Veridicality, commitment, and mood choice

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Truth and Knowledge

(1) On May 15, 2018, Anastasia Giannakidou is in Geneva.

(2) On January 10, 2018, Anastasia Giannakidou was in Geneva.

(3) On July 10, 2018, Anastasia Giannakidou will be in Geneva.

Objective truth: what is
Knowledge: what I know about it

Truth, mood, and tense

Indicative vs. subjunctive in Greek

(4) Efije i Ariadne.
left. 3SG the Ariadne
Ariadne left.

(5) Na/ As fiji o Janis. (Greek)
SUBJ/ OPT leave.PERF.NON-PAST.3SG the John.
John may go./ Let John go.

Correlation with tense: indicative correlates with past (and present), subjunctive has future orientation

The tenses of Greek

Giannakidou 2009, 2014

(6) graf- -o. (imperfective nonpast: PRES)
write.IMPERF NON-PAST.1SG.
I am writing (right now).
'Write' (generally).

(7) *grap- s- o
write- PERF NON-PAST.1SG.
(Greek perfective nonpast: ,* on its own: NON-PAST)

(8) e- graf- a. (Greek imperfective past)
PAST- write.IMPERF- PAST.1SG.
'I used to write.' / 'I was writing.'

(9) e- grap- s- a. (Greek aorist: PAST)
PAST- write- PERF- PAST.1SG.
I wrote.

NONPAST: dependent tense

The tense of the subjunctive

(10) *grap- s- o
write- PERF NON-PAST.1SG.
(Greek perfective nonpast: ¸* on its own: NON-PAST)

(11) Morphological perfective non-past in Greek denotes NON-PAST (Giannakidou 2009):
$[\![\text{NON-PAST}]\!] = \lambda P \lambda t \lambda w(P(t, \infty)(w))$

NON-PAST: temporal polarity item, t is dependent

Selection patterns: indicative

(12) Indicative verbs in Greek (oti, pos, pu)

a. epistemic and emotive factive verbs: ksero, gnorizo (know), metaniono (regret), xairomai (be glad)
b. fiction verbs: onirevome (dream), fandazome (imagine)
c. doxastic (non-factive): pistevo (believe), nomizo (think), theoro (consider), vrisko (find)
d. conciousness: exo epignosi (be aware)
e. purely assertive: leo (say), dhiavazo (read), isxirizome (claim), dilono (declare, assert)
f. memory verbs: thimame (remember) . perception verbs: vlepo (see), akouo (hear)

Doxastic, epistemic and dream fiction verbs also take indicative in French, Spanish, Catalan, Portuguese, and Romanian (Farkas 1992, Villalta 2008, Quer 1998, Marques 2014, Baunaz 2015, Puskas 2014 among others)

Examples: epistemic and doxastic verbs

(13) O Nicholas kseri oti/pos/*na efije i Ariadne.
the Nicholas knows.3SG that.IND/*SUBJ left. 3SG Ariadne
Nicholas knows that Ariadne left.

(14) O Nicholas pistevi oti/*na efije i Ariadne.
the Nicholas believe.3SG that.IND left.3SG the Ariadne.
Nicholas believes that Ariadne left.

(15) O Nicholas exi epignosi oti/*na i Ariadne ton
the Nicholas has awareness.3SG that.IND the Ariadne him
voithise.
helped.3sg
Nicholas is aware that Ariadne helped him.

(16) O Nicholas onireftike oti/*na efije i Ariadne.
the Nicholas dreamt.3SG that.IND left.3SG the Ariadne.
Nicholas dreamt that Ariadne left.

Subjunctive verbs

(17)
a. modal verbs: prepi (must), bori (may)
b. volitionals: thelo (want), skopevo (plan)
c. directives: dhiatazo (order), simvulevo (advise), protino (suggest),
d. permissives: epitrepo (allow); apagorevo (forbid)
e. implicatives: katorthono (manage), anagazo (force)

Examples

(18) Prepi na/*oti vrehi.
must subjunctive/indicative rain.3sg
It must be raining.

(19) Bori na/*oti vrehi.
may subjunctive rain.3sg
It may be raining.

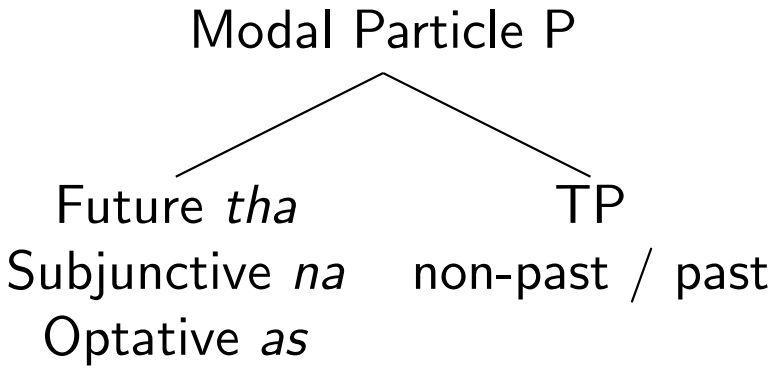
(20) Prepi na/*oti evrekse.
must subjunctive/indicative rain.PAST.3sg
It must have rained.

