



Semantics & Pragmatics SoSe 2020

Lecture 11: Modality

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Q&A

Tutorial 4

- ▶ *In Exercise 1 k): The solution given is $\exists X(Xs \wedge Xm) \wedge \exists X(\neg Xj)$. Wouldn't it be better to use another variable Y to point out that the property that Jumbo does not have need not be the same property as the one Simba and Maya have, i.e. $\exists X(Xs \wedge Xm) \wedge \exists Y(\neg Yj)$?*

Yes, this is a fair point, it is better to use two variables here.

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Q&A

Tutorial 5

- ▶ *Exercise 1 h) there is predicate variable Z in the solution instead of Y.*

Yes, good point, I changed it.

- ▶ *Exercise 2 a): Order of application of constants: lambda conversion $\lambda y(\lambda x(C(z)(y)(x)))(a)(b)$ gets to be $C(z)(b)(a)$ in the solution, when according to the slides it should be $C(z)(a)(b)$. Which order of application is correct?*

Yes, it is $C(z)(a)(b)$.

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Q&A

Tutorial 5

- ▶ *Exercise 2 e): In the solution we have $C(A) \wedge A(x)$ of type t even though there is still one free variable. Does it work like this or was there meant to be a constant?*

Variables like x, y, z which stand in for individual constants have type e . A has type $\langle e, t \rangle$, hence $A(x)$ has type t . Note that I mentioned in the lecture that this is somewhat problematic given that type t normally means that we can assign a truth value, which we cannot for a formula like $A(x)$. This is where lambda abstraction comes in handy since $\lambda x(A(x))$ is again of type $\langle e, t \rangle$.

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Q&A

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- ▶ *In Exercise 3 there was some confusion with notation used since visually it looks like predicates.*

Yes, but you need to understand that distinguishing different types of constants and variables by using different fonts (or font sizes) is just a visual aid. In a type-theoretic language where you have a potentially infinite number of constants and variables of different types we cannot distinguish them all by fonts. So, in this case, it is important to read and remember how the types for certain variables and constants are defined.

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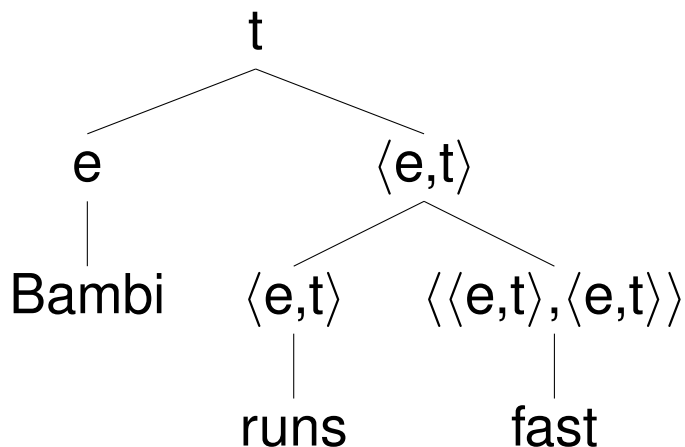


Q&A

Tutorial 5

- ▶ *And in 3.a (Bambi runs fast.) shouldn't it be like $F(R)(b)$ instead of $F(R(b))$ since we first apply run to fast, and then Bambi to it?*

Yes! This is a great observation. It is true, we first need to apply $F(R)$ to get a type $\langle e,t \rangle$ and then we can apply it to Bambi (b) to get type t ! This also follows from the type-theoretic tree we would draw:



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Overview

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Epistemic Possibility

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Section 1: Introduction to Modality



