

## The Semantics of Epistemic Modality

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**Abstract:** According to the standard semantics of epistemic modals, including Kratzer (1979 and 1991), epistemic modals are dealt with on the basis of entailment by what is known. The problem with the treatment is that the entailment from what is known is not appropriate for the semantics of epistemic modals in some cases. Another problem to note is that *must p*, where *p* is a prejacent, does not necessarily mean that *p* in epistemic modality. To remedy this, this paper argues that evidentiality must be incorporated into the semantics of epistemic modals, which implies that epistemic modals signal that a certain conclusion is reached from a body of evidence. Based on this, the present study argues that the semantics of epistemic modals consists of an evidential component which signals a source of information and an epistemic component which reflects the speaker's assessment of the source of information. This may assist in understanding the speaker's choice of epistemic modals in an utterance and the difference in strength between epistemically modalized sentences and unmodalized ones.

Key words: epistemic modals, evidentiality, evidential judgment list, informatively valid inference, modal base, preparatory conditions, ordering source

### 1. Introduction

Epistemic modals are interpreted on the basis of a body of information or evidence, which is frequently referred to as the so-called what is known. Consider the following sentence where *must* and *may* are used as an epistemic modal.

- (1) a. John must be rich.  
b. John may be rich.

After observing John spending a lot of money to buy very expensive things, you might reach a strong conjecture, as in (1a) or a weak presumption, as in (1b), that he is rich, based on your observation or knowledge. Hence, *must* in (1a) and *may* in (1b) are

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epistemic. Sentence like (1a-b) implies that the speaker does not know for sure that John is rich. The epistemic use of modals is interesting not only because the speaker has a body of knowledge that leads her to the conclusion, but the knowledge is not sufficient to make it known to the speaker that John is rich, but also because the speaker may choose either a strong epistemic modal like *must* or a weak epistemic modal like *may* even in the situation mentioned above –i.e. she sees John spending a lot of money. This is one of the topics I will investigate in this paper.

Modals can carry various modal meaning.<sup>2</sup> Despite this, the modals have been traditionally classified as two major categories: epistemic modality and root modality, a term which covers non-epistemic modality such as permission, obligation, and ability etc. (Butler (2003), Incharralde (1998), and Jackendoff (1972) among others). This may be because unlike the root modality, the epistemic modality is closely related to the speaker's attitude toward the truth of the proposition under the scope of the modal. As Perkins (1983) points out, the epistemic modality basically reflects the state of lack of knowledge, which seems to be ironic in the view of the fact that the term *epistemics* itself derives from the Greek word *episteme* for knowledge. The lack of knowledge, or more precisely an incomplete body of knowledge, appears to bring about the speaker's different attitudes about the embedded proposition –i.e. the speaker's degree of

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<sup>2</sup> To see this, let us take the modal verb *must* for instance:

- (i)
  - a. Students must return to the dormitory by 11 p.m.
  - b. Because this computer is better than that one, we must buy this one.
  - c. To be a college professor, you must hold a Ph.D.
  - d. You must finish your homework before you go to sleep.
  - e. John must vent his anger.

A sentence like (ia) leads to a deontic reading, given the dormitory regulations students have to comply with. The modal verb *must* in a sentence like (ib) is preferential since the speaker expresses her own preference. The modal in (ic) is an example of teleological modality which expresses a goal. If a mother says a sentence like (id) to her son to voice her desire described by (id), then *must* is bouletic, also known as *boulomaic*. Given the current state of John's emotion, stressful complexion, or furrowed brow and so forth, the modal *must* in (ie) is interpreted as circumstantial modality which expresses possibility or necessity implied by circumstances.

certainty.<sup>3</sup> The degree of certainty can be expressed by using various kinds of modal verbs, as illustrated in the following set of examples:

- (2) A: Someone is at the door.
- B: a. That would be Mary.
- b. That must be Mary.
- c. That will be Mary.
- d. That should be Mary.
- e. That may be Mary.
- f. That might be Mary.

The speaker B may respond to A's utterance by using different modal verbs, as exemplified in (2a-f). All the modal verbs here are interpreted to be epistemic since they all convey the conjecture that the person who is at the door is Mary. It is, however, worth noting that there are differences in the degree of certainty: the certainty goes down from a-sentence to f-sentence. Epistemic *would* in B's response in (2a) conveys the highest degree of certainty of the prejacent proposition that the person who is at the door is Mary,<sup>4</sup> as was mentioned in Ward et al (2003). Epistemic *must* in (2b) expresses

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<sup>3</sup> Notice that there might be cases where people can be strongly certain that the prejacent *is* true without having sufficient knowledge or convincing evidence. Normally, as we have more knowledge about the content expressed by the prejacent, we become more certain of its truth. The case I am mentioning here is completely opposite of the normal case. I assume that the degree of certainty will be expressed in the normal situation.

<sup>4</sup> In order to make this explicit, consider the following examples from Song (2007) which show semantic differences between epistemic *must* and *would*.

- (i) a. A: Who's the current Prime Minister of Denmark?  
 B: That would be Rasmussen.  
 b. B: That must be Rasmussen.

B's responses in (ia) and (ib) can be accepted as an appropriate answer to A's question, depending on the context of use. When the speaker chooses epistemic *would*, she has first-hand evidence that convinces her that the prejacent is true, implicating that she has a precise knowledge of what happens to an eventuality described by the prejacent. In

the second highest level of confidence, and so forth.<sup>5</sup>

In addition to this, it should be noted that unmodalized sentences make a stronger claim than epistemically modalized sentences (Giannakidou (1999), Karttunen (1972), Kratzer (1991), Lyons (1977), Perkins (1983), and Stone (1994) among others). Suppose you look out the window and see it is raining outside. Then you have to utter an unmodalized sentence like (3a) to describe the situation, whereas a modalized sentence like (3b) is not felicitous:

- (3) a. It is raining outside.  
 b. #It must be raining outside.

In contrast, suppose you are inside a building and see people coming in carrying a wet umbrella. The utterance of a modalized sentence like (3b) sounds appropriate in this situation.<sup>6</sup> In the former situation, the speaker of (3a) witnesses falling rain at the time

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contrast, this is not necessarily true of epistemic *must*. To see this, consider (i) once again. After reading an newspaper article about Rasmussen, Prime Minister of Denmark, the speaker B comes to know precisely who the Prime Minister of Denmark is. In this situation, B's utterance with *would* in (ia) is acceptable, whereas (ib) with *must* is not. This is an indication that the speaker B commits to the truth of his assertion under the scope of epistemic *would*. Suppose, in contrast, B, who has no idea who the Prime Minister of Denmark is, concludes from pieces of evidence that the Prime Minister is Rasmussen. Epistemic *must* is felicitous in this situation. That is, it must be the case that the speaker B in (ib) is very convinced that the Prime Minister is Rasmussen, but B does not commit himself to the truth of his assertion since epistemic *must* focuses on a reasoning process, as noted by Ward et al (2003). If B knew the identity of the Prime Minister at the time of the utterance of (ib), *must* in (ib) would be infelicitous.

<sup>5</sup> Celce-Murcia and Larsen-Freeman (1999) presents modal adverbials which are equivalent in meaning to the modal verbs in (2), as illustrated in (i):

(i)	must:	necessarily, very certainly	High Certainty
	will:	fairly certainly	
	should:	probable, probably, likely	
	may:	perhaps, maybe, quite possibly	
	could, might:	possible, possibly	Low Certainty

<sup>6</sup> It should, however, be noted that an unmodalized sentence like (3a) can be uttered in this situation as well. It seems to me that utterances are, whether they are modalized or unmodalized, closely related to the speaker's attitude toward how she interprets a body of evidence or knowledge available to her. Even when the speaker has indirect evidence that people are coming in holding an umbrella without directly seeing it is raining, she may accept it as sufficient and convincing evidence in some contexts –i.e. this reflects the speaker's assessment of the likelihood of the eventuality

of utterance, on the basis of which he or she asserts that it is raining. This implies that in uttering (3a), the speaker commits to the truth of the proposition expressed by (3a), because he or she indeed has available visual evidence that it is raining outside.<sup>7</sup> In the latter case, on the other hand, the speaker of (3b) uses the logical inference from a body of evidence that people who are walking into the building are holding a wet umbrella, instead of having no available direct evidence. To put it differently, in uttering an unmodalized sentence like (3a), the speaker has what Karttunen (1972) calls direct knowledge that involves no reasoning, yet this is not the case with a modalized sentence like (3b). An epistemically modalized sentence like (3b) implies that the reason for people's carriage of wet umbrellas is that it is raining, rather than that it must be the case that it is raining. In this sense, the epistemic modal seems to serve to signal the speaker's assessment of the likelihood that this is the right explanation of the situation under consideration. What we have discussed here might be a clue as to the account of why the unmodalized sentence makes a stronger claim than its corresponding modalized sentence.

Given what I have discussed so far, it seems to be clear that the purpose of this paper is two-fold; to provide a proper semantics of epistemic modality and to account for what is responsible for the difference in confidence between epistemically modalized sentences and unmodalized sentences. Traditionally, the semantics of epistemic modality is presented in terms of what is known. Thus, a sentence like (2b) is interpreted to mean that the person who is at the door is Mary is true in every world

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under consideration. When this happens, the speaker can use an unmodalized sentence to describe the situation in question. This will be discussed below in this paper.