(21) Bori na/*oti evrekse.
may subjunctive rain.PAST.3sg
It may have rained.

Greek: modality distinct from lower tense

Giannakidou 2009

(22)



The future particle in the same position as subjunctive, optative moods; modal and temporal information as syntactically distinct in Greek. C subordinates. Hence C, Mood, and T are all involved in mood selection (see also Baunaz 2015, Todorovic 2012 for Serbian)

Question:

What regulates mood choice?
Answer: Veridicality and epistemic commitment!

English *must*: "weak" or "strong"?

1. Weak: Karttunen 1972, Kratzer 1977, 1991, Giannakidou 1997, 1999, 2013, Portner 2009, Giannakidou and Mari 2013, 2014, 2016, 2018, to appear
2. Strong: von Fintel and Gillies 2010

Doctor talking to patient:

(23) a. You must have the flu.
b. You may have the flu.
c. You have the flu.

Which one makes the patient more confident about the doctor knowing what she has?

Modals are epistemically weak, hence the subjunctive

Giannakidou 1998, 1999, Giannakidou and Mari 2016, 2018, to appear

1. The criterion for weakness is nonveridicality: MUST is weak because it has a nonveridical modal base.
2. All modals, are epistemic weakeners, i.e. their use indicates that the speaker does not have knowledge or belief of ϕ.
3. Unlike possibility modals, MUST conveys positive bias towards ϕ, and this makes it averse to the scope of negation.
4. Positive bias is weaker than knowledge of ϕ, hence the subjunctive.

MUST is incompatible with knowledge of ϕ

(24) Ariadne might be in the house.

(25) Context: I can't see Ariadne.
She must be in the house.

(26) Context: *I know for sure*, I just saw Ariadne getting into the house.
#She must be in the house.
#Sie ist wohl im Haus.
Prepi na ine sto spiti.

Evidential component in MUST? Not really. A simpler way to put it is that MUST is incompatible with knowledge or belief of ϕ (Giannakidou and Mari 2016, 2018, to appear)

MUST incompatible with knowledge of ϕ: the rain example

(27) Context: I am looking through the window, and I can see that it is raining.
#It must/may be raining.

(28) #Prepi na vrehi. (Greek MUST)
must subjunctive rain.3sg
It must be raining.

(29) #Tha vrehi. (Greek, epistemic future, equivalent to MUST)
future rain.3sg
It must be raining.

If I see the rain, *I know* that it is raining, I can therefore not use a modal, including MUST.

Against indirectness I: unclear vision

(30) Context: I am looking through the window, and it is foggy and dark. I don't fully trust what I am seeing:
It must be raining.

(31) Prepi na vrehi. (Greek MUST)
must subjunctive rain.3sg
It must be raining.

(32) Tha vrehi. (Greek, epistemic future, equivalent to MUST)
future rain.3sg
It must be raining.

• So, it's not about direct perception or not, but about how reliable I take the sensory information to be in establishing knowledge.
•von Fintel and Gillies/Karttunen cannot predict the contrast between seeing clearly vs. not clearly, because both are direct.

Against indirectness II: hearing

I hear that it is raining

(33) It must be raining.

(34) (Tha) Prepi na vrexi.

(35) Deve star piovendo.

Evidence is direct but partial: The speaker does not know that it is raining just by hearing. Hearing is less reliable as source of knowledge.

Against indirectness III: reported conversation

Giannakidou and Mari 2016:

(36) You and your sister were out of touch for a couple of years. Today she calls you on the phone to catch up. She tells you that her daughter Maria plays the piano. Later, you tell your husband:

a. #I Maria tha/prepi na pezi piano.
   #Maria must play the piano.

b. #Maria suonerà il piano.
   #Maria FUT.3sg play the piano.

Speaker has knowledge that *p* provided by her sister's utterance. MUST is blocked.

It doesn't matter that the source is indirect, MUST is not sensitive to that (pace Karttunen, von Fintel and Gilllies).

MUST needs inferential gaps

Giannakidou and Mari 2016: inferential gaps is another argument for MUSTp not entailing know/believe p

(37) #2+ 2 must be 4.

(38) #2+2 (tha) prepi na kani 4. (Greek)

2+2 is a simple addition, known to the speaker at t_u (parallel to when the speaker sees the rain and *#It must be raining* is out).

(39) 4534 + 5679 tha kani 10213. (Greek)
4534 + 5679 must be 10213.

This is a context in which the speaker cannot know the sum of the addition at t_u, but can calculate it. Gaps are needed to use MUST.

Epistemic weakening and reduced commitment

With modals, the speaker is not committed epistemically to *p*.

(40) Scale of epistemic commitment (Giannakidou and Mari 2016)
p >> *MUST* p>> *MIGHT p*; where >> means: epistemically more committed

1. Assertion of *p* conveys full commitment of *i* to *p*; MUST *p* conveys partial commitment, and MIGHT *p* is trivial (i.e. the weakest) commitment.
2. The degree of commitment correlates with how informative the sentence is (Giannakidou 2013)

Unmodalized sentences: speaker knows for sure that p

'full commitment'

(41) I Ariadne ine/itan arosti, #ala dhen ime ke endelos
the Ariadne is/was sick, but not be.1sg and completely
sigouri.
sure
Ariadne is/was sick, but I am not entirely sure.

