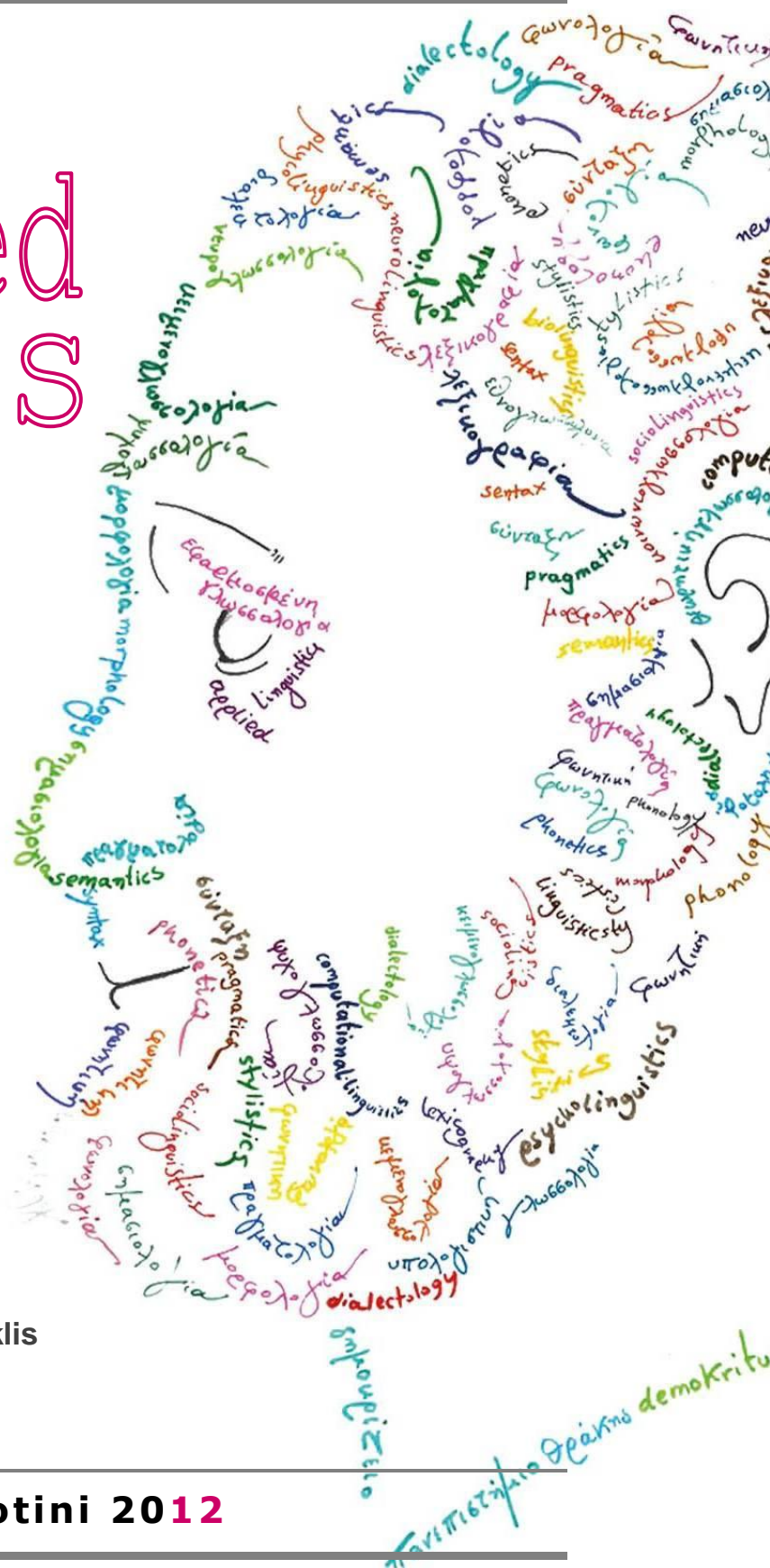


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THE GREEK FUTURE: EPISTEMIC MODALITY AND MODAL CONCORD

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ABSTRACT

*In this paper, I propose an analysis of the Greek so-called ‘future’ particle *tha* (θα) as an epistemic necessity modal operator with present perspective. This analysis renders *tha* similar to the English modal *must*—and as in English, I will argue that we find evidential uses (further studied in Giannakidou and Mari to appear, and shown to hold in both Greek and Italian). The main evidence for the modality of *tha* will be drawn from co-occurrence with modal adverbs which constitutes, I will argue, modal concord in the sense of Huitink (2012). My analysis is similar to Tsangalidis (1999) who argues that the particle *tha* is not a prototypical future tense marker—but differs from Tsangalidis who claims that *tha* is not a modal operator either. The major implications of what I propose here is that the category ‘future’ is modal, at least in Greek, and that the ‘future’ reading is simply forward shifting of the time of the event due to the presence of an adverbial.*

1. The future: tense or modality?

The question of whether the category ‘future tense’ in natural languages is a tense or modality has been central in linguistic semantics, and both answers have been explored (for modal accounts, see Prior, 1967; Bertinetto, 1979; Copley, 2002; Squartini, 2004; Mari, 2009, Klecha 2011; for a defense of the temporal analysis see Kissine 2008). Certainly, the English future word ‘will’ has been known to admit purely modal readings, and is typically characterized in the grammars as a modal verb. We also read, for instance in Palmer (1987), that “it is tempting to refer to the meaning of *will* as probability, alongside possibility and necessity for *may* and *must*. But the word ‘probable’ does not provide a good paraphrase. A better paraphrase is again in terms of conclusion: ‘A reasonable conclusion is that.. (Palmer 1987: 136)’.”

