# Semantic uncertainty

## 1. Introduction

Semantically uncertain propositions can be defined in terms of truth conditional semantics. They cannot be assigned a truth value, i.e. it cannot be stated for sure whether they are true or false, given the speaker's current mental state.

Semantic level uncertainty can be subcategorized into *epistemic* and *hypothetical*. The main difference between epistemic and hypothetical uncertainty is that while instances of hypothetical uncertainty can be true, false or uncertain, epistemically uncertain propositions are definitely uncertain – in terms of possible worlds, hypothetical propositions allow that the proposition can be false in the actual world but in the case of epistemic uncertainty, the factuality of the proposition is not known. The entire classification is presented in Figure 1.

## 2. Epistemic uncertainty

In the case of epistemic uncertainty, it is known that the proposition is neither true nor false: they describe a possible world where the proposition holds but this possible world does not coincide with the speaker's actual world. In other words, it is certain that the proposition is uncertain. Epistemic uncertainty is related to epistemic modality: a sentence is epistemically uncertain if on the basis of our world knowledge we cannot decide at the moment whether it is true or false (hence the name) (Kiefer 2005). The source of an epistemically uncertain proposition cannot claim the uncertain proposition and be sure about its opposite at the same time.

> EPISTEMIC:
> It **may** be raining. It is **probably** raining. It is **possible** that it is raining.

In these sentences, the event of raining is not stated unequivocally: it is not known whether it is raining now or not.
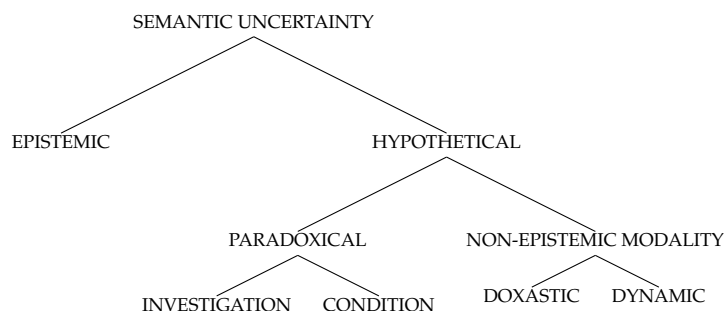
## 3. Hypothetical uncertainty

As for hypothetical uncertainty, the truth value of the propositions cannot be determined either and nothing can be said about the probability of their happening. There are four subclasses of hypothetical uncertainty, which are presented below.

First, propositions under investigation (i.e. hypotheses that are examined in detail, like research questions in scientific publications) fall into this category as until further analysis, the truth value of the proposition under question cannot be stated. Second, conditionals can also be classified as instances of hypotheses. It is also common in these two types of uncertain propositions that the speaker can utter them while it is certain (for others or even for him) that its opposite holds hence they can be called instances of paradoxical uncertainty. Some examples are due:

> INVESTIGATION:
> We **examined** the role of NF-kappa B in protein activation.

SEMANTIC UNCERTAINTY

EPISTEMIC                          HYPOTHETICAL

PARADOXICAL        NON-EPISTEMIC MODALITY

INVESTIGATION    CONDITION        DOXASTIC    DYNAMIC

**Figure 1**
Types of semantic uncertainty.

Schumer's aides would not talk about **whether** they planned to refer to it in any advertisements.
    CONDITION:
**If** it rains, we**'ll** stay in.
They couldn't estimate the size of the charge **until** they determine which employees will participate in the retirement plan.

Hypothetical uncertainty is connected to non-epistemic types of modality as well. Doxastic modality expresses the speaker's beliefs and hypotheses – which may be known as true or false by others in the current state of the world. Necessity (duties, obligation, orders) is the main objective of deontic modality, dispositional modality is determined by the dispositions (i.e. physical abilities) of the person involved whereas circumstantial modality is defined by external circumstances. Buletic modality is related to wishes, intentions, plans and desires. An umbrella term for deontic, dispositional, circumstantial and buletic modality is dynamic modality (Kiefer 2005).