(42) Ariadne was sick, # but I am not entirely sure.

Must and the *I am not entirely sure* test

Giannakidou and Mari 2014, 2016: MUST allows expressions showing that the speaker does not know 'for sure' that p is true.

(43) a. I Ariadne prepi na troi tora, alla den ime
the Ariadne must subj eat.non-past3sg now, but not be.1sg
ke endelos sigouri.
and completely sure.

b. Giacomo deve star mangiando, ma non sono
Giacomo must be eat-gerund, but not be.1sg
completamene sicura.
completely sure
'Giacomo must/will be eating now, but I am not entirely sure.'

(44) #Ariadne is eating now, but I am not entirely sure.

Must in the wild, with explicit denial of knowledge

Lassiter 2016, Goodhue 2018

(45) This is a very early, very correct Mustang that has been in a private collection for a long time. ... The speedo[meter] shows 38,000 miles and it must be 138,000, but I don't know for sure.

(46) I don't know for sure, sweetie, but she must have been very depressed. A person doesn't do something like that lightly.

Must in the wild, with explicit denial of knowledge

More examples from Lassiter

(47) It must have been a Tuesday (but I don't know for sure), I can't remember"

(48) I have an injected TB42 turbo and don't like the current setup. There is an extra injected located in the piping from the throttle body... Must be an old DTS diesel setup but I'm not certain. Why would they have added this extra injector?

MUST and epistemic future with past

(49) a. I Ariadne tha itan arrosti xthes.
the Ariadne FUT be.past.3sg sick yesterday
'Ariadne must/#will have been sick yesterday (that's why she didn't come to the meeting).'

b. Giovanni sarà stato malato ieri.
Giovanni FUT.be.3sg been sick yesterday.
'Giovanni must/#will have been sick yesterday.'

(50) a. I Ariadne prepi na milise xthes.
the Ariadne MUST SUBJ talk.past.3sg yesterday.
'For all I know, Ariadne must have spoken yesterday.'

German, Dutch FUT: like Greek, Italian

(51) (He is so grumpy.). Hij zal wel slecht gisteren geslapen hebben!
'He must/#will have slept really bad yesterday!'

(52) Ich habe meinem Freund letzte Woche einen Brief geschrieben; er wird ihn sicher schon bekommen haben.
I wrote a letter to my friend last week; he must surely have already received it. (Lederer 1969, p.98, ex. 584).

Broekhuis and Verkuyl 2014: Dutch *zullen* is an epistemic operator

Predictive future

Future adverbs, and an embedded perfective non-past:

(53) a. Tha vreksi avrio. (Greek)
FUT rain.perf.nonpast.3sg tomorrow.

b. Domani pioverà. (Italian)
Tomorrow rain.FUT.3sg
'It will rain tomorrow.'

Reduced commitment with the future too.

Interim summary

- Epistemic MUST does not entail knowledge of p;
- In fact, the use of a modal is a signal that the speaker doesn't know p, that she is not fully commited to it.
- MUST p is therefore epistemically weaker than a non-modalized assertion, where the speaker if fully committed.
- The weakness of MUST (and MIGHT) is responsible for the subjunctive.

The grammatical category doesn't matter

- We saw that MUST can be a verb, a particle, a tense morpheme
- So, the label "MUST" characterizes the semantic function, not the grammatical category

Epistemic subjunctive

Giannakidou 2016

(54) Isos/pithanon na efije o Nicholas.
Maybe/possibly subj left.3sg the Nicholas
Maybe Nicholas left.

Na, crucially, is incompatible with modals of probability and necessity.

(55) #Malon/Sigoura na kimate o Nicholas.
Probably/ certainly SUBJ sleep.3sg the Nicholas

(56) Malon/Sigoura tha kimate o Nicholas.
Probably/ certainly fut sleep.3sg the
Probably/Certainly Nicholas is asleep.

Epistemic subjunctive is a possibility modal

Giannakidou 2016

(57) At the utterance time t_u,
$[\![\text{Subjunctive (NON-PAST}(p))]\!]^{\mathcal{S}} = 1$ iff
$\exists w' \in \text{MB}_{\mathcal{S}} : \exists t' \in [t_u, \infty) \wedge p(w't')$

(58) At the utterance time t_u,
$[\![\text{Subjunctive (PAST}(p))]\!]^{\mathcal{S}} = 1$ iff $\exists w' \in \text{MB}_{\mathcal{S}} : \exists t' \prec t_u \wedge p(w't')$

Tha, prepi, dovere, must are necessity modals

Epistemic MUST, basic truth condition:

(59) At the utterance time t_u,
$[\![\text{MUST (NON-PAST(p))}]\!]^{\mathcal{S}} = 1$ iff
$\forall w' \in \text{Best}_{\mathcal{S}} : \exists t' \in [t_u, \infty) \wedge p(w', t')$ (future reading)

(60) At the utterance time t_u,
$[\![\text{MUST (PAST(p))}]\!]^{\mathcal{S}} = 1$ iff $\forall w' \in \text{Best}_{\mathcal{S}} : \exists t' \prec t_u \wedge p(w', t')$
(epistemic reading)

(61) At the utterance time t_u,
$[\![\text{MUST (PRES(p))}]\!]^{\mathcal{S}} = 1$ iff $\forall w' \in \text{Best}_{\mathcal{S}} : p(w', t_u)$

How exactly does this semantics require the subjunctive?

