Inquisitive Knowledge Attribution and the Gettier Problem*

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Abstract. A disjunctive belief cannot be described as knowledge if the subject does not justifiably believe a true disjunct, even if the whole disjunctive belief is true and justified (Gettier 1963). This phenomenon is problematic if the verb *know* semantically operates on a (classical) proposition, as standardly assumed. In this paper, I offer a solution to this problem using Inquisitive Semantics, arguing that *know* operates on the set of alternative possibilities expressed by its complement. It will also be shown that the proposed semantics for *know* provides a novel account of its compatibility with both declarative and interrogative complements.

1 Introduction

The attitude verb *know* can embed either a declarative or an interrogative complement, in contrast to other attitude verbs, such as *believe* or *ask/wonder*, which take only one of the two complement types, as shown in (1).

(1) a. John **knows** {that Sue came / who came} to the party.
b. John **believes** {that Sue came / *who came} to the party.
c. John **asked** me/**wonders** {*that Sue came / who came} to the party.

One of the basic issues in the semantics of question-embedding concerns this selection property of *know* and other verbs that behave similarly (e.g., *forget*, *tell*). Namely, how we can semantically account for the compatibility of *know* (and other verbs) with both a declarative and an interrogative complement.

The standard answer to this question states that the basic denotation of *know* selects for a proposition, which is the meaning of declarative clauses, and assumes some form of reduction from the meaning of embedded interrogatives to propositions (e.g. Karttunen 1977, Groenendijk and Stokhof 1984). However, such an account wrongly predicts that a *believe*-type verb should be able to embed an interrogative complement provided that the reduction is general.[1]

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[1] An exception is Ginzburg (1995), who has a reduction in terms of coercion, but avoids this problem by positing an ontological distinction between the objects *believe* and *know* select for. Unfortunately, limited space prevents me from going into an extensive comparison between Ginzburg's and the current proposal, but it is important to note that the current proposal accounts for the difference in the selection restrictions in an ontology that is more conservative than Ginzburg's.

In this paper, I propose an alternative approach to the issue that avoids this problem, focusing on a puzzling interpretation of a disjunction in a declarative complement of *know*, known as the GETTIER PROBLEM. Specifically, I will propose that *know* always operates on a *set of alternative possibilities*, which is typically the type of an interrogative meaning, even when *know* takes a declarative complement. I will argue that the solution to the Gettier problem crucially requires the proposed view of the meaning of *know*, and implement the analysis using the treatment of disjunction in Alternative Semantics and Inquisitive Semantics (Groenendijk 2009, Groenendijk and Roelofsen 2009).

2 The Gettier Problem (Gettier 1963)

Knowledge has been traditionally analyzed as a JUSTIFIED TRUE BELIEF (JTB) in epistemology. This traditional view is also underlying in the lexical entry for *know* in the standard semantic theory, as in (2), which basically treats the meaning of *know* as that of *(justifiably) believe* + factivity.[2,3]

(2) $[\![\text{know}]\!] = \lambda p \in D_{\langle s,t\rangle} \lambda x \lambda w \colon [p(w) = 1].\mathsf{JDOX}_{x,w} \subseteq p$
where $\mathsf{JDOX}_{x,w} = \{w' \mid w' \text{ is compatible with } x\text{'s justified belief in } w\}$

In his famous 1963 paper, Gettier presents counterexamples to this JTB analysis of knowledge. In the situation described in (3), the knowledge attribution in (4) is intuitively false even though the proposition 'Jones owns a Ford or a BMW' is a true and justified belief of Smith.

(3) Situation: Smith justifiably believes that Jones owns a Ford. (He saw Jones with the key of a Ford, driving a Ford etc.) He justifiably deduces from this belief that Jones owns a Ford or a BMW although he is unopinionated about whether Jones owns a BMW. However, it turns out that Jones in fact does not own a Ford, but he owns a BMW.

(4) Smith knows that [Jones owns a Ford or he owns a BMW].

A Gettier example need not involve a disjunction. The following is a case where the belief in question involves an existential quantification.

(5) Situation: "James, who is relaxing on a bench in a park, observes a dog that, about 8 yards away from him, is chewing on a bone. So he believes [that there is a dog in the park]. [However,] what he takes to be a dog is actually a robot dog so perfect that, by vision alone, it could not be distinguished from an actual dog. James does not know that such robot dogs exist. But in fact a Japanese toy manufacturer has recently developed them, and what

[2] In this paper, a presupposition is captured in terms of partial functions. A clause after a comma in a lambda term indicates a restriction on the domain of the function that the lambda term expresses.