<sup>7</sup> Lyons (1977) and Giannakidou (1999) makes a similar point by saying that the unmodalized sentence like *It is raining* plays the role of the speaker being more strongly committed to the truth of the proposition expressed by the sentence *It is raining* than the modalized sentence like *It must be raining*.

consistent with a body of (relevant) information that is known. There might be, however, cases where the information that is known produces an utterance with epistemic modals that is not appropriate for the context of use. Suppose that you know that the person who is at the door is Mary. In this circumstance, you can't make an utterance like *That must be Mary* in (2b), even though that the utterance is something that is entailed by what you know. This suggests that the what-is-known-based analysis is not on the right track. If this is right, what can be the right way to deal with the semantics of epistemic modals? This is one question whose answers this paper will explore. Besides this, recall that, as was discussed in (3a) and (3b), an epistemic modalized sentence like *It must be raining* and an unmodalized sentence like *It is raining* are both allowed in the situation where the speaker sees people carrying a wet umbrella. The question arises of how it is possible for the speaker to use different types of (un)modalized sentences to express different degrees of certainty even in the situation where she has exactly the same information or evidence. This is the other question whose answers this paper will investigate.

## **2. Standard Semantic Treatment of Epistemic Modals and its Limitations**

Necessity and possibility modals are represented as the necessity modal operator  $\Box$  and the possibility modal operator  $\Diamond$ , respectively. In possible worlds semantics, the modal operators are semantically dealt with in terms of an accessibility relation which holds between members in the set of possible worlds based on a relation  $R$ . For example, deontic modality is evaluated with respect to a set of accessible worlds consistent with what the law or regulation provides, and the accessible worlds for epistemic modality are, on the other hand, those that are compatible with what is known. The semantics of

necessity is based on entailment, whereas the semantics of possibility is given in terms of compatibility. In other words, necessity modals are treated as universal quantifiers over accessible worlds, and, on the other hand, possibility modals as existential quantifiers over accessible worlds. When it comes to the semantics of epistemic modals, as was mentioned briefly earlier, it is based on entailment or compatibility by what is known. According to the standard semantic analysis, including Kratzer's (1979, 1981, and 1991), epistemic necessity modals like *must* say that the proposition *p* under the scope of a modal operator is true in a world *w* iff *p* is entailed from what is known, whereas epistemic possibility modals like *may* and *can* asserts that the prejacent proposition is true in *w* iff *p* is compatible with what is known. The problem I'd like to mention about this kind of interpretation is that the notion of *what is known* is neither necessary nor sufficient for the semantics of epistemic modals, as argued by Westmoreland (1998).

To see this, consider the following scenario. Scenario #1: Suppose that one of your colleagues, namely John, never leaves his office without turning off the light, and you see that it is left on. It would be reasonable to utter the following sentence:

(4) John must be in his office.

A sentence like (4) is interpreted as John being in his office in all the best worlds compatible with what is known (i.e. the light is on in John's office). Scenario #2: Suppose, however, that you approach John's office, open the door, and see that he is in his office. In this case, it would sound extremely strange to utter (4). When you report this situation to another colleague of yours, you must use an unmodalized sentence, as

in (5):

(5) John is in his office

Then the question arises of why it would be inappropriate to say a sentence like (4), while this is not the case with (5), even though there is a body of evidence available to the speaker (i.e. the speaker has visual evidence because she sees that he is in his office). To put it differently, the semantics of an epistemic modal like *must* would have to predict that (4) is acceptable in scenario #2; *must(John-is-in-the-office)* is true in a world *w* iff *John is in the office* follows (or is entailed) from what is known to the speaker. The truth conditions for epistemic modals would be perfectly appropriate for (4), since the speaker knows that John is in his office for he has actually seen him in his office. Despite this, (4) with *must* in it is not acceptable in scenario #2, whereas the unmodalized sentence (5) is. This is not properly accounted for in terms of the classical modal semantics and Kratzer's (1991) theory of modality.

Another thing that is important to note is that the semantics of epistemic modal expressions in natural language are fundamentally analyzed in terms of modal logic which is involved in reasoning or inference with regard to necessity and possibility. In modal logic, system T, also known as Reflexivity Axiom, says that  $\Box p \rightarrow p$ , which means if *p* is necessary, then *p* is the case. As its name suggests, this axiom holds in circumstances where reflexivity relations are available to all the members in a set of accessible worlds. In epistemic logic, one sub-type of modal logic which is related to knowledge, the concept of "what is known" is basically marked as having a property of reflexivity. In other words, every accessible world compatible with what is known is in

reflexivity relations. Thus, System T is applicable to the semantics of epistemic modal expressions, as long as they are semantically defined in terms of the epistemic modal necessity operator  $\Box$ . However, this poses a problem since it leads to a strong claim about epistemic modals like *must* in natural language. To see this, consider the following sentences:

- (6) a. John must be sick  
 b. John is sick.

Under the assumption that *must* is treated as an epistemic necessity modal operator, a sentence like (6a) can be represented as  $\Box p$ , where  $p$  is a proposition expressed by (6b). According to System T, we can predict that “ $\Box p \rightarrow p$ ” holds. In other words, if *John must be sick* is true, then *John is sick* is true. However, this does not make sense at all. One should note that an unmodalized sentence like (6b) is definitely stronger than a modalized sentence like (6a), since the former commits to the truth of the proposition expressed by *John is sick*, while the latter implies that the speaker does not know for sure that John is sick. Given this, the truth of  $\Box p$  does not guarantee that of  $p$ . Therefore, System T does not hold in epistemic modals in natural language.

### 3. Epistemic Modality and Evidentiality

#### 3.1 How Is Epistemic Modality Related to Evidentiality?

Evidentiality refers to grammatical expressions that serve to signal a source of information or evidence the speaker has for her statement. To illustrate this, consider the following examples from Tuyuca, a Tucanoan language which is spoken in the western

Amazon region including Brazil and Colombia (Barnes (1984: 257)):<sup>8</sup>

- (7) a. *díiga*      *apé-wi*  
       soccer      play-Visual  
       ‘He played soccer.’ (I saw him play.)
- b. *díiga*      *apé-ti*  
       soccer      play-Nonvisual  
       ‘He played soccer.’ (I heard the game and him, but I didn’t see it or him.)
- c. *díiga*      *apé-yi*  
       soccer      play-Apparent  
       ‘He played soccer.’ (I have seen the evidence that he played: his distinctive shoe print on the playing field. But I did not see him play.)
- d. *díiga*      *apé-yigi*  
       soccer      play-Secondhand  
       ‘He played soccer.’ (I obtained the information from someone else.)
- e. *díiga*      *apé-hīyi*  
       soccer      play-Assumed  
       ‘He played soccer.’ (It is reasonable that he did.)

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<sup>8</sup> The English language is said to have no evidential system. So for the better understanding how the evidentials work in a specific language, I introduce Tuyuca that is one of the languages which show a great variety of evidentials. What is interesting here is that other Germanic languages like German Dutch than English have, if limited, evidential system which is usually expressed in terms of modal verbs. The function of evidentiality can be realized in English by using phrases like *I saw* and *I hear*, as in (i):

- (i) a. I saw him playing soccer.  
       b. I heard that he played soccer.

Strictly speaking, however, those expressions are not taken to be evidential markers since it is expressed with morphemes.

The examples in (7) show that Tuyuca has at least five distinctive evidentials: Visual, Nonvisual, Apparent, Secondhand, and Assumed.<sup>9</sup> All the sentences in (7) illustrate that the proposition expressed by the sentence *He played soccer* is interpreted differently, depending on which type of evidential marker is used in a sentence. A sentence like (7a) conveys a strongest claim since the source of information is direct visual evidence. Even though direct evidence occurs in (7b), (7b) is still weaker than (7a) because the source of information is direct nonvisual evidence. According to Barnes (1984), Apparent evidence occurs when the speaker draws conclusions from direct evidence, while Assumed evidence is used when the speaker has ‘prior knowledge’ about the state of things or habitually general behavior patterns (Barnes (1984: 262)).<sup>10</sup>

It is generally held in the literature that the difference in grammatical functions between evidentiality and epistemic modality lies in the fact that as we saw in (7a-e), the former plays the role of encoding sources of evidence—whether it is direct or indirect evidence<sup>11</sup>—on which the speaker bases her statement, whereas epistemic modality which is involved in necessity and possibility with respect to what is known or available

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<sup>9</sup> If we sort the evidentials in Tuyuca on the basis of Willett’s taxonomy, Visual and Nonvisual belong to Attested evidence, Secondhand Reported evidence, and finally Apparent and Assumed Inferring evidence. Notice that nonvisual is equivalent to other sensory evidence in Willett (1988).

<sup>10</sup> Faller (2002) argues that the distinction Barnes (1984) makes between Apparent and Assumed is not on the right track. Her argument is based on the fact that both of them can be used in a situation where the speaker draws a conclusion from direct evidence. Her account of them is that the difference is due to the degree of strength of the available direct evidence. The speaker’s use of the Apparent evidence indicates that she has strong direct evidence on which she bases her convincing inference, whereas in case of the Assumed evidence, the speaker leaves open the possibility that her inference might be wrong. Notice that Faller’s distinctions still suggests that the Apparent evidence makes a stronger claim than the Assumed evidence.

