However, we submit that an agent ignorance implications is in fact attested in this case, as indicated by the infelicity of (47a) and B's reply in (47b).

(47) a. #Given that he lied to her about his spouse's identity,
          Aisha doesn't know who Ben is married to.
      b. A: Aisha doesn't know who Ben is married to.
          B: #That's right. She thinks he is married to Shorsh.

The data presented in this subsection strengthen the conclusion, already invited by the observations in the previous subsection, that the neo-Gricean account of agent ignorance implications in *know whether* reports is incorrect, or at least, insufficient.

6. Conclusion

After showing that agent ignorance implications of negative *know whether* reports are amenable to straightforward derivation as quantity implicature under neo-Gricean assumptions, we have shown that, surprisingly, such an account is at least insufficient. We take our findings to suggest that, unlike speaker ignorance implications, agent ignorance inferences are encoded in the conventional meaning of negative *know whether* reports. This leaves us with the question *how* agent ignorance implications are encoded in the conventional meaning. A related question requiring further work is raised by the superficial resemblance between agent ignorance implications of negative *know whether* reports and the so-called false-answer sensitivity of *know wh* reports (George 2011, Klinedinst & Rothschild 2011, Spector & Egré 2015, Uegaki 2015, Cremers 2016, Theiler et al. 2016), viz. the question whether this resemblance might actually reflect a close underlying link between the two phenomena.

References

Abenina-Adar, Maayan (2018). *Whether*-questions and *ever*-free relatives. Unpublished manuscript, UCLA.
Alonso-Ovalle, Luis (2006). *Disjunction in alternative semantics*. Ph.D. thesis, University of Massachusetts Amherst.
Chemla, Emmanuel (2008). An epistemic step for anti-presuppositions. *Journal of Semantics* 25:2, 141–173.

---

[6] To be sure, Katzir's (2007) theory of alternatives assumed above fails to derive relevant symmetric alternatives to *know wh*-reports like those in (46). In fact, it is unclear that this theory predicts embedded wh-questions to compete with embedded that-clauses at all. In an alternative view (e.g., Mayr 2017) alternatives are construed as propositions determined by the semantics of the embedded question. In that case, too, alternatives need not be symmetric. In fact, under a Hamblin/Karttunen-semantics for the embedded wh-question (Hamblin 1973, Karttunen 1977), it is predicted that no two alternatives are symmetric.

Chemla, Emmanuel (2009). Presuppositions of quantified sentences: experimental data. *Natural Language Semantics* 17:4, 299–340.

Cremers, Alexandre (2016). *On the semantics of embedded questions*. Ph.D. thesis, Ecole Normale Superieur, École doctorale Cerveau, cognition, comportement (Paris).

Eckardt, Regine (2007). The syntax and pragmatics of embedded yes/no questions. Schwabe, Kerstin & Susanne Winkler (eds.), *On Information Structure, Meaning and Form*, John Benjamins, Amsterdam, 447–467.

Egré, Paul (2008). Question-embedding and factivity. *Grazer Philosophische Studien* 77:1, 85–125.

Fox, Danny (2007). Free choice and the theory of scalar implicatures. Sauerland, Uli & Penka Stateva (eds.), *Presupposition and implicature in compositional semantics*, Palgrave MacMillan, 71–120.

Fox, Danny (2014). Cancelling the maxim of quantity: Another challenge for a gricean theory of scalar implicatures. *Semantics and Pragmatics* 7:5, 1–20.

George, Benjamin Ross (2011). *Question embedding and the semantics of answers*. Ph.D. thesis, University of California, Los Angeles.

Geurts, Bart (2011). *Quantity Implicatures*. Cambridge University Press, Cambridge.

Groenendijk, Joroen & Martin Stokhof (1982). Semantic analysis of wh-complements. *Linguistics and Philosophy* 5:2, 175–233.

Guerzoni, Elena & Yael Sharvit (2014). *Whether or not anything* but not *whether anything or not*. Crnič, Luka & Uli Sauerland (eds.), *The Art and Craft of Semantics: a Festschrift for Irene Heim*, MIT Working Papers in Linguistics (MITWPL), Cambride, MA, 199–224.

