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A unified analysis of the future as epistemic modality
The view from Greek and Italian

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Abstract We offer an analysis of the Greek and Italian future morphemes as epistemic modal operators. The main empirical motivation comes from the fact that future morphemes have systematic purely epistemic readings—not only in Greek and Italian, but also in Dutch, German, and English *will*. The existence of epistemic readings suggests that the future expressions quantify over epistemic, not metaphysical alternatives. We provide a unified analysis for epistemic and predictive readings as epistemic necessity, and the shift between the two is determined compositionally by the lower tense. Our account thus acknowledges a systematic interaction between modality and tense—but the future itself is a pure modal, not a mixed temporal/modal operator. We show that the modal base of the future is nonveridical, i.e. it includes p and $\neg p$ worlds, parallel to epistemic modals such as *must*, and present arguments that future morphemes are a category that stands in between epistemic modals and predicates of personal taste. We identify, finally, a subclass of epistemic futures which are *ratificational*, and argue that *will* is a member of this class.

Keywords Future · Prediction · Epistemic modality · MUST · (Non)veridicality · Predicates of personal taste · Tense · Denial · Being wrong

1 The future: What is the nature of prediction?

The future, as a notional category in language, has puzzled theorists since Aristotle's famous sea battle examples (*De Interpretatione*, Book IX). Aristotle offers what can be thought of as the first non-deterministic analysis. He posits that, while the truth

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or falsity of a future sentence will be determined by how things will turn out, at the speech time the future is open. This openness of the future is both metaphysical (a future event may or may not happen), and epistemic, in the sense that one cannot *know* a future event because it hasn't happened, in contrast to past or present events.

In the literature on tense, on the other hand, future sometimes features as the dual of past tense (Prior 1967). Kissine (2008), more recently, defends a temporal analysis of *will*; but it is not at all obvious that *will* is a tense. Huddleston and Pullum (2002), in their comprehensive *Cambridge grammar of the English language* say that: "our knowledge of the future is inevitably much more limited than our knowledge about the past and the present, and what we say about the future will typically be perceived as having the character of *prediction* rather than an unqualified factual assertion." (Huddleston and Pullum 2002:190). Huddleston and Pullum therefore treat *will* not as a tense but as a modal, and highlight that *will* is a member of the class of English modal verbs. Earlier advocates of modality of *will* are Palmer (1987), Coates (1983), and Enç (1996); a more recent addition is Klecha (2013).

Enç (1996) points out that regular tenses, present and past, are deictic (Partee 1984; Heim 1994; among many others), while the future is not. The past tense in *Ariadne finished her homework*, for instance, denotes a contextually salient time in the past where Ariadne finished her homework, but *Ariadne will finish her homework* does not refer to a time. As Aristotle points out, there may, or *may not*, be a future time *t* at which Ariadne finishes her work in the actual world. This is a significant asymmetry between past and future that prevents characterization of future as tense; Enç (1996) offers a number of additional asymmetries in defense of her position that *will* is a modal.

Cross-linguistically too, future expressions are known to convey modality (see e.g. Bertinetto 1979; Copley 2002; Pietrandrea 2005; Mari 2009a, 2009b, 2009c, 2015b; Giannakidou 2012; Giannakidou and Mari 2013a, 2013b, 2016a; Broekhuis and Verkuyl 2014). It therefore appears reasonable to assume that prediction involves modality. The question then becomes: what kind of modality? The Aristotelian position is that prediction involves indeterminacy: FUT *p* is metaphysically unsettled or *objectively nonveridical*, in the sense that it is not true at the time of utterance;[1] and it remains to be seen if the prejacent *p* will be true at a future time (Giannakidou 1998, 2013a; Giannakidou and Zwarts 1999; Condoravdi 2002; Copley 2002; Kaufmann 2005; MacFarlane 2005; Bonomi and Del Prete 2008; Cariani and Santorio 2015; Todd 2016). Besides objective unsettledness and nonveridicality, the future sentence is also *epistemically* unsettled: the speaker does not, and cannot, know whether there will be a future time *t* at which the prejacent will be true in the actual world.[2] In other words, there are two kinds of modality that are candidates for prediction: metaphysical and epistemic modality. How do we chose?

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[1] We use FUT in this article to refer to expressions of future cross-linguistically, i.e. English *will*, Italian future morpheme (called *futuro* in the Italian grammars and literature), and Greek *tha* are FUT. We also use FUT to indicate the semantic function: FUT in various languages are realizations of the operator FUT in this sense. In the text, it is easy to see which sense is intended, but we also clarify when necessary. Likewise, we use MUST to refer to expressions of universal epistemic modality cross-linguistically, i.e. English *must*, Italian *dovere* and Greek *prepi* are MUST.

[2] There is also a deterministic view: no unsettledness, just one future but we lack knowledge of it (Kissine 2008). That would render future morphemes tense operators. A mixed position could also be conceived,

In this paper, we focus on the Greek and Italian future morphemes, and argue that the study of these futures allow us to make a good argument that the modality of prediction is epistemic and *not* metaphysical. To our knowledge, there is no detailed formal analysis of prediction as epistemic modality, and we are set to present such an analysis here. At the time of prediction, the speaker has knowledge that determines what she predicts, and this knowledge is the foundation (i.e. the modal base) for prediction. Crucially, in case knowledge or beliefs of the speaker conflict with what is the case, the prediction relies not on what is the case but on what the speaker believes to be the case.

The discussion proceeds as follows. In Sect. 2, we show that future morphemes cross-linguistically can be used with present or past tenses receiving purely epistemic readings. This presents our first and most central argument that future morphemes function as epistemic operators, i.e. akin to *must*. If epistemic modality is needed for epistemic future anyway, then the null hypothesis is that the predictive reading is also epistemic. In Sect. 3, we offer the formal framework of modality that we will use, including the notion of *subjective veridicality* that is needed for truth relativized to individuals. In Sect. 4, we consider and reject the metaphysical analysis of the future, offering additional arguments for a strong parallelism between prediction and epistemic *must*. We also show that metaphysical modality is often not relevant, or makes the wrong predictions. We then lay out our epistemic analysis of prediction. In Sect. 5, we address the role of tense in determining which reading will emerge, and we focus on how the non-past produces the predictive reading. We give a fully explicit syntax-semantics of the Greek and Italian structures containing future. In Sect. 6, we compare our analysis to the idea of *will* as a bouletic modal, and offer more cross linguistic predictions. In our discussion, it becomes clear that *will* is also an epistemic future, but of the particular kind we call *ratificational*, following Mari (2015b).

2 Epistemic future as an epistemic modal

A major argument for the role of epistemic modality in the future is the existence of *epistemic future* (Giannakidou and Mari 2013a, 2013b, 2016b). Epistemic future arises when future expressions are used with lower present or past tenses without making a prediction. This should not happen if future expressions were simply future tenses. Epistemic future is observed in Greek and Italian, but also in Dutch, German, English, and many other languages (see Comrie 1985; Haegeman 1983; Palmer 1987; Kush 2011; Matthewson 2012).[3] We start with the following, well-known, English data:

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namely that future morphemes are ambiguous between modals and tenses. Such a view would stumble upon the fact that the temporal information correlates with lower tense, as we shall see. The possibility for modal and temporal ambiguity in any case should be dispreferred if an unambiguous analysis succeeds.

[3]Pietrandrea (2005) uses the term 'epistemic future' for the first time for Italian future, but only for the epistemic use of the future. We thank Fabio Del Prete for bringing this point to our attention.

(1)   a.   That will be the postman.

        b.   The French will be on holiday this week. (Palmer 1987)

These sentences do not make predictions. Rather, they seem to convey epistemic modality: given what I know and general stereotypical assumptions, the French *must* be on holiday this week (see Palmer 1987 and the references above for more data and nuances). Dutch and German futures have similar use (examples from Broekhuis and Verkuyl 2014 and Giannakidou 2014a for Dutch; Lederer 1969 for German; Tasmowski and Dendale 1998; Dendale 2001; de Saussure and Morency 2011, and Mari 2015b for French, forthcoming-b).

(2)   Context: I can't see Hein.

        Hein zal (wel) in de/op zee zijn. (Dutch)

        Hein FUT.3SG particle in the/ on sea be

        'Hein must be at sea (swimming/on a boat).'

(3)   Context: the speaker is wondering about the time, there is no watch:

        a.   Es wird   jetzt 5 Uhr sein. (German)

             it FUT.3SG now 5 hour be

        b.   Het zal   nu   5 uur zijn. (Dutch)

             it   FUT.3SG now 5 hour be

             'It must be now 5 o'clock.'