<sup>11</sup> After investigating cross-linguistic evidential markers, Willett (1988:57) proposes a taxonomy of evidential types. According to him, the type of evidentials is divided into Direct and Indirect evidence. Direct evidence, which is labeled as Attested, is composed of visual, auditory, and other sensory evidence. Indirect evidence is further split into Reported and Inferring. Reported evidence is further subdivided into second-hand, third-hand, and folklore evidence, whereas Inferring evidence results and reasoning. In addition, he also labels second-hand and third-hand evidence as hearsay. The second-hand evidence refers to the situation where the speaker obtains information from direct witness, and the third-hand evidence, on the other hand, is related to the speaker getting information from someone who is not direct witness. Evidence from folklore pertains to the case where the speaker bases sources of information on the story that has been transmitted from generation to generation. The inference from results differs from the inference from reasoning in the sense that the former and the latter are involved in inferring something on the basis of observable evidence (i.e. the results of an eventuality), and intuition and logic (or mental construct), respectively.

evidence expresses the speaker's attitudes toward the prejacent, or the judgment of the truth of the prejacent, as in a sentence like *John must be honest*, which describes the speaker's certainty of the prejacent proposition (cf. Dendale and Tasmowski (2001), Faller (2002), de Haan (1999), and Sweester (1990) among others). Many linguists have agreed with the claim that there are certain connections between epistemic modality and evidentiality (cf. Bybee (1985), Chafe (1986), Drubig (2001), Faller (2002), von Stechow and Gillies (2007), Lyons (1977), Palmer (1986), and Willett (1988)). It is, however, still contentious how the former is related to the latter and vice versa, let alone draw the boundaries between them. One view of this could be to say that evidentiality is sub-part of epistemic modality. Palmer (1986) conceives of evidentiality as a part of epistemic modality in the sense that it expresses an indication of reliability of the speaker's knowledge. Bybee (1985) also take a position on this matter by treating evidentiality as part of epistemic modality. Another view we can think of could be to say that evidentiality includes epistemic modality. For instance, Chafe (1986) divides evidentiality into two types: the broad sense of evidentiality which involves the speaker's attitudes toward her knowledge, and the narrow sense of evidentiality which conveys the source of the speaker's knowledge or information. This amounts to saying that epistemic modality is included in evidentiality. What one should note here is that the view mentioned above suggests that the two categories both belong to as a single grammatical category, since one is a sub-category of the other.

Dendale and Tasmowski (2001), Faller (2002), and Van der Auwera and Plungian (1998) take a position against the views that has been addressed above. They claim that evidentiality and epistemic modality are separate grammatical categories, but have an overlapping (or intersective) relation to each other. The following examples

from Western Tarahumara, a Uto-Aztec language show that the two categories are disjoint:<sup>12</sup>

- (8) a. alué hu-rá (Burgess (1984:104))  
       he be-QUOT  
       ‘They say it is he.’
- b. rahá-ra-guru  
       burn-QUOT-truth  
       ‘They say he burned it and it’s probably true.’
- c. simí-le-ga-ra-e  
       go-Past-STAT-QUOT-DUB  
       ‘Someone said he went out but he didn’t.’

In (8), the quotative (or reportive) suffix *-rá*, can occur with a suffix that indicates truth or doubt. The suffix indicating truth or doubt is taken to be a pure epistemic morpheme since it carries out the speaker’s assessment of the truth of the proposition under consideration.<sup>13</sup> A sentence like (8a) where only an evidential marker occurs does not show the speaker’s commitment to the truth of the proposition. In sentences like (8b-c), in contrast, evidential marker is followed by epistemic markers, which displays the speaker’s judgment or evaluation of the proposition. The above examples show that evidential markers can occur in a sentence with or without epistemic markers. This is an indication that evidentiality and epistemic modality are independent of each other. If

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<sup>12</sup> Faller (2002: 84) also presents similar examples from Cuzco Quechua that are in favor of this.

<sup>13</sup> One should recall the definition of evidentiality and epistemic modality that I have discussed at the beginning of this section.

they belonged to the same category, it would be difficult to explain why one can occur with the other in a single sentence. So the sub-part relation should be ruled out. Given this, the separation of epistemic modality and evidentiality appears to be on the right track.

Following Dendale and Tasmowski (2001), Faller (2002), de Haan (1999), and Van der Auwera and Plungian (1998) among others, I will adopt the overlapping relation between epistemic modality and evidentiality, based on the claim that they are separate. The overlapping relation is more reasonable than the sub-part relation, as we saw in the above examples from Western Tarahumara. Modality has different flavors of modal forces such as epistemic, deontic, and circumstantial modality and so forth. Evidentiality shows different sources of information such as visual, auditory, or inferential evidentials, as was mentioned in (8a-e) above. Epistemic modality overlaps inferential evidentiality among those different flavors and sources, since they have it in common that they are involved in *inference*.<sup>14</sup> Epistemic modals signal that there exists an indirect inference from the source of information. This implies that they have a flavor of evidentiality besides an aspect of epistemic modality. In other words, they have both an epistemic and an evidential flavor. The evidential component represents a source of information, while the epistemic component is involved in the assessment or judgment of the source of information.

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<sup>14</sup> According to Van der Auwera and Plungian (1998), epistemic necessity overlaps inferential evidentials because both categories convey “the certainty of a judgment relative to other judgment” (Van der Auwera and Plungian (1998:85)). They also argue that as for epistemic possibility, there is no overlapping relation to inferential evidentials. One should note that like epistemic necessity, epistemic possibility is also connected to inferential evidence, which is too weak to reach a firm conclusion, as noted by Palmer (2001) and Faller (2002). This is an indication that we can extend Van der Auwera and Plungian’s proposal to epistemic possibility. Faller (2002) takes a different position on this matter than Van der Auwera and Plungian (1998). She is in favor of the extended version, since the inferential evidential marker *-cha* in Cuzco Quechua, which is equivalent to epistemic possibility, describes a possibility on which the speaker’s reasoning is based. Thus, in Faller’s point of view, there is a overlapping relation between epistemic modality (necessity or possibility) and inferential evidentiality. I will follow Faller’s position in this paper.

### 3.2 Advantages

English epistemic modals like *must* incorporate an indirect evidential or more precisely an inferential evidential, as was addressed in the previous sub-section. Thus, they play the role of signaling the sources of information, evidence, or knowledge on which the speaker bases her statement or conclusion. In what follows, I will illustrate that the evidential meaning needs to be incorporated into the semantics of epistemic modals.

Consider scenario #1 and #2 which has been mentioned in Section 3 once again, along with (4) and (5), repeated below as (9) and (10), respectively:

(9) John must be in his office.

(10) John is in his office.

The above examples show that the semantic analysis of an epistemic modal like *must* based upon what is known is not sufficient to deal with the epistemic use of *must*. However, the incorporation of evidentiality into the semantics of *must* could provide a solution to this problem. As an evidential, *must* functions to play the role of encoding a source of information or evidence on which the speaker makes a statement.<sup>15</sup> It follows from this that the prejacent proposition is a conclusion that the speaker can reach from the source of information. In scenario #1, for example, the speaker of (9) has arrived at the conclusion that John is in his office, on the basis of the visual evidence that the light is on in his office. The visual evidence is encoded as inferential, one type of sources of information. In other words, (9) is, under scenarios #1, understood to mean that the speaker has a piece of observed evidence that she has seen that the light is left on in

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<sup>15</sup> This is not to say that epistemic *must* should be taken to be a pure evidential marker. Instead, what I am claiming in this paper is that it has both an epistemic modal component and an evidential component, as was mentioned above.

John's office, therefore she concludes that he is in his office.<sup>16</sup> In contrast, in scenario #2, the speaker has actually seen that John is in his office. This is a visual evidential which is included in direct evidence. Thus, in (9), the use of *must* which has a flavor of inferential evidential is in conflict with the visual evidential. Direct evidentials like visual ones are more reliable than indirect evidentials like inferential, and hence, in scenario #2, the unmodalized sentence like (10) is acceptable, whereas the epistemically modalized sentence like (9) is not. This shows that the evidential meaning constitutes a part of the semantics of epistemic modality.

Another point I'd like to make regarding the incorporation of epistemic modals into evidentiality is that it has an advantage over the classical modal semantics in the sense that it can account for the fact that there is difference in strength between modalized sentences and their corresponding unmodalized sentences. Epistemically modalized sentences like (9) are weaker than their corresponding unmodalized sentences like (10)<sup>17</sup> (von Stechow and Gillies (2007), von Stechow and Iatridou (2006), Karttunen (1972), and Perkins (1983) among others). As Karttunen (1972), and Westmoreland (1998) point out, (9) implies that when uttering (9), the speaker has no first-hand evidence that leads her to conclude that John is in his office, nor does she have any sources trustworthy or reliable enough to assert that John is in his office. Instead, the proposition expressed by (9) logically follows from other established facts and evidence available to the speaker. In contrast, the utterance of (10) is an indication that the speaker has established facts or pieces of direct evidence about John being in

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<sup>16</sup> Sweetser (1990) and Westmoreland (1998) make a similar point in the interpretation of epistemic *must*. According to Sweetser, a sentence like (9) is paraphrased as this: The available direct evidence compels the speaker to conclude that John is in his office. Notice that Westmoreland (1998) argues that epistemic necessity should be treated as evidentiality, rather than as epistemic modality. This is a different point from what I am arguing here.

<sup>17</sup> It should be noted that this is not properly accounted for within the modal semantics, including Kratzer's (1991) system.

his office (i.e. the speaker actually sees that John is in the office) which grant her a strong assertion that John is in his office. A sentence like (10) requires no logical inference or reasoning whatsoever, while this is not the case with (9). Thus, this might provide a clue as to the answer to the question of why (9) with *must* is weaker than its corresponding unmodalized sentence in (10).<sup>18</sup>

Cross-linguistic examinations of evidentials show that they have language-specific hierarchies which spell out an order of evidential types according to directness or reliability (cf. Barnes (1984), Faller (2002), de Haan (1999), Oswald (1986), and Willett (1985) among others). For example, de Haan (1998, 1999) proposes a cross-linguistic evidential hierarchy. He argues that evidential types are ordered on a scale according to the reliability of sources of information, as shown in (11).<sup>19</sup>

(11) Visual < Auditory < Nonvisual < Inferential < Reportative (quotative)  
 ← more reliable                      less reliable →

Besides, he associates the evidential hierarchy in (11) with Horn scales. That is, the use of a lower-ranking evidential on the scale implicates that the speaker does not have a higher-ranking source of information, which is exactly like scalar implicature. In order to save space, I have not discussed the proposals of hierarchical structures of evidentials by other scholars who have mentioned above,<sup>20</sup> but one should notice that there is a disagreement on the details of the evidential hierarchy.<sup>21</sup> In spite of this, there appears

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<sup>18</sup> It should be noted that the standard modal semantics, including Kratzer (1991), fails to answer the question.