Giannakidou 2009, 2016, Giannakidou and Mari in preparation

- MUST presupposes a nonveridical modal base (*Nonveridicality Axiom*)
- The indicative is the mood of epistemic commitment.
- The subjunctive is the mood of weakened commitment (nonveridicality).
- An unmodalized (past or present) assertion presupposes a veridical modal base, therefore indicative is the default.

Grammar treats knowledge and belief as commitment

Strong belief: selects the indicative, mood of assertion

(62) I Ariadne kseri oti o Nicholas efige xthes.
the Ariadne knows that.IND the Nicholas left.3sg yesterday
'Ariadne knows that Nicholas left yesterday.'

(63) I Ariadne pistevi oti o Nicholas efige xthes.
the Ariadne believes that.IND the Nicholas left.3sg yesterday
'Ariadne believes that Nicholas left yesterday.'

Greek epistemics generally take IND, i.e. also *theoro, vrisko* consider, find

Veridicality as actual truth

Truth entailing functions (Zwarts (1995), Giannakidou (1994, 1997, 1998, 1999, 2013)

(64) Def 1. Objective veridicality.
(i) A propositional function F is veridical iff F$p \rightarrow p$ is logically valid.
(ii) F is nonveridical iff F$p \nrightarrow p$;
(iii) F is antiveridical iff F$p \rightarrow \neg p$.

objective veridicality = actuality

Veridicality and tense

(65) Nicholas brought dessert.

(66) Nicholas is washing the dishes.

(67) Veridicality of temporal operators.
Let F be temporal function, t an instant or an interval.
F is veridical iff Fp at a time t entails that p is true at a (contextually given) time $t' \leq t$; otherwise F is nonveridical.
(Giannakidou 2002 (23)):

(68) PAST is veridical because PAST (p) at t_u entails that p was true at a time prior to t_u.

(69) PRES is veridical PRES (p) at t_u entails that p is true t_u.

NONPAST does not refer to an existing time, hence it is nonveridical.

Modals are objectively non-veridical

(70) Nicholas might/must be a doctor.

(71) Nicholas might/must have brought dessert.

(72) MUST(p) does not entail that p is true

(73) MIGHT(p) does not entail that p is true

Veridicality can also be understood *epistemically*

And in this case we talk about commitment: in terms of what one knows, believes, imagines, etc.

(74) a. I Ariadne ine/itan arosti, #ala dhen ime ke endelos sigouri.
b. Giacomo è malato, #ma non sono sicura.
'Ariadne/Giacomo is sick, #but I am not entirely sure.'

In uttering an unmodalized past or present sentence, the speaker expresses an epistemic judgement. She is committed to the truth of what she says (this is why she asserts it). She knows or believes p to be true.

Individual anchors and their private spaces

Individual anchors (Farkas 1985, Giannakidou 1998, 1999)

(75) Def. 2 *Epistemic state of an individual anchor i*
An epistemic state $M(i)$ is a set of worlds associated with an individual *i* representing worlds compatible with what *i* knows or believes.

Subjective veridicality: full commitment in a private space

(76) Def. 3 *Subjective veridicality*
A function F that takes a proposition p as its argument is subjectively veridical with respect to an individual anchor i iff Fp entails that i knows or believes that p is true.

This means that i's epistemic state $M(i)$ is homogenous, epistemically settled: $M(i) \subseteq p$. i is committed to p.

Commitment: positive or negative

(77) $\forall w[w \in M(i) \rightarrow w \in \{w' | p(w')\}]$: i knows/believes p, i is fully committed to p

(78) *Epistemic settledness of* M(i) (Giannakidou and Mari 2016, 2018)
M(i) is epistemically settled about p iff
$(\forall w' \in \mathrm{M}(i) p(w')) \vee (\forall w' \in \mathrm{M}(i) \neg p(w'))$

A settled epistemic state is a commitment state, and contains either only p worlds (the epistemic state is positively settled) or only $\neg p$ worlds (the epistemic state is negatively settled).
Veridicality is positive settledness.

Veridicality, epistemic settledness, and commitment

(79) a. An epistemic state $M(i)$ is veridical about p iff it is positively settled: i.e $\forall w' \in M(i) : p(w')$ (commitment to p)

b. An epistemic state $M(i)$ is antiveridical about p iff it is negatively settled: i.e $\forall w' \in M(i) : \neg p(w')$ (commitment to not p)

Subjective veridicality, assertability

(80) a. John won the race.

b. $[\![$ John won the race $]\!]^{M(speaker)} = 1$ iff
$\forall w[w \in M(\text{speaker}) \rightarrow w \in \{w' |$ John won the race in $w'\}]$

If the speaker asserts *John won the race*, she believes or knows that John won the race, hence p is settled in M(speaker), the speaker is committed to p. M(speaker) is thus a veridical modal space.