Translation Summary

Natural Language	PL	FOL	SOL	TL
<i>John smokes.</i>	p	S_j	S_j	$S(j)$
<i>John smokes and drinks.</i>	$p \wedge q$	$S_j \wedge D_j$	$S_j \wedge D_j$	$S(j) \wedge D(j)$
<i>Jumbo likes Bambi.</i>	r	$L_j b$	$L_j b$	$L(b)(j)$
<i>Every man walks.</i>	p_1	$\forall x(Mx \rightarrow Wx)$	$\forall x(Mx \rightarrow Wx)$	$\forall x(M(x) \rightarrow W(x))$
<i>Red is a color.</i>	q_1	Cr	CR	$C(R)$
<i>smokes and drinks</i>	—	—	—	$\lambda x(S(x) \wedge D(x))$
<i>every man</i>	—	—	—	$\lambda X(\forall x(M(x) \rightarrow X(x)))$
<i>every</i>	—	—	—	$\lambda Y(\lambda X(\forall x(Y(x) \rightarrow X(x))))$
<i>is</i>	—	—	—	$\lambda X(\lambda x(X(x)))$

PL: Propositional Logic

FOL: First-Order Predicate Logic

SOL: Second-Order Predicate Logic

TL: Typed Logic (Higher-Order) with λ -calculus

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Modality: Possibility vs. Necessity

Modality is “a category of linguistic meaning having to do with the expression of possibility and necessity.” Most languages (if not all) have some means to express possibility vs. necessity.

Kroeger (2019), p. 293, citing von Stechow (2006), p. 20.

- (1) *It is possible that* John smokes.
- (2) *I am convinced that* John *just has to* smoke.
- (3) *Its better if* Jumbo likes Bambi.

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Grammaticalized Modality

“[...] we will focus our attention on the kinds of modality which can be expressed **grammatically**, e.g. by *verbal affixation, particles, or auxiliary verbs*.”

Kroeger (2019), p. 293.

- (4) John *could* smoke.
- (5) John *must* smoke.
- (6) Jumbo *should* like Bambi.

Note: The idea of “grammaticalized markers” of modality (or any other linguistic category) is that there are strongly *conventionalized* markers available to the speaker to encode a particular grammatical function, rather than spontaneously circumscribing it. In English, for example, rather than saying, “In the past I go ...” or “Some time ago I go ...”, we typically say “I went ...”.

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Modal Auxiliaries

In many (Indo-European) languages modality is encoded in so-called **modal auxiliaries**.

Kroeger (2019), p. 293.

English

could

should

must

etc.

German

könnte

sollte

muss

etc.

Italian

potrebbe

dovrebbe

deve

etc.

French

peut

doit

doit

etc.

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Note: These are my personal translations. The third person singular form is here assumed representatively.



Section 2: Modal Strength and Type



Modal Strength and Type

“The range of meanings expressible by grammatical markers of modality varies **along two basic semantic dimensions**. First, some markers are “stronger” than others. [...] Second, it turns out that the concepts of “possibility” and “necessity”, which are used to define modality, each include a variety of sub-types.”

Kroeger (2019), p. 294.

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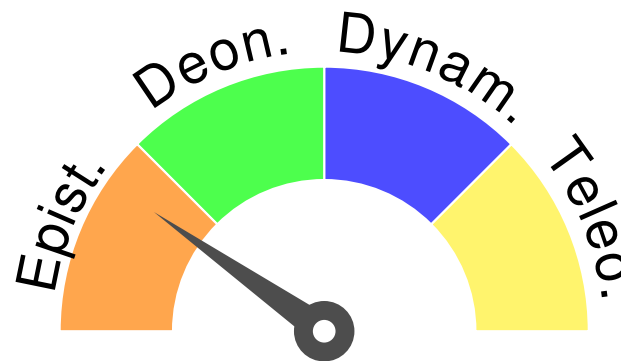
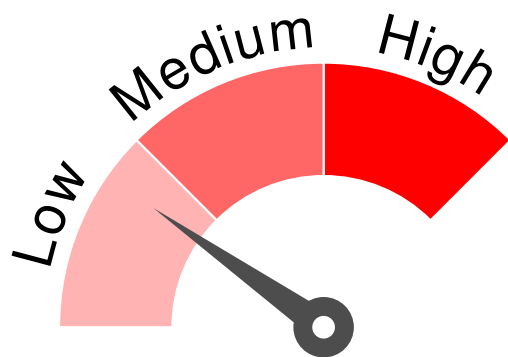
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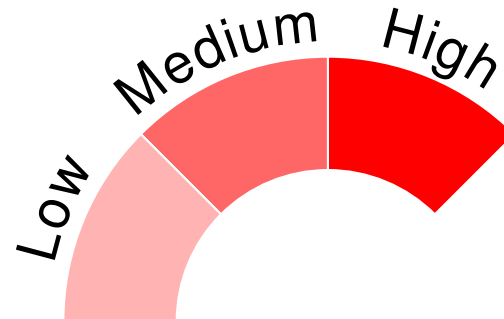