<sup>19</sup> de Haan (1999) simply assumes that inferential is more reliable than reportive without providing any evidence for this.

<sup>20</sup> I will not go into discussing this in detail because what I have discussed here is sufficient to explore the question we are considering now. Besides, the detailed discussion of hierarchy is beyond the present study.

<sup>21</sup> The linguists mentioned here come up with different hierarchical structures. This might be due to the fact (i) that

to be an overall agreement: Visual < Other Sensory < Inference.

Let us get back to the main line of discussion, and see how the question under consideration will be answered. According to the evidential hierarchy, direct evidentials such as visual and auditory evidence rank higher than indirect evidentials such as reportive and inferential evidence. This is because the hierarchy says direct evidentials count as a more reliable source of information than indirect evidentials. Thus, a modalized sentence like (9) is surely predicted to be weaker than a unmodalized sentence like (10), since the former and the latter are involved in a visual evidential and an inferential evidential, respectively. If we incorporate evidentiality, we can easily take account of why modalized sentences are weaker than unmodalized ones, as far as epistemic modality is concerned.

#### **4. Properties and Functions of the Evidential Judgment List**

##### **4.1 Evidential Judgment List**

Recall from the previous section that epistemic necessity modality is marked as an evidential in one sense, and as an epistemic modality in other sense. The encoding of the source of information, more precisely inferential evidential, signals that the prejacent proposition is reached on the basis of the inferential evidential, but the strength of the statement (or the prejacent) pertains to the speaker's judgment or

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the languages they look into are different in a way that they have evidential system –i.e. some languages are more abundant in evidential system than other languages, and (ii) that they set up different ordering criteria such as directness or reliability etc. For example, Barnes (1984) proposes the following hierarchy based on Tuyuca: Visual < Nonvisual < Apparent < Secondhand < Assumed. Willett (1988), who examines cross-linguistic evidential markers, ranks evidential types on the basis of directness and reliability: Attested (Direct) < Reported < Inferring. Faller (2002) proposes an evidential hierarchy in which a two-dimensional ordering is placed on a scale of evidential types with different ordering criteria–i.e. the amount of inference required to reach a statement, as in Visual < Auditory < Other Sensory < Inference from Results < Reasoning, and the number of the intervening speakers, as in Direct < Second-hand < Third-hand < Hearsay / Folklore.

evaluation of what is expressed by the prejacent. In other words, the inferential evidence plays the role of leading the speaker to some certain conclusion, while the speaker's judgment (or evaluation) plays a role in leading the speaker to have certain attitude toward the statement, i.e. whether or not she has a high level of confidence in the prejacent proposition.

This is supported by the following example. Suppose you are inside a building and see people coming into the building carrying a wet umbrella. Based on this, you might make utterances like (12a-c):

- (12)    a. It may be raining outside.  
           b. It must be raining outside.  
           c. It is raining outside.

A *may*-modalized sentence like (12a) makes a weaker claim than a *must*-modalized sentence like (12b), which is in turn weaker than unmodalized sentence like (12c). The inferential evidential source of evidence on which the speaker bases her statement is that she has seen people holding a wet umbrella, but the speaker can express different levels of confidence in the proposition by uttering (12a), (12b) or (12c). This is due to the speaker's attitude about the encoding of the source of information. In other words, the speaker's assessment of indirect evidence which is associated with epistemic modals determines which modalized sentence to choose. Epistemic modality indeed marks the speaker's judgment of how the indirect evidence is evaluated or encoded. If we assume that epistemic modals are pure evidential markers, we will have difficulty accounting for why sentences like (12a-b) are appropriate in this situation. This shows that

epistemic modality has an evidential and an epistemic modal component.

From the above example, the speaker has some evidence that people walking into the building are carrying a wet umbrella, and based on the evidence, she has reached the conclusion that it is raining outside. One should, however, notice that sentences like (12a-c) are all appropriate even when exactly the same evidence is available to the speaker. This shows that how the speaker evaluates the source of information (i.e. the inferential evidential—people carrying a wet umbrella) plays a significant role in determining which modalized sentence should be chosen from (12a-c). In other words, the degree of confidence in the speaker's assertion based on the evidence depends on the way she assesses it. The speaker's attitudes toward the evidence will definitely affect her choice of epistemic modals. If the speaker believes that the evidence is strong enough to conclude that it is raining outside, she will choose to use a sentence with epistemic *must*. If the speaker believes that the evidence is weak, on the other hand, she will choose to use a sentence with epistemic *may*. In this sense, the choice of epistemic modals is purely dependent on the speaker's assessment or judgment of the evidence under consideration.

In order to capture this property of epistemic modality, I propose in this paper that the speaker uses a set of inferring principles that pertains to the speaker's beliefs and knowledge, when evaluating and judging a source of information. The inferring principles represent the way the speaker makes an inference from the evidence available to her, and we label the set of inferring principles an Evidential Judgment List. The Evidential Judgment List is a set of propositions representing a body of indirect evidence as well as the inferring principles that are associated with what the speaker believes about it. It reflects the beliefs or attitudes which the speaker has about the

encoding of a source of information. Each individual is assumed to have her own Evidential Judgment List, which is constantly updated when new evidence is introduced in the context. On the basis of the List, the speaker judges the way inferential evidence<sup>22</sup> is encoded, and consequently, this will play the role of determining how confident the speaker is of the content of the prejacent proposition.

#### 4.2 Epistemic Modals and Presuppositions

I have argued in this paper that epistemic modals are involved not only in an epistemic aspect but also in an evidential aspect. When it comes to the evidential aspect, epistemic modality is involved in inferential evidential which is one type of indirect evidence in the field of evidentiality. A body of available evidence signals the use of an epistemically modalized sentence. According to this, the following sentence

(13) It must be raining.

can be understood to mean that given the source of information, or inferential evidence (i.e. the speaker sees that people are coming into the building carrying a wet umbrella), the speaker is quite certain that it is raining. What has made the speaker of (13) reach such a conclusion? Needless to say, it is the indirect evidence that people are carrying a wet umbrella that has led her to firmly believe that it is raining. How can we capture this kind of evidential flavor in epistemic modality? To find answers to this question seems to pose a theoretical challenge to the semantic area, since the meaning of evidentiality, especially the semantics of epistemic modality based on evidentiality, has

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<sup>22</sup> Remember that inferential evidence is a source of information that is related to epistemic modality.

been usually dealt with within pragmatics, which indicates that the analysis of the meaning of evidentiality goes beyond the semantic area. For this reason, this section is devoted to discussing how to find out the answer to the above question.

Consider (13) once again. It is certain that the speaker of (13) bases her statement on the (visual) evidence. Without the evidence, the speaker wouldn't make such an utterance at all. Thus, it seems to be reasonable to say that when making an utterance, the speaker has evidence signaling her readiness to use an epistemic modal in the utterance. This suggests that the use of the epistemic modal appears to be involved in presuppositions (cf. von Stechow and Gillies (2007), Izvorski (1997), and Song (2008) among others). More precisely, the epistemic modality presupposes that the speaker has evidence supporting the content of the prejacent proposition, as illustrated in the following:

- (14)  $EM\phi$  presupposes that the speaker has evidence for  $\phi$ , where EM stands for an epistemic modal operator.

One should note that the presuppositions induced by epistemic modals are compatible with the speaker's Evidential Judgment List (henceforth EJL). If the presupposition is felicitous in a given context, the evidence supporting (or licensing) the use of a modalized sentence will be added to the speaker's Evidential Judgment List, consequently updating it. If not, the evidence is not compatible with the speaker's EJL, and thus it does not affect the List. For example, the speaker can reach a conclusion that John is in his office, based on the observable evidence that the light is on in his office, as in the example we have seen above. This kind of inference is possible only if the

evidence on which the speaker bases her statement is compatible with the speaker's Evidential Judgment List. If not, the observable evidence would crash.

The fact that the presupposition triggered by the epistemic modal holds suggests that the speaker has appropriate evidence for her conclusion expressed by the prejacent. When this happens, the evidence is compatible with the speaker's EJM. If the evidence is compatible with the speaker's EJM, it will be added to the speaker's existing EJM. The addition of it to the EJM results in updating the EJM to a new EJM, shrinking the size of the speaker's EJM. In other words, the new evidence (i.e. the proposition expressed by the evidence) intersects with sets of propositions denoted by the speaker's EJM, and thus we only consider a set of possible worlds in which all the propositions in the updated EJM are true. This is reminiscent of a context set proposed by Stalnaker (1974, 1978). Accepting that a proposition is a set of possible worlds, he defines the context set as a set of possible worlds that are compatible with all the propositions shared by the participants in the conversation. One should, however, note that the EJM is different from the context set in two aspects. First, the propositions in the context set are mutually accepted ones. In contrast, the EJM does not consist of mutually accepted propositions. Instead, all the propositions in the EJM are the ones accepted by the speaker only. Second, the propositions in the context set are not necessarily ones that all the participants believe to be true, whereas the propositions in the EJM are what the speaker believes to be true.

