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Faculty of Philosophy
General Linguistics

Semantics & Pragmatics SoSe 2022

Lecture 10: Modality

31/05/2022, Christian Bentz

Q&As Tutorial 4

1 d) Do we need parentheses always with three connectors, e.g. ((Xx ∧ AX) ∧ Gx)?

In a strict sense, yes. Remember that connectors are defined to be generated always alongside parentheses in the syntactic definitions of our logical languages. In this particular case, they are functionally superfluous, however, since the rule of "commutativity" says that the expressions connected with logical *and* can always be permuted.

Q&As Tutorial 4

1 d) For ($Xx \wedge \mathcal{A}X$) does the order matter here? Is there a rule that second order variables come first?

Same as above: the rule of "commutativity" says that the expressions connected with logical *and* can always be permuted. So order does not matter here.

Q&As Tutorial 4

1 d) "If an animal is grey, then it is an elephant." Could we translate this as:

$\forall x \forall X(((Xx \wedge \mathcal{A}X) \wedge Gx) \rightarrow Ex)$
instead of
$\forall x(\exists X((Xx \wedge \mathcal{A}X) \wedge Gx) \rightarrow Ex)$

This seems a valid alternative, yes.

Q&As Tutorial 4

Ex. 1 (i) "For all animals it is the case that they are chased by someone." Can we move the existential quantifier for y to the end? So the answer will be:

$\forall x(\exists X(Xx \wedge \mathcal{A}X) \rightarrow \exists y Cyx)$
instead of
$\forall x \exists y(\exists X(Xx \wedge \mathcal{A}X) \rightarrow Cyx).$

Yes, this is fine, since there is only one *y* that the existential quantifier scopes over.

Q&As Tutorial 4

1 h) "All elephants chase all lions". Could we replace the conditional (→) with logical and (∧)? So we would have:

$\forall x \forall y((Ex \wedge Ly) \wedge Cxy)$
instead of
$\forall x \forall y((Ex \wedge Ly) \rightarrow Cxy)$

No, there is a subtle difference between these two expressions. Note that the expression with ∧ actually says that all individuals in your domain are lions and/or elephants (and that the elephants chase the lions). In the expression with the conditional, on the other hand, you can actually have other individuals in the domain (not just elephants and lions).

Q&As Tutorial 4

1 h) again, would the following work:

$\forall x(Ex \rightarrow \forall y(Ly \wedge Cxy))$
instead of
$\forall x \forall y((Ex \wedge Ly) \rightarrow Cxy)$

No, note that in this case you are actually saying: “If x is an elephant then it follows that all *y*s are lions.” Again, this is arguably not what the natural language sentence says. If you say “all elephants chase all lions” you are not saying that everybody is a lion under some condition (Ex).

Q&As Tutorial 4

1 k) "Simba and Maya have something in common, and there is at least one property that Jumbo does not have." Can we use X again after the connective ∧ in $\exists X(Xs \wedge Xm) \wedge \exists Y \neg Yj$*?*

If we used *X* here throughout it would mean that the property which Maya and Simba have in common is the property which Jumbo does not have. But this is not what the natural language sentence says. Note that the usage of *X* and *Y* here is the same as for mathematical functions, i.e. *X* and *Y* can be the same, but they don't have to be.

Q&As Tutorial 4

In 1 n) "There is an animal which is not fast", shouldn't we have "at least one" here instead of "an" when we translate this with existential quantifiers?

Well, "at least one" would be more precise, yes. But it is a fact that we have natural language statments with the indefinite determiner used in this way, and the closest translation here is with the extistential quantifier. Note that if somebody added here "actually there is another animal which isn't fast" then this would not falsify the original statement, or would it?