- (1) The French’ll be on holiday this week.
- (2) No doubt, you’ll remember John.

The sentences above with *will* are conjectural rather than temporal, and *will* seems to convey a sort of ‘inferential’, epistemic modality: *given what I know, it is quite likely* or *it is quite plausible*, or in cases of stronger certainty, *it must be the case* that that the French are on holiday this week. The modality is stronger than mere possibility, and ranges from strong probability to weak and classical necessity (Kratzer 1981, 1991). However, *must* and *will* are not equivalent:

- (3) John will be in his office.
- (4) John must be in his office (Palmer 1987: 136).

Must conveys stronger certainty than *will* in the pair above, and it also seems to have an evidential component (see von Stechow and Gillies 2010 and references therein): *all the worlds compatible with the best indirect evidence I have*, are worlds where John is in his office. *Must*, at the same time, unlike *will*, does not necessarily make reference to a time after the utterance time:

- (5) Utterance time, 9 pm: John must have left at 6 pm; #by 10 pm).
- (6) Utterance time, 9 pm: John will have left (#at 6 pm; by 10 pm).

In this paper, I will propose that the Greek future particle *tha* (θα) is, contrary to the traditional grammar label, not a future tense but a modality operator, pretty much like *will* and *must*. The epistemic, non-future, uses of *θα* have been known in the literature since Tzartanos' grammar (1953); they have also been noted in the grammar of Holton et al. (1997), and were studied in more detail in Tsangalidis's seminal work on *tha*. They have also acknowledged in more recent literature e.g. Chiou (2012). I will further show here that the 'future' reading itself is not devoid of epistemic modality either, there are therefore no purely temporal uses of *tha*. Tsangalidis himself reaches the conclusion that *tha* is neither a modal nor a temporal operator, but rather a hybrid, mixed category. The analysis I will propose in this paper treats *tha* as a modal (epistemic) operator, with present—not future—perspective (a position that I adopt from my earlier work (Giannakidou 2009)). In ongoing work, Giannakidou and Mari study the evidential component underlying *tha*, but given space limitations, I will not expand on this here.

The main argument for the modality of *tha* comes from its non-future readings with present and past, and from its interaction with modal adverbials. In the examination of this interaction, we discover that Greek exhibits rich patterns of modal concord, not only with *tha* but also with the other necessity modal *prepi*. I adopt Huitink's 2012 analysis of modal concord as a suitable framework for the analysis of Greek, but we also note a flexibility with both necessity modals in Greek that may be used as an argument for probability based theories of modality such as e.g. Lassiter (2011).

The modal analysis of *tha* has a variety of implications which set up a lively agenda for future research. First, it allows us to move beyond the choice *particle or verb?*, dictated by typological studies (Tsangalidis 1999) and which collapses essentially the semantic category 'modal operator' with the syntactic status of 'modal verb'. Modality is a semantic category that can have various syntactic realizations (Kratzer 1981, 1991, Portner 2009)— verbs, adverbs, morphemes such as *-able*— and as I suggest here also particles. It is misleading to reject the modal analysis of *tha* just because it is not, syntactically, a verb (see a similar point in Roussou and Tsangalidis 2010). Second, the modal analysis of *tha* establishes a correlation between epistemic modality and temporal interpretation, a route that has not been previously taken but which is very promising in allowing a better understanding of the category 'future'.

The paper unfolds as follows. In the next section, I describe the epistemic reading of *tha* in detail, along with the future use. Instrumental to this discussion is the co-occurrence of *tha* with modal adverbs, showing that the modal readings have a gradient force that is stronger than mere possibility, and closer to high probability and necessity. In section 3, I will outline the temporal polarity analysis of Giannakidou 2009 which I will use as the basis for the derivation of the future meaning; in section 4, I further develop the epistemic modal analysis of *tha* and offer a preliminary analysis of the modal concord patterns observed.

2. *Θα*: future, epistemic readings, and co-occurrence with modal adverbs

The Greek verb is obligatorily inflected for tense and aspect, and the particle *tha* is used with all four tense and aspect combinations: perfective non-past (PNP), perfective past (PP), imperfective non-past (INP) and imperfective past (IP). I illustrate the basic temporal/aspectual distinctions below (cf. Mackridge 1985, Holton et al. 1997):

- | | | | | | | |
|-----|----|------------------------------|---------------|----|---------------------------------------|-----------------|
| (7) | a. | graf- | -o (INP) | b. | grap- s- | -o (PNP) |
| | | write. imperf | -1sg.nonpast | | write- perf . | 1sg.nonpast |
| | | 'I am writing (right now).' | | | [no English equivalent; * on its own] | |
| | | 'I write (generally).' | | | | |
| (8) | a. | e- | graf- -a (IP) | b. | e- | grap- s- a (PP) |
| | | past- write. imperf . | 1sg.past | | past- write- perf . | 1sg.past |
| | | 'I used to write.' | | | 'I wrote.' | |
| | | 'I was writing.' | | | | |

The basic temporal opposition is between a morphological past, which is usually marked by the prefix *e-* attaching to the verbal stem and specific inflection; and a nonpast which is signaled by the absence of the prefix *e-* (hence the label *nonpast*), and which has its own inflection. The form in (7b)— the PNP— is a dependent form: it is not possible on its own, but only in combination with nonveridical particles (i.e. particles that create a nonveridical domain; Giannakidou 1998, 1999, 2009) such as the subjunctive *na*, *tha*, the optative *as*, *prin* 'before', *an* 'if':

- (9) a. **As** fiji o Janis.
as leave.PNP.3sg the John
'Let John go.' (request or permission)
- b. **Na** fiji o Janis.
na leave.PNP.3sg the John
'Let John go.' (request or permission)
- c. **Tha** fiji o Janis.
tha leave.PNP.3sg the John
'John will leave.' (future)
- d. {**An/Prin**} fiji o Γιάννης....
If/before leave.PNP.3sg the John
'If/before John goes away....'