#### 4.3 The Evidential Judgment List Update

As was mentioned in the previous section, the presuppositions which are triggered by the use of modals and which are felicitous have the EJM updated. This amounts to

saying that the use of modals is licensed in the context. Once the use of modals turns out to be appropriate for the context of use, the speaker will evaluate the evidence which has triggered the presupposition, on the basis of the speaker's EJP. Then the speaker tends to make a decision on the choice of modals, depending on how certain the speaker is of the proposition entailed by the evidence. In this sense, the speaker's EJP plays an important role in judging the evidence. For its better understanding, I will mention some characteristics of the speaker's EJP which are assumed in this paper. I assume that the speaker's EJP are propositional, which means the speaker's EJP are expressed in the form of propositions. In most cases, a body of evidence is presented non-linguistically to the speaker. Despite this, all the evidence that is available to the speaker is assumed to be represented by propositions.

Another characteristic is that the speaker's EJP dynamically changes as a result of the addition of new evidence to it. When new evidence, which is expressed in the form of a sentence  $\psi$ , becomes available to the speaker, the speaker will incorporate it into her EJP by adding it to her existing EJP set-theoretically, as in  $EJP + \psi = EJP'$ , where  $EJP' = EJP \cup \{\psi\}$ . This indicates that the speaker's EJP is expanded by  $\psi$ . Thus, I will name this an expansion operation. However, such an expansion does not always work. We can think of two cases where the expansion of the speaker's EJP fails: redundancy and contradiction. If  $\psi$  is redundant in the sense that the proposition expressed by it is already in the speaker's EJP, the EJP does not change at all. That is, if  $\psi$  is a member of EJP, then  $EJP'$  is equivalent to EJP. If the new evidence  $\psi$  contradicts the speaker's EJP, the resulting EJP will be inconsistent. In order to prevent EJP from being inconsistent, we need to remove all the propositions in EJP that contradict  $\psi$ . This

can be done in two steps. First, eliminate propositions in E<sub>JL</sub> that are contradictory to  $\psi$  in such a way that the outcome is a set of propositions in E<sub>JL</sub> that are consistent with the new evidence  $\psi$ , as in (15)

$$(15) \quad E_{JL}' = E_{JL} \cap \{\neg\psi\}$$

We now have the updated E<sub>JL</sub>' that is consistent with  $\psi$ . The next step is to expand E<sub>JL</sub>' by adding  $\psi$  to E<sub>JL</sub>' through the expansion operation. I will refer to this kind of procedure as an elimination operation. The expansion operation and the elimination operation indicates that the speaker's E<sub>JL</sub> takes new evidence as its argument and returns the updated E<sub>JL</sub>, i.e. it denotes a function from E<sub>JL</sub> to E<sub>JL</sub>.

### **5. Inference from the Updated Evidential Judgment List**

I assume in this paper that the speaker's E<sub>JL</sub> is a set of propositions that represent a body of evidence, and it is non-logically closed. What is entailed by the E<sub>JL</sub> is, however, logically closed under consequence operations. To put it differently, every proposition that is inferred from the E<sub>JL</sub> is a logical consequence of the speaker's own E<sub>JL</sub>. For instance, if a person believes a proposition  $p$ , which implies that  $p$  is in her E<sub>JL</sub>, then she also believe the proposition expressed by “ $p$  or  $q$ ”, not by “ $p$  and  $q$ ”, to be true, and thus “ $p$  or  $q$ ”, not “ $p$  and  $q$ ”, is also in her updated E<sub>JL</sub>. If both  $p$  and  $q$  are in the speaker's E<sub>JL</sub>, then the proposition expressed by “ $p$  and  $q$ ” is a member of her updated E<sub>JL</sub>. Generally speaking, every proposition that is logically inferred from the speaker's E<sub>JL</sub> belongs to her E<sub>JL</sub> (i.e. more precisely, her updated E<sub>JL</sub>).

To incorporate this idea, I will introduce an operator that plays the role of

abstracting everything that logically follows from EJL, following Hansson (1999). The operator is referred to as the consequence operator *Con*. The operator *Con* is a function that assigns to an element in EJL a proposition that logically follows from EJL. Given this, we can define  $Con(P)$  as follows:

- (16) For any set of propositions  $P$ ,  $Con(P)$  is a set of propositions of  $P$  which logically follows from  $P$ .

If a set  $P$  is closed under logical consequences, it has its own logical inference, and hence  $Con(P)$  is a subset of  $P$ . If a proposition  $p$  is a logical consequence of  $P$ , then the following will hold:

- (17)  $p \in Con(P)$  holds iff  $p$  is a logical consequence of  $P$

(17) says that a proposition  $p$  follows logically from a set  $P$  just in case  $p$  is an element of a set of things of  $P$  that logically follows from  $P$ .

With this in mind, let us discuss how the consequence operator will be incorporated into the semantics of epistemic modals. For convenience's sake, I will introduce an individual  $a$  and a possible world in the representation of EJL, as in  $EJL\langle a, w \rangle$ , which represents "a's EJL in a world  $w$ ." Given this, we can represent everything, more precisely, every proposition that is inferred from  $a$ 's EJL in a world  $w$ , as in (18):

- (18)  $Con(EJL\langle a, w \rangle)$  denotes a set of logical consequences of  $a$ 's EJL in  $w$ .

When the updated EJL' is obtained as a result of the addition of new evidence to the existing EJL, we can get a set of propositions that are logically inferred from a' EJL' in  $w$  in terms of the consequence operator  $\text{Con}$ , as in  $\text{Con}(\text{EJL}'\langle a, w \rangle)$  which represents a set of propositions that logically follows from the updated EJL an individual  $a$  has in  $w$ . For instance, suppose an individual  $a$  sees people carrying a wet umbrella. This evidence will be added to  $a$ 's existing EJL, resulting in the updated EJL'. Given this, we can possibly infer that it is raining outside. The proposition expressed by *It is raining outside* is something that can be entailed by the evidence. We can get the resulting consequence in the two stages, as was discussed in the previous section. In the first stage, the new evidence is added to  $\text{EJL}\langle a, w \rangle$  and then the consequence operator applies to the updated  $\text{EJL}\langle a, w \rangle$  that is obtainable from the application of the expansion and elimination operation. That is, the proposition is a member of  $\text{Con}(\text{EJL}\langle a, w \rangle \cup \{\text{people are carrying a wet umbrella}\})$ .

## 6. Formalization

It has been argued above that the interpretation of the epistemic modals is involved in the two different aspects: modality and evidentiality. What is mainly concerned with in this section is, thus, to present reasonable explanations of how the two aspects incorporate into the semantics of the epistemic modals; specifically to explore how the evidential aspect can be embodied in the semantic analysis of epistemic modality.

Following Kratzer (1977, 1981, and 1991), I will accept the claim that two parameters such as a modal base and an ordering source are involved in the semantic

treatment of the epistemic modals.<sup>23</sup> The modal base is a conversational background which is closely related to the fundamental understanding of the modal relation, and the ordering source is, on the other hand, viewed as a stereotypical conversational background which plays the role of imposing an ordering among accessible worlds.<sup>24</sup> Conventionally, the epistemic modal base is taken to be a set of propositions that are known to the speaker. What I am doing here, however, departs from the conventional notion of the epistemic modal base. I assume that the epistemic modal base is the Common Ground (henceforth CG) in the sense of Stalnaker (1974 and 1978). The CG is refers to a set of propositions mutually shared by the participants in a conversation. In this sense, the CG is a kind of a background of beliefs or assumptions commonly accepted by the speaker and her addressee as true. This kind of background plays the role of making the conversation go smoothly. We don't have to say things that are already mutually assumed by the speaker and the addressee in the CG since this would be redundant, nor do we assert that things which are incompatible with the CG since this would be self-contradictory. Thus, no propositions which are redundant and contradictory to the existing CG can be admitted into the current CG. This implies that the participants in the conversation who are mutually aware of the CG decide whether to accept a newly introduced assertion (or proposition) as being compatible with the current CG. When it does not show any redundancy or contradiction, it is admissible into the CG-i.e. it becomes a member of the CG. The admission is something similar to the addition of the proposition the new assertion denotes to the CG, resulting in the CG

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<sup>23</sup> Even though I employ Kratzer's notions like the modal base and the ordering source in this paper, the basic ideas of those two notions I will propose here are somewhat different from Kratzer's, as we will see below.

<sup>24</sup> One should note that this is how Kratzer's (1991) framework of modality describes the characteristics of the ordering source. I will, however, come up with a different type of ordering source based on the view of the epistemic modals as involving evidentiality, as we will see below.

which is updated. The CG constantly updates itself in this way, whenever an assertion is newly introduced in the discourse of conversation. Thus, the CG is said to be more convenient for the addition of a proposition than the conventional epistemic modal base.

Since we have seen that the semantics of the epistemic modal is involved in epistemic modality and evidentiality, the Common Ground and the Evidential Judgment List need to be very closely related to each other. One should note that the former and the latter are pertinent to the epistemic modal aspect and the evidential aspect of epistemic modality, respectively. The CG plays a fundamental role in selecting (relevant) possible worlds where a set of propositions that the participants in the conversation believe to be true might be evaluated. On the other hand, an individual  $a$ 's EJP places an ordering on the possible worlds compatible with the CG, indicating the possible worlds which are most highly ranked are included in the relevant possible worlds, while this is not the case with the possible worlds which are not best-ranked. In this sense, the CG is to the epistemic modal base what the EJP is to the ordering source. Thus, they are closely connected to each other when it comes to the interpretation of the epistemic modals.