Overview

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Section 1: Introduction to Modality

Translation Summary

Natural Language	PL	FOL	SOL	TL
John smokes.	p	Sj	Sj	S(j)
John smokes and drinks.	$p \wedge q$	$Sj \wedge Dj$	$Sj \wedge Dj$	$S(j) \wedge D(j)$
Jumbo likes Bambi.	r	Ljb	Ljb	L(b)(j)
Every man walks.	p_1	$\forall x(Mx \rightarrow Wx)$	$\forall x(Mx \rightarrow Wx)$	$\forall x(M(x) \rightarrow W(x))$
Red is a color.	q_1	Cr	$\mathcal{C}R$	$\mathcal{C}(R)$
smokes and drinks	_	_	_	$\lambda x(S(x) \wedge D(x))$
every man	_	_	_	$\lambda X(\forall x(M(x) \rightarrow X(x)))$
every	_	_	_	$\lambda Y(\lambda X(\forall x(Y(x) \rightarrow X(x))))$
is	_	_	_	$\lambda X(\lambda x(X(x)))$

PL: Propositional Logic
FOL: First-Order Predicate Logic
SOL: Second-Order Predicate Logic
TL: Typed Logic (Higher-Order) with λ-calculus

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 Fintel (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.

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 ...".

Modal Auxiliaries

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

Kroeger (2019), p. 293.

English	**German**	**Italian**	**French**
can	*können*	*potere*	*pouvoir*
shall	*sollen*	*dovere*	*devoir*
must	*müssen*	*dovere*	*devoir*
etc.	etc.	etc.	etc.

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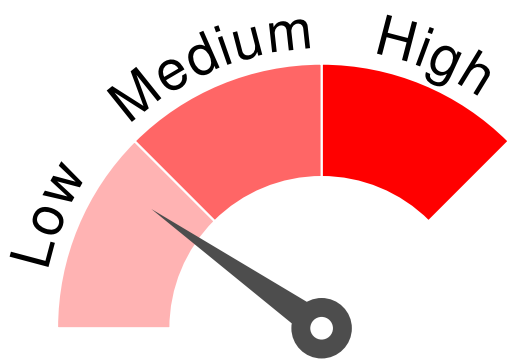
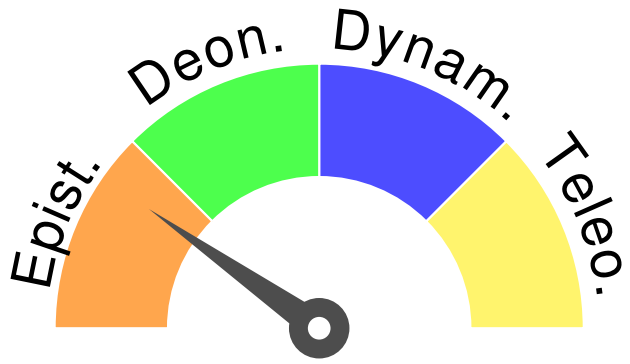
Section 2: Modal Strength and Type

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.





Modal Strength (aka Force)

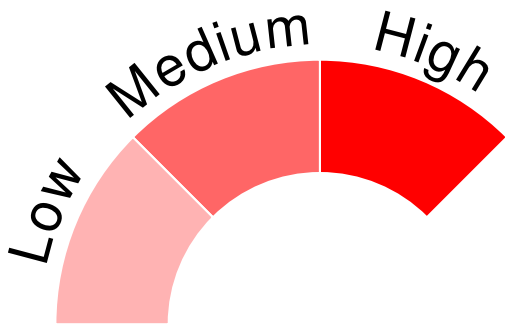
Statements can express stronger or weaker **commitment to the truth** of the so-called base proposition. The example sentences below are ordered in decreasing strength.

Kroeger (2019), p. 294.

(7) Arthur must/has to be home.