Modal Strength (aka Force)

Statements can express stronger or weaker **commitment to the truth** of the so-called base proposition. The example sentences below are ordered in decreasing strength.

Kroeger (2019), p. 294.

- (7) Arthur **must/has to** be home.
- (8) Arthur **should** be home.
- (9) Arthur **might** be home.



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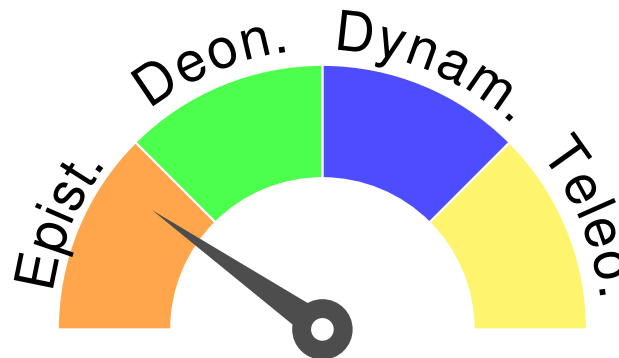
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Modal Type (aka Flavor)

The second dimension relevant to modality concerns the different ways in which a statement can be possibly or necessarily true, i.e. the **type of modality**.



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Modal Type (aka Flavor): Epistemic vs. Root

“**Epistemic modality** is often said to be “speaker-oriented”, because it encodes possibility or necessity in light of the speaker’s knowledge. **Non-epistemic** modal marking reflects some facet of the circumstances surrounding the described situation or event [...]”

Kroeger (2019), p. 307.

- (10) John didn’t show up for work. He *must* be sick.
[spoken by co-worker; Epistemic]
- (11) John didn’t show up for work. He *must* be fired.
[spoken by boss; Deontic (type of Root modality)]

Note: Non-epistemic modal marking is *rooted* in the particular *circumstances* of the *situation*. This is why it is variously called **Root**, **Circumstantial** or **Situational** Modality.

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Modal Type (aka Flavor): Epistemic vs. Root

Note that *deontic*, *dynamic*, *teleological*, and *bouletic* (and other possible types sometimes discussed in the literature) are considered **subtypes of root modality**.

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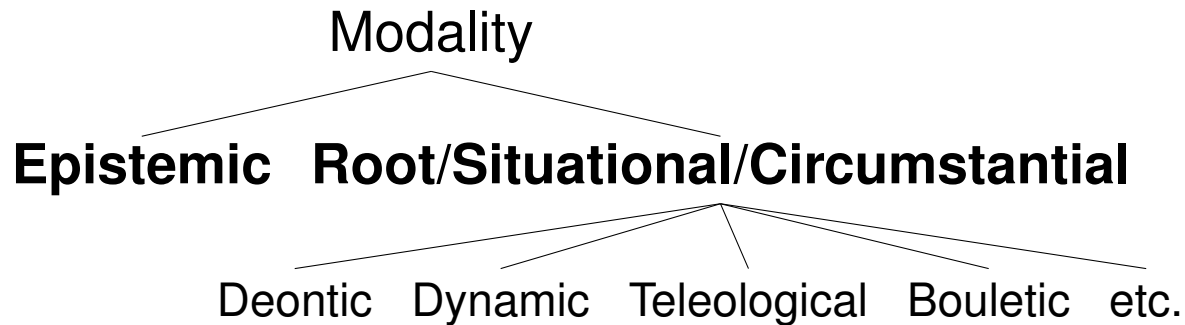
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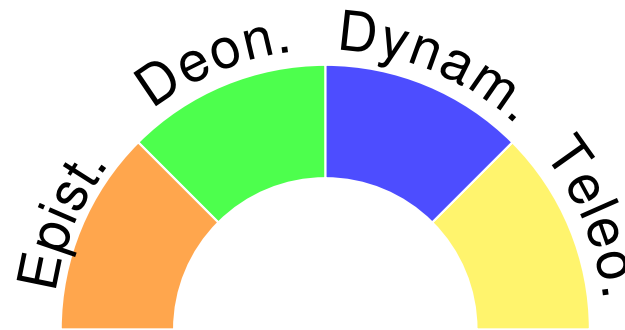