    DOXASTIC:
He **believes** that the Earth is flat.
In fact, he **thinks** several steelmakers will report actual losses through the third quarter of 1990.
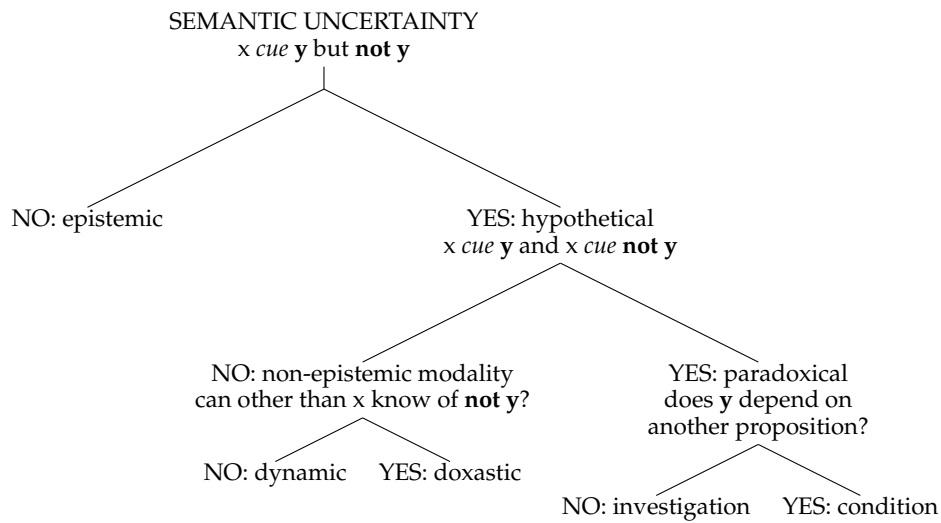    DYNAMIC:
I **have to** go.
We **decided** to retire as soon as possible.

To sum up, instances of hypothetical uncertainty are:

- doxastic modality (hypotheses and beliefs, i.e. propositions that are assumed but not (yet) confirmed)

- propositions under investigation

- conditions (1st and 2nd conditionals (*if…then…*), *until/unless* clauses)

- dynamic modality:
  - deontic modality (events related to duties, obligations, orders…)
  - buletic modality (plans, intentions, desires…)
  - circumstantial modality (related to external circumstances)
  - dispositional modality (related to physical abilities)

SEMANTIC UNCERTAINTY
x *cue* **y** but **not y**

NO: epistemic

YES: hypothetical
x *cue* **y** and x *cue* **not y**

NO: non-epistemic modality
can other than x know of **not y**?

YES: paradoxical
does **y** depend on
another proposition?

NO: dynamic          YES: doxastic

NO: investigation       YES: condition

**Figure 2**
Tests for determining semantic uncertainty types.

Conditions and instances of dynamic modality are related to future: in the future, they may happen but at the moment it is not clear whether they will take place or not / whether they are true, false or uncertain.

## 4. A test battery for types of semantic uncertainty

The following test battery is designed to decide what type of semantic uncertainty is present in a sentence under investigation. First, sentences should be normalized, that is, all suspicious uncertainty cue candidates should be removed from the sentence. Nominalized events (e.g. *investigation* or *regulation*) should be transformed into a clause or should be verbalized (*investigate* or *regulate*). The test battery is represented in the form of a decision tree with test questions in each node (see Figure 2).

Examples illustrating the test-based classification of propositions are shown below. Cues are in bold.

1. *Such an amino acid* **may** *be discovered, so it* **may** *deepen our understanding of the evolution and diversity of the genetic code.*
   Normalized sentence: *Such an amino acid is discovered. It deepens our understanding of the evolution and diversity of the genetic code.*
   ## *Such an amino acid may be discovered, so it may deepen our understanding of the evolution and diversity of the genetic code but it is certain that such an amino acid is never discovered so our understanding is never deepened.*
   → epistemic

2. *Diplomacy* **appears** *to be making headway in resolving the United Nation's standoff with Iraq.*
   Normalized sentence: *Diplomacy is making headway in resolving the United Nation's standoff with Iraq.*

## *Diplomacy appears to be making headway in resolving the United Nation's standoff with Iraq, but diplomacy is not making headway in resolving the United Nation's standoff with Iraq.*
→ epistemic

3.  ***If** such an amino acid is discovered, it **will** deepen our understanding of the evolution and diversity of the genetic code.*
    Normalized sentence: *Such an amino acid is discovered. It deepens our understanding of the evolution and diversity of the genetic code.*
    *If such an amino acid is discovered, it will deepen our understanding of the evolution and diversity of the genetic code but it is certain that such an amino acid is never discovered so our understanding is never deepened.*
    → hypothetical
    *If such an amino acid is discovered, it will deepen our understanding of the evolution and diversity of the genetic code and if no such an amino acid is discovered, it will not deepen our understanding of the evolution and diversity of the genetic code.*
    → paradoxical
    The events depend on each other.
    → condition