As we see in these examples, the combination nonveridical particle plus PNP creates future orientation: the intended event is to be located at an interval starting at the utterance time and stretching through the time afterward. So, future orientation is *not* an exclusive property of *tha*, but typical of the whole class of nonveridical particles and connectives in combination with this particular verbal form, the PNP. We also see that some of the particles function as higher modal or illocutionary force operators (e.g. the optative or the subjunctive), or they directly correspond to C positions as is the case with the connectives.

I will give examples of *tha* with each combination next, but I wanted first to frame the discussion by saying that in *all* combinations, even with the PNP, *θα* is interpreted epistemically. In addition, with PNP, we have the future reading, which is more due to properties of the PNP (Giannakidou 2009). My account differs from Tsangalidis (1999) who claims non-ambiguity and distinguishes between *tha* with PP which gives 'pure' epistemic past readings, and *tha* with the PNP which gives 'pure' non-epistemic future readings. (Tsangalidis allows the other combinations to be open to both temporal and modal readings). My claim is that there is no 'pure' future reading, and that the epistemic reading is always available with *tha* (see also Chiou 2012 for a similar intuition that the epistemic reading is generally available in all cases). It is important to note that Giannakidou and Mari (to appear) reach a similar conclusion for the Italian future suffix too.

Let us now consider in some detail the epistemic meaning of *tha*.

2.1 The epistemic reading of *θα*: co-occurrence with adverbs and the necessity modal

The epistemic reading arises as a 'pure' reading—in the sense of lacking future—in combinations of *tha* with imperfective non-past (INP) and perfective past (PP). I describe first the combination of *tha* with nonpast; the reading with the PP is exactly the same, only about a past event.

Consider the sentences below. In the glosses below I will refer to *tha* as FUT:

- (10) a. I Ariadne tha kimate tora.
the Ariadne FUT sleep.INP.3sg now
Ariadne must be sleeping now.
- b. I Ariadne tha ine giatros.
the Ariadne FUT be.3sg doctor
Ariadne must be a doctor.
- c. I Ariadne tha pezi tora.
the Ariadne FUT play.INP.3sg now
Ariadne must be playing now.

I use both stative and non-stative predicates, and as we see, in all cases, the most plausible paraphrase is the one indicated in the translations where I use the verb *must*. The reading is epistemic, inferential: I am considering information I have, and draw an inference based on that information. For example, with regard to (a), I know that Ariadne has the habit of taking a nap at 2pm, I also know that she always sticks to

schedule, and I also know that today has been a regular day. So at 2 pm, I utter the sentence expressing my relative certainty that Ariadne is, *for all I know*, asleep. Likewise, I know also that usually by 6 pm Ariadne is down at the yard playing with her friends. At any time after 6 pm then, I can utter (c) with the same degree of certainty. Finally, (b) expresses an inference that is more based on knowledge plus behavioral evidence: I have witnessed Ariadne expressing opinion on medical matters, she cites medical papers all the time, and similar things, hence I am entitled to conclude (b).

We must note that the certainty about the truth of the proposition is relatively strong, as we will witness below with the use of adverbials. But before we discuss that, it is important to mention that if I have direct evidence of the even happening, I cannot use *tha*. Just like in English, e.g., if I am watching the rain falling, it is quite weak to say “It must be raining”:

- (11) Context: I am watching the rain through the window. I say:
#*Tha vrex!* “It must be raining”.

This seems to suggest a sensitivity to the nature of evidence: if I have direct evidence to the truth of the sentence, *tha* is unacceptable. This sensitivity suggests that the statement with *tha* is weaker than the non-modalized assertion ‘It is raining’ or ‘Ariadne is a doctor’—weaker in the sense of nonveridical (Giannakidou 1998, 1999: not entailing the truth of the sentence in the context). Statements with indirect evidentials are similarly weak (nonveridical), and do not entail the truth of the sentence in the context—see for instance Fallor 2002, Smirnova 2011, and Murray 2012. If direct evidence supports the stronger statement, I am not being a co-operative speaker by choosing a weaker statement.

So, *tha* does convey a strong sense of certainty, it is still however non-veridical and conveys a non-homogeneous epistemic space that allows for the possibility that *not p*, like all modals (Giannakidou 1998, 1999; *pace* con Fintel and Gillies 2010), and nonveridical contexts in general. Now, notice that *tha* is fine with high probability adverbs such as *malon* ‘probably/most likely’, *sigoura* ‘certainly’ and *oposdhipote* ‘definitely’—but is bad with mere possibility adverbs such as *isos* ‘maybe/perhaps’ and *pithanon* ‘possibly’:

- (12) I Ariadne {malon/profanos/sigoura/oposdhipote} *tha ine* jatros.
the Ariadne probably/obviously/certainly/definitely FUTbe.3sg doctor.
Ariadne must {probably/obviously/certainly/definitely} be a doctor.

- (13) I Ariadne {isos/pithanon} **tha ine* jatros.
the Ariadne maybe/possibly FUT be.3sg doctor
Maybe Ariadne is a doctor.