Further Modal Types (aka Flavors)

The names for modal subtypes are mostly derived from Ancient Greek terms.

- ▶ **Epistemic**
(from Ancient Greek *επιστημη*, “knowledge”)
- ▶ **Deontic**
(from Ancient Greek *δεν*, “obligation, duty”)
- ▶ **Dynamic**
(from Ancient Greek *δυναμις*, “power”)
- ▶ **Teleological**
(from Ancient Greek *τελος*, “goal, purpose”).



Note: There are further types discussed in the literature. For instance, **Bouletic (Boulomaic)** (from Ancient Greek *βουλομαι*, “to desire/want”). However, the more types we introduce, the harder it gets to clearly distinguish them. For instance, *to have a desire* and *to have a goal* are conceptually very similar.

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Epistemic Modality

“Epistemic modality indicates possibility and necessity **relative to the speaker’s knowledge of the situation**, i.e., whether the proposition is possibly or necessarily true in light of available evidence.”

Kroeger (2019), p. 294.

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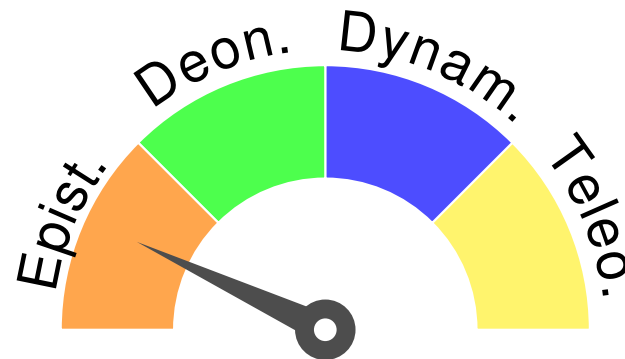
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- (12) John didn’t show up for work. He **must** be sick.
- (13) The older students **may** leave school early (unless the teachers watch them carefully).
- (14) It **has to** be raining. [Seeing people outside with umbrellas]





Deontic Modality

“**Deontic** modality indicates possibility and necessity relative to some **authoritative person or code of conduct** which is relevant to the current situation, i.e., whether the truth of the proposition is required or permitted by the relevant authority.”

Kroeger (2019), p. 294-295.

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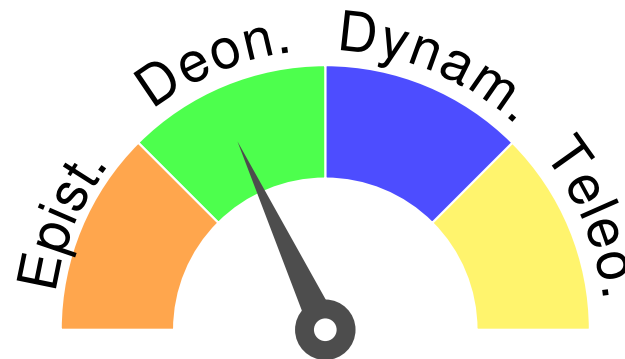
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- (15) John didn't show up for work. He **must** be fired.
- (16) The older students **may** leave school early (if the headmaster allows it).
- (17) Visitors **have to** leave by six pm. [hospital regulations]





Dynamic Modality

“Huddleston & Pullum (2002: 178) define **dynamic modality** as being “concerned with **properties and dispositions** of persons, etc., referred to in the clause, especially by the subject NP.” The most common examples of dynamic modality are expressions of **ability** with the modal *can*.”