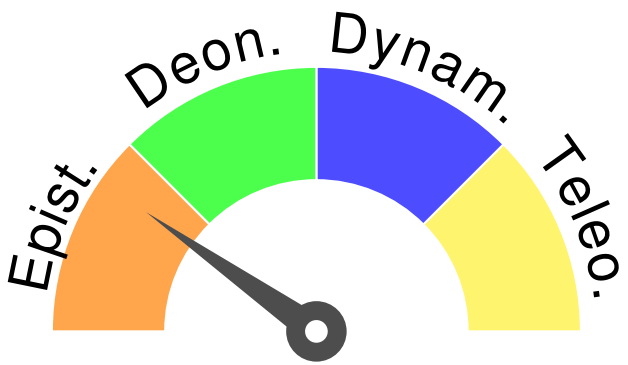
(8) Arthur should be home.

(9) Arthur might/could be home.



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**.



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.

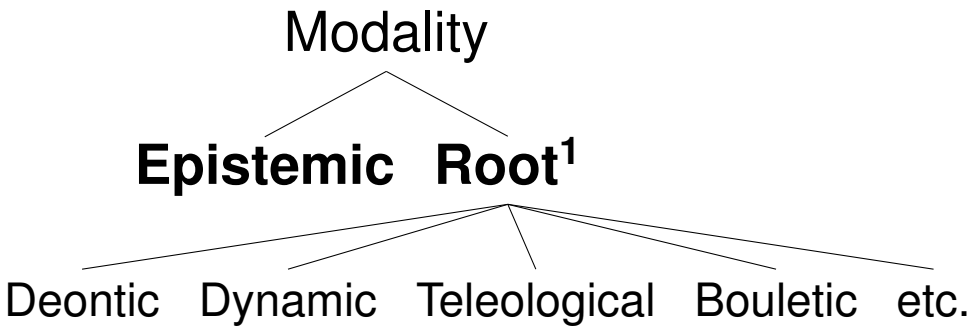
(10) John didn't show up for work. He *must* be sick. [spoken by co-worker; Epistemic]

(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.

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**.

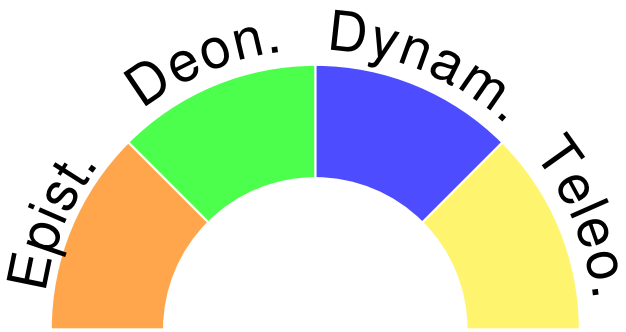


[1] **aka Circumstantial or Situational.**

Further Modal Types (aka Flavors)

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

- **Epistemic**
  (from Ancient Greek ἐπιστήμη "knowledge")
- **Deontic**
  (from Ancient Greek δέον "obligation, duty")
- **Dynamic**
  (from Ancient Greek δύναμις "power")
- **Teleological**
  (from Ancient Greek τέλος "goal, purpose").



Note: There are further types discussed in the literature. For instance, **Bouletic (Boulomaic)** (from Ancient Greek βούλομαι, "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.

Epistemic Modality

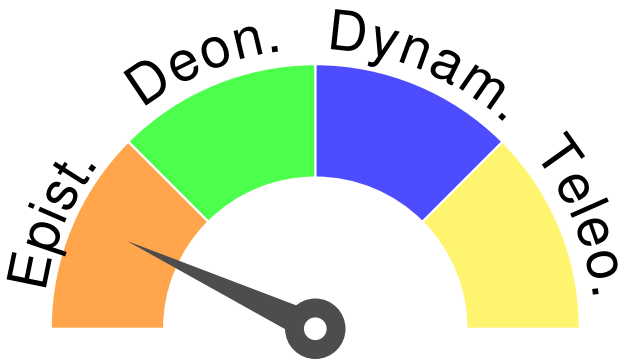
"Epistemic modality indicates possibility and necessity **relative to the speaker's knowledge of the situation**, i.e., whether the proposition is possibly or necessarily true in light of available evidence."

Kroeger (2019), p. 294.

(12) John didn't show up for work. He must be sick.