4.  ***Unless** these brave doctors are better protected, fewer doctors in the next generation **will** be willing to place themselves in such danger.*
    Normalized sentence: *These brave doctors are better protected. Fewer doctors in the next generation will be willing to place themselves in such danger.*
    Copredication:
    1. *Unless these brave doctors are better protected, fewer doctors in the next generation will be willing to place themselves in such danger but it is for sure that these brave doctors will not be better protected and fewer doctors will be willing to place themselves in such danger.*
    2. *Unless these brave doctors are better protected, fewer doctors in the next generation will be willing to place themselves in such danger and it is for sure that these brave doctors will be better protected and more doctors will be willing to place themselves in such danger.*
    The first test is to show that if the normalized form of the *unless* clause is false, the second clause is true. If the normalized form of the *unless* clause is true, the second clause is false (second test). The original sentence behaves similarly to conditionals, the only difference being that the falsehood of the condition will trigger the truth of the second clause.
    → condition

5.  *We have **investigated** the role of isomer 9-cis RA in FL hematopoiesis.*
    Verbalized sentence: We have investigated whether isomer 9-cis has a role in FL hematopoiesis.
    Normalized sentence: *Isomer 9-cis has a role in FL hematopoiesis.*
    *We have investigated the role of isomer 9-cis RA in FL hematopoiesis and it turned out that isomer 9-cis has no role in FL hematopoiesis.*
    → hypothetical
    *We have investigated whether isomer 9-cis has a role in FL hematopoiesis and we have investigated whether isomer 9-cis has no role in FL hematopoiesis.*
    → paradoxical

The events do not depend on each other.
→ investigation

6. *Most observers **believe** that the use of land as collateral is years away.*
Normalized sentence: *The use of the land as collateral is years away.*
*Most observers believe that the use of land as collateral is years away but it is not so far.*
→ hypothetical
*Most observers believe that the use of land as collateral is years away and they believe that it is not so far.*
→ non-epistemic modality
*However, analysts are certain that it has already happened.*
→ doxastic

7. *The CIA has been **accused** of having played a key role of engineering the regime change against Ali Bhutto by Ramsey Clark.*
Normalized sentence: *Ramsey Clark accused the CIA of having played a key role in engineering the regime change against Ali Bhutto.*
*The CIA played a key role in engineering the regime change against Ali Bhutto.*
*Clark accused the CIA of having played a key role in engineering the regime change against Ali Bhutto but it did not play a key role.*
→ hypothetical
*##Clark accused the CIA of having played a key role in engineering the regime change against Ali Bhutto and Clark is sure that it did not play a key role.*
→ non-epistemic modality
*Clark accused the CIA of having played a key role in engineering the regime change against Ali Bhutto but others have evidence that it did not play a key role.*
→ doxastic

8. *I **want** to leave this place as soon as possible.*
Normalized sentence: *I leave this place as soon as possible.*
*I want to leave this place as soon as possible but I'm sure I stay here because I have nowhere to go.*
→ hypothetical
*##I want to leave this place but I don't want to leave this place.*
→ non-epistemic modality
*##I want to leave this place but others have evidence that I stay.[1]*
→ dynamic

9. *I **can** swim.*
Normalized sentence: *I swim.*
*I can swim but I'm not swimming.*
→ hypothetical
*##I can swim but I cannot swim.*
→ non-epistemic modality
*##I can swim but others have evidence that I cannot swim.*
→ dynamic

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[1] Provided that the speaker and others are in the same mental state concerning the situation, i.e. they share the same knowledge about circumstances and conditions of leaving.

## 5. Co-occurrence of different types

In some sentences, hypothesis and epistemic cues also occur. Both are annotated as in:

*We have **examined** the **potential** role of PKC in induction of the interleukin 2 gene in T cells.*
Verbalized sentence: *PKC has a potential role in induction of the interleukin 2 gene in T cells.*
Normalized sentence: *PKC has a role in induction of the interleukin 2 gene in T cells.*
*##PKC has a potential role in induction of the interleukin 2 gene in T cells but it has no role in it.*
→ epistemic
*We have examined whether PKC has a potential role in induction of the interleukin 2 gene in T cells and we have examined whether PKC has no potential role in induction of the interleukin 2 gene in T cells.*
→ hypothetical
*We have examined whether PKC has a potential role in induction of the interleukin 2 gene in T cells and it has no potential role in it.*
→ paradoxical
The events do not depend on each other.
→ investigation

Thus, there is an instance of the investigation type of uncertainty within which there is epistemic uncertainty.

## References
Kiefer, Ferenc. 2005. *Lehetőség és szükségszerűség [Possibility and necessity]*. Tinta Kiadó, Budapest.