I will take the CG, which is regarded as the epistemic modal base, to be a pair of an individual (or an agent)  $a$  and a world  $w$ , as in  $CG(\langle a, w \rangle)$ , which means the CG an agent  $a$  has in a world  $w$ . Given this,  $CG(\langle a, w \rangle)$  can be taken to be the epistemic modal base for an individual  $a$  in  $w$ . Let  $W$  be the set of possible worlds and  $CG$  be a function which assigns to every agent-world pair a set of propositions that the participants in the conversation mutually assume to be true. The epistemic modal base can be represented by the following:

$$(19) \quad CG(\langle a, w \rangle) = \{p: a \text{ accepts } p \text{ to be true in } w \text{ by } a\}$$

Given  $CG(\langle a, w \rangle)$  which is the epistemic modal base, we can determine the epistemic accessibility relation. The epistemic accessible worlds can be defined as a set of possible worlds where all the propositions in  $CG(\langle a, w \rangle)$  are true, more exactly, for any world  $w$  and  $w'$ ,  $w'$  is an accessible world from  $w$  if and only if every proposition in  $CG(\langle a, w \rangle)$  is true in  $w'$ , as in  $\cap CG(\langle a, w \rangle)$ . The epistemic accessible worlds can be represented as in (20):

$$(20) \quad \cap CG(\langle a, w \rangle) = \{w' \in W: \forall p[p \in CG(\langle a, w \rangle) \rightarrow w' \in p]\}$$

The definition in (20) denotes a set of possible worlds where every proposition in  $CG(\langle a, w \rangle)$  is true. This plays the role of restricting the domain of the epistemic modals by selecting only relevant possible worlds.

The domain of the epistemic modal needs to be further restricted by the ordering source, since we need to identify a set of correct, more precisely relevant worlds where the prejacent in the question is evaluated. As was mentioned above, an agent  $a$ 's EJM is associated with the ordering source. Let  $g$  be a function that assigns to every possible world a set of propositions following logically from a set of propositions in an individual  $a$ 's EJM. This can be represented as follows:

$$(21) \quad g(\langle a, w \rangle) = \{p: p \in \text{Con}(\text{EJM}\langle a, w \rangle)\}$$

The ordering source generated by  $g(\langle a, w \rangle)$  represents a set of propositions which

logically follow from the agent  $a$ 's EJL. The set of propositions in  $g(\langle a, w \rangle)$  is a conversational background which plays a significant role in imposing an ordering on accessible worlds in  $\cap CG(\langle a, w \rangle)$ . In this sense,  $g(\langle a, w \rangle)$  is a set of propositions that can be used as the ordering source which determines the order of possible worlds. In other words, the set of worlds which are best-ranked according to the ordering  $\leq_{g(\langle a, w \rangle)}$  established by the set of propositions  $g(\langle a, w \rangle)$  is considered to be accessible worlds for the epistemic modals. This excludes worlds, which are in  $\cap CG(\langle a, w \rangle)$ , from a set of accessible worlds from  $w$ , if they do not turn out to be a best world according to the ordering source. Which world should be included in or excluded from the best-ranked worlds is determined by the conversational background called the ordering source. Thus, the primary function of the ordering source  $g(\langle a, w \rangle)$  is to determine which world is better than which world.

What has been discussed so far can be summarized as this: in the semantic interpretation of epistemic modality, the common ground provides a background of "open possibilities" –i.e. a set of relevant possible worlds which might be taken to be as actual as the actual world. And then a set of logical consequences from an individual's EJL imposes an ordering among those possibilities compatible with the common ground. The individual's utterance of epistemically modalized sentences is judged appropriate to the extent that it would make the possibilities best ranked according to that individual's EJL. This is to say that a body of (inferential) evidence orders the relevant possible worlds, ranking some as better than others. The proposition in the scope of the epistemic modal is evaluated on this ground. To see this, suppose that the individual  $A$ 's belief that people carry an umbrella when it rains is in the common ground.  $A$  sees people carrying a wet umbrella. This evidence would rank the world where it is raining highest among

other worlds according to A's EJL. Thus, A's utterance of an epistemically modalized sentence like *It must be raining* is true in this situation.

To implement the idea that has been mentioned above, we can define the ordering of accessible worlds in terms of  $\leq_{g(\langle a, w \rangle)}$  as follows:

- (22) For any world  $u$  and  $v \in CG(\langle a, w \rangle)$ ,  $v \leq_{g(\langle a, w \rangle)} u$  iff  $\{p: p \in g(\langle a, w \rangle) \text{ and } u \in p\} \subseteq \{p: p \in g(\langle a, w \rangle) \text{ and } v \in p\}$

One should remember that the propositions in  $g(\langle a, w \rangle)$  are those that follow from an individual  $a$ 's EJL in a world  $w$ . Definition (22) says that a world  $v$  is either better than or ranked the same as another world  $u$ , iff every position which is true in  $u$  is also true in  $v$ . It provides a partial order on the worlds compatible with  $\cap CG(\langle a, w \rangle)$ . The preajacent proposition, thus, has to be considered only in the best worlds. In other words, the domain of the epistemic modal is confined to the set of worlds in  $\cap CG(\langle a, w \rangle)$ -or the propositions in  $\cap CG(\langle a, w \rangle)$ , and this set is further restricted by the ordering generated by  $\leq_{g(\langle a, w \rangle)}$ . The set of worlds in  $\cap CG(\langle a, w \rangle)$  which are most highly ranked according to  $\leq_{g(\langle a, w \rangle)}$  is the accessible worlds for the epistemic modal. This amounts to saying that the ordering on the set of worlds in  $\cap CG(\langle a, w \rangle)$  plays the role of excluding those worlds which are away from the ideal established by  $\leq_{g(\langle a, w \rangle)}$ , even though they are in  $\cap CG(\langle a, w \rangle)$ . Given what has been discussed so far, we can state the semantics of epistemic *must* informally and roughly like this: *must( $\phi$ ) is true in  $w$  with respect to  $CG$  and  $g$  iff  $\phi$  is true in every best accessible world generated by the ordering source  $g(\langle a,$*

$w \succ$ ).<sup>25</sup> The semantics of epistemic *may* can be stated in the same manner, except that it existentially quantifies over the best accessible worlds. One should note that the two parameters—i.e.  $CG$  and  $g$ —involving the interpretation of the epistemic modals incorporate into an individual's EWL which represents a body of evidence available to that individual.

## 7. Analysis

This section is devoting to discussing how to account for the semantics of the epistemic modals which have the dual aspects, on the basis of what has been discussed so far. It has been widely accepted that in modalized sentences, modals, which are treated as operators, posit a logical relation between the restrictor and the prejacent proposition. To represent this, modalized sentences can be treated as (23) (von Stechow and Gillies (2007) and Papapragou (2000)), which departs from Kratzer (1991) that treats modals as scoping immediately over the prejacent (see also Butler (2003)):

- (23)  $M(R, \phi)$ , where  $M$  is a modal operator,  $R$  a modal restrictor (i.e. the conversational background), and  $\phi$  a prejacent proposition.

In (23), the modal operator is taken to be a two-place operator. In (23),  $R$  and  $\phi$  can be seen as a restrictor and a nuclear scope, respectively.  $R$  is so called since it plays the role of restricting the domain of the modal force. One should also note that  $R$  is something like a pronominal type of conversational background in the sense that their

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<sup>25</sup> Notice that this is a tentative semantic definition of epistemic must. I will provide the ultimate version of its semantics below in this section.

interpretations are entirely context-dependent, as noted by von Fintel and Gillies (2007). According to (23), the modal operator gets the prejacent  $\phi$  to bear a logical relation to a set of relevant propositions in the restrictor  $R$ . To see how (23) works, the formula  $must(R, \phi)$  can be truth-conditionally defined as  $must(R, \phi)$  is true in  $w$  iff  $\phi$  is true in every  $R$ -accessible world from  $w$  which is closest to the ideal. Based on this, we can define the semantics of epistemic *must* and *may* as (24a) and (24b), respectively:

- (24) a.  $\llbracket must(R, \phi) \rrbracket^{CG, g, w} = 1$  iff for every world  $w' \in \llbracket R \rrbracket^{CG, g, w}$ ,  $\llbracket \phi \rrbracket^{CG, g, w'} = 1$   
 b.  $\llbracket may(R, \phi) \rrbracket^{CG, g, w} = 1$  iff for some world  $w' \in \llbracket R \rrbracket^{CG, g, w}$ ,  $\llbracket \phi \rrbracket^{CG, g, w'} = 1$   
 (C.B:  $R = \{w' : w' \in \cap CG(<a, w>) \text{ and } w' \in \text{Best-Ranked}(<a, w>)\}$ )

Remember that  $R$  refers to a set of worlds that can be taken to be the accessible worlds for the interpretation of epistemic modals. This is how  $R$  is determined. First, extract a set of worlds where every proposition in  $\cap CG(<a, w>)$  is true, and the worlds in this set are ordered according to the ordering  $\leq g(<a, w>)$ , and then those worlds which are best-ranked belong to the restrictor  $R$ . To put it differently,  $R$  denotes a set of possible worlds in  $\cap CG(<a, w>)$  that are most highly ranked according to the ordering generated by  $g(<a, w>)$ . Those worlds in  $R$  are the set of accessible worlds. Given this, (24a) says that the prejacent proposition is true in every best accessible world, while (24b) says that the prejacent is true in some best accessible world. One should recall that as was mentioned above, a body of indirect evidence is incorporated into the calculation of the ordering source  $g$ . This shows that what the epistemically modalized sentence states follows from the evidence under consideration.

To see how the framework proposed in this paper works, consider once more the situation where John never leaves his office without turning off the light. Noticing that the light is on in his office, Mary can utter either of the following sentences:

- (25) a. John must be in his office.  
b. John may be in his office.