(13) The older students might/may(?) leave school early (unless the teachers watch them carefully).

(14) It has to be raining. [Seeing people outside with umbrellas]



Deontic Modality

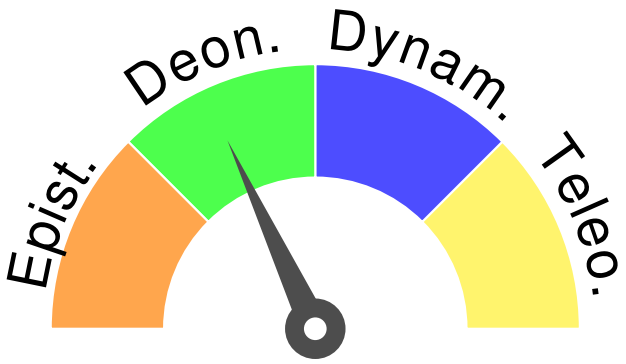
"**Deontic** modality indicates possibility and necessity relative to some **authoritative person or code of conduct** which is relevant to the current situation, i.e., whether the truth of the proposition is required or permitted by the relevant authority."

Kroeger (2019), p. 294-295.

(15) John didn't show up for work. He must be fired. [boss speaking]

(16) The older students may leave school early. [headmaster speaking]

(17) Visitors have to leave by six pm. [hospital regulations]



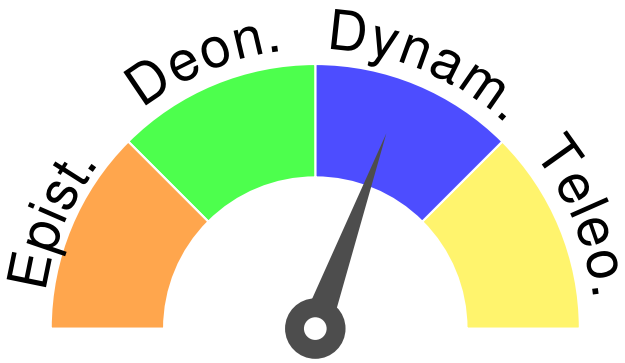
Dynamic Modality

"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.

(18) John has to sneeze.

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



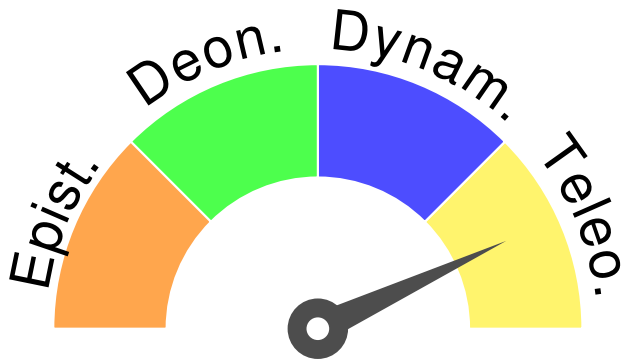
Teleological Modality

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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Section 3: The Polysemy Controversy

Polysemy of Modal Auxiliaries

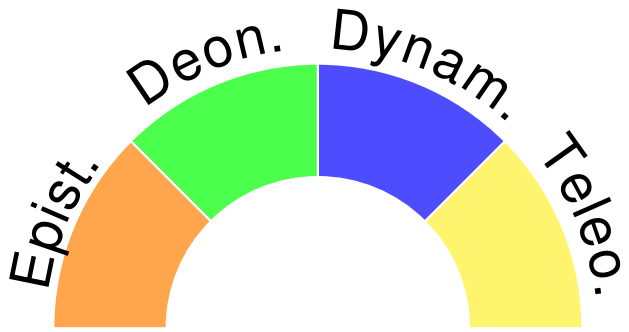
In several languages, **modal auxiliaries** can be used for different types of modality. This might suggest that they are **polysemous**. However, in Kroeger (2019), p. 304 it is argued that they are not in fact polysemous, but rather **indeterminate** to start with (i.e. as a lexical entry), and then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



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** [...])."