Hamblin, Charles L. (1973). Questions in Montague English. *Foundations of Language* 10, 41–53.

Heim, Irene (1991). Artikel und Definitheit. von Stechow, Arnim & Dieter Wunderlich (eds.), *Semantik: ein internationales Handbuch der Zeitgenössischen Forschung*, de Gruyter, Berlin, 487–535.

Hintikka, Jaakko (1969). Semantics for propositional attitudes. J.W., Davis, Hockney D.J. & Wilson W.K. (eds.), *Models for modalities*, Springer, Dordrecht, 87–111.

Karttunen, Lauri (1973). Presuppositions of compound sentences. *Linguistic Inquiry* 169–193.

Karttunen, Lauri (1977). Syntax and semantics of questions. *Linguistics and Philosophy* 1, 3–44.

Katzir, Roni (2007). Structurally-defined alternatives. *Linguistics and Philosophy* 30:6, 669–690.

Klinedinst, Nathan & Daniel Rothschild (2011). Exhaustivity in questions with non-factives. *Semantics and Pragmatics* 4:2, 1–23.

Lahiri, Utpal (2002). *Questions and Answers in Embedded Contexts*. Oxford University Press.

Larson, Richard K (1985). On the syntax of disjunction scope. *Natural Language & Linguistic Theory* 3:2, 217–264.

Lauer, Sven (2014). Mandatory implicatures in Gricean pragmatics. Degen, Judith, Michael Franke & Noah Goodman (eds.), *Proceedings of Formal and Experimental Pragmatics*, University of Tübingen, 21–28.

Leahy, Brian (2016). On presuppositional implicatures. *Topoi* 35:1, 83–91.

Lewis, David (1982). Whether report. Pauli, T. (ed.), *Philosophical Essays Dedicated to Lennart Åquist on his Fiftieth Birthday*, Filosofiska Studier, Uppsala.

Mayr, Clemens (2017). Predicting polar question embedding. *Proceedings of Sinn und Bedeutung*, vol. 21, 1–18.

Meyer, Marie-Christine (2013). *Ignorance and Grammar*. Ph.D. thesis, Massachusetts Institute of Technology.

Rouillard, Vincent & Bernhard Schwarz (2017). Epistemic narrowing from Maximize Presupposition. Lamont, Andrew & Katerina A. Tetzloff (eds.), *Proceedings of the 47th annual meetung of the North East Linguistic Society (NELS 47)*, GLSA (Graduate Linguistics Student Association), Department of Linguistics, University of Massachusetts, 49–62.

Rouillard, Vincent & Bernhard Schwarz (in press). Presuppositional implicatures: Quantity or Maximize Presupposition? *Proceedings of Sinn und Bedeutung 22*.

Sauerland, Uli (2004). Scalar implicatures in complex sentences. *Linguistics and Philosophy* 27, 367–391.

Sauerland, Uli (2008). Implicated presuppositions. Steube, Anita (ed.), *The discourse potential of underspecified structures*, Berlin: Mouton de Gruyter.

Schlenker, Philippe (2012). Maximize Presupposition and Gricean reasoning. *Natural language semantics* 20:4, 391–429.

Spector, Benjamin & Paul Egré (2015). A uniform semantics for embedded interrogatives: An answer, not necessarily the answer. *Synthese* 192:6, 1729–1784.

Theiler, Nadine, Floris Roelofsen & Maria Aloni (2016). Truthful resolutions: A new perspective on false-answer sensitivity. Moroney, Mary, Carol-Rose Little, Jacob Collard & Dan Burgdorf (eds.), *Proceedings of Semantics and Linguistic Theory (SALT) 26*, CLC Publications, 122–141.

Uegaki, Wataru (2015). *Interpreting questions under attitudes*. Ph.D. thesis, Massachusetts Institute of Technology, Cambridge, Massachusetts, URL `https://dspace.mit.edu/handle/1721.1/99318`.

Proceedings of the 36th West Coast Conference on Formal Linguistics

edited by Richard Stockwell, Maura O'Leary, Zhongshi Xu, and Z.L. Zhou

Cascadilla Proceedings Project   Somerville, MA   2019