As indicated, the Dutch and German future words *zal, wird* are used as epistemic equivalents to *must*. The *must* statement is epistemically weaker than an unmodalized assertion (an idea that we further develop in this paper, and which goes back to Karttunen 1972; von Fintel and Gillies 2010 call it the *Mantra*). As Huddleston and Pullum put it, the knowledge grounding the future sentence "is more limited" than knowledge grounding a sentence with a simple present or past. Modal particles such as *wel, wohl* can also be used with the future; when alone in German, they have a similar *must* equivalent use (Zimmermann 2011; Giannakidou 2014a):

(4)   Max ist wohl   auf See. (German; example from Zimmermann 2011)

        Max is particle on sea

        'Max must be at sea.'

Zimmermann says that with *wohl*, the epistemic commitment of the speaker is *weakened* compared to the plain sentence, while also conveying a confidence that the proposition is likely to hold. This is the typical reading of the *must* sentence—and the take-home message is that we find it with the modal particles, MUST, and the future words.

Broekhuis and Verkuyl (2014) treat the Dutch *zal* as an epistemic modal expressing that the prejacent proposition is the result of reasoning based on information judged as 'reliable and well-founded,' and Giannakidou (2014b; attributing the example to Hoeksema) further shows that *zal* receives a purely epistemic reading with past, as in (5), where in the context Max is grumpy).

(5) Hij zal   wel   slecht geslapen hebben! (Dutch)
     he FUT.3SG particle bad   slept   have
     'He must have slept really bad!'

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

Morphologically, a present perfect appears in Dutch and German, just as in English
must have slept, and not a simple past **must slept*. The simple past is excluded be-
cause the modal verb takes an infinitival complement, and this necessitates the use of
the auxiliary resulting in the apparent present perfect. McCawley (1988) notes that in
nonfinite contexts, past tense surfaces as the perfect (for recent discussion see Arregi
and Klecha 2015). Greek, on the other hand, lacks infinitives and the modal embeds
a tensed clause which can be a simple past (ex. (12), (13)).[4] In Sect. 5, we analyze
the apparent perfect under FUT as a combination of a semantic PAST and PERF.[5]
The sentences above, in any case, show that a future morpheme can combine with
lower PAST, and when this happens the predictive reading disappears. The above are
purely epistemic statements about a past situation the speaker considers likely to have
happened.

   There appears to be a generalization, then, that future morphemes cross-linguis-
tically are not used just to make predictions, but also as *must*-equivalents. Common
to future and *must* is that the speaker does not *know* that *p* is true. If she knows that
p is true, she cannot use a modal at all (Giannakidou 1999, 2013a; Giannakidou and
Mari 2016b).

   For Greek and Italian, epistemic future has been known for quite a while
(Bertinetto 1979; Rocci 2000; Squartini 2004; Pietrandrea 2005; Mari 2009a, 2009b,
2009c, 2015a for Italian; Tsangalidis 1998; Giannakidou 2012; Chiou 2014 for
Greek; Giannakidou and Mari 2012, 2013a), but the data have unfortunately not fea-
tured significantly in formal theories of the future, which tend to focus on *will*. Unlike
will, which is a modal verb, the future markers in Italian and Greek are a bound mor-
pheme and a particle (*tha*) respectively. In Greek, the future *tha* is followed always
by a tensed verbal form (TP), as holds generally for all modal particles including the
subjunctive *na*, and others that are not relevant here. The Italian pattern is not the
exact parallel to Greek, but is similar in the relevant respects (Sect. 5.3).

   To understand the patterns, it is important to note that tense and aspect are always
reflected morphologically on the Greek verb. The grammars describe the morpholog-
ical opposition between past and non-past, and the aspectual distinction is perfective
vs. imperfective. The morphological combinations create three semantic tenses (Gi-
annakidou 2009, 2014a): a present (PRES), a PAST, and a NON-PAST, which is the
tense used for prediction. We illustrate the combinations below:

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[4]The past can be non-relative (Greek), or relative (Italian); see Verkuyl (2011) for more on the notion of
relative past, and our discussion in Sect. 5.

[5]PERF stands for the semantic perfective. From now on, we use lower case to refer to the morphological
components, and the capital letters for the semantic components.

(7) Graf-   -o.   (Greek imperfective non-past: creates PRES)
     write.IMPERF NON-PAST.1SG
     'I am writing' (right now).
     'Write' (generally).

The morphological imperfective non-past is semantically the present tense (PRES) in Greek (Giannakidou 2014a), comparable to English simple present and progressive. The combination of this form with FUT is fully equivalent to MUST PRES *p* in English (Giannakidou and Mari 2016b).

    The perfective non-past is a dependent form, *ungrammatical* by itself as indicated:

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

The perfective non-past has no English equivalent, and it is in fact quite rare to find grammatical perfective non-pasts in languages (Giorgi and Pianesi 1997). Holton et al. (1997) and Giannakidou (2009) call this form the *verbal dependent*. This is the form used for prediction, but also with the subjunctive and other modal particles. We analyze it as a semantic NON-PAST in Sect. 5.

    The past is marked in Greek with the presence of *e-*, and we have again two options, perfective and imperfective. The imperfective past is the typical preterite as in, e.g. Romance languages. The perfective past, on the other hand, is called the *aorist* and denotes a single (usually completed) event in the past. It is interpreted as a default simple past in English:

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

(10) E-   grap- s-   a.   (Greek perfective past (aorist))
     PAST- write- PERF- PAST.1SG
     'I wrote.'

Future *tha* combines with all of the above tenses. Notice first the combinations of FUT with the PRES (imperfective non-past in Greek, gerund plus stative in Italian):

(11) a. I Ariadne tha troi   tora. (Greek)
         the Ariadne FUT eat.IMPERF.NON-PAST.3SG now
         'Ariadne must be eating now.'
     b. Giacomo ora starà   mangiando. (Italian)
         Giacomo now be.FUT.3SG eat.GERUND
         'Giacomo must be eating now.'

As shown above, FUT plus PRES does not have a predictive reading. In Italian, as we discuss in Sect. 5.4, Aktionsart plays the role that aspect plays in Greek. (The role of Aktionsart in connection with modal interpretation has been studied across languages and categories, see Condoravdi 2002; Laca 2008; Copley 2009;

Mari 2015a, 2015b). Combinations of FUT with a lower PAST (an aorist in Greek), also receive epistemic non-predictive readings:

(12)   a.   I   Ariadne tha itan   arrosti xthes   (ji'afto dhen
            the Ariadne FUT be.PAST.3SG ill   yesterday (for-this not
            irthe).   (Greek)
            came.PERF.PAST.3SG)
            'Ariadne must/#will have been ill yesterday (that's why she didn't come).'
       b.   Giovanni sarà   stato malato ieri   (per questo non é
            Giovanni be.FUT.3SG been ill   yesterday (for this   not has
            venuto). (Italian)
            come)
            'Giovanni must/#will have been ill yesterday (that's why he didn't come).'

(13)   a.   I   Ariadne tha efige   xthes.   (Greek)
            the Ariadne FUT leave.PERF.PAST.3SG yesterday
            'Ariadne must have left yesterday.'
       b.   Gianni avrà   parlato ieri.   (Italian)
            Gianni have.FUT.3SG spoken yesterday
            'Gianni must/ #will have spoken yesterday.'

With PAST, then, Greek and Italian FUT receive epistemic non-predictive readings, as in Dutch and German.[6] These uses, crucially, are quite common and do not feel in any way marked or exceptional.

For the sake of completeness, consider that with PAST, we do not obtain a future of a past reading in either language. To obtain a future of a past, Italian uses the conditional, and Greek the imperfective past (Giannakidou 2012:ex. (21)):

(14)   Gianni sarebbe   arrivato più   tardi.
       Gianni be.COND.3SG arrived more late
       'Gianni would arrive later.'

(15)   I   Ariadne tha efevge   argotera.
       the Ariadne FUT leave.IMPERF.PAST.3SG later
       'Ariadne would leave later.'

Tha plus imperfective past is argued to be the Greek equivalent to conditional mood (Iatridou 2010; Giannakidou 2012). We will adopt this position here, and will not discuss the conditional further.

Mari (2009a, 2009b, 2009c), Giannakidou and Mari (2013a, 2013b, 2016b) observe that epistemic futures, like epistemic necessity modals, cannot be used if the speaker knows *p*. This has been treated as an evidentiality constraint (Karttunen 1972; von Fintel and Gillies 2010; Giannakidou and Mari 2016b). As we see, FUT is akin to MUST, and can even co-occur with it:

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[6]Epistemic *will* with the past is odd, as indicated. We suggest why this is so in our discussion of *will* in Sect. 6.3.