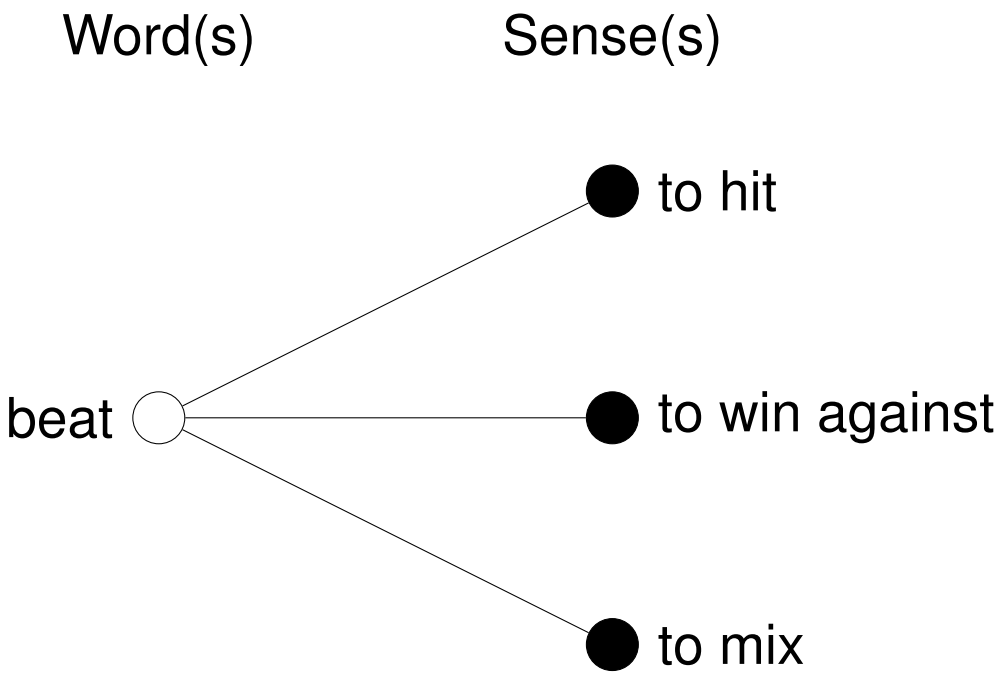
Kroeger (2019). Analyzing meaning, p. 23

(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

Ambiguity (Polysemy)



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*).

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.

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.

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.

An 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.

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, i.e. **indeterminate**.

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Section 4: Formal Account 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."

$$p \subseteq W \tag{1}$$

"[...] 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.

Note: This is very similar to the definition we gave for *propositions as the set of situations/cases in which a sentence is true*. As Zimmermann & Sternefeld (2013: 143-144) point out, a "possible world" is a complete specification of all possible cases/situation that could in theory be relevant for deciding on the truth of a given sentence. So this is a generalized definition of proposition.

Modal Logical Operators

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

$$\Diamond p : \textit{it is possible that } p \tag{2}$$

$$\Box p : \textit{it is necessary that } p \tag{3}$$

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

$$\Diamond p \equiv \exists w[w \in p] \tag{4}$$

$$\Box p \equiv \forall w[w \in p] \tag{5}$$

Modal Propositional Logic

We defined the clauses of the syntax of a propositional logic language *L* as in the respective lecture. 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

$\Box p$
$\Box\Diamond p$
$\Box p \vee \Diamond q$
$\neg\Diamond(p \wedge q)$
$p \rightarrow \Box\Diamond p$