[3] The reference to a *justified* belief (JDOX) instead of a mere belief (DOX) might not be strictly standard in semantics. What I mean by 'standard' in the text here is the analysis of *know* as a straightforward extension of *believe* with additional conditions on its arguments and accessibility relation.

James sees is a prototype that is used for testing the public's response. But, just a few feet away from the robot dog, there is a real dog. Sitting behind a bush, he is concealed from James's view." (Steup 2009, pp.7-8)

(6) James knows that there is a dog in the park.

Again, the knowledge attribution in (6) is intuitively false although the proposition 'there is a dog in the park' is a true and justified belief of James. This example is also important because it does not involve an inference from falsehood, which one might consider as the source of the problem in (3-4). The belief in (5) can be directly justified by James' visual perception.

This famous problem in epistemology is also a problem for the standard semantic analysis of *know* in (2), which incorrectly predicts sentences (4) and (6) to be true in the given contexts.[4] In the next section, I will offer a solution to this puzzle using the treatment of disjunction in Inquisitive Semantics.

3 Analysis in Inquisitive Semantics

In this section, after briefly setting up the theoretical framework of Inquisitive Semantics in Section 3.1, I propose a solution to the Gettier problem by arguing that *know* operates on the *set* of possibilities denoted by its complement, unlike in the standard analysis where it operates on a classical proposition. In the last subsection, I show that the proposed meaning for *know* can be used with *wh*-complements with necessary modifications.

3.1 Disjunction in Alternative/Inquisitive Semantics

In Inquisitive Semantics (Groenendijk 2009, Groenendijk and Roelofsen 2009), the semantic value of a sentence is conceived of as possibly multiple ways of updating the common ground. Each update possibility (referred to simply as a POSSIBILITY) is modeled as a set of indices (of type $\langle s, t\rangle$) (Groenendijk and Roelofsen 2009). A sentence denotes a set (of type $\langle st, t\rangle$) of such alternative possibilities qua index-sets. Also, for expository purposes, I model possibilities containing a presupposition as partial functions from indices to truth values in cases where the presupposition is relevant to the discussion.

In the context of this paper, particularly important is the treatment of disjunction. Along with the proposals in Alternative Semantics (Kratzer and Shimoyama 2002, Alonso-Ovalle 2006, a.o.), Inquisitive Semantics treats a sentential disjunction as a set union (Groenendijk and Roelofsen 2009).

[4] The puzzle might remind one of the free choice effect of a disjunction under a possibility modal or an imperative (Ross 1941, Kamp 1973, a.o.). However, the behavior of a disjunction under *know* is crucially different from free choice in licensing the inference pattern in (i), the failure of which is the hallmark of free choice, e.g., (ii).

(i) John knows that Sue came, but he does not know that Mary came. $\models$ John knows that Sue or Mary came. (Disjunction under *know*)

(ii) You may take a pear, but you may not take an apple. $\not\models$ You may take a pear or an apple. (Free choice permission)

(7) $[\![\alpha \text{ or } \beta]\!] = [\![\alpha]\!] \cup [\![\beta]\!]$

That is, the meaning of a disjunction is the union of the sets of possibilities conveyed by each disjunct. In this way, Inquisitive Semantics captures the *hybrid* nature of disjunction: a disjunction is INQUISITIVE in proposing alternative possibilities just like a question, while it is also INFORMATIVE in eliminating a possibility (namely, one where neither disjunct is true) from the common ground just like a classical assertion.[5]

3.2 First Attempt: Point-wise Function Application

Having set up the theoretical background, let us return to the Gettier problem. One immediate question that arises is how an attitude verb semantically composes with its complement, given that the complement denote a *set* of alternative possibilities. The standard approach to subsentential composition in this kind of setup is to use the rule of POINT-WISE FUNCTION APPLICATION (PFA) in (8) following the literature of Alternative Semantics after Hamblin (1973).

(8) If $[\![\alpha]\!] \subseteq D_{\langle\sigma,\tau\rangle}$ and $[\![\beta]\!] \subseteq D_\sigma$, then
$[\![\alpha\ \beta]\!] := \{d \in D_\tau \mid \exists a \in [\![\alpha]\!] \exists b \in [\![\beta]\!][d = a(b)]\}$ (**Point-wise FA; PFA**)

A natural denotation for *know* one would expect in a compositional system like Alternative Semantics that utilizes PFA is simply the singleton set of its standard denotation, as given in (9).