This contrast suggests that the force of the modality of *tha* is stronger than mere possibility, and parallel facts about FUT and the adverbials hold in Italian (Giannakidou and Mari, to appear). Notice also that *tha* is compatible with a range of adverbs from high probability to necessity (*oposdhipote* ‘definitely’ which is the Greek equivalent to ‘necessarily’ in epistemic contexts).¹

The same behavior characterizes the Greek necessity modal *prepi* (the only necessity modal verb in Greek), which combines with the same range of adverbs, *but also with FUT itself*:

¹ The cognates *anagastika* ‘necessarily’ *ipixreotika* ‘obligatorily’ resist epistemic uses in Greek, and are preferred in deontic contexts. The sentence below creates an obligation that Ariadne be a doctor:

- (i) #*I Ariadne prepi anagastika/ipoxreotika na ine giatros.*
Ariadne must necessarily/obligatorily be a doctor.

The # marks the epistemic reading. In a context where an obligation makes sense, the use of *anagastika/ipoxreotika* is fine:

- (ii) Context: Ariadne wants to get a job at the hospital. I say: “In order to apply,
I Ariadne prepi anagastika/ipoxreotika na ine giatros.”
Ariadne must necessarily/obligatorily be a doctor

- (14) I Ariadne {malon/#isos} tha prepi na efije.
 Ariadne probably FUT must subj left.PNP.3sg
 ?Ariadne probably must have left.

- (15) I Ariadne (tha) prepi na efije.
 Ariadne FUT must subj left.PNP.3sg
 ?Ariadne probably must have left.

- (16) Ta pedia prepi oposdhipote na ine sto spiti.
 The children must definitely SUBJ be.3pl in-the home
Epistemic necessity: The children must definitely be at home

- (17) Ta pedia **prepiprofanos/endexomenos** na ine sto spiti.
 The children **must obviously/potentially** SUBJ be.3pl in-the home
Epistemic necessity: The children must probably be at home

(All complementation is finite in Greek, and modal verbs take subjunctive *na* complements). *Prepi* is compatible with a range of adverbs above a certain threshold of high probability reaching to necessity. In this, it differs from English where *must* resists modification by adverbs other than strong necessity modals (ex. 14, 15), (though such occurrences are not unattested, as David Lassiter communicated to me)². It seems plausible to say that Greek collapses the Kratzerian distinction between *should* (weak necessity) and *must* (necessity) in the same lexical item (unlike English). Soward counts as necessity seems to be ‘more flexible’ in Greek—a fact that can also be used to support measure function based theories of modality such as e.g. Lassiter 2011, as I will comment briefly at the end of the paper. At any rate, given the co-compatibility of *tha* and *prepi*, we must conclude that they express matching modalities. We can view this as a case of modal concord in the sense of the most recent discussion in Huitink 2012, an idea I develop further in section 4.2.

2.2 FUT plusperfective non-past: future *and* epistemic reading

The combination of FUT and the perfective non-past (PNP) gives the temporal reading:

- (18) O Janis tha ftasi stis 5 pm/avrio. (future)
 The John FUT arrive.PNP.3sg at 5 pm/tomorrow.
 ‘John {will/#must} arrive at {5 pm/tomorrow}.’

A paraphrase with *must* is pretty odd in this case. Notice also that we have the adverbials ‘at 5 pm’ and ‘tomorrow’. Without them, the epistemic reading is free to surface:

- (19) Context: It’s late, the weather is bad, and we know Ariadne is travelling. You worry, and I want to reassure you and say:
 Min anisixis. I Ariadne tha ftasi. (epistemic)
 Not worry.imperative.2sg. the Ariadne FUT arrive.PNP.3sg.
 ‘Don’t worry. Ariadne will arrive.’

² Dan Lassiter offers the following, corpus retrieved, examples with *must possibly* and *must perhaps*:

- (i) The Parish borders the North Downs and is on the edge of a designated Area of Outstanding Natural Beauty. Surrounded by this amazing countryside it offers outstanding views. Just stand at Eastwell Towers and gaze out towards the Wye Crown, *it must possibly be one of the finest views in the South East*.
 (ii) This book is an odyssey, a journey up through the mists of time from the remote past. It explores what *must perhaps be the most fundamental of all questions* - who we are.

In this case, I am expressing a certainty that Ariadne will arrive which I mean to be comforting. This is a reading that we also get with *will*.

The epistemic reading is alsoprominent with the evidential “*ipan*” ‘they say’:

- (20) *O Janis tha gini kala, ipan.*
the John FUT recover.3sg said.3pl.
‘John will recover, they say.’

Finally, consider the following example (from Holton et al. 1997):

- (18) *Kaθe proi tha sikothi, tha pji to kafedhaki tu, tha dhiavasi tin efimeridha tu, kai kata tis 8.30 tha fiji jia to grafio tu.*
‘Every morning he will get up, drink his coffee, read his newspaper and at approximately 8.30 he will leave for the office.’

This is a series of generic sentences, with no reference to the future—in Greek or in English. So, the ‘future’ reading of *tha*, in the absence of a definite adverbial such as ‘at 5 pm’ is never ‘pure’, never devoid of epistemic modality. I must mention Chiou’s 2012 analysis which agrees with my conclusion above that *tha* always contributes an epistemic modal semantic core, and further argues that “the future interpretations arise as implicatures related to the Levinsonian I- principle. In essence, it is proposed that future-time reference is an I- enriched interpretation of the modal base achieved at the level of communication and depends on pragmatic cues of speaker intentions.” (Chiou 2012: 35). In this account too, we find the future reading being not a semantic contribution of *tha* itself, but due to more general conversational principles.