Kroeger (2019), p. 296.

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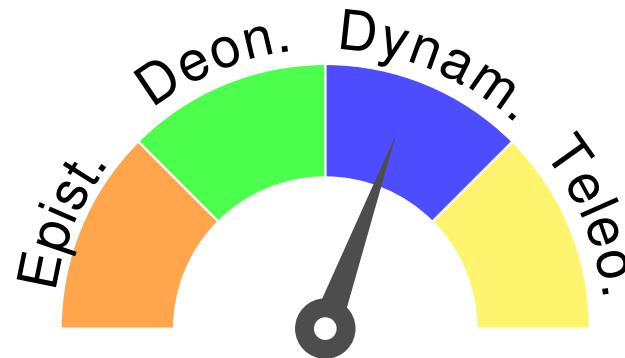
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(18) John **has to** sneeze.

(19) Anne est très forte. Elle **peut**
soulever cette table.
'Anne is very strong. She **can** lift
this table.'





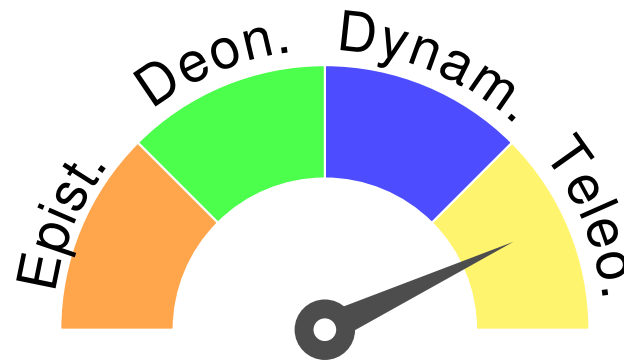
Teleological Modality

Teleological modality has to do with **achieving goals** or serving a purpose.

Kroeger (2019), p. 296.

(20) To get home in time, you **have to** take a taxi.

(21) Anne doit être à Paris à 17 heures. Elle **peut/doit** prendre le train pour aller à P.
'Anne must be in Paris at 5pm. She **can/must** take the train to go to P.'



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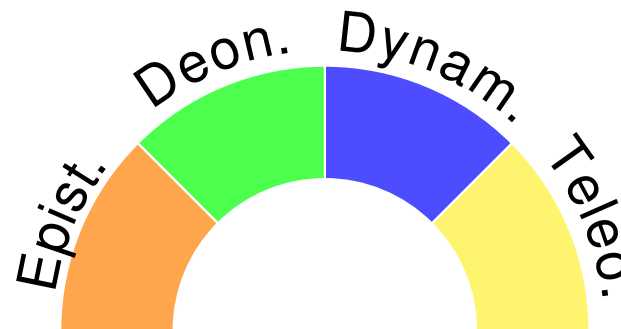
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Polysemy of Modal Auxiliaries

In several languages, **modal auxiliaries** can be used for different types of modality. This might suggest that they are **polysemous**. However, in Kroeger (2019), p. 304 it is argued that they are not in fact polysemous, but rather **indeterminate** to start with (i.e. as a lexical entry), and then get assigned a particular type of modality by context.

- (22) It **has to** be raining. [Seeing people outside with umbrellas]
- (23) Visitors **have to** leave by six pm. [hospital regulations]
- (24) John **has to** sneeze.
- (25) To get home in time, you **have to** take a taxi.



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Polysemy (Lexical Ambiguity)

“It is possible for a single word to have more than one sense. [...] Words that have two or more senses are said to be **ambiguous** (more precisely, **polysemous** [...]).”

Kroeger (2019). *Analyzing meaning*, p. 23

(26) A boiled egg is hard to *beat*.

beat, verb

Sense 1: to strike or hit repeatedly

Sense 2: to win against

Sense 3: to mix thoroughly

etc.