(9) $[\![\text{know}]\!] = \{\lambda p \in D_{\langle s,t\rangle} \lambda x \lambda w{:}[w \in p].\mathsf{JDOX}_{x,w} \subseteq p\}$

If we apply the denotation of *know* in (9) to the set of possibilities in (10) via PFA, we get the set in (11) as the meaning of the Gettier example in (4).

(10) $[\![\text{Jones owns a Ford or he owns a BMW}]\!] = \{F\} \cup \{B\} = \{F,B\}$

(11) $[\![\text{Smith knows that Jones owns a Ford or he owns a BMW}]\!]$
$= \{\lambda w{:}[w \in F].\mathsf{JDOX}_{\mathbf{s},w} \subseteq F,\ \lambda w{:}[w \in B].\mathsf{JDOX}_{\mathbf{s},w} \subseteq B\}$

Assuming that the truth of a sentence is determined as in (12) (along the lines of the notion SUPPORT in Groenendijk and Roelofsen 2009), we predict (11) to be false in the Gettier scenario in (3).

(12) φ is true in w iff there is some $p \in [\![\varphi]\!]$ such that $p(w) = 1$

This is so because the first possibility in (11) is undefined for the situation, as the presupposition triggered by the factivity of *know*, i.e. F, is false. The latter possibility is false even though defined, as Smith does not believe B in the situation. Thus, what we end up is the correct prediction that the Gettier example in (4) is false, somewhat surprisingly.

However, this analysis is clearly too strong as it predicts that a disjunction under *know* is always equivalent to a matrix disjunction of *know*. This means that we cannot capture a 'purely disjunctive' knowledge, which does not require a knowledge of any specific disjunct, as described in the following sentence.

[5] A sentence φ is INQUISITIVE iff $[\![\varphi]\!]$ contains at least two possibilities (none of which contains another). A sentence φ is INFORMATIVE iff $\bigcup [\![\varphi]\!] \neq \mathcal{W}$ (ie. for some index, all possibilities in $[\![\varphi]\!]$ are false.)

(13) Smith knows that Jones owns a Ford or he owns a BMW, but he doesn't know specifically which he owns.

In order to capture the meaning of (13) in the current system, we seem to need an operation to 'collapse' multiple possibilities denoted by the complement into a single big possibility, along the lines of the NON-INQUISITIVE CLOSURE in (14).

(14) $[\![!\,\alpha]\!] := \{\bigcup [\![\alpha]\!]\}$ **(Non-inquisitive closure of $[\![\alpha]\!]$)**

By applying this operation to the complement, we can capture the purely disjunctive knowledge in (13), as shown below.

(15) $[\![$Smith knows **!**(that Jones owns a Ford or he owns a BMW)$]\!]$
$= \{\lambda w{:}[w \in F \cup B].\mathsf{JDOX}_{\mathbf{s},w} \subseteq F \cup B\}$

The problem is how to constrain this closure operation. Allowing the operation freely would get us back to the original Gettier problem, as (15) is true also in the Gettier scenario. How can we allow attribution of a purely disjunctive knowledge in a sentence like (13) while block it in the Gettier case? The next section presents an answer to this question by analyzing knowledge as requiring a *strongest* true belief.

3.3 Solution: Knowledge Requires a Strongest Justified Belief

What distinguishes a Gettier case and a purely disjunctive knowledge as in (13) is that the subject believes a false disjunct in the former while she believes no specific disjunct in the latter. The descriptive generalization, therefore, is that purely disjunctive knowledge attribution, or 'collapsing' of alternative possibilities, is valid only if the subject believes no specific disjunct.

We can account for the generalization if a purely disjunctive knowledge *entails* that the subject has no justified belief about a specific disjunct. That is, the generalization is captured if we analyze x *knows* p *or* q as ambiguous between the following two translations in classical logic.