(16) *Context: Direct visual perception of rain, the speaker sees the rain falling.*

  a. #It must be raining.
  b. #Tha vrexi.   (Greek)
        FUT rain.IMPERF.NON-PAST.3SG
  c. #Starà   piovendo.   (Italian)
        be.FUT.3SG rain.GERUND
  d. #Tha prepi na   vrexi.   (Greek)
        FUT must SUBJ IMPERF.NON-PAST.3SG
  e. #Dovrà   star piovendo.   (Italian)
        must.FUT.3SG be rain.GERUND

It is odd to say *It must be raining* when looking outside the window at the rain falling. Eye-sight provides a most reliable source of knowledge: when you see that it is raining, you know that it is raining. This is a strong, veridical state (a point to be further expanded in the paper). By uttering *It must be raining* the speaker appears to either question her own knowledge, or simply saying something weaker than what is actually the case, in both cases an odd outcome.

In the inferential context, which does not imply knowledge of p, FUT and MUST are perfectly fine:

(17) I see a wet umbrella.

  a. It must be raining.
  b. (Tha)   Prepi   na   vrexi. (Greek)
        FUT/must subjunctive rain.IMPERF.NON-PAST.3SG
  c. Deve   star piovendo.   (Italian)
        must.PRES.3SG be rain.GERUND
        'It must be raining.'
  d. Starà   piovendo.   (Italian)
        be.FUT.3SG rain.GERUND
        'It must be raining.'

If I see a wet umbrella, I can *assume* that it is raining, but I do not *know* that it is raining. This has been described in the literature as sensitivity of MUST to indirect knowledge, but Giannakidou and Mari (2016b) use this seeming evidential sensitivity as an argument for nonveridicality of MUST. MUST, they argue, requires *partial knowledge* only. The crucial point here is that future and epistemic necessity modals pattern on a par in being nonveridical, thus not compatible with knowledge of p (that direct evidence provides). Finally, FUT co-exists with MUST, as we see, and we discuss what this entails in the conclusions.

The predictive reading emerges with perfective non-past in Greek, and eventives in Italian:

(18) O Janis tha ftasi   avrio.   (Greek)
        the John FUT arrive.PERF.NON-PAST.3SG tomorrow
        'John will arrive at 5pm/tomorrow.'

(19)   Gianni arriverà   domani.   (Italian)
        John   arrive.FUT.3SG tomorrow
        'John will arrive tomorrow.'

This form appears with other modal particles such as the subjunctive and the optative, again with future orientation. Recall, as shown earlier (ex. (8)), that it is ungrammatical on its own.

(20)   Thelo na   ftasi   noris o   Janis. (Greek)
        I-want SUBJ arrive.PERF.NON-PAST.3SG early the John
        'I want John to arrive early.'

(21)   As   ftasi   noris o   Janis! (Greek)
        OPT arrive.PERF.NON-PAST.3SG early the John
        'Let John arrive early!'

The perfective non-past is semantically a NON-PAST, and we address its role in Sect. 5. The syntax we adopt, following Giannakidou (2009), is the following:

(22)   Modal Particle P
                      ╱╲
                    ╱   ╲
          Future *tha*   TP
        Subjunctive *na*   non-past / past
          Optative *as*

We assume that Italian has the same abstract structure, but relies on Aktionsart below TP. Greek and Italian look similar to languages such as Gitksan (with prospective aspect under their modal; Matthewson 2012), and Hindi (Kush 2011). In the rest of the paper, our goal is to give an adequate characterization of the meaning of the future markers *tha* and Italian *futuro*. Given the basic sample of data presented here, the following generalizations emerge:

1. *Tha* and *futuro* are not used just for prediction.
2. *Tha* and *futuro* have purely epistemic readings with present and PAST forms (including present perfects in Germanic languages and past participles in Italian).
3. The lower tense fully determines the type of reading. Prediction arises with lower NON-PAST.

Given the above, it becomes clear that *tha* and *futuro* are not purely predictive operators. (And given what we see in typological works (e.g. Palmer 1987), purely predictive future markers without any epistemic uses are simply hard to find.) In our earlier work (Giannakidou and Mari 2016b), we offered an analysis of non-predictive *tha* and *futuro* as equivalent to epistemic *must*. If indeed *tha* and *futuro* are epistemic in the non-predictive use, the null hypothesis is that they are epistemic also in the prediction. Such a simple unified theory should be preferred over an ambiguity account distinguishing between epistemic vs. metaphysical *tha* and *futuro* (e.g. the one we suggested in Giannakidou and Mari 2013b).

We will propose that the interaction with tense determines the type of reading; but unlike Condoravdi (2002), (a) *tha* and *futuro* are not mixed modal/temporal operators,

and (b) the tense doesn't change the modality (i.e. the type of modal base), which remains epistemic. Prediction is epistemic reasoning, i.e. a conjecture, about an event that is not located in the present or past. In the epistemic analysis, *tha* and *futuro* are the duals of epistemic possibility *might*, which also makes a prediction with non-past forms (see Enç 1996):

(23)   Ariadne might see the movie tomorrow.

What the speaker knows at present allows her to predict that it is possible that there will be a time *t* tomorrow when Ariadne sees the movie. This is a predictive *possibility* reading; the future modal creates a stronger statement because it is a necessity modal:

(24)   Ariadne will see the movie tomorrow.

Let us now focus on epistemic future. This will allow us to elaborate on the notions on nonveridicality and relative truth that appear to be crucial for epistemic modals and the future.

3 Epistemic modality, (non)veridicality, and truth

We assume a Kratzerian semantics where modals take modal bases and ordering sources, and add two ingredients, following Giannakidou (1998, 2012, 2013b), Mari (2009a, 2009b) and Giannakidou and Mari (2013a, 2013b, 2016b): the first one is the *Nonveridicality Axiom* that all modal bases are nonveridical (see also Beaver and Frazee 2014 for nonveridicality as a defining property of the category modality). The second addition concerns the nature of the veridicality judgement. We will talk about objective and subjective truth, the latter being truth relative to an individual's knowledge and beliefs.

3.1 Objective veridicality and nonveridicality

Montague (1969) uses 'veridicality' to characterize perception verbs such as *see*. Giannakidou (1997, 1998, 1999) and Zwarts (1995) define veridicality in terms of truth entailment:[7]

(25)   Veridicality; nonveridicality; antiveridicality (modifying Zwarts 1995; Giannakidou 1997, 1998, 1999). Let F be a unary sentential operator. The following statements hold:
        (i) F is veridical iff $Fp \rightarrow p$ is logically valid;
        (ii) F is nonveridical iff $Fp \nrightarrow p$;
        (iii) F is antiveridical iff $Fp \rightarrow \neg p$.

Operators, or more broadly, functions F that have veridicality and nonveridicality are propositional.[8] F is veridical iff Fp entails p. F is nonveridical if Fp does not entail

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[7] See Giannakidou (2013a) for a formal connection between truth and existence.

[8] See Bernardi (2002) for type-flexible definitions.

p, i.e. if when Fp is true, p may or may not be true. The contrast is illustrated below with the adverbs *yesterday* and *allegedly*:

(26)   Yesterday, John flew to Paris.

(27)   Allegedly, John flew to Paris.

Yesterday is a veridical adverb because *yesterday (John flew to Paris)* entails that John flew to Paris. But *allegedly* is nonveridical because *allegedly (John flew to Paris)* doesn't entail that John flew to Paris; *allegedly (John flew to Paris)* also doesn't entail that he didn't. Nonveridical operators are typically uncertainty operators. Modal adverbs appear to be nonveridical:[9]

(28)   {*Probably, Possibly, Maybe, Perhaps*}, John flew to Paris.

Note that nonveridical operators do not entail the falsity of p; this is a property of a subset of them such as negation which is *antiveridical*. Antiveridical operators are also nonveridical, since for them too the veridicality schema is not valid: $\neg p$ does not entail p.[10]

Thus far, (25) defines veridicality *objectively*—or extensively, i.e, as a truth entailment about what is the case in the real world without reference to subjective parameters such as what individuals know or believe. Nonveridicality is the absence of truth entailment. In this objective sense, veridicality and anti-veridicality correspond to metaphysical settledness: if a function F is veridical, p in Fp is metaphysically settled; $\neg p$ is also metaphysically settled. Under a nonveridical operator, on the other hand, p is metaphysically unsettled. Besides modal adverbs, modal verbs too are nonveridical and metaphysically unsettled.