Fundamental Tautologies

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

$$\Diamond\phi \leftrightarrow \neg\Box\neg\phi \tag{6}$$

as well as

$$\Box\phi \leftrightarrow \neg\Diamond\neg\phi \tag{7}$$

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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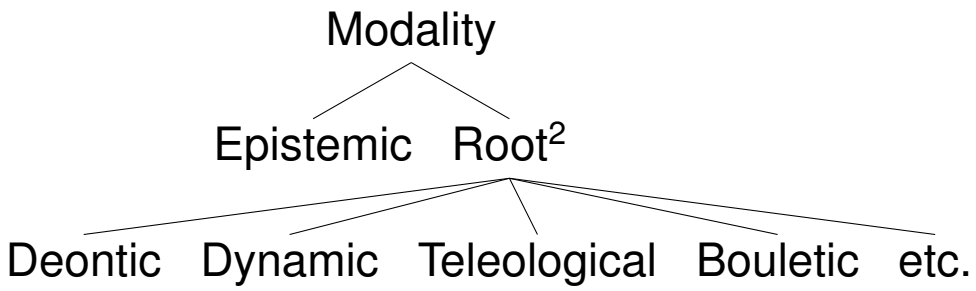
Section 5: Modality and Truth-Conditions

Modality and Truth-Conditions: Yet Another Controversy

Is **modality** relevant for **truth conditions** or not?

"It is often claimed in the linguistics literature that **epistemic modality**, unlike other kinds of modality, **does not contribute to the truth conditions of the utterance**. [...] The intuition underlying this view is that epistemic modality in natural language marks the degree and/or source of the speaker's commitment to the embedded proposition."

Kroeger (2019), p. 309, citing Papafragou (2006), p. 1688.



[2]aka Circumstantial or Situational.

Modality and Truth-Conditions

"However, some of the **standard tests for truth-conditional content** indicate that this is not the case: **both types of modality can be part of the proposition** and contribute to its truth conditions."

Kroeger (2019), p. 309.

Battery of Tests:

- The Challenge Test
- The Yes-No Question Test
- The Negation Test

The Challenge Test

Is the epistemic modal marker part of what can be **challenged** about a proposition?

(38) A: John profited from the old man's death, he *must* be the murderer.
B: That's not true; he *could* be the murderer, but he doesn't *have to* be.

– Yes ✓

The Yes-No Question Test

Can the epistemic modal marker be the focus of a **yes-no question**?

(39) A: *Must* John be the murderer?
B: Yes, he *must*. or: No, he doesn't *have to* be.
(Note that *yes, he is*, or *no, he isn't* wouldn't work here.)

– Yes ✓

The Negation Test

Can the epistemic modal marker be **negated by clausal negation**, i.e. does negation scope over and hence include the modal marker as part of the negated proposition?

(40) Smith *cannot* be the candidate.
[epistemic reading: $\neg\Diamond p$ ✓; with p: Smith is the candidate.]

(41) Smith *might not* be the candidate.
[epistemic reading: $\Diamond\neg p$ x]

– Sometimes ✓[3]

[3] Though if we read the first sentence as involving necessity, then negation would not scope over it here either ($\Box\neg p$). In other languages, such as German or Malay, this test seems more clearly positive across different modal markers, as further discussed in Kroeger (2019), p. 310.

Modality and Truth-Conditions

According to the discussion in Kroeger (2019) – and contrary to some claims in the linguistic literature – **epistemic modal markers** might be seen as **contributing to the truth-conditional content of a proposition**, rather than just merely expressing the degree of certainty about a proposition.

Language	Challenge	Yes-No Question	Negation
English	yes	yes	(yes)