According to Giannakidou and Mari (to appear), the future reading arises as a temporally specific reading *when the speaker is in possession of direct knowledge*. This typically happens when we have an adverb (future, as here, or past as in the examples next). When the adverb is present, it provides direct evidence about a time, and this time serves to constrain the temporal space for the location of the eventuality denoted by the VP. The future reading is simply the forward narrowing down of the time of the event denoted by the sentence. In other words, the future reading comes as a temporal domain restriction, and the sentence is not merely an assessment, but becomes a prediction (for more discussion and examples see Giannakidou and Mari to appear).

2.3 *Tha* with past: epistemic and conditional

Tha is possible with both perfective and imperfective past. The perfective past (PP) gives rise to an epistemic interpretation, pretty much like the one we saw with the imperfective present. The only difference is that we are now epistemically assessing a past event, just like with combinations of *must* with present perfect in English:

- (19) a. I Ariadne tha kimithike tora.
the Ariadne FUT sleep.PP.3sg now
Ariadne must have fallen asleep by now.
a I Ariadne tha milise xthes.
the Ariadne FUT talk.PP.3sg yesterday
Ariadne must have talked yesterday.

I know Ariadne’s habits, plans etc. So I can infer *now* that at some point prior to now, Ariadne fell asleep. Crucially, I am assessing the sentence at the present time—the utterance time, a fact consistent with the analysis of Giannakidou 2009 outlined in section 3.

Everything we said about the epistemic reading earlier holds fully here, including the adverb uses and co-occurrence with *prepi*:

- (20) I Ariadne (tha) prepi {malon/oposdhipote/*isos} na kimithike tora.
the Ariadne FUT must probably/definitely/maybe subj sleep.PP.3sg now
Ariadne must {?probably/definitely} have slept now.

So again, we have high probability plus modal concord. With *tha* and the imperfective past (IP), on the other hand, a conditional, possibly counterfactual reading arises (Iatridou 2000, Giannakidou 2009; Smirnova 2011b):

- (21) I Ariadne *tha* *efevge* *tora*.
 the Ariadne FUT leave.IP.3sg now
 Ariadne would leave now.

- a. *Ala dhen efije telika.*
 But she didn't actually leave.
 b. *Ke pragmati, ine sto treno.*
 And indeed she is in the train.

The counterfactual reading is an implicature: it is cancellable. But not so with the past perfect:

- (22) I Ariadne *tha* *ixe fiji*
 the Ariadne FUT had left.PERF.past
 Ariadne would have leave left.
 # *Ke pragmati, ine sto treno.* ‘#And indeed she is in the train’

It is reasonable to assume that the counterfactual reading is not a genuine compositional reading—in the sense that it is not derived from the meaning of past and imperfective. Rather, it seems plausible to treat it as an implicature that we get because we are not using the simple past. We can imagine the hearer thinking that if the speaker knew that Ariadne drank the syrop, they would have used the perfective form which is stronger because it conveys completion. They didn't, therefore the speaker must not know that Ariadne drank the syrop, hence the counterfactual inference.

So, to sum up: *tha* behaves like a high-end necessity epistemic modal. The future reading emerges with the verbal dependent form perfective non-past—and is not particular to *tha* in this case (it is also observed with the optative, subjunctive particles etc). I proceed now with the analysis of Giannakidou 2009 which explains precisely this case, and then augment it with a modal component for *tha*.

3. Giannakidou 2009: the dependency of the perfective non-past and the particles as *n*

In Giannakidou 2009 I made two claims which play a central role here in deriving the future reading with the PNP. The first claim was that the Greek PNP cannot make reference to the utterance time, as is usually assumed to happen with apparent present tenses. In other words, Greek nonpast does not function as a present tense. Instead, the PNP denotes an interval whose left boundary is a dependent (Giannakidou 1998), *non-deictic* variable *t*. The presence of such a variable renders an expression ‘polarity’ sensitive, and will limit its distribution:

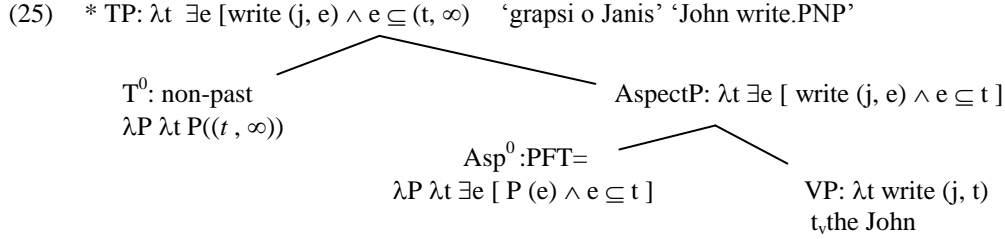
- (23) *Non-deictic variables* (Giannakidou in press: (109))
 A variable *x* is non-deictic iff *x* cannot be interpreted as a free variable.

A non-deictic variable is a semantically and syntactically deficient object (for more on this see Giannakidou and Quer 2012) that *cannot* pick up contextual values by default, like regular variables do. An item containing such a variable will thus depend on another element in the sentence to be valued. I proposed the following semantics for PNP:

- (24) $\llbracket \text{nonpast} \rrbracket = \lambda P \lambda t P((t, \infty))$

This semantics is inspired by Abusch's (2004) analysis of *WOLL* as a substitution operator. According to Abusch, "in the substitution operator, *t* is a bound variable that corresponds to the tense argument of *will*

[which is n , coming from the higher PRES; clarification mine]. For a top-level occurrence of *will*, the effect is to substitute (n, ∞) for n " (Abusch, 2004:39). However, with the Greek nonpast we will not be able to do this substitution because, unlike *will*, which triggers PRES at the top level (Abusch 2004: (48)), the Greek nonpast cannot trigger PRES, and without it, t remains free at the top. But t is a dependent variable, and as such it cannot be left free. In this case, the structure becomes ill-formed:



The interval (t, ∞) lacks temporal orientation, because t is unvalued: it can only be interpreted as a bound or identified variable, and here there is nothing above nonpast to give it a value. The PNP form must therefore rely on another element in the sentence to give a value to t .