The sentences under the veridical or nonveridical operator can be called veridical and nonveridical too. Another way to phrase the above is to say that an objectively veridical sentence refers to a fact, while a non-veridical sentence does not refer to a fact. Consider now the modal verbs:

(29)   Nicholas might/must bring dessert.

(30)   Nicholas might/must have brought dessert.

Modal verbs are also non-veridical; they do not entail the(f)actual truth of their prejacent p. MIGHT $p \rightarrow p$ is not logically valid, the possibility modal is thus nonveridical. Epistemic *MUST* is also nonveridical, since MUST $p \rightarrow p$ is also not logically valid. The principle T of modal logic ($\Box p \rightarrow p$) is only validated with aleithic modality and is invalid with epistemic and deontic modality (see Zwarts 1995; Giannakidou 1998, 1999; also Portner 2009). Non-aleithic modal functions, then, as a class (possibility and necessity modals, modal adverbs) are nonveridical in that they do not entail the truth of their prejacent; p is not a fact under a modal.

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[9]An anonymous reviewer points out adverbs such as *evidently, clearly, unfortunately*, which could be seen as veridical. But these are factive adverbs; our point above is that *modal* adverbs are nonveridical, not *all* adverbs.

[10]Negation is the prototypical antiveridical operator, responsible for licensing negative polarity items (Giannakidou 1998, 1999, 2013b). Of the other logical connectives, disjunction is also nonveridical whereas conjunction is veridical.

We move on to discuss next *subjective* (non)veridicality, which is the notion we need in order to talk about relativized truth and speaker commitment.

3.2 Subjective (non)veridicality: Relative and objective truth

In objective terms, we talk about sentences being true or false in the world irrespective of the individuals asserting them. This may be adequate for textbook purposes, but the truth judgement often appears to be more complex, and it is done not in isolation but relative to the speaker and hearer, who assess whether a sentence is true or not given what they know or what they believe (Giannakidou 1994, 1998, 1999, 2009; Harris and Potts 2009; de Marneffe et al. 2012). That such relativization is needed becomes particularly visible when we discuss propositional attitude verbs (*know, believe, imagine*, etc.) and their complements (Farkas 1992; Giannakidou 1994, 1998; Mari 2016); but the role of the individual in assessing truth is apparent even in unembedded sentences, as expressed also very lucidly in Harris and Potts (2009) recent assertion that *all* sentences are perspectival.

When a speaker asserts a positive unmodalized sentence in the present or past, unless she is lying, she asserts p because she knows or believes that p is true; but when a speaker uses a modal verb, she may think that p is possible or even likely, but she doesn't know for sure that p is true. When speakers make assertions or assess assertions of others, they make *veridicality judgments* about the truth of the sentence— and the veridicality judgement is more complex than truth assignment objectively because it depends on what speakers know and how they extract information from context (see especially Giannakidou 1998, 2013a; Mari 2005a, 2005b; Giannakidou and Mari 2016b; and de Marneffe et al. 2012 confirm this complexity with corpus data).

It makes sense, then, to talk about **objective** and **relative** veridicality for all sentences;[11] for some sentences, in fact, we can only have relative truth, i.e. for sentences with predicates of personal taste (Lasersohn 2005; Stephenson 2007). In relative veridicality, the individual making the judgement is the *individual anchor* (Farkas 1992; Giannakidou 1994, 1998, et sequ.), or the *judge* (Lasersohn 2005), and p is assertable if the speaker knows or believes p. Another way to phrase this is to say that the speaker is committed to p. If the speaker doesn't know or believe p, she is said to not be committed to p (Smirnova's 2013 notion of *epistemic commitment*). Moore paradoxical sentences *#p and I do not know that p* are thought to be infelicitous because the assertion of p requires that the speaker knows that p. In this framework, objective truth is truth irrespective of the individual anchor, relative truth is truth relative to the anchor (see also discussion in Giannakidou and Mari 2016a, 2016b).

Giannakidou relativizes truth by making the veridicality judgement relative to individual anchors and their epistemic states. The truth of a sentence is now anchored to the individual asserting it. In main clauses the anchor is by default the speaker.[12] *Models of evaluation* are defined to describe the information states of anchors (see

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[11]We are grateful to the reviewers of this paper for prompting questions to this end.

[12]Individual anchoring of truth should be seen on a par with other kinds of anchoring of propositional content, i.e. temporal anchoring, or event anchoring (e.g. Hacquard 2006, 2010).

Giannakidou 2013a for updated discussion). These models are sets of worlds, relative to i, corresponding to what i believes or knows.[13] We call these models epistemic states in our definition below:

(31)   *Epistemic state of an individual anchor i* (Giannakidou 1999:ex. (45))
        An epistemic state M(i) is a set of worlds associated with an individual i
        representing worlds compatible with what i knows or believes.

We use the term **correct** to indicate a matching relation between the truth value of p subjectively, i.e. with regard to an epistemic state, and objectively. i is correct if the value of p subjectively in M(i) is the same as the valuation of p objectively. i is said to be wrong if the value of p in M(i) is not the same as the valuation of p objectively. These will be useful when we consider the judgments about future sentences and epistemic modals in Sect. 4.

Given M(i), we now identify (non)veridicality subjectively as a property of functions F:

(32)   *Subjective veridicality* (for functions)
        A function F that takes a proposition p as its argument is subjectively veridical with respect to an individual anchor i and an epistemic state M(i) iff Fp
        entails that i knows or believes p: iff $\forall w'[w' \in M(i) \rightarrow p(w')]$.

Subjective veridicality reflects knowledge as in the classical treatment of Hintikka (1962), and *homogeneity*. Veridical functions require that the individual anchor is in an epistemic state that fully supports p, regardless of whether p is actually (i.e. objectively) true. For instance, *Nicholas believes that Ariadne is a doctor* reflects a veridical epistemic state, but the sentence *Ariadne is a doctor* can be objectively false.

(33)   [[Nicholas believes that p]] is true in w with respect to M($Nicholas$) iff:
        $\forall w'[w' \in M(Nicholas) \rightarrow p(w')]$

The truth condition of the *believe* sentence does not entail actual truth, but *believe* is subjectively veridical,[14] because the whole M($Nicholas$) supports p:

(34)   *Support of a proposition p*
        Let X be a set of worlds. X supports a proposition p iff all worlds in X are
        p-worlds.

The verb *know*, of course, also reflects such a homogenous epistemic state, it is therefore also subjectively veridical.

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[13]The difference between knowledge and belief is not important for our purposes here, and in many other cases, e.g. for mood choice, it doesn't matter—as verbs of knowledge and belief both select the indicative in many languages (Giannakidou and Mari 2016b). Mari (2016) however refines the typology of non-epistemic and fictional attitudes and shows that there is a systematic ambiguity between *expressive-belief* (the classical Hintikkean belief) and *inquisitive-belief* (the subjunctive trigger for languages in which mood is parametric to the status of p in the common ground). These differences do not matter here, and we only focus on the Hintikkean interpretation of belief.

[14]See, however, Mari (2016) for the distinction between *expressive* and *inquisitive* belief, based on mood distribution in Italian.

When all worlds in M(i) are p worlds, p is *epistemically* settled in M(i). This is a state of subjective veridicality: full epistemic commitment. The epistemic state is a homogenous p-space. For unembedded sentences, subjective veridicality and epistemic settledness are conditions on the assertability of the sentence:

(35)   *Flavio is a doctor* is true with regard to the speaker i iff $\forall w'[w' \in \text{M}(i) \rightarrow doctor(Flavio)(w')]$.

In other words, an unmodalized, unembedded sentence is subjectively veridical in expressing the speaker's belief or knowledge that p. A negative sentence, in a parallel manner, expresses the speaker's belief or knowledge that *not p*, it is therefore also epistemically settled, i.e. a homogenous space of $\neg p$ worlds:

(36)   *Flavio is not a doctor* is true with regard to the speaker i iff $\forall w'[w' \in \text{M}(i) \rightarrow \neg doctor(Flavio)(w')]$.

Hence subjective veridicality can homogeneity are not identical: a negative sentence conveys a homogenous state which is not veridical because the speaker does not know or believe p.