The veridicality of knowledge

(81) $[\![$Nicholas knows that $p]\!]$ is defined in w iff $w \in p$; if defined, $[\![$Nicholas knows that $p]\!]$ is true in w wrt $M(Nicholas)$ iff: $\forall w'[w' \in M(Nicholas) \rightarrow w' \in \lambda w''\{w''|p(w'')\}]$

• M(Nicholas) is a non-partitioned, homogenous epistemic space of commitment.

• Therefore knowing p and asserting p are stronger than any variant of MUST p.

The veridicality of Hintikka belief

(82) $[\![$Nicholas believes that $p]\!]$ is true in w with respect to $M(Nicholas)$ iff:
$\forall w'[w' \in M(Nicholas) \rightarrow w' \in \lambda w''\{w''|p(w'')\}]$

Therefore believing p is also stronger than any variant of MUST p.

Nonveridicality: non-homogeneity, non-commitment

(83) *Subjective nonveridicality*
A function F that takes a proposition p as its argument is subjectively nonveridical with respect to an individual anchor i and an epistemic state M(i) iff Fp does not entail that i knows or believes that p is true.

• A nonveridical M(i) does not as a whole support p: there is a subset of M(i) supporting p, maybe the subset that best complies with knowledge or evidence of i.
• This renders M(i) nonveridical. A non-veridical M(i) conveys weaker belief.

Nonveridicality: not being committed to p

(84) *Nonveridical epistemic state*
An epistemic state M(i) is nonveridical about p iff M(i) contains both p and $\neg p$ worlds.

•Nonveridical epistemic states M(i) are non-homogenous, containing p and $\neg p$ worlds. Modal and Inquisitive spaces such as questions are prototypical nonveridical epistemic states.
• This underlies the inferential character of MUST. Nonveridicality *not* indirectness!

Modal bases of modals are nonveridical spaces

(Giannakidou 1997, 1999, Giannakidou and Mari 2014, 2016, to appear)

(85) *Nonveridicality Axiom of modals*
MODAL (M) (p) can be defined only if the modal base M is nonveridical, i.e. only if M contains p and non-p worlds.

Non-aleithic modals (possibility and necessity), epistemic, deontic, bouletic, etc) obey this principle. (see also Condoravdi 2002, diversity condition).

The semantics of MUST: Ideal worlds

Given a non-veridical epistemic modal base $\mathrm{M}(i)(t_u)(w_0)$, we define $\mathrm{Ideal}_{\mathcal{S}}$ as a function over $\mathrm{M}(i)(t_u)(w_0)$. The output $\mathrm{Ideal}_{\mathcal{S}}$ is a subset of $\mathrm{M}(i)(t_u)(w_0)$

(86) $\mathrm{Ideal}_{\mathcal{S}}\left(\mathrm{M}(i)(t_u)(w_0)\right) = \{w' \in \mathrm{M}(i)(t_u)(w_0) : \forall q \in \mathcal{S}(w' \in q)\}$

Ideal worlds are those in which ground norms (stereotypicality conditions, normality conditions), hold.

NB: Our Ideal is different from the Kratzerian, Portner Best, because it is not an ordering source. It is a secondary modal base.

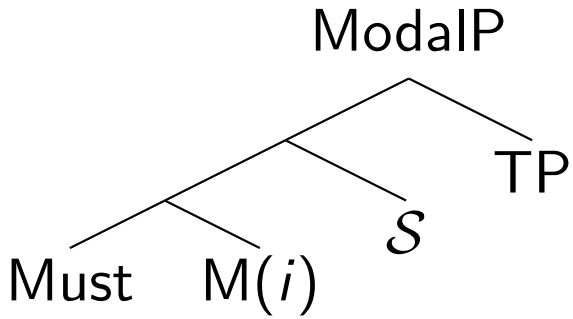
The semantics of MUST

Let t_u be the utterance time:

(87) $[\![\text{prepi}/tha/futuro/\text{MUST (PAST }(p))]\!]^{M,i,\mathcal{S}}$ will be defined only if the modal base $\text{M}(i)(t_u)$ is nonveridical and it is partitioned into $\text{Ideal}_{\mathcal{S}}$ and $\neg\text{Ideal}_{\mathcal{S}}$ worlds. ;
if defined, $[\![\text{prepi}/tha/futuro/\text{MUST (PAST }(p))]\!]^{M,i,\mathcal{S}} = 1$ iff
$\forall w' \in \text{Ideal}_{\mathcal{S}} : \exists t' \prec t_u \wedge p(w', t')$