Obviously, Mary bases her utterance on the evidence that the light is on in John's office. As was mentioned above, the occurrence of epistemic modals in sentences like (25a) and (25b) presupposes that the speaker has a body of indirect evidence for the prejacent proposition. If the presupposition is satisfied in the context under consideration, then we can move on to calculate the semantics of the epistemic modals. Otherwise, the derivation of the semantics would crash. In other words, the modalized sentences in (25a) and (25b) would be assigned no truth conditions, which indicates the use of epistemic *must* and *may* is infelicitous in this context.

When the presupposition is felicitous, the next step is to update the agent's EJL after checking whether the evidence<sup>26</sup> is compatible with the EJL. If the evidence in question turns out to be compatible with the agent Mary's existing EJL, it is added to her EJL in terms of the expansion operation.<sup>27</sup> The outcome is something like (26) in which Mary's current EJL has been updated:

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<sup>26</sup> Remember that the evidence here is the same as that mentioned in the presupposition.

<sup>27</sup> As was discussed above in section 4.3, there are two cases where a body of new evidence is blocked from being added to the speaker's EJL: redundancy and contradiction. In the former, there is no change in the EJL, whereas in the latter, , and the expansion operation applies after all the propositions in EJL that contradict the new evidence have been eliminated. When saying the new evidence is compatible with Mary's EJL in this case, I presumably assume that the new evidence in question is far away from the redundancy and the contradiction case.

$$(26) \quad \text{EJL}'(\langle M, w \rangle) = \text{EJL}(\langle M, w \rangle) \cup \{\text{The light is on in John's office}\}$$

In (26),  $\text{EJL}'\langle M, w \rangle$  represents the updated EJL of Mary in a world  $w$ . Sentences like (25a) and (25b) can be semantically represented as (27a) and (27b) respectively:

- (27)    a.  $\text{must}(\text{R}, \text{be-in-his-office}(j))$ <sup>28</sup>  
           b.  $\text{may}(\text{R}, \text{be-in-his-office}(j))$

In (27a),  $\text{R}$  denotes a set of worlds which intersect the worlds where every proposition in  $\cap \text{CG}(\langle a, w \rangle)$  is true with the best-ranked worlds generated by a set of propositions in  $\text{Con}(\text{EJL}'(\langle a, w \rangle))$ . According to what has been mentioned above, in (27),  $\text{R}$  first selects a set of worlds obtainable from the accessibility relation  $\cap \text{CG}(\langle M, w \rangle)$  that represents a set of possible worlds where every proposition in  $\text{CG}(\langle M, w \rangle)$  is true. The set is further restricted by the ordering source generated by  $g(\langle M, w \rangle)$  or  $\text{Con}(\text{EJL}'(\langle a, w \rangle))$ . The ordering source here represents a set of possible worlds where every proposition that follows from the agent's  $\text{EJL}'$  is true. That is, the accessible worlds in  $\cap \text{CG}(\langle M, w \rangle)$  are ordered according to the ordering established by  $\leq g(\langle M, w \rangle)$ . The worlds that are best-ranked remain in the domain of the epistemic modal in question, more precisely in the restrictive clause  $\text{R}$ . The prejacent proposition in question is now evaluated in those worlds. According to the semantic definition of epistemic *must* in (24a), (27a) is true in  $w$  with respect to  $\text{CG}$  and  $g$ , iff the prejacent proposition *John is in his office* is true in every possible world which is most highly ranked according to the

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<sup>28</sup> For convenience's sake, the possessive pronoun *his* is taken to be part of the whole predicate since the interpretation of the pronouns is not the purpose of the present study. Besides, I take *be-in-his-office* to be a one-place predicate, which is of type  $\langle e, t \rangle$ .

order generated by  $\leq_g \langle M, w \rangle$ , or  $\leq_{\text{Con}}(\text{EJL}' \langle M, w \rangle)$ . This indicates that after the evidence under consideration (i.e. The light is on in John's office) has been added to Mary's existing EJJ, there must be a set of propositions that are entailed by Mary's updated EJJ. The agent Mary might believe among those propositions, some propositions seem to more plausible, which implies that the possible worlds where those proposition are true rank highest, i.e. the world where John is in his office is true or the world where John is working now is true might be included in the best-ranked possible worlds. If this is the case, there must be a good reason for Mary to reach the conclusion that John is in his office from the evidence in question. In other words, John is in his office is true in every ideal world established by the ordering source which is based on a set of propositions entailed by Mary's updated EJJ, or more precisely, a set of propositions that logically follows from Mary's updated EJJ entails that John is in his office, as in  $\text{Con}(\text{EJL}' \langle M, w \rangle) \subseteq \llbracket \text{John is in his office} \rrbracket^{\text{CG}_g, w}$ . This shows how the evidence in question is involved in the interpretation of epistemic *must*. I will get into the detailed discussion of how epistemic possibility is interpreted since the similar explanation goes for epistemic *may*.

### 8. Pragmatic Anomaly

Suppose that Mary sees that it is raining outside. In this situation, the following utterance is not appropriate, as was mentioned above:

(28) #It must be raining. (Seeing that the rain is falling down)

Epistemic modals signal that the speaker of an utterance with epistemic modals has

inferential (or indirect) evidence on which she bases her statement. They do not signal direct evidence such as a visual evidential. The situation under consideration makes it the case that the speaker of (28) has a body of visual evidence since she really sees that it is raining at the time of the utterance of (28). The direct evidence that it is raining is added to the speaker's EJM, as in (29):

(29)  $EJM \cup \{\text{It is raining}\}$

The addition results in updating the speaker's EJM in such a way that the new evidence is taken to be a member of the EJM, if it is neither redundant nor contradictory. Given this, the proposition expressed by (28) can be inferred from the updated EJM by applying the consequence operator. In other words, the prejacent in (28) can be possibly a member of a set denoted by  $\text{Con}(EJM(\langle a, w \rangle))$ . This may allow (28) to be a valid inference. Besides, everything that logically follows from a certain set of facts is reflexive in the sense that a proposition A might follow from itself. Thus, we need some device that prevents such a kind of inference from being valid.

When we make an inference from a certain fact, that inference must be informative –i.e. the inference must be about providing new and useful information. To take an example, suppose that you know that Tom is a student. If you said you can infer from this established fact that Tom is a student, this kind of inference would be useless because it does not convey any useful information at all. In order to prevent this, we need to place some constraint on the application of the consequence operator, which I call an Informatively Valid Inference. This can be defined as something like this:

## (30) Informatively Valid Inference

A proposition  $p$  is an informatively valid inference iff for any  $p$ , if  $p \in \text{EJL}'(\langle a, w \rangle)$ , then  $p \notin \text{Con}(\text{EJL}'(\langle a, w \rangle))$ .

In (30),  $\text{EJL}'$  is the updated EJJ which is the outcome of the addition of a proposition expressed by the evidence in question to the previous EJJ. The Definition (30) says that in order for an inference to be informatively valid, the proposition obtainable from the inference which is in the updated EJJ cannot be in a set of logical propositions following from the updated EJJ.

Let us get back to (28) and see how this works. When the speaker witnesses that it is raining, the proposition expressed by this evidence will be added to the speaker's existing EJJ, if it is neither redundant nor contradictory, and as a result, it will be an element of the set denoted by the speaker's  $\text{EJL}'$ . Possibly, the proposition *It is raining* expressed by the evidence can also be a member of the set denoted by  $\text{Con}(\text{EJL}'(\langle a, w \rangle))$  since every inference is reflexive. However, the Informatively Valid Inference prevents this. Note that the proposition expressed by *It is raining* is both in  $\text{EJL}'(\langle a, w \rangle)$  and in  $\text{Con}(\text{EJL}'(\langle a, w \rangle))$ , which violates the Informatively Valid Inference constraint. Thus, (28) is not appropriate.

As a matter of fact, the Informatively Valid Inference seems to be related to pragmatics. To see this, suppose that the two patrons, who are waiting for their dinner in a restaurant, are getting irritated because it's been quite a long time since they placed their order, yet the dinner has not been served yet. Consider the following the conversation taking place in this situation:

- (31) a. Patron A: (getting a little bit upset) Looks like they are going to get us our  
dinner tomorrow morning.
- b. Patron B: What do you mean?
- c. Patron A: I mean it takes much longer than I expected to get our dinner. And I  
am getting upset.
- d. Patron A: #I mean they are going to get out dinner tomorrow morning. And I  
am getting upset.

Patron A's utterance in (31a) does not implicate that they will really bring their dinner tomorrow morning, but that he is complaining about the delayed dinner. It is obvious that the utterance in (31b) is more appropriate for the reply to Patron B's question in (31b) than that in (31d). The former is an attempt to account for what Patron A intends to mean beyond what he has actually said, while the latter is simply a literal repetition of the utterance made by Patron A in the previous context.

According to Grice (1975), the participants in a conversation converse on a cooperative basis to the extent that they tend to direct their utterances toward the purpose of the exchange of conversation in which they are engaged. In order to observe the cooperative principle, they should make their utterances clear and relevant to what is being talked about, while providing sufficient information that is required for the current purpose of the exchange. Given this, we can notice with ease that Patron A's response in (31c) respects the maxim of relevance and quantity, while this is not the case with his response in (31d). (31d) is neither relevant to nor as informative as is required for the answer to Patron B's question, since it is a simple repetition which has already appeared

in the previous context. Thus, Patron A's response is pragmatically anomalous after all.