We can understand the effect of affirmation vs. negation better in defining epistemic settledness as follows:

(37)   *Epistemic settledness of M(i)*
         M(i) is epistemically settled about p iff $(\forall w' \in \text{M}(i)p(w')) \vee (\forall w' \in \text{M}(i)\neg p(w'))$

A settled epistemic state is homogeneous and contains either only p worlds (the state is positively epistemically settled) or only $\neg p$ worlds (the state is negatively epistemically settled). Subjective veridicality arises when p is positively settled; $\neg p$ reveals a subjectively antiveridical state. Summarizing, we define subjective veridicality as a property of states as follows:

(38)   *Subjective veridicality and antiveridicality (as properties of states).*
         a.   An epistemic state M(i) is subjectively veridical about p iff it is epistemically settled positively: i.e. $\forall w' \in \text{M}(i) : p(w')$
         b.   An epistemic state M(i) is subjectively antiveridical about p iff it is epistemically settled negatively: i.e. $\forall w' \in \text{M}(i) : \neg p(w')$

In contrast to veridicality and anti-veridicality, subjective nonveridicality imposes non-homogeneity on M(i). The individual anchor i does not know or believe p:

(39)   *Subjective nonveridicality* (for functions)
         A function F that takes a proposition p as its argument is subjectively nonveridical with respect to an individual anchor i an epistemic state $M(i)$ iff Fp does not entail that i knows or believes p: iff $\exists w' \in \text{M}(i) : \neg p(w') \wedge \exists w'' \in \text{M}(i) : p(w'')$.

A subjectively nonveridical function, e.g. *possibly* creates uncertainty and epistemic unsettledness in M(i). i does not know that p, and does not know that *not p* either. The epistemic space is partitioned into a p and a $\neg p$ space. Giannakidou (2013a)

calls subjectively non-veridical operators, for this reason, *inquisitive*; questions, the prototypical inquisitive expressions are partitioned spaces therefore nonveridical.

We can once again move from nonveridicality as a property of functions to non-veridicality as a property of states.

(40)   *Epistemic unsettledness*
       M(i) is epistemically unsettled about p iff $\exists w' \in$ M(i) $: \neg p(w') \land \exists w'' \in$ M(i) $: p(w'')$

(41)   *Subjective nonveridicality and epistemic unsettledness*
       An epistemic state M(i) is subjectively nonveridical about p iff it is epistem-ically unsettled.

With subjective nonveridicality, M(i) as a whole does not support p: there is a sub-set of M(i) that supports p, maybe the subset that best complies with knowledge or evidence of i, but there is a complement set that doesn't support p. Nonveridical epis-temic states are thus *weaker* than veridical ones because veridical states fully support p but nonveridical states only partially do so.

Modal verbs cannot be used when the speaker knows p, they reflect nonveridical states:

(42)   Epistemic modal verbs are subjectively nonveridical
       MAY/MUST p can be defined relative to an epistemic state $M(i)$ if and only if $\exists w' \in$ M(i) $: \neg p(w') \land \exists w'' \in$ M(i) $: p(w'')$.

With modal verbs generally, and epistemic modals in particular, M(i) is partitioned. Modal statements are therefore epistemically weaker than unmodalized assertions, as we noted several times. This explains why when the speaker knows p (as in the earlier context of direct perception of rain), it is not felicitous to modalize the sentence.

Hence, modal sentences are weaker than unmodalized sentences both objectively and subjectively. There is a distinction between an unmodalized past and present as-sertions, which impose homogenous epistemic states fully supporting p (or $\neg p$ if the sentence is negative), and modal sentences which are nonveridical and only partially support p in $M(i)$ (or the modal base).[15] Modalization creates a non-veridical epis-temic state, which is a space partitioned into p and $\neg p$ worlds. A portioned epistemic space creates a weaker statement than a non-partitioned one.

Here are, finally, veridicality and nonveridicality as properties of modal spaces—as might be needed also for modal bases of non-epistemic modals:

(43)   *Veridical, nonveridical modal spaces (sets of worlds)*
       a.   A modal space M is *veridical* with respect to a proposition p iff
            $\forall w'(w' \in M \to p(w'))$
       b.   A modal space M is *nonveridical* with respect to a proposition p iff
            $\exists w', w'' \in M(w' \neq w'' \land (p(w') \land \neg p(w'')))$
       c.   A modal space M is *antiveridical* with respect to a proposition p iff
            $M \cap p = \emptyset$.

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[15]We thank two anonymous reviewers for their insights that led to this discussion.

It becomes obvious that modal bases in a Kratzerian semantics are nonveridical spaces, or as Condoravdi (2002) puts it, diverse. We propose that nonveridicality be a precondition on modalities, as can be seen in *Nonveridicality Axiom* below:

(44) *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.

Nonveridicality is a presupposition of all modals. The nonveridicality axiom guarantees that the modal base M be partitioned into a set of worlds where *p* is true (the positive set) and its complement where *p* is not true (the negative set). This partition is crucial: MODAL *p* will not entail *p* since there are $\neg p$ worlds in M, and the actual world may be in $\neg p$. Non-aleithic modals (possibility and necessity, epistemic, deontic, bouletic, etc.) obey this principle, and therefore come with partitioned modal bases; consequently, they do not entail *p*.[16]

3.3 Epistemic future as epistemic *must*

For the analysis of epistemic future, Giannakidou and Mari (2016b) adopt the analysis of epistemic *must* (Kratzer 1991; Giorgi and Pianesi 1997; Portner 2009). Like Italian *dovere* and Greek *prepi*, *tha* and *futuro* associate with an epistemic modal base M(*i*) which is the set of propositions known by the speaker *i* at t_u (the utterance time). w_0 is the world of evaluation.

(45) M(*i*) (t_u) $= \lambda w.'w'$ is compatible with what is known by the speaker *i* in w_0 at t_u.[17]

The epistemic modality is by default *subjective* (Lyons 1977), and knowledge changes with time. Epistemic modality is therefore parametric to knowledge at t_u, as is often acknowledged in the literature (see Portner 2009; Hacquard 2006, 2010). For us here, t_u is a parameter of evaluation for FUT/MUST, and this has implications that we discuss further in Sect. 5.

Given what the speaker knows, the modal base of epistemic FUT and MUST is nonveridical and contains both *p* and $\neg p$ worlds. *p* is true in the subset of M(*i*) that complies with the ordering source. We use a normative ordering source $\mathcal{S}$. Normality conditions have most notably been discussed in relation with genericity (see Asher and Morreau 1995) and progressives (Dowty 1979; Landman 1992; Portner 1998)—and are known under the term normality (Asher and Morreau 1995), inertia (Dowty 1979) stereotypicality (Portner 2009) reasonability (Landman 1992; Portner 1998; Mari 2014). Our ordering source $\mathcal{S}$ here ranks as Best those worlds

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[16]There are two exceptions to the Nonveridicality axiom, and both result in trivialization of modality. The first exception is the actuality entailment of an ability modal, in which case the modal is trivialized (see Mari forthcoming-a). The second is with aleithic modality, as in *1 + 1 must equal 2*. Giannakidou and Mari (2016b) treat similar deductive contexts with *must* as involving aleithic modality, thus maintaining the nonveridicality axiom (and therefore the so-called *weakness* of the modal (Karttunen 1972)). With both aleithic modality and actuality entailment, the distinction between modal and non modal statement is lost.

[17]It should be clear that our notation M(*i*) corresponds to the Kratzerian notation using set intersection $\cap f_{epistemic}(w_0, i)$, where this returns the set of worlds compatible with what it is known in w_0 by *i*.

in which *strange things do not happen*, and is stereotypical (à la Portner 2009). The output Best$_\mathcal{S}$ is a subset of the modal base. Consider (46), for instance. If a child had red cheeks and was sneezing, then, under stereotypical circumstances, she has the flu. However, circumstances are not necessarily stereotypical. In such non-stereotypical circumstances these symptoms are indicative of a potentially worse disease.

(46)   I   Ariadne tha   ixe   gripi. (Greek)
       the Ariadne FUT have.PAST.IMPERF.3SG flu
       'Ariadne must have had the flu.'

(47)   Giacomo avrà   avuto   l'influenza. (Italian)
       Giacomo have.FUT.3SG have.PAST.PART the-flu
       'Giacomo must have had the flu.'

The modal base is partitioned into a positive set (p worlds) and a negative set ($\neg p$ worlds); FUT universally quantifies over Best worlds (its restrictor) and relates the worlds in the Best set to p (the nuclear scope). The positive set relates to Portner's (2009) Best. The Best worlds are the ideal worlds, the ones best conforming to knowledge, rules, or goals (depending on the nature of modality). Ordering of worlds is defined in (48):

(48)   *Ordering of worlds*: Portner (2009:65)
       For any set of propositions X and worlds $w, v : w \leqslant_X v$ iff for all $p \in X$, if $v \in p$, then $w \in p$.

Given an epistemic modal base $M(i)(t_u)$, we can rewrite Best as a function over $M(i)(t_u)$, still in the spirit of Portner (2009). Let $\mathcal{S}$ be the normative ordering source.