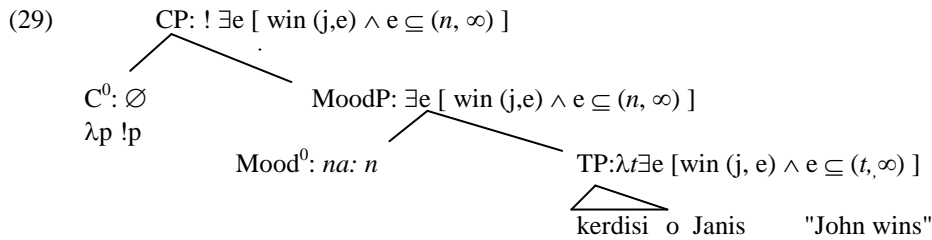
And here comes the second claim I made: given the dependent nature of nonpast it becomes necessary to introduce n in some other node in the clause, higher than TP. This is where the particles enter the picture: they are generated in nodes higher than TP and function as PRES, they provide the utterance time. So, the denotation of *tha* I gave in Giannakidou 2009 was simply n , which after combining with TP gives a value to the dependent variable t of the PNP:

(26) $\llbracket \text{tha} \rrbracket = n$

(27) $\llbracket \text{tha} \rrbracket (\text{TP} (29)) = \lambda t \exists e [\text{write}(j, e) \wedge e \subseteq (t, \infty)] (n) = \exists e [\text{write}(j, e) \wedge e \subseteq (n, \infty)]$

So, *tha* gives us n , so we now have n to identify t and replace it. The event will now be located at the interval that starts at the utterance time and stretches through infinity. This explains the possibility of future for the PNP, while saying that *tha* is NOT a future tense. The result is a future orientation, the event of writing will be located at the interval following n . As I said at the beginning, this happens also with the subjunctive particle and the optative, so the need to have particles is semantically motivated:

(28) $\llbracket \text{na} \rrbracket = n$



Na thus functions as PRES in a subjunctive clause, and this partly explains why *na* and *tha* do not co-occur (Giannakidou 2009, Roussou 2000): one of them would be redundant. Here n is introduced by the Mood head which hosts *na*. In the absence of a modal or adverbial or a question particle, at C^0 we have the operator that gives the illocutionary force of a request or a command: $\lambda p !p$. The optative, I will suppose, is located in C, as the imperative morpheme, and therefore gives the illocutionary force.

In other words, the particles in the Greek clause (and related particles in Balkan languages, I would suppose) ‘expand’ the verbal structure beyond the V itself, and function as PRES. Importantly, the particles are always linked, even in main clauses—since e.g. *na* is under the force operator— with a C position. There is more detailed consideration of all this in Giannakidou 2009 (see also Lekakou and Nilsen 2007 for discussion).

Kratzer posits two conversational backgrounds as arguments of a modal expression— the modal base and the ordering source. (Additional parameters can be set, such as a secondary ordering source, as suggested in von Fintel and Iatridou, or a choice function as in Matthewson et al. 2007). These two arguments derive a number of modal ‘forces’ and ‘flavors’. The modal base f is the factual background, and the ordering source g is a normative background. With FUT, the modal base is epistemic; specifically it is the set of propositions known by an individual, i.e. the speaker in an unembedded context. A proposition p corresponds to a set of worlds, namely, the set of worlds in which it is true. A set of propositions A corresponds to a set of sets of worlds, and its intersection to a set of worlds, namely, the worlds in which all of the propositions of A are true. So, our modal base will be the following, and the relevant individual will be the speaker:

$$(32) \quad \cap f_{\text{epistemic}}(w) = \lambda w'. w' \text{ is compatible with what is known by the speaker in } w$$

Now, the ordering source orders the worlds in the modal base with respect to how well they conform to a given norm or ideal (often sensitive to the context). Modal expressions of necessity like *prepi* and *tha* ‘must’ quantify over those modal base worlds that adhere to the norms in the ordering source as much as possible. The ordering source g , when applied to a world, gives the set of norms of that world, and this set determines a partial order $\leq_g(w)$ on set of possible worlds, as defined below:

$$(33) \quad \text{The ordering } \leq_g(w)$$

For all $u, z \in W$, for any $g(w) \subseteq \wp(\wp(W))$:

$u \leq_{g(w)} z$ iff $\{p: p \in g(w) \text{ and } z \in p\} \subseteq \{p: p \in g(w) \text{ and } u \in p\}$

The ordering states that for any pair of worlds u, z , u is closer to the ideal set by $g(w)$ if the set of propositions true in z is a *subset* of the set of propositions true in u . A necessity modal requires that for all worlds u of the modal base, there is a world v that comes closer to the ideal imposed by the ordering source, and in all worlds z closer than v to the ideal, the proposition p expressed by its complement is true: p is true in all of the most ideal worlds of the modal base. We can simplify this definition by making the so-called ‘limit assumption’, i.e., by assuming that there always are accessible worlds that come closest to the ideal. We can call these worlds $Bestg(w)(\cap f(w))$, following (Portner 2009), or $\max g(w)(\cap f(w))$, following Huitink. We obtain the following lexical entries for *prepi*, *tha* and *must*:

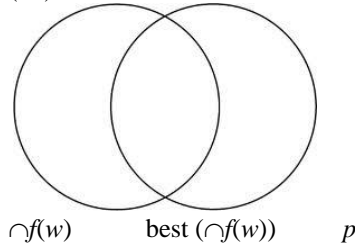
$$(34) \quad \text{For any world } w, \text{ and conversational backgrounds } f, g:$$

$\llbracket \text{prepi/ tha/ MUST} \rrbracket_{w,f,g} = \lambda q \langle st \rangle. \forall w' \in Best_{g(w)}(\cap f(w)): q(w') = 1;$

where $Bestg(w)(X)$ selects the most ideal worlds from X , given the ordering given by $g(w)$

Crucially, only in the *Best* worlds is p true, therefore the universal modal is nonveridical: the modal base is a non-homogenous space containing p and *non- p* worlds, as can be seen in the diagram below:

$$(35)$$



This explains why the modalized sentence even with a necessity modal, is ‘weaker’ than a non-modalized assertion: there are worlds in the modal base $\cap f(w)$ where p is not true, and the actual world may turn out to be one of those worlds. Just to make sure that we appreciate this, consider the following case:

namely that *tha* and *prepi* convey weak necessity, this use of expected. But since it is a combination of the elements we are discussing here, I do not consider it a lexical item itself (nor do von Fintel and Iatridou).

- (36) Context: Ariadne is sneezing, has a fever, watery eyes, etc.
 B: She must have the flu.
 a. *Prepi* na exi gripi.
 must subj have.3sg flu
 b. *Tha* exi gripi.
 must have.3sg flu

The doctor is assessing, and given what he knows (the symptoms, his knowledge of what the symptoms mean, the time of the year, etc) he is entitled to conclude that Ariadne has the flu. In the worlds compatible with his best knowledge/evidence, etc., this is his verdict. However, his modal base allows also for worlds in which Ariadne does not have the flu (*non-p*) but an allergy, or pneumonia. The doctor's judgment may be that these worlds are not the correct basis for forming his current diagnose, they are not best; but they are there in the modal base. The more of those *non-p* worlds the doctor allows, or the more he allows them to influence his judgment, the less certain he becomes. If the doctor wants to exclude *non-p* worlds, he must make the stronger statement without *must/ta/prepi*, that relies on a veridical epistemic space which is homeogenous: *all worlds* compatible with what he considers as the basis for his diagnose are *p* worlds. I summarize the distinction below (for more detailed discussion see my earlier works (Giannakidou 1998, 1999, 2006, 2011):

- (37) *Veridical and nonveridical modal space*
 (i) A modal space (a set of worlds) *W* is veridical with respect to a proposition *p* just in case all worlds in *W* are *p*-worlds. (*Homogeneity*).
 (ii) If there is at least one world in *W* that a *non-p* world, *W* is nonveridical. (*Non-homogenous space*).

All modals come with non-homogeneous, therefore nonveridical spaces (*pace* von Steinhilber and Gillies 2010); and do subjunctive selective verbs and indirect evidentials (see also Smirnova 2011). The idea of homogeneous and non-homogeneous modal space has also been expressed in terms of *diversity* in Condoravdi 2002.

This concludes our basic discussion of the modality of *prepi* and *tha*. I must also mention, finally, that there are differences between *tha* and *prepi*, most prominently (a) the fact that *prepi* is also a deontic modal (so it can be associated with a deontic modal base) unlike *tha* which is only epistemic, and (b) that *prepi* is indeed compatible with past tense (*e-prepe*). Temporally, *tha* retains present perspective, and never scopes below past (see also Giannakidou and Mari to appear). I will close now by very briefly addressing the role of the adverbs.

4.2 *Tha* and the role of adverbs: modal concord

Recall the range of adverbs that *tha* and *prepi* combine with. I will only give the example here with *tha*, and gloss it as MUST. I remind the reader that the possibility adverbs are excluded:

- (38) I Ariadne {malon/profanos/sigoura/oposdhipote/*isos/* pithanon} tha ine jatros.
 the Ariadne probably/obviously/certainly/definitely/maybe/possibly MUST be.3sg doctor.
 Ariadne must {?probably/obviously/certainly/definitely/} be a doctor.

(There may be slight differences between *tha* and *prepi* when we consider a wider range of adverbials, but this needs to be assessed at a later time, as in these core cases they appear to be similar. A corpus study, for instance, could be valuable). The question is: what is the function of the adverbs? The very fact that they range from weak to classical necessity suggests a flexibility of *tha* that we don't find with *must*—which is odd, or only marginally acceptable with *probably*. The adverb in Greek disambiguates, specifies, the exact force of the modal.

I will capture this disambiguation by following Huitink's (2012) most recent account of modal concord. Huitink argues that the adverbs "fill the ordering source argument slot" of the modal verbs. This means that the phenomenon involves matching, which I find very appealing. The modal *tha* and *prepi* are compatible

with the whole range of necessity meanings, and the adverb requires matching modality. With matching modality, the adverb narrows down the interpretation of the modal. Huitink specifies the meaning of adverbs such as Dutch *verplicht* ‘obligatorily’ and *misschien* ‘perhaps’ in the following way, where P stands for a modal operator that has already combined with a modal base (so P is of type $((s, (st, t)), (st, st))$):

- (39) a. $\llbracket \text{verplicht} \rrbracket = \lambda P: P$ is universal. $P(\lambda w \lambda p.p$ is obliged in $w)$
 b. $\llbracket \text{misschien} \rrbracket = \lambda P: P$ is existential. $P(\lambda w \lambda p.p$ is known in $w)$

The idea is that *verplicht* combines with a modal verb, checks whether it has the right quantificational force, and then applies this verb to an ordering source which assigns to each world the set of propositions that are obliged in it.