(16) x knows p or q.

a. $(w \in p \wedge \mathsf{JDOX}_{x,w} \subseteq p) \vee (w \in q \wedge \mathsf{JDOX}_{x,w} \subseteq q)$

b. $(w \in p \cup q) \wedge \mathsf{JDOX}_{x,w} \subseteq (p \cup q) \wedge \underline{\mathsf{JDOX}_{x,w} \not\subseteq p \wedge \mathsf{JDOX}_{x,w} \not\subseteq q}$

The reading in (16a) is equivalent to a matrix disjunction, in which the possibilities in the complement are not collapsed by the closure. On the other hand, the reading in (16b) captures the purely disjunctive knowledge, in which the possibilities are collapsed by the closure. The crucial point here is the underlined condition in (16b), which requires the subject *not* to believe either disjunct specifically. This condition falsifies the Gettier case as the subject believes the false disjunct, i.e. that Jones owns a Ford in the Gettier scenario. As we saw above, the Gettier case is false in the reading in (16a), either. Thus, we succeed in predicting the Gettier example to be false under any reading. Generalizing the disjunction case, a Gettier case involving an existential quantification as in (5-6) above can be accounted for, as will be shown shortly in the formal analysis.

Thus, the claim is that every standard Gettier case involves multiple possibilities induced by a disjunction/existential quantification over individuals, times or places. Knowledge attribution is invalid in these cases when the subject believes no true possibility while believing a false one. In Section 4, I discuss other putative Gettier cases that the analysis sketched here is not applicable to, and claim that they should be treated separately.

Now, let us move on the compositional implementation of this analysis. To derive the two readings in (16) in a unified way, I encode in the meaning of *know* that a knowledge requires a *strongest* justified belief among the relevant possibilities. Specifically, I propose the following denotation for *know*. Crucially, this denotation directly operates on the set of alternative possibilities in its complement, via ordinary Function Application but not via Point-wise FA.

(17) $[\![\text{know}]\!] = \lambda Q \in D_{\langle st,t\rangle}\{\lambda x \lambda w \colon [\exists p' \in Q[w \in p']].$
$\exists p \in uniQ[w \in p \wedge \mathsf{JDOX}_{x,w} \subseteq p \wedge strong(p, \mathsf{JDOX}_{x,w}, uniQ)]\}$

- $uniQ := \{\bigcup s \mid s \in \mathcal{P}(Q)\}$ (the closure of Q under union)
- $strong(p, q, S)$ iff $\neg\exists p' \in S[p' \subset p \wedge q \subseteq p']$
(p is the smallest among the sets in S that are as big as q)

Below, I illustrate how this entry for *know* works in the specific examples. Let us consider example (4), repeated below. First, the closure-under-union (*uni*) of the possibility-set denoted by the complement is (18).

(4) Smith knows that Jones owns a Ford or he owns a BMW.

(18) $uni[\![\text{J. owns a Ford or he owns a BMW}]\!] = uni\{F, B\} = \{F, B, F \cup B\}$

Applying (17) to this set, and supplying the subject via PFA, we get the meaning for the sentence in (19) below. The meaning in (19) contains a single possibility which presupposes that either F or B is true, and entails that there is a true proposition among (18) such that Smith justifiably believes it and that he believes no stronger possibility in (18).

(19) $[\![\text{Smith knows that Jones owns a Ford or he owns a BMW}]\!]$
$= \{\lambda w \colon [\exists p' \in \{F, B\}[w \in p']].\ \exists p \in \{F, B, F \cup B\}$
$[w \in p \wedge \mathsf{JDOX}_{\mathbf{s},w} \subseteq p \wedge strong(p, \mathsf{JDOX}_{\mathbf{s},w}, \{F, B, F \cup B\})]\}$

In the following, I illustrate the evaluation of (19) under four possible belief states of the subject one by one, in all of which F is actually false but B is true. The four states are ones where Smith justifiably believes (i) F but not B, (ii) $F \cup B$ but neither F nor B, (iii) B but not F, and (iv) both F and B. The evaluation is summarized in the following list, where the (a)-clauses describe which possibility in (18) is Smith's strongest justified belief in each state, and (b)-clauses describe whether this possibility is true. If there is a proposition that meets these two conditions, (19) is evaluated true.

(i) $\mathsf{JDOX}_{\mathbf{s},w} \subseteq F \cap \neg B$ **(A Gettier state)**
  a. F is Smith's strongest justified belief in $\{F, B, F \cup B\}$
  b. $w \notin F$ (since $w \in \neg F \cap B$) ⇒ **(19) false**.

(ii) $\mathsf{JDOX}_{\mathbf{s},w} \subseteq F \cup B \wedge \mathsf{JDOX}_{\mathbf{s},w} \not\subseteq F \wedge \mathsf{JDOX}_{\mathbf{s},w} \not\subseteq B$ **(Purely disj. belief)**
 a. $F \cup B$ is Smith's strongest justified belief in $\{F, B, F \cup B\}$
 b. $w \in F \cup B$ (since $w \in \neg F \cap B$) $\Rightarrow$ **(19) true**.