(49) $\text{Best}_\mathcal{S}(M(i)(t_u)) = \{w' \in M(i)(t_u) : \forall q \in \mathcal{S}(w' \in q)\}$

So defined, Best$_\mathcal{S}$ delivers the worlds in the epistemic modal base in which all the propositions in $\mathcal{S}$ are true.[18] What the quantifier demands is that those worlds are in the support set of p in $M(i)$. The set Best$_\mathcal{S}$ is also parametric to time. Unless otherwise stated, we consider that Best$_\mathcal{S}$ is determined at the utterance time (this will be indeed always the case in the reminder of the paper).

The Greek future marker *tha*, the Italian *futuro*, and the English modal *must* have the same denotation in the epistemic reading. When combined with PAST, as we mentioned earlier (see discussion surrounding (12) sqq.), FUT takes high scope, and we do not obtain a future in the past but an epistemic interpretation (we use the symbols $\prec$ and $\succ$ for temporal precedence and succession, respectively):

(50) $[\![\text{FUT}/tha/futuro/\text{MUST (PAST }(p))]\!]^{M,i,\mathcal{S},t_u}$ will be defined only if the modal base $M(i)(t_u)$ is nonveridical; if defined,
       $[\![\text{FUT}/tha/futuro/\text{MUST (PAST }(p))]\!]^{M,i,\mathcal{S},t_u} = 1$ iff $\forall w' \in \text{Best}_\mathcal{S} : \exists t' \prec t_u \wedge p(w', t')$

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[18] Since only those worlds are considered in which *all* the propositions in $\mathcal{S}$ are true, the function Best determines a cut-off point.

(The present reading embeds a PRES, but since this case is discussed extensively in Giannakidou and Mari 2016b we omit consideration here). The truth conditions derive both objective and subjective nonveridicality: FUT/MUST (PAST p) and FUT/MUST (PRES p) do not entail p, or that i knows p. FUT/MUST, in this analysis, are both strong (because of quantification over a homogeneous space of worlds ranked as Best) and epistemically weaker (because of nonveridicality) than unmodalized positive assertions in the simple past or present, which convey veridical epistemic states.[19]

We proceed now to the predictive reading. Given the epistemic analysis of *tha* and *futuro*, the null hypothesis is to extend it to prediction. However, recent analyses (including our own Giannakidou and Mari 2013a, 2013b) use metaphysical modality, we will thus first consider this option.

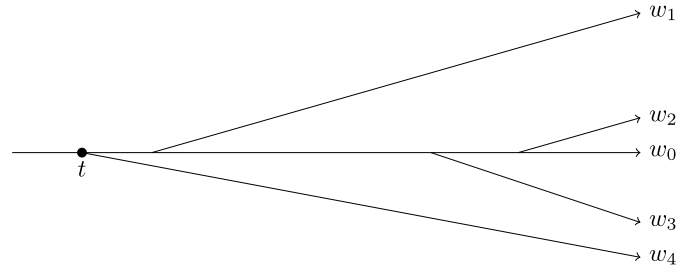## 4 Prediction as epistemic modality with *tha* and futuro

The existence of epistemic future by itself, as we said at the beginning, is a major challenge to a metaphysical view of the future. If FUT is an epistemic modal in this use already, the simplest thing to assume is that FUT is also epistemic in the predictive use—any other assumption would be essentially an ambiguity analysis. In this section, we present specific challenges for the metaphysical view illustrating that (a) prediction does not depend on what will actually be the case, and (b) the predictive reading of the future is parallel to epistemic modals.

4.1 A shot at the metaphysical analysis: The future criterion

The metaphysical unsettledness of the future is typically captured with branching time models (Thomason 1984). Thomason himself provides a supervaluationist theory, according to which a future sentence is true if and only if in all branches opening up at the time of the utterance there is a time at which p is true, and it is false if and only if in all branches opening up at the time of the utterance there is a time at which p is false. Put this way, a negative future sentence like *There won't be a sea battle tomorrow* does not mean that not all the worlds are sea-battle worlds, but that all worlds are non-sea battle worlds. Copley (2002) asks the question of how we can be so certain when we talk about the future while the future is open. She adds ordering sources. It is possible, then, to defend an account of metaphysical alternatives with epistemic ordering sources added. Here is what such an analysis of *tha* and *futuro* could look like (see Mari 2009c; Giannakidou and Mari 2013b).

Let us start with the standard $W \times T$ forward-branching structure. A three-place relation $\simeq$ on $T \times W \times W$ is defined such that (i) for all $t \in T$, $\simeq_t$ is an equivalence relation; (ii) for any $w, w' \in W$ and $t, t' \in T$, if $w' \simeq_{t'} w$ and t precedes t', then $w' \simeq_t w$. In words, w and w' are historical alternatives at least up to t' and thus differ only, if at all, in what is future to t'. For any given time, a world belongs to

Fig. 1 $\mathcal{I}(t)$

an equivalence class comprising worlds with identical pasts but possibly different futures. Let w_0 be the actual world.

For any time $t \in T$, we define the set of historical alternatives ($\mathcal{I}$) as the set of worlds that are identical to the actual world w_0 at least up to and including t (Thomason 1984).

(51) $\mathcal{I}(t) := \{w \mid w \simeq_t w_0\}$

In the case depicted in Figure 1, the set of historical alternatives at t is the set given in (52).

(52) $\mathcal{I}(t) = \{w_1, w_2, w_0, w_3, w_4\}$

$\mathcal{I}(t)$ represents the modal base fixed at t. One can impose that the modal base be non-veridical, and thus require that it be partitioned into p and $\neg p$ worlds.

(53)   For any time t, $\mathcal{I}(t)$ is nonveridical.

Now, given this metaphysical structure, what a speaker knows or believes at the time of prediction still plays a key role: two different people can make two different predictions, depending on what they know. Consider the case in which Mary and Susan are waiting for Gianni. Mary utters (54):

(54)   Gianni arriverà   alle 4. (Italian)
        John   arrive.FUT.3SG at   4
        'John will arrive at 4.'

(55)   O   Janis tha ftasi   stis 4. (Greek)
        the John FUT arrive.PERF.NON-PAST.3SG at   4
        'John will arrive at 4.'

In making the prediction, Mary is using her knowledge. She knows facts as well as generalizations based on personal experience, and rules of thumb about traffic conditions. She knows that around 4 pm it is typically not yet rush hour, that the traffic is easy outside rush hour. She also knows that if you travel outside rush hour the trip from Hyde Park to Lakeview will take 20 minutes. We will call the set of propositions, following Giannakidou and Mari (2013b), the *future criterion*, and use $\mathcal{E}$ to refer to it. Mary's future criterion is the following set of propositions:

(56)   Mary's future criterion $\mathcal{E}_{Mary} = \{$ 'around 4 it is not yet rush hour,' 'the traffic is easy outside rush hour,' 'if you travel outside rush hour the trip from Hyde Park to Lakeview will be take 20 minutes'$\}$

Now, imagine that Susan knows something more. Her future criterion includes the set Mary's does, but also the proposition that there is construction going on that day on the Lake Shore Drive.

(57)   Susan's future criterion $\mathcal{E}_{Susan}$ = {'around 4 it is not yet rush hour,' 'the traffic is easy outside rush hour,' 'if you travel outside rush hour the trip from Hyde park to Lakeview will be take 20 minutes,' 'there is construction going on on the Lake Shore Drive,' 'when there is construction on the road, traffic slows down'}

Given (57), Susan disagrees with Mary and utters (58).

(58)   No. Gianni arriverà   alle 5. (Italian)
        no John   arrive.FUT.3SG at   5
        'No; John will arrive at 5.'

(59)   Oxi. O Janis tha ftasi   stis 5. (Greek)
        no   the John FUT arrive.PERF.NON-PAST.3SG at   5
        'No. John will arrive at 5.'

Because $\mathcal{E}_{Susan}$ contains the construction information, her prediction about Gianni's arrival is for a later time, differing from Mary's. Clearly, then, what one knows affects what one predicts. Susan and Mary are in a state of disagreement, reminiscent of disagreement observed with epistemic modals (a.o. Lasersohn 2005; Stephenson 2007). The prediction is therefore subjective, anchored to the knowledge of the individual making it.

One could use the future criterion as an ordering source, and the more propositions a world satisfies, the better it is. We could then define the set Best, relatively to the ordering $\mathcal{E}_i$.

(60)   Best worlds as per $\mathcal{E}_i$.
        $\text{Best}_{\mathcal{E}_i} : \{w' \in \mathcal{I}(t_u) : \forall q \in \mathcal{E}_i (w' \in q)\}$.