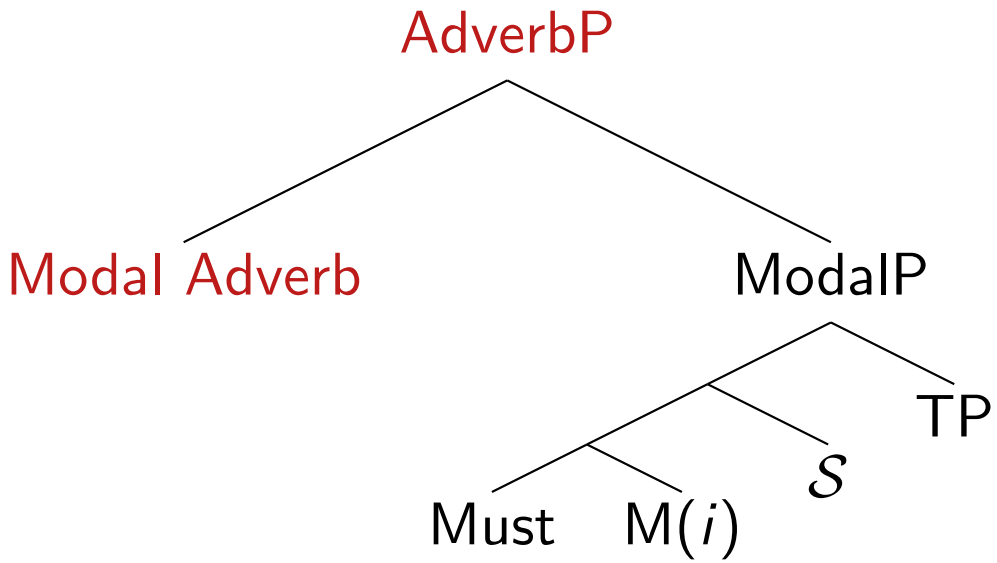
Adding layers

We could stop here.



Adding layers

The modal structure is like this:



Adding layers: ranking of the two sets

- The modal adverb ranks Ideal better than Non-Ideal, gives positive bias to MUST
- ...and renders it a positive polarity item (PPI).

MUST as a PPI

(88) Ariadne must not be a doctor.(= MUST (Ariadne not be a doctor)).

(89) Ariadne must not eat meat. (Ariadne is a vegetarian).

(90) a. Ariadne cannot be a doctor.
b. Ariadne cannot talk to Dean.

(91) a. Ariadne doesn't have to be a doctor (to apply for this job).
b. Ariadne doesn't need to spend a lot of money (for Jason't birthday gift).

Modal adverbs as PPIs: bad in the scope of negation

(92) a. #Dhen prepi profanos/malon na ine giatros.
Not must obviously/probably subj be.3SG doctor

b. #Non deve probabilmente/sicuramente essere un
#Not must.3SG.PRES probably/certainly/forse be a
dottore.
doctor.
'He must not obviously/probably/maybe be a doctor.'

Modal adverbs as PPIs: good above negation

(93) a. Profanos/Malon, dhen prepi na ine giatros.
Obviously/probably, not must subj be.3SG doctor
Obviously/probably, he must not be a doctor.
(MUST>NOT)

b. Probabilmente, non deve essere un dottore.
probably/certainly not must3SG.PRES be a doctor.

The adverb provides a meta-evaluation function $\mathcal{O}$

Giannakidou and Mari to appear:

- The modal structure contains a meta-evaluation $\mathcal{O}$.

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- $\mathcal{O}$ contains those propositions that allow *i* to evaluate the relative ranking of stereotypical as better possibilities than non-stereotypical worlds.

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- $\mathcal{O}$ contains those propositions that allow *i* to evaluate the relative ranking of stereotypical as better possibilities than non-stereotypical worlds.
- $\mathcal{O}$ captures the speaker's confidence in normalcy effects, gives positive bias.
- $\mathcal{O}$ can vary in what it contains, and generalizes to all kinds of attitudes that take the subjunctive.

Positive bias

MUST

(94) Positive bias of epistemic necessity modals .
Ideal$_{\mathcal{S}}$ is weak necessity with respect to $\neg$Ideal$_{\mathcal{S}}$, relative to M(i) and $\mathcal{O}$.

(95) $[\![\emptyset]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}} = \lambda q.$ Ideal$_{\mathcal{S}}$ is a weak necessity with respect to $\neg$Ideal$_{\mathcal{S}}$ relative to M(i) and $\mathcal{O}$ & q

The default positive bias of the adverb

MUST Final:
By default, there is a silent 'probably'.

(96) $[\![\emptyset\,\text{MUST}\ (\text{PRES}\ (p))]\!]^{\mathcal{O},\text{M},i,\mathcal{S}}$ is defined only if the modal base $\text{M}(i)$ is nonveridical and it is partitioned into $\text{Ideal}_{\mathcal{S}}$ and $\neg\text{Ideal}_{\mathcal{S}}$ worlds. If defined,