(iii) $\mathsf{JDOX}_{\mathbf{s},w} \subseteq \neg F \cap B$
 a. B is Smith's strongest justified belief in $\{F, B, F \cup B\}$
 b. $w \in B$ (since $w \in \neg F \cap B$) $\Rightarrow$ **(19) true**.

(iv) $\mathsf{JDOX}_{\mathbf{s},w} \subseteq F \cap B$
 a. B and F are Smith's strongest justified beliefs in $\{F, B, F \cup B\}$
 b. $w \notin F$, but $w \in B$ (since $w \in \neg F \cap B$) $\Rightarrow$ **(19) true**.

As illustrated above, we predict sentence (4) to be true in states (ii-iv) but false in state (i), namely the Gettier scenario where the subject justifiably believes a false disjunct but does not believe a true one. This is exactly the judgment pattern that we observe for a sentence with a disjunction under *know*.

In the reminder of this section, I illustrate the interpretation of an example involving an existential quantification, as in (6) repeated below.

(6) James knows that there is a dog in the park.

Although I have to gloss over the compositional details for the sake of space, the denotation of the complement in (6) will look like the following, generalizing the semantics for disjunction in Inquisitive Semantics.

(20) $[\![\text{there is a dog in the park}]\!] = \{\{w | \mathbf{dog}(x)(w) \wedge \mathbf{inPark}(x)(w)\} | x \in D_e\}$

The meaning for the sentence in (6) will thus be the following, which contains the single possibility entailing that there is a true possibility in *uni*(20) such that James believes it and that there is no stronger possibility in *uni*(20).

(21) $[\![\text{James knows that there is a dog in the park}]\!]$
$$= \{\lambda w \colon [\exists p' \in (20)[w \in p']].\ \exists p \in uni(20)[w \in p \wedge \mathsf{JDOX}_{\mathbf{j},w} \subseteq p \wedge strong(p, \mathsf{JDOX}_{\mathbf{s},w}, uni(20))]\}$$

As the reader can check, (21) predicts that sentence (6) is false in the Gettier scenario described in (5), while it is true in other states parallel to those in (ii-iv) in the disjunction case above.

3.4 Extension to Interrogative Complements[6]

So far, I have been discussing only the embedding of a declarative complement by *know*. What about the embedding of an interrogative complement, as in (22)?

(22) Smith knows {whether Jones or Lee/who} came to the party.

If we assumed that the denotation of a *wh*-complement looks as in (23) (i.e. the Hamblin denotation), and directly applied the meaning of *know* in (17), we would face a problem: (22) is predicted to be true when Smith knows that either Jones or Lee came to the party, but does not know specifically who did.

[6] I thank Benjamin George for extensive discussion on the content of this section.

(23) $[\![\text{whether Jones or Lee came to the party}]\!] = \{J, L\}$

The problem is that a purely disjunctive knowledge, which we allowed in the case of declarative embedding, should somehow be blocked in the case of interrogative embedding. Remember that in the previous section, a purely disjunctive knowledge is made possible by the union operation by *uni* encoded in the meaning of *know*. To extend the analysis to interrogative embedding, however, I revise the analysis so that the *uni* operation is contributed *not* by the meaning of *know*, but by *the declarative clause*.[7] Also, I propose that *wh*-complements contribute the *partition operation* (Groenendijk and Stokhof 1984) instead of *uni*. More specifically, I propose a revised meaning for *know* in (24) and the entries for the declarative and interrogative complementizers, as follows.

(24) $[\![\text{know}]\!] = \lambda Q \in D_{\langle st,t\rangle}\{\lambda x \lambda w\colon [\exists p' \in Q[w \in p']].$
$\exists p \in Q[w \in p \wedge \mathsf{JDOX}_{x,w} \subseteq p \wedge strong(p, \mathsf{JDOX}_{x,w}, Q)]\}$

(25) a. $[\![\text{that}]\!] = \lambda Q.uni(Q)$ b. $[\![\text{wh(ether)}]\!] = \lambda Q.part(Q)$, where
$part(Q) := \{\{w' \sim_Q w\} \mid w \in \mathcal{W}\}$ and $w' \sim_Q w$ iff $\forall p \in Q[p(w) = p(w')]$

Under this system, the meaning for the *wh*-complement in (23) will be the partition in (26), and the meaning for the whole sentence will be (27).