<https://dictionary.cambridge.org/dictionary/english-german/beat>

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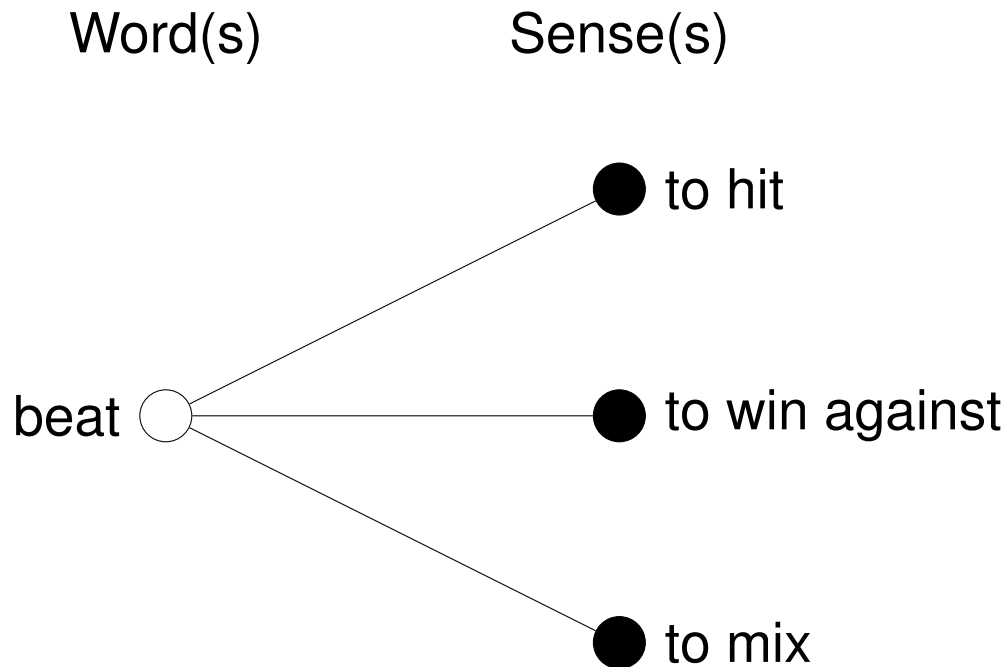
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Ambiguity (Polysemy)



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Indeterminacy

A type of variable reference, i.e. a word can have variability in its reference despite having a single defined sense. That is, the sense is **indeterminate** with regards to a particular dimension of meaning.

Kroeger (2019). Analyzing meaning, p. 81.

cousin, noun

Sense: a **son or daughter** of one's uncle or aunt.

<https://dictionary.cambridge.org/dictionary/english-german/cousin>

Note: The term *cousin* in English does not further specify the gender of the person referred to. Hence, it is indeterminate with regards to natural gender. In German, the natural gender is determined by the gender of the article and a suffix (*der Cousin/die Cousin-e*).

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Ambiguity vs. Vagueness/Indeterminacy

There are a range of tests proposed in the literature which are based on the fact that senses of ambiguous words are **antagonistic**, meaning that they cannot apply simultaneously:

- ▶ Zeugma Test
- ▶ Identity Test
- ▶ Sense Relations Test
- ▶ **Contradiction Test**

Kroeger (2019). Analyzing meaning, p. 84.

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Contradiction Test

“If a sentence of the form *X but not X* can be true (i.e. not a contradiction), then expression must be ambiguous.”

Kroeger (2019). *Analyzing meaning*, p. 87-88.

- (27) They are not *children* any more, but they are still my *children*.
- (28) It is *light*, but not *light*.
- (29) He is my *cousin*, but not my *cousin*.

Note: *children* is used here in two distinct senses, i.e. *offspring* and *preadolescent person*, hence, there is no strict contradiction. The second example might be somewhat of a marked usage, but it is strictly speaking no contradiction, if we assume two distinct senses of *light*. Contrast this with the same structure for *cousin*, which now gives rise to a contradiction.