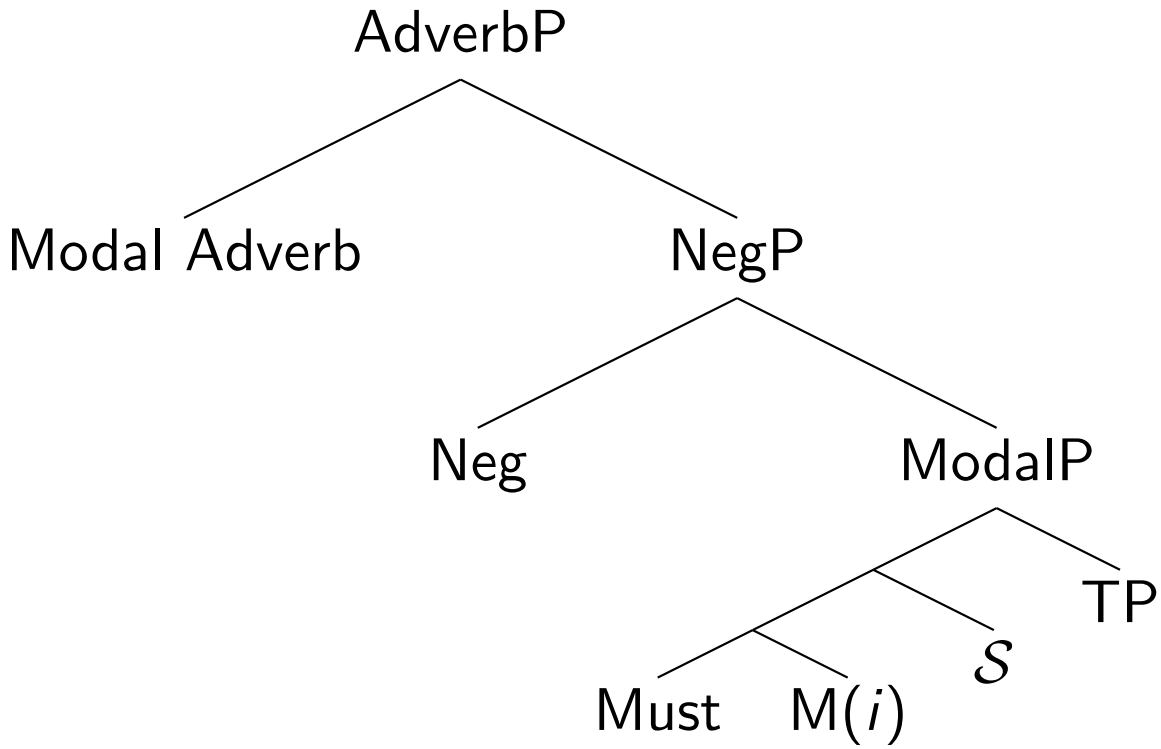
The default positive bias of the adverb

MUST Final:
By default, there is a silent 'probably'.

(96) $[\![\emptyset\,\text{MUST (PRES }(p))]\!]^{\mathcal{O},\text{M},i,\mathcal{S}}$ is defined only if the modal base $\text{M}(i)$ is nonveridical and it is partitioned into $\text{Ideal}_{\mathcal{S}}$ and $\neg\text{Ideal}_{\mathcal{S}}$ worlds. If defined,
$[\![\emptyset\,\text{MUST (PRES }(p))]\!]^{\mathcal{O},\text{M},i,\mathcal{S}} = 1$ iff: $\text{Ideal}_{\mathcal{S}}$ is a weak necessity with respect to $\neg\text{Ideal}_{\mathcal{S}}$ relative to $\text{M}(i)$ and $\mathcal{O}$ &
$\forall w' \in \text{Ideal}_{\mathcal{S}} : p(w', t_u)$

Predicting PPI-hood of the adverb and of the modal verb

(97)



Why does NEG have to be interpreted below it ?

Homogeneity condition imposed by $\mathcal{O}$ on the Ideal set

Recall: the Ideal$_{\mathcal{S}}$ set is the set where the prejacent is true.

(98) Homogeneity constraint on Ideal$_{\mathcal{S}}$.
$\mathcal{O}$ requires that Ideal$_{\mathcal{S}}$ be homogeneous insofar as the prejacent of the modal is concerned.

Justification: The Ideal set is the one where the prejacent is true. If it were non-homogeneous, the speaker would be equally committed to the truthfulness of the prejacent and of its negation.

Predicting PPI-hood of the adverb and of the modal verb

If NEG were interpreted above MUST:

(99) $[\![\text{PROBABLY NOT MUST (PRES } (p))]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}}$ is defined only if .... as above
$[\![\text{PROBABLY NOT MUST (PRES } (p))]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}} = 1$ iff: $\mathrm{Ideal}_{\mathcal{S}}$ is a weak necessity with respect to $\neg\mathrm{Ideal}_{\mathcal{S}}$ relative to $\mathrm{M}(i)$ and $\mathcal{O}$ & $\neg\forall w' \in \mathrm{Ideal}_{\mathcal{S}} : p(w', t_u)$

Predicting PPI-hood of the adverb and of the modal verb

Hence negation must be interpreted low.