(26) $[\![\text{whether Jones or Lee came to the party}]\!]$
$= part(\{J, L\}) = \{J \cap L, \neg J \cap L, J \cap \neg L, \neg J \cap \neg L\}$

(27) $[\![\text{Smith knows whether Jones or Lee came to the party}]\!]$
$= \{\lambda w\colon [\exists p' \in (26)[w \in p']].$
$\exists p \in (26)[w \in p \wedge \mathsf{JDOX}_{\mathbf{s},w} \subseteq p \wedge strong(p, \mathsf{JDOX}_{\mathbf{s},w}, (26))]\}$

Thus, (27) predicts that (23) is true iff Smith has a justified true belief about the true cell in the partition in (26), just as in Groenendijk and Stokhof's (1984) partition semantics for *wh*-complements. Note that the condition on the strongest belief is here vacuous since cells in a partition do not contain each other. A purely disjunctive knowledge is not allowed since, if Smith believes that either J or L is true, but neither believes J nor L specifically, there is no proposition in (26) that Smith believes.

4 Other Putative Gettier Cases

In the literature, authors discuss other cases of putative Gettier problems which cannot be accounted for by the current analysis. One paradigm case is the fake barn case by Goldman (1976):

[7] It is interesting in this connection that Ciardelli et al. (2010) speculate that natural language declaratives in general involve their own version of non-inquisitive closure in (i), which is similar to my *uni*, in defining Inquisitive Semantics with Attentive Content.

(i) $\mathbf{!}\varphi := \varphi \vee \neg\neg\varphi$

(28) Situation: While Henry was driving through a certain country, he saw a building, and identified it as a barn. His sight is excellent and he is perfectly justified in identifying it as a barn. However, the country he was driving through was actually a strange country that has many fake barns. But, by accident, the building he saw was one of the few *real* barns. In fact, if he had seen a different one, he might have wrongly identified the fake barn as a real barn.

(29) Henry knows that what he saw was a barn.

The judgment that (29) is false in the situation in (28) cannot be accounted for by the current analysis since there *is* a true possibility in the denotation of the complement which is a strongest justified belief of Henry, namely that the particular building he saw was a barn.

Such cases are different from the standard cases discussed in the previous section in that they involve a skeptical hypothesis that is independent of the truth of the complement of *know* or the subject's belief state. In fact, as Kratzer (2002) notes, a case like (28-29) is judged less clearly as false if the the skepticism in the context is dubious or weaker. In contrast, the judgment of the falsity of the standard Gettier cases does not depend on the context independent both of the truth of the complement and of the subject's belief state. Thus, I claim that these other Gettier cases should be treated with a separate argument from the one accounting for the standard cases discussed in the previous section. More specifically, I argue that the skeptical hypotheses in the context of these cases raise the standard of belief *justification*, along the lines of Epistemic Contextualism (cf. e.g. DeRose 1992).

5 Conclusions and Remarks on Other Attitude Verbs

In this paper, I argued that the Gettier problem can be given a solution by analyzing *know* as operating on a *set of alternative possibilities* denoted by its declarative complement, using proposals in Alternative Semantics and Inquisitive Semantics. Also, we saw that this meaning for *know* can be easily extended to the case of interrogative complements. The difference between a declarative and an interrogative is that the former involves a closure under union, while the latter involves a partition. In sum, the Gettier problem provides support for the view that *know* always operates on a set of possibilities even when it combines with a declarative complement. Putting it differently, the problem motivates the view that 'knowing p' is to be able to resolve an *issue* raised by p.

Lastly, I below make a brief remark about how the selection restrictions of other attitude verbs can be accounted for. Under the current approach, the selection restrictions of attitude verbs such as *believe* and *ask/wonder* are accounted for in terms of the properties of the set of possibilities they select for. As for *believe*, I propose the following entry, which entails that the subject believes the union of the possibility set denoted by the complement.

(30) $[\![\text{believe}]\!] = \lambda Q \in D_{\langle st,t\rangle}\{\lambda x \lambda w.\mathsf{DOX}_{x,w} \subseteq \bigcup Q\}$

The entry in (30) is incompatible with a non-informative complement because it would derive a trivial entailment. This correctly accounts for the fact that *believe* does not take an interrogative complement since the union of a partition is equal to the universe. As for verbs such as *ask* or *wonder*, I claim that they require an inquisitive and non-informative complement. Therefore, these verbs cannot embed a declarative complement, which is either non-inquisitive or informative. I have to leave a further explanation of these restrictions for future research.

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