One must add also stereotypicality conditions—and this would complicate the matter rendering FUT a modal with two ordering sources. As we show next, no matter how many and which ordering sources are added, the metaphysical modal base is simply not appropriate to begin with.

The future criterion, in any case, would end up carving the space of metaphysical possibilities into those that are p worlds and those that are not, and FUT would universally quantify over the Best set returned by the future criterion. That would look like the following:

(61)   Truth conditions for predictive FUT with a metaphysical modal base (to be rejected)
        $[\![\text{FUT}/\textit{tha}/\textit{futuro} (\text{NON-PAST} (p))]\!]^{\mathcal{I},\mathcal{E},i,t_u}$ will be defined only if the metaphysical modal base $\mathcal{I}(t_u)$ is nonveridical; if defined,
        $[\![\text{FUT}/\textit{tha}/\textit{futuro} (\text{NON-PAST} (p))]\!]^{\mathcal{I},\mathcal{E},i,t_u}$ is 1 iff $\forall w' \in \text{Best}_{\mathcal{E}_i} : \exists t' \in (t_u, \infty) \wedge p(w', t')$

This analysis says that p is true only in the metaphysical alternatives that are consistent with current knowledge of i. The worlds are metaphysical, i.e. they are versions of reality out there, and we expect that p is true in a non-singleton subset of them.

4.2 FUT and epistemic modals: Problems with the metaphysical view

The main problem with the metaphysical analysis above is that FUT p can be true even if the metaphysical space $\mathcal{I}(t_u)$ is anti-veridical. This implies that metaphysics is irrelevant for the truth of prediction, which seems to rely solely on what the speaker knows or believes at the time of making it.[20] This conclusion is further supported by parallelisms between FUT in the predictive reading and epistemic modals—and which, to our knowledge, have not been discussed before. In addition, we highlight the category *indeterminate* predictions, also hardly featured in the relevant literature. It becomes clear that we pursue a relativistic stance on the epistemic nature of predictions.

4.2.1 Predictive future, epistemic modality and relative truth

A speaker i can make a prediction about p even if there are *no* metaphysical branches that make p true. We call this an antiveridical metaphysical modal base. Imagine that, sadly, Susan had a car accident and died on the spot. Mary does not know that Susan died, and utters (62):

(62)   Incontrerò   Susan domani.   (Italian)
        meet.FUT.1SG Susan tomorrow
        'I will meet Susan tomorrow.'

(63)   Tha dho   ti Susan avrio.   (Greek)
        FUT meet.PERF.NON-PAST.1SG the Susan tomorrow
        'I will meet Susan tomorrow.'

Mary makes a prediction (FUT p) based on her state of knowledge. The fact that objectively the proposition *Susan meets Mary tomorrow* cannot be true appears to be irrelevant for FUT p. This means that Mary's prediction is true or false in a relativistic manner (see Lasersohn 2005; Stephenson 2007). Given what she knows (e.g. that Susan called her yesterday providing a place and time for the meeting), Mary will meet Susan tomorrow. The prediction FUT p thus solely depends on what Mary knows at t_u, and this holds for all three languages—Greek, Italian, and English.

It is helpful at this point to offer some comments on what it means for a prediction to be true relativistically, from now on *true_i*. A *true_i* prediction, as we just showed, is relative to i making it, and in our system of subjective veridicality (Sect. 3), the speaker is always a parameter of evaluation akin to Lasersohn's judge (see also Stephenson 2007). The similarity with predicates of personal taste and epistemic modality is immediate:

(64)   a.   Mary: Fish is tasty.
        b.   Susan: No, fish is not tasty.

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[20]We are grateful to the reviewers for their useful feedback on these central points.

The proposition *Fish is tasty* is true$_i$ for Mary but false$_i$ for Susan, the two are in a classic case of faultless disagreement. Importantly, with predicates of personal taste this disagreement can never be objectively resolved, since there is no matter of fact that fish is or is not tasty (see Stephenson 2007). The truth is therefore fully determined by the individual anchor only; predicates of personal taste only have relative truth.[21]

As we saw above, the individual anchor is crucial in determining the basis of knowledge for forming the prediction—but as Aristotle already noted (see also Mac-Farlane 2005), there *will* be a matter of fact for p. Setting aside for a moment the case in which we have an antiveridical metaphysics, in the other cases, the predicted sentence p will receive a truth value objectively (true$_o$ or false$_o$), albeit at a later time. Hence, objectively, the complement sentence p of FUT, unlike a sentence with a predicate of personal taste, indeed gets resolved.[22] However, just as with personal taste, the matter is not resolved at the time of the prediction.

Notice also the parallelism with epistemic modals in present and past:

(65)   a.   For all I know, Mary must be at home right now.
         b.   For all I know, Mary must have been at home this morning.

Just as with predictions, the individual anchor determines the basis of knowledge for epistemic MUST p (see also Papafragou 2006). Unlike with predicates of personal taste, with epistemic modals there is a matter of fact (Stephenson 2007): p is/was or is not/was not true. With epistemic modals the matter is settled at t_u—but with predictions, aside from the cases of antiveridical metaphysics, it will be settled at a later time. In this respect, predictions stand in between predicates of personal taste and epistemic modals: p may be objectively settled (as with epistemic modals), but it is not yet objectively settled at the time of utterance (as with predicates of personal taste).

In the specific case of predictions and antiveridical metaphysics, the matter *is* settled objectively at t_u: given that Susan is dead, the sentence *Susan meets Mary tomorrow* is objectively false at t_u. In other words, FUT p (the prediction) is true relative to the speaker, but p is false objectively.

Regardless of whether the matter can be objectively settled or not, sentences with predicates of personal taste and epistemic modals have been claimed to be true$_i$/false$_i$ at the time of utterance (Lasersohn 2005; Stephenson 2007), regardless of the objective status of p, if any. Our claim here is that predictions are also equally true$_i$/false$_i$ at the time of utterance, regardless of whether p will turn out to be objectively true or false.[23]

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[21] The individual anchor for us is always a parameter of evaluation, and may (embedding with propositional attitudes) or may not be syntactically present (as in unembedded sentences).

[22] Note that, for MacFarlane (2005) the future sentences cannot be assigned a truth value at the time of utterance. For us, it is assigned a truth value, it is true/false, parametrically to i.

[23] An anonymous reviewer points to us the following excerpt from MacFarlane (2014).

> Suppose you are standing in a coffee line, and you overhear Sally and George discussing a mutual acquaintance, Joe. SALLY says: Joe might be in China. I didn't see him today. GEORGE: No, he can't be in China. He doesn't have his visa yet. SALLY: Oh, really? Then I guess I was wrong. It

As we just saw, with epistemic modals, objectively, *p* has a truth value; but for the MUST *p* sentence to be true, the objective value of *p* is irrelevant. It may be the case that I have the wrong information and Mary is not in fact home. My information at the time of utterance was such that it supported *p* in the Best worlds, and this forms the sole basis for my assessment. I therefore made a true$_i$ assessment given my knowledge. In other words, the epistemic assessment (MUST *p*) is true relative to the speaker, but the prejacent *p* may turn out to be false objectively. Likewise, FUT *p* is true in a relativistic manner. At the time of utterance the assessment is not false$_i$ if *p* is false unbeknownst to the speaker. MUST *p* is false$_i$ if the speaker knows that *p* is not true and still asserts MUST *p*. Likewise, the prediction is false$_i$ if the speaker knows that Susan is dead and still utters *I will meet Susan tomorrow*. In both cases, in fact, we claim that the speaker is lying.

To sum up: predictions and assessments with MUST/FUT *p* are true$_i$ or false$_i$ (i.e. subjectively) relative to the individual anchor's *i* knowledge, while *p* has a truth value objectively depending on what is/was/will be the case. The objective value of *p* does not matter for the truth$_i$ of predictions, just as it does not matter for epistemic modals and for predicates of personal taste. In all cases, truth conditions are assigned independently of the objective status of *p*.

4.2.2 Indeterminate predictions: Far into the future

What we call next *indeterminate* predictions also plead for treating future as epistemic. Imagine utterances like the following:

(66) a. O Janis tha pandrefti   tin Mary kapja
          the John FUT marry.PERF.NON-PAST.3SG the Mary some
          mera. (Greek)
          day
          'John will marry Mary some day.'

      b. Giacomo parlerà   come giornalista alla   televisione un
          Giacomo talk.FUT.3SG as   journalist on-the television one
          giorno. (Italian)
          day
          'Giacomo will talk as a journalist on TV some day.'