(100) $[\![\text{PROBABLY NOT MUST (PRES } (p))]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}}$ is defined only if the modal base $\mathrm{M}(i)$ is nonveridical and it is partitioned into $\text{Ideal}_{\mathcal{S}}$ and $\neg\text{Ideal}_{\mathcal{S}}$ worlds. If defined, $[\![\text{PROBABLY NOT MUST (PRES } (p))]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}} = 1$ iff: $\text{Ideal}_{\mathcal{S}}$ is a weak necessity with respect to $\neg\text{Ideal}_{\mathcal{S}}$ relative to $\mathrm{M}(i)$ and $\mathcal{O}$ & $\forall w' \in \text{Ideal}_{\mathcal{S}} : \neg p(w', t_u)$

Prediction is borne out: universal epistemic modals are PPI.
What about existential epistemic modals ?

Positive bias versus equilibrium

MIGHT

Nonveridical equilibrium (Giannakidou 2013)

(101) Nonveridical equilibrium An epistemic state M is in nonveridical equilibrium iff M is partitioned into p and $\neg p$, and there is no ordering source.

Possibility modals, questions are in nonveridical equilibrium. There is no preference between p and $\neg p$, whcih means that $\mathcal{O}$ is empty.

(102) (For all I know) Ariadne might/may pass the exam.

MIGHT and equilibrium

MIGHT + DEFAULT POSSIBILITY SILENT ADVERB

(103) $[\![\text{Maybe/Forse/Isos}]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}} = \lambda q.\ \mathcal{O}$ is empty & q

(104) $[\![\emptyset\ \text{MIGHT (PRES }(p))]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}}$ is defined only if $\mathrm{M}(i)$ is nonveridical and partitioned into $\text{Ideal}_{\mathcal{S}}$ and $\neg\text{Ideal}_{\mathcal{S}}$ worlds. If defined,
$[\![\emptyset\ \text{MIGHT (PRES }(p))]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}} = 1$ iff $\mathcal{O}$ is empty &
$\exists w' \in \mathrm{M}(i) p(w', t_u)$

No PPI-hood for might

With MIGHT:

- There is a secondary modal base (in the assertability conditions), but no ranking. And because there is no ranking, there is no need for homogeneity in the quantified set.
- Prediction is borne out. Existential modals are NOT PPIs.

Volition: partition, meta-evaluation, positive bias towards p

The idea is to generalize the ingredients of MUST
$\mathcal{O}$ now ranks Ideal and Non-Ideal worlds in terms desirability:

(105) $[\![\emptyset \text{ WANT (PRES } (p))]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}}$ is defined only if the modal base $\mathrm{M}(i)$ is nonveridical and it is partitioned into $\text{Ideal}_{\mathcal{S}}$ and $\neg\text{Ideal}_{\mathcal{S}}$ worlds. If defined,

Volition: partition, meta-evaluation, positive bias towards p

The idea is to generalize the ingredients of MUST
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(105) $[\![\emptyset \text{ WANT } (\text{PRES } (p))]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}}$ is defined only if the modal base $\mathrm{M}(i)$ is nonveridical and it is partitioned into $\text{Ideal}_{\mathcal{S}}$ and $\neg\text{Ideal}_{\mathcal{S}}$ worlds. If defined,
$[\![\emptyset \text{ WANT } (\text{PRES } (p))]\!]^{\mathcal{O},\mathrm{M},i,\mathcal{S}} = 1$ iff: $\text{Ideal}_{\mathcal{S}}$ is more desired $\neg\text{Ideal}_{\mathcal{S}}$ relative to $\mathrm{M}(i)$ and $\mathcal{O}$ & $\forall w' \in \text{Ideal}_{\mathcal{S}} : p(w', t_u)$

Volition a lot like MUST: but $\mathcal{O}$ now relies on desires. This idea is to generalize this analysis to all subjunctive taking verbs.

Conclusions

1. The criterion for weakness of modals is that they are all nonveridical. Their modal bases are non-homogenous spaces containing ϕ and $\neg\phi$ worlds (Nonveridicality Axiom).
2. The nonveridicality of modals makes them epistemically weaker than knowledge or belief of ϕ.
3. The illusion of strength of MUST comes from its non-empty $\mathcal{O}$ and the resulting positive bias.
4. Mood selection is a requirement of full epistemic commitment (indicative) and nonveridicality (subjunctive).
5. All modals and volitionals are nonveridical and therefore select subjunctive.

This material was based on:

- Giannakidou, A. 2013. Inquisitive assertions and nonveridicality. In *The dynamic, inquisitive, and visionary life of ϕ, ?ϕ and possibly ϕ: Festschrift for J. Groenendijk, M.Stokhof and F. Veltman*. 115-126.
- Giannakidou, A. and A. Mari 2016. Biased modality and epistemic weakness with future/MUST. In *Mood, Aspect, Modality: New Answers to Old Questions*. U. of Chicago Press.
- Giannakidou, A. and A. Mari. 2018. A unified analysis of the future as epistemic modality: the view from Greek and Italian. *Natural Language and Linguistic Theory*
- Giannakidou, A. and Mari, A. to appear, *Linguistics and Philosophy*. The semantic roots of positive polarity with modal verbs and adverbs.
- Giannakidou, A. and Mari, A. in preparation, *Veridicality in Grammar: propositional attitudes, mood, and negation*. University of Chicago Press.