We can pursue this analysis for Greek facts. The adverbs *oposdhipote* ‘definitely’ and *malon* come with the presupposition that they need to attach to a universal modal. *Tha* is a universal so they can combine with it; but *isos* and *pithanon* ‘possibly’ aren’t universal so the combination fails:

- (40) a. $\llbracket \text{malon/oposdhipote} \rrbracket = \lambda P: P$ is universal. $P(\lambda w \lambda p.p$ is known in $w)$
 b. $\llbracket \text{isos/pithanon} \rrbracket = \lambda P: P$ is existential. $P(\lambda w \lambda p.p$ is known in $w)$

When the argument of the adverb is not a universal, their combination is not defined, and therefore becomes odd. *Malon* and *oposdhipote* both consider known facts, but *malon* is weaker than *oposdhipote* ‘necessarily’ in expressing high probability (or weak necessity), and not classical necessity. Due to space, I cannot work out the details of weak necessity that are relevant here. A way to capture this, though, within the theories of modality I am assuming, is to say that the accessibility relation of *malon* accesses more facts and therefore allows less worlds in the modal base (following Portner’s discussion of deontic *should* and *must* (Portner 2009: chapter 2). This would entail that the adverb affects the accessibility relation directly, not just the ordering source.

For adverbs like *profanos* ‘obviously’, Huitink suggests to consider a stereotypical ordering source (following Kratzer’s human necessity), which will give us a proposition “less certain” than a proposition that is necessary with respect to all epistemically accessible worlds. Bare epistemic MUST would quantify over this latter set. In this way, Huitink claims, MUST OBVIOUSLY expresses a weaker quantification than bare MUST on its own. I believe this holds for the combinations *tha profanos* and *prepi profanos* in Greek too:

- (41) a. I Ariadne tha ine profanos jatros.
 the Ariadne MUST be.3sg obviously doctor.
 b. I Ariadne prepi profanos na ine jatros.
 the Ariadne MUST obviously subj be.3sg doctor.
 Ariadne must obviously be a doctor.
 c. I Ariadne tha prepi profanos na ine jatros.
 the Ariadne MUST MUST obviously subj be.3sg doctor.
 Ariadne must obviously be a doctor.

Notice the three way concord in the c example with *tha*, *prepi* and the adverb. Indeed these statements are weaker than the statements without *profanos*.

I must close this discussion soon, but the last thing I wanted to say is that, I think, the concord phenomena that we observe in Greek may serve to support measurement based approaches to modality like Lassiter 2011. Lassiter proposes a theory of modality where the modal sentences get their truth values by comparing the position of their proposition on a relevant scale to a threshold value (determined by context and the lexical semantics of the modal). In this assumption, a rough semantics of MUST will be the following:

- (42) $\llbracket \phi \text{ must be the case} \rrbracket^{M,w,g} = 1$ if and only if $\text{must}(\phi)$ is greater or equal to ϑ_{must}
 (Lassiter 2011: (1.6))

We have here a measure for what counts as MUST—the threshold value ϑ_{must} . This threshold may differ

from one language to another—recall that in English *must* is harder (though not impossible) with *probably*, but in Greek, combinations of *malon* with *prepi* and *tha* are common. So, the threshold for MUST in Greek is lower and includes weak necessity (or high probability).

Modal concord, in this frame, can be restated as specifying subspaces on the measurement scale, a guide of where to look for the numerical value of *tha p*: e.g. on a scale from 0 to 1, with *malon*, we must look at values of high probability, say between .8-.9; with *oposdhipote*, we only look at .99. The adverbs therefore serve as value restrictors, as probability restrictors, which I find a very promising way to think about their role. Another way to rephrase this idea is to say that the adverbs function as degree modifiers (thanks to Dan Lassiter for this suggestion). If modal adverbs are probability degree modifiers, the differences in acceptability as we move down the range of epistemic modals (ordered by strength) become similar to the contrast between *slightly damp/wet/#soaking* or *somewhat large/#enormous* or *totally #ajar/open*. The modal-adverbial relation becomes thus parallel to the degree modifier-adjective relation in establishing permissible and non-permissible combinations that rely on the combinatorial restrictions of the modifiers as they ‘match’ (or do not match) the probability space established by the modal operator. Though I cannot undertake the task of making this promising idea more concrete in the present paper, I hope to be able to do so in future work.

4. Conclusion

I have only scratched the surface, in this paper, of the rich patterns of modal concord in Greek, and on the interaction between necessity modals and temporality in this language. Certainly the facts that I was able to consider here deserve a more thorough and careful examination for a better understanding—and for better appreciating the consequences they may have for the various tools for linguistic modality that have been developed in the past few years, especially for the gradability and concord approaches to modality.

I hope to have conveyed in this paper that the study of Greek necessity modals such as *tha* and *prepi* can teach us valuable lessons about the linguistic realizations of necessity. *Tha*, a traditionally known ‘future’ particle, turns out to have a broad usage as an epistemic modal operator of weak and classical necessity. The future meaning emerges as a particular case of combining *tha* with the verbal dependent form PNP. The gradable (or flexible) modality range of *tha* enabled us to make reference to modal concord and, in the end, to probability measure approaches to modality. Probability measurements have been posited also in the analysis of evidentials—most prominently in the theory of McCready and Ogata 2007 for Japanese evidentials. Most of the examples in that paper are future oriented. This may be an accident, but maybe not. The relation of evidentiality and the future is explored further in Giannakidou and Mari to appear, where the idea of ‘measuring’ the evidence plays a key role.

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