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Contradiction Test for Modal Auxiliaries

- (30) John *must* be sick, but he *must* not be sick.
- (31) John *can* be sick, but he *cannot* be sick.
- (32) John *might* be sick, but he *might* not be sick.
- (33) John *may* be sick, but he *may* not be sick.
- (34) John *should* be sick but he *should* not be sick.

Note: If we come to the conclusion that these are clear contradictions, then the modal auxiliaries involved are rather **indeterminate** with regards to modal type. If, however, we consider these non-contradictory, then the modal auxiliaries are rather **polysemous** with regards to modal type.

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Another Argument for Indeterminacy

[...] modal auxiliaries in languages like English and French are not in fact polysemous. Kratzer suggests that the lexical entry for words like *must* and *may* specifies only the **strength of modality** [...], and that they are **indeterminate** as to the type or “flavor” of modality (epistemic vs. deontic, etc.).”

“Part of the evidence for this claim is the observation that type of modality can be overtly specified by **adverbial phrases** or other elements in the sentence [...]. Notice that these adverbial phrases do not feel redundant, as they probably would if the modal auxiliary specified a particular type of modality as a lexical entailment.”

Kroeger (2019). *Analyzing meaning*, p. 304, citing work by Angelika Kratzer.

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The Adverbial Phrase Test

- (35) EPISTEMIC:
(In view of the available evidence,) John must/may be the murderer.
- (36) DEONTIC:
(In view of his parents' orders,) John may watch TV, but he must go to bed at 8pm.
- (37) ABILITY/DYNAMIC:
(In view of his physical abilities,) John can lift 200 kg.

Note: If we come to the conclusion that the adverbial phrases in parentheses are not redundant, then this supports the idea that type of modality is not lexically specified, but inferred from context.

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Section 4: Formal Accounts of Modality



Possible Worlds Semantics

“In **possible worlds semantics**, a proposition is identified with the **set of possible worlds in which it is true**. Suppose we are given a set W of possible worlds. A proposition is a subset of W .”

$$p \subseteq W \quad (1)$$

“[...] A proposition p is true in a world $w \in W$ iff $w \in p$. Otherwise, p is false in w .”

Kratzer (1991). Modality, p. 640.

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Modal Logical Operators

The **strenght of modality** as discussed above is represented by two **modal operators** which represent the extreme ends of the spectrum:

$$\diamond p : \textit{it is possible that } p \quad (2)$$

$$\square p : \textit{it is necessary that } p \quad (3)$$

Modality in this sense can then be construed as **quantification over possible worlds**, e.g.

$$\diamond p \equiv \exists w [w \in p] \quad (4)$$

$$\square p \equiv \forall w [w \in p] \quad (5)$$

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Modal Propositional Logic

We defined the clauses of the syntax of a propositional logic language L in Lecture 4. In order to account for (simple, binary strength) modality, we just need to add one more syntactic clause:

(v) If ϕ is a formula in L , then $\Box\phi$ and $\Diamond\phi$ are too.

Gamut (1991), Volume 2, p. 21.

Examples of valid formulas

$\Box p$

$\Box\Diamond p$

$\Box p \vee \Diamond q$

$\neg\Diamond(p \wedge q)$

$p \rightarrow \Box\Diamond p$

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Fundamental Tautologies

The two basic modal operators can be defined **tautologically** with reference to each other, such that we have:

$$\diamond\phi \leftrightarrow \neg\Box\neg\phi \quad (6)$$

as well as

$$\Box\phi \leftrightarrow \neg\diamond\neg\phi \quad (7)$$

The first tautology translates as: *something is possible if and only if it is not the case that it is necessarily not the case.*

The second tautology translates as: *something is necessary if and only if it is not the case that it is possibly not the case.*

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Feature 75A: Epistemic Possibility

This feature is described in the text of chapter 75 by Johan van der Auwera and Andreas Ammann

You may combine this feature with another one. Start typing the feature name or number in the field below.