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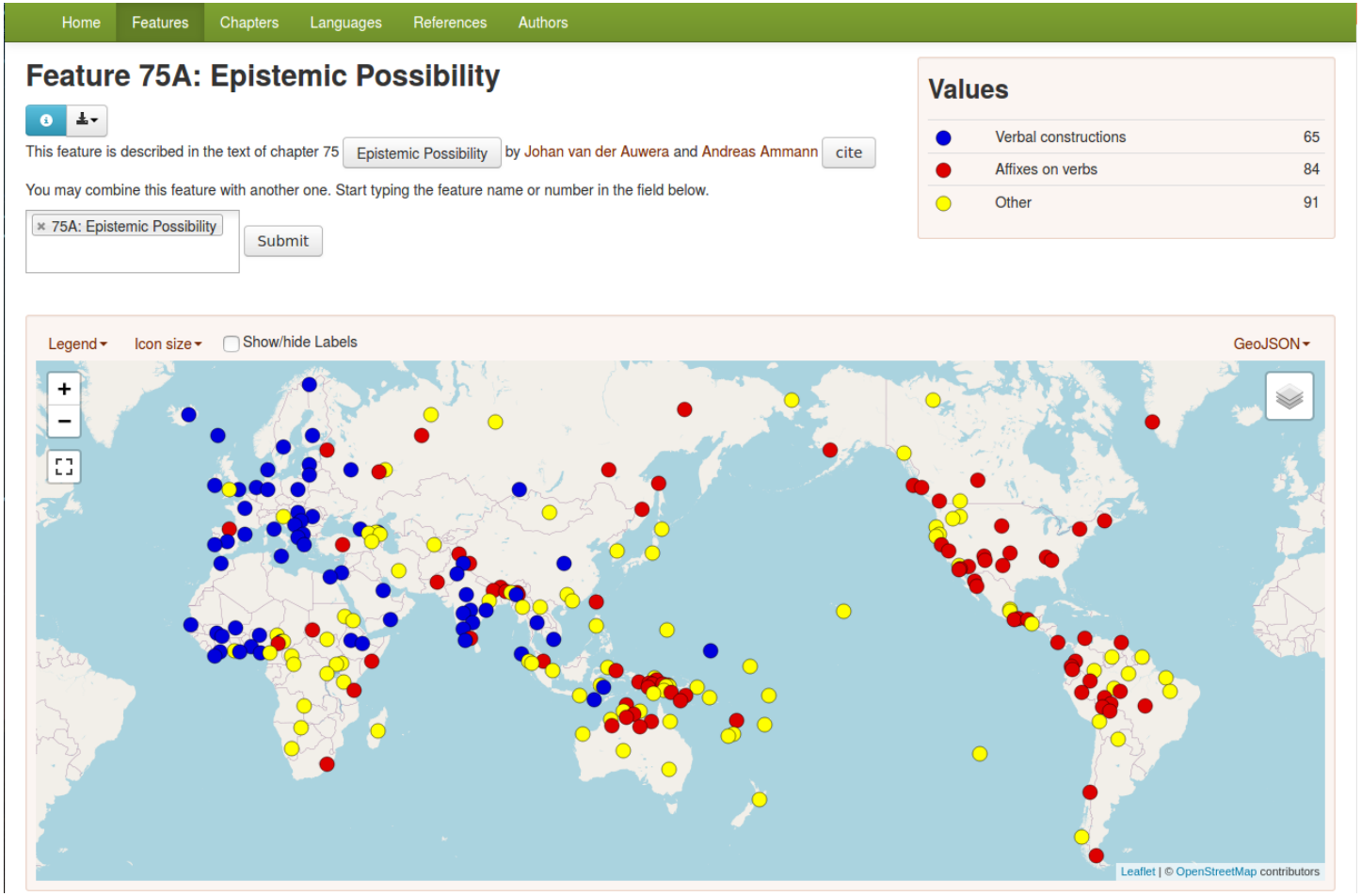
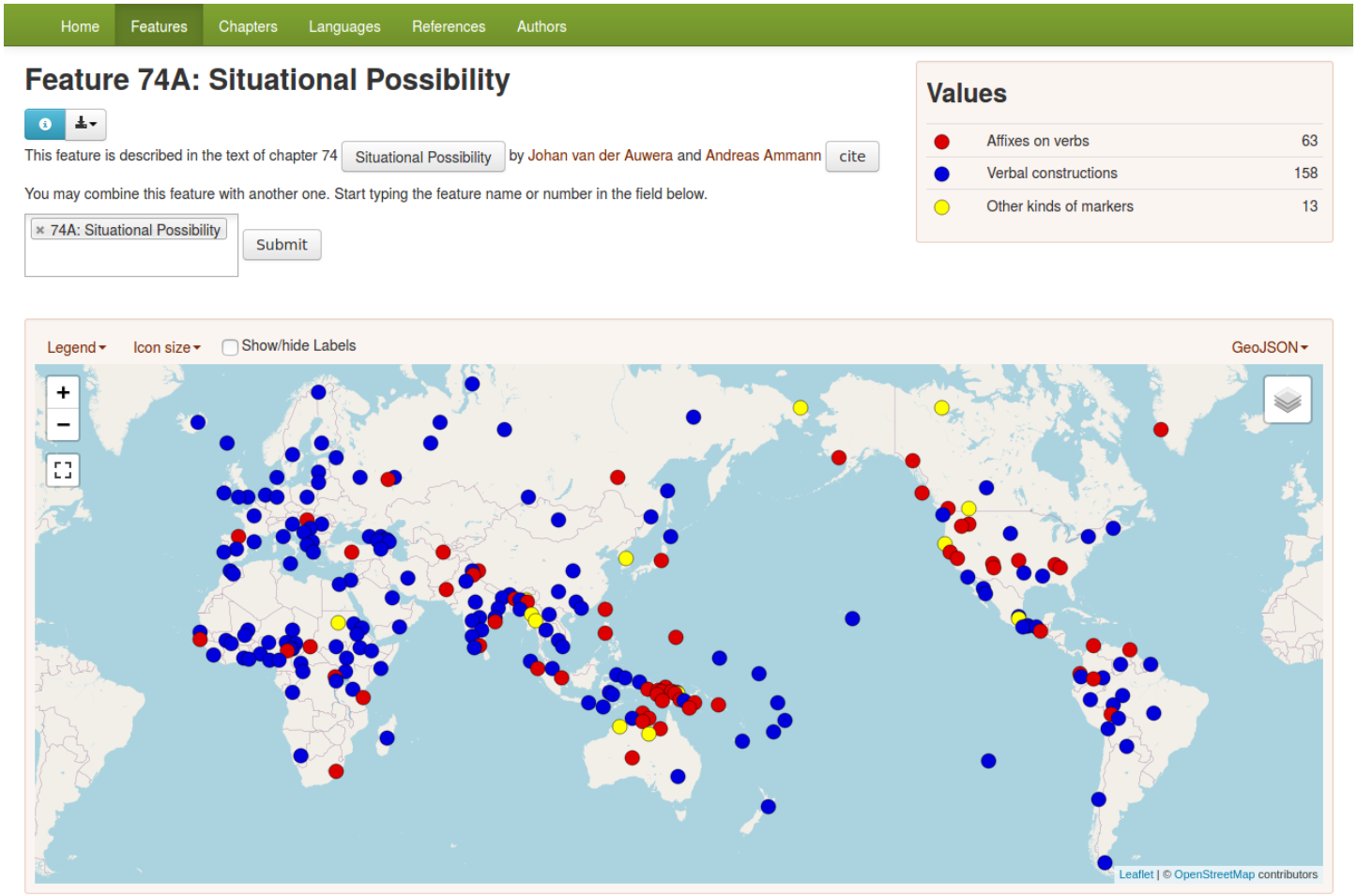
Section 6: Cross-Linguistic Variation in Modality



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

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

https://wals.info/chapter/75



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

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

https://wals.info/chapter/74

Summary

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- **Modality** as a grammatical category refers to the expression of **possibility and necessity**.
- It is coded by some grammaticalized means in a considerable part of the world's languages (149/240 or ca. 62% in the WALS chapter on Epistemic Possibility).
- Modality is typically analyzed along two dimensions: **modal strength (force)**, and **modal type (flavor)**.
- A fundamental distinction of modal types is often drawn between **epistemic modality** (referring to speaker certainty) and **non-epistemic modality** (root/circumstantial/situational).

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Thank You.

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