In the same reasoning, if the violation of the Informatively Valid Inference takes place, as we saw in (28) above, the prejacent proposition that is entailed by  $\text{Con}(\text{EJL}'(\langle a, w \rangle))$  is not as informative as is required for what the use of epistemic modals signals, since it is already in the agent a's EJL', which violates the maxim of quantity. Remember that inferential evidence is what epistemic modals signal. However, the situation where a sentence like (28) is uttered definitely contains the directly observed fact that it is raining. This makes (28) uninformative. Therefore, a sentence like (28) is pragmatically anomalous, and the anomaly can be accounted for in terms of conversational implicature.

### **9. Pragmatics of Strong and Weak Modality**

This section is devoted to discussing how we can account for the fact that people select different epistemic modals even when they have the same indirect evidence. Let us consider the circumstance mentioned above once again. Suppose that you see that the light is on in John's office. In this situation, you may utter one of the following sentences:

- (32)
- a. John is in his office.
  - b. John must be in his office.
  - c. John should be in his office.
  - d. John may be in his office.

As was mentioned earlier, the speaker of an unmodalized sentence like (32a) commits

herself to the truth of (32a). A sentence like (32b) with a strong epistemic modal like *must* is weaker than (32a), but stronger than (32c) with a weak epistemic necessity modal and (32b) with an epistemic possibility. The epistemic possibility like *may* in (32d) is the weakest in meaning. What the sentences in (32) have in common is that they describe the statement the speaker bases on the directly observed fact that the light is on in John's office. Epistemic modality is characterized by the marking of the speaker's degree of certainty and/or the necessity/possibility of the truth of the propositional content. That is, the kind of evidence a speaker has will frequently determine the degree of certainty with which she believes a proposition. For example, the speaker of (32a) judges the evidence in question to be strong enough to convince her that John is in his office. On the other hand, (32d) can be uttered when the speaker judges the evidence to be a weak indicator that John is in his office. In this way, it is the speaker's attitude toward the evidence that affects the selection of epistemic modals. If that is the case, the question arises of what it is that makes it possible for the different modals to reflect the speaker's different attitudes toward the established fact in question to occur in this situation, and how we can explain it. In what follows, I will elaborate upon the answer to this question.

In recent years, many linguists and philosophers have argued that the context in which epistemic modals are used as well as the context in which they are evaluated needs to be considered for the semantic interpretation of sentences with epistemic modals (cf. Egan et al. (2005), von Stechow and Gillies (2007), and Macfarlane (2006)). Epistemic modality is mainly concerned with the evaluation of the evidence in question. The indirect evidence could be a body of evidence of the speaker alone or a group including the speaker. The ordering source for epistemic modals is a set of relevant

propositions inferred from an individual  $a$ 's EJP (i.e.  $\text{Con}(\text{EJP}(\langle a, w \rangle))$ ), and the propositions in this set are judged according to how reliable and reasonable they are. Therefore, the degree of the confidence is determined by whether a consequence in  $\text{Con}(\text{EJP}(\langle a, w \rangle))$  is judged to be reliable. The more reliable it is judged to be, the stronger epistemic modals will be chosen. Hence, the sentence (32b) with epistemic *must* implicates that its speaker judges the evidence under consideration to be much more reliable than the evidence the speaker of (32d) with epistemic *may* judges to be. It's needless to say that in an unmodalized sentence like (32a), the evidence is judged to be the most reliable. In the speaker's point of view, the evidence is reliable enough for the speaker to commit herself to the truth of the proposition expressed by (32a).

One should note that it is beyond the semantic area to determine whether a body of evidence is judged to be reliable and how reliable it could be (i.e. the degree of reliability of the evidence). This is because epistemic modalized sentences reflect the speaker's attitude toward evaluating the evidence in the context where they are used, as exemplified in (32). The speaker encodes the indirect evidence in question as insufficient to make a direct assertion. For this reason, the speaker does not so much commit herself to the truth of the preajncent by using unmodalized sentences as reduce the degree of certainty by using epistemic modals. The speaker's choice of strong or weak modals depends on the speaker's attitude about the encoding of the evidence. Thus, the degree of certainty is definitely pragmatic.

What I'd like to claim to capture the pragmatic aspect of the speaker's encoding the indirect evidence is that the epistemic modals are involved in presuppositions.<sup>29</sup>

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<sup>29</sup> Recall that I have mentioned that the epistemic modals presuppose that the speaker has a body of evidence. This presupposition holds regardless types of epistemic modals such as epistemic necessity and epistemic possibility. However, the presupposition I am discussing here is something different from the one I have mentioned above. The

The use of epistemic necessity modals like *must* is an indication that the speaker accepts that the evidence for epistemic necessity modals is much stronger than that for epistemic possibility modals like *may*. The speaker of the utterance with an epistemic modal is committed to possessing a body of evidence appropriate for the use of epistemic modal at the utterance time (cf. Faller (2006)).<sup>30</sup> Otherwise, the speaker would have no good reason to make an utterance with an epistemic modal. This is something that is assumed to be presupposed before an utterance with an epistemic modal is made. Following Searl (1969), I will refer to this as a preparatory condition, which must be met before the speaker uses an epistemic modal. If the speaker is committed to possessing a body of appropriate evidence for epistemic modals, the use of them is felicitous in the sense that it satisfies the preparatory conditions. On the contrary, if the speaker is not, the use of epistemic modals is not felicitous since it does not satisfy the conditions.

In order to incorporate the preparatory conditions, I will introduce the two-place predicates *hunch* (in accordance with Mackenzie (1989))<sup>31</sup> and *certain* into the presuppositional approach. Here are the definitions of each of the predicates:

- (33) *certain* (s, p) is true iff an individual s has some reason for being convinced that the proposition p in  $\text{Con}(\text{EJL}(\langle s, p \rangle))$ .
- (34) *hunch* (s, p) is true iff an individual s has some reason for considering the proposition p in  $\text{Con}(\text{EJL}(\langle s, p \rangle))$  possible, but no solid evidence.

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presupposition I am concerned with here is that each type of an epistemic modal triggers its own presuppositions, besides the presuppositions that hold for every epistemic modals.

<sup>30</sup> Faller (2006) also makes a point similar to this. However, the point she makes is about evidentials.

<sup>31</sup> The predicate *hunch* is taken from Mackenzie (1987).

The predicate *certain* in (33) is related to epistemic necessity modals like *must*, whereas *hunch* in (34) epistemic possibility modals like *may*. Based on (33) and (34), we can define the preparatory conditions for the epistemic modals. The preparatory conditions for the epistemic necessity modal and the epistemic possibility modal can be stated as (35) and (36), respectively:

(35) Preparatory Conditions for Epistemic necessity modals

$\text{must}(\phi)$  presupposes that the speaker  $s$  of  $\text{must}(\phi)$  commits herself to possessing a body of evidence that leads to  $\text{certain}(s, \phi)$ .

(36) Preparatory Conditions for Epistemic possibility modals

$\text{may}(\phi)$  presupposes that the speaker  $s$  of  $\text{may}(\phi)$  commits herself to possessing a body of evidence that leads to  $\text{hunch}(s, \phi)$ .

To see how the preparatory conditions work, consider the sentences in (32a-d) one more time. First, consider (32b) where epistemic *must* occurs. The speaker observes that the light is on in John's office, which can be taken to be a piece of indirect evidence. According to (33) and (35), (32b) presupposes that at the time of the utterance of (32b), the speaker commits herself to possessing a body of evidence that convinces her that John is in his office. If the preparatory condition is met, the utterance (32b) is felicitous since the speaker strongly believes that the observed fact has provided her with a good reason for being certain that John is in his office. This suggests that the speaker judges the evidence to be strongly reliable enough to be sure of the content expressed by the prejacent. If the preparatory condition is not met, however, (32b) is not felicitous. In contrast, (32d) presupposes that the speaker commits herself to possessing a body of

evidence that makes her have a hunch that John is in his office. If the preparatory condition is met, it will imply that the speaker believes that the observed evidence is not strong enough for her to be convinced of the content of the prejacent. This indicates that the speaker has already judged the evidence to be less reliable before her utterance of (32d). This is how we can explain why the speaker will select strong or weak epistemic modality in the discourse.

What about an unmodalized sentence like (32a)? As was mentioned earlier, the speaker of (32a) is committed to the truth of the proposition expressed by (32a), which indicates that she is making an assertion. In other words, the speaker considers the evidence so strong that she asserts that the statement following from the evidence is true. It seems to me that the occurrence of the unmodalized sentence under consideration is not accounted for in terms of the presupposition which has been mentioned so far. Instead, the conversational implicature in the sense of Grice (1975) might provide a better explanation for (32a). According to the maxim of quality, (32a) implicates that the speaker really believes the assertion she has made on the basis of the observed evidence is true. If the speaker did not believe it, she would violate the maxim of quality because she has made the assertion which she believes to be false.

## **10. Closing Remarks**

As was noted by Westmoreland (1998), the semantics of epistemic modals is not properly treated in the standard semantics of modality which is based on entailment from what is known. As a possible solution to this, this paper has argued that the evidential flavor needs to be incorporated into the semantics of epistemic modals. In other words, the use of an epistemic modal signals that the speaker reaches a certain

conclusion from a body of evidence. Departing from Westmoreland who claims that epistemic modals must be treated as evidential markers, I have asserted that we need to consider the two components such as an evidential component and an epistemic component in the treatment of epistemic modals. The former behaves like a source of information or an evidential on which the speaker bases her statement, whereas the latter reflects the speaker's attitudes toward the assessment of the source of information. The semantic analysis of epistemic modals presented in this paper successfully accounts for why the prejacent proposition cannot be inferred from a body of direct evidence, which is problematic in the what-is-know-based treatment of epistemic modality, as well as for the difference in strength between epistemically modalized sentences and unmodalized ones.

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