Values

● Verbal constructions	65
● Affixes on verbs	84
● Other	91

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(38) John *may* have arrived. (Epistemic possibility)

(39) John *must* have arrived. (Epistemic necessity)

<https://wals.info/chapter/75>



Feature 74A: Situational Possibility



This feature is described in the text of chapter 74 [Situational Possibility](#) by [Johan van der Auwera](#) and [Andreas Ammann](#) [cite](#)

You may combine this feature with another one. Start typing the feature name or number in the field below.

Values

●	Affixes on verbs	63
●	Verbal constructions	158
●	Other kinds of markers	13

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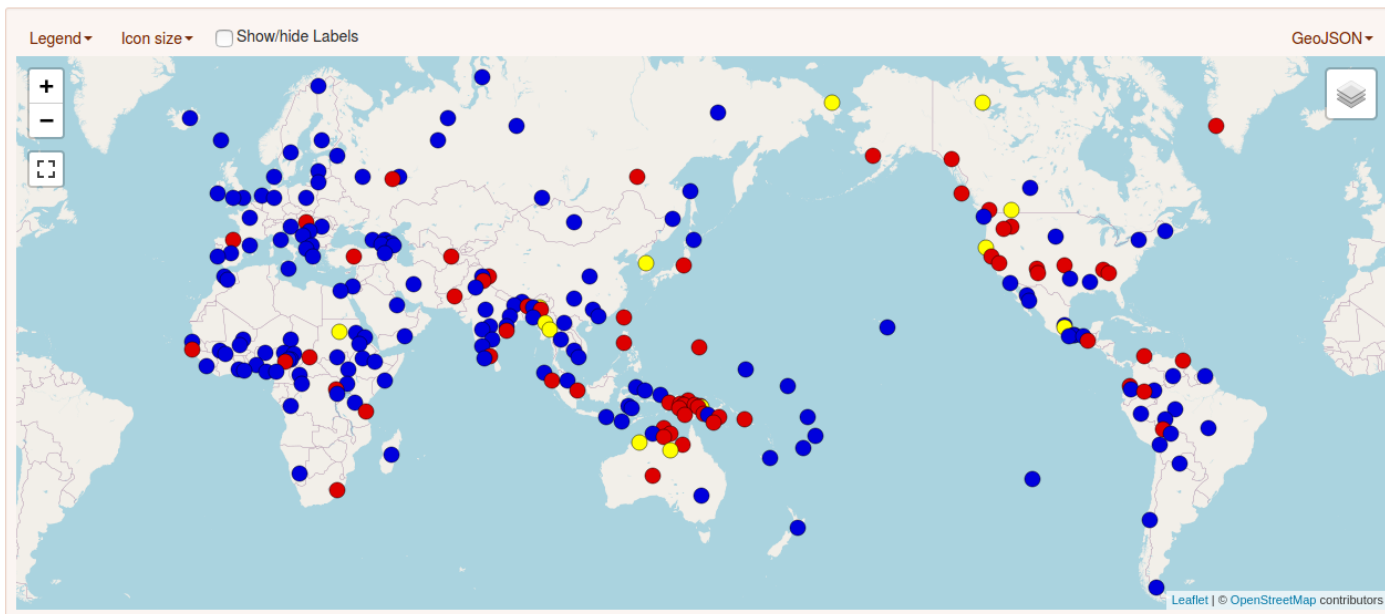
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(40) You *may* leave now. (Situational possibility (Deontic))

(41) You *must* leave now. (Situational necessity (Deontic))

<https://wals.info/chapter/74>



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Feature 76A: Overlap between Situational and Epistemic Modal Marking

Marking

This feature is described in the text of chapter 76 [Overlap between Situational and Epistemic Modal Marking](#) by Johan van der Auwera and Andreas Ammann [cite](#)

You may combine this feature with another one. Start typing the feature name or number in the field below.

Values	
● Overlap for both possibility and necessity	36
● Overlap for either possibility or necessity	66
○ No overlap	105

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- (42) You *may* leave now. (Situational possibility (Deontic))
- (43) John *may* be at home. (Epistemic possibility)
- (44) You *must* leave now. (Situational necessity (Deontic))
- (45) John *must* be at home. (Epistemic necessity)

<https://wals.info/chapter/76>



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Thank You.

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