---

seems that George is contradicting Sally and rejecting her claim. It also seems that, having learned something from George, Sally concedes that she was wrong. Finally, it seems appropriate for her to retract her original claim, rather than continuing to stand by it. Think how odd it would be were she to respond: SALLY: Oh, really? # Still, I was right when I said 'Joe might be in China,' and I stand by my claim.

Extending the argument for epistemic English *might* to Italian and Greek future, we would claim that those who judge epistemic/future claims to be false when the prejacent is false are looking at the bare propositional content excluding the speaker index. Those who judge such claims to be true even when the prejacent is false are looking at the final truth value including the speaker index. For clarity we are glossing truth/falsity as truth$_i$/falsity$_i$ to highlight those cases in which the speaker index is taken into account. We thank the reviewer for providing this material.

These are indeterminate predictions—a common kind of prediction often reinforced by indefinite adverbs such as *some day* which create temporal distance between the time of prediction and the time of (possible) fact. The speaker again relies on knowledge at the present time, i.e. for (66b), that Giacomo is very charming, talented and communicative, he dreams of becoming a journalist etc., as well as stereotypical assumptions that unless something bizarre happens, one fulfills her dreams. How the actual world will turn out to be is too far into the future to assume reasonably that it plays a role when making the prediction. The speaker makes her prediction even though the actual world to be is, from the perspective of now, hard to access. Normalcy conditions will also have to be relaxed, thus rendering these predictions a bit weaker. Overall, indeterminate prediction suggests that the speaker reasons with what she knows, and projects that knowledge into an expectation about the future.

4.3 Prediction as epistemic modality

The parallelism between epistemic modality and prediction that we observed suggests that metaphysics is not foundation for the prediction. We found the prediction to be epistemic and subjective, just like epistemic modal statements. As such, both epistemic and predictive statements depend for their truth and correctness on what the predictor knows or believes. The null hypothesis, namely that *tha* and Italian *futuro* are epistemic modals in the predictive reading can thus be pursued. Keep in mind that *will* was shown to pattern similarly in all respects discussed here.

The truth condition for predictive FUT is the one for epistemic future, the only difference being that here we have lower NON-PAST, which is the interval (t_u, ∞):

(67) $[\![\text{FUT}/tha/futuro\ (\text{NON-PAST}\ (p))]\!]^{M,i,\mathcal{S},t_u}$ will be defined only if the modal base $M(i)(t_u)$ is nonveridical; if defined,
$[\![\text{FUT}/tha/futuro\ (\text{NON-PAST}\ (p))]\!]^{M,i,\mathcal{S},t_u} = 1$ iff $\forall w' \in \text{Best}_{\mathcal{S}} : \exists t' \in (t_u, \infty) \land p(w', t')$

We show how exactly how these truth conditions are compositionally derived in Sect. 5. The spirit of our analysis is close to Veltman (2006), who uses expectation in defining information states. An information state is a pair $\sigma = \langle \epsilon, s \rangle$, where s is a proposition and ϵ is an expectation pattern, an ordering of worlds. $\langle w, v \rangle \in \epsilon$ means that w is at least as expected as v (every expectation that is met by v is also met by w, $w \leqslant_{\epsilon} v$). As Portner points out commenting on Veltman, 'another way to describe the maximally normal worlds uses the vocabulary of ordering semantics' (Portner 2009:100). In Veltman, the ordering is expectedness, that is to say, the best worlds are the most expected ones, or those which are as normal as possible, given the beliefs we have about how the world really is. This is also the view that we have been defending here.

The analysis is exactly parallel to that for epistemic future, i.e. once again we take into account an epistemic modal base, facts known by the speaker, and stereotypical ordering sources. The modal base contains worlds compatible with what the speaker *i* knows. Consider now the disagreement between Mary and Susan about the time of Gianni's arrival. Mary utters:

(68)   Gianni arriverà   alle 4. (Italian)
            John   arrive.FUT.3SG at   4
            'John will arrive at 4.'

(69)   O Janis tha ftasi   stis 4. (Greek)
            the John FUT arrive.PERF.NON-PAST.3SG at   4
            'John will arrive at 4.'

Susan replies:

(70)   No. Gianni arriverà   alle 5. (Italian)
            no John   arrive.FUT.3SG at   5
            'No; John will arrive at 5.'

(71)   Oxi. O Janis tha ftasi   stis 5. (Greek)
            no   the John FUT arrive.PERF.NON-PAST.3SG at   5
            'No. John will arrive at 5.'

What we called the future criterion is the body of information that Mary and Susan have, i.e. the set of propositions known by Mary and Susan, i.e. their epistemic modal bases.

(72)   Mary's epistemic modal base = { 'around 4 it is not yet rush hour,' 'the traffic is easy outside rush hour,' 'if you travel outside rush hour the trip from Hyde Park to Lakeview will be take 20 minutes'}

(73)   Susan's epistemic modal base = { 'around 4 it is not yet rush hour,' 'the traffic is easy outside rush hour,' 'if you travel outside rush hour the trip from Hyde park to Lakeview will be take 20 minutes,' 'there is construction going on on the Lake Shore Drive (LSD),' 'when there is construction on the road, traffic slows down'}

The epistemic space of each Mary and Susan is nonveridical. They do not know whether Gianni has an appointment with a doctor that day, in which case, he won't be home before 7 pm. Their epistemic space is thus partitioned into p and $\neg p$ worlds. Each of them uses another set of propositions, which represents the normality conditions. Both Mary and Susan reason on the assumptions that Gianni is in good health, does not run out of gas, that the lake does not invade the LSD, and so on. The worlds in which normality conditions are met are p worlds and future expressions quantify over this set. Note that there might also be extraordinary worlds in which Gianni arrives at 4, e.g. worlds where the lake invades the LSD but nonetheless John makes it home.

Before concluding our analysis of FUT as epistemic modal uniformly across the epistemic and the predictive use, we want to emphasize two points. First, the non-veridicality of the FUT does not entail that the facts are unsettled, as we saw in the case of felicitously predicting p while in fact p is metaphysically settled negatively.

Second, assuming that all sentences are evaluated with regard to to the speaker's epistemic state, MUST and FUT sentences are epistemically weaker than the un-modalized present or past. This is so because the truth condition of the umodalized

present or past requires that the epistemic state be veridical; the assertability of PRES *p* and PAST *p* require *i′* knowledge (or belief) of *p*. MUST/FUT, on the other hand, are subjectively nonveridical because their modal base is partitioned into Best worlds where *p* is true, and ¬*p* worlds (by the nonveridicality axiom). There is bias towards the *p* worlds (Giannakidou and Mari 2016b), as noted earlier, but MUST/FUT *p* does not imply knowledge of *p*. MUST/FUT *p* are therefore predicted to be excellent in inferential contexts (like e.g. when I see a wet umbrella) but odd in contexts that entail knowledge of *p* (e.g. when I see the rain therefore I *know* that it is raining).

Obvious mathematical truths, in agreement with this prediction, do not cope well with prediction:

(74) #(Domani) 2+2 farà 4. (Italian)
  #(Avrio) 2+2 tha kani 4. (Greek)
  '#(Tomorrow) 2+2 will be 4.'
  # 2+2 must be 4.

FUT and *must* are odd on the epistemic reading (without 'tomorrow,' as well as, of course, on the predictive reading). 2+2 is a simple addition, its result known to the speaker at t_u. This example is parallel to when the speaker sees the rain, thus knows that it is raining, and therefore cannot say *It must be raining*. For the use of FUT and MUST, nonveridicality needs to be satisfied, hence the speaker must not know that 2+2 equals 4, which is an odd thing not to know. Importantly, FUT and MUST are fine when some calculation is needed:

(75) 68,009,753 + 8,007,525 farà 76,017,278. (Italian)
  68,009,753 + 8,007,525 tha kani 76,017,278. (Greek)
  '68,009,753 + 8,007,525 will/must be 76,017,278.'

This is a context in which the speaker cannot know the sum of the addition at t_u, but can calculate it in a few seconds—a perfect inferential context that sanctions the use of FUT and MUST. In other words, as Giannakidou and Mari (2016b) put it, the alleged evidential effect of epistemic universals such as FUT and MUST is not a special requirement for them, but a by-product of the nonveridicality axiom of modals that makes them incompatible with knowledge of *p*. Their modal bases, by nonveridicality, must contain ¬*p* worlds, and this is not the case when *p* is known.

Finally, our account allows us to disentangle bare assertions from epistemic modal sentences with respect to the notion of "correctedness," thus paving the way for a deeper understanding of denials. It should be by now clear that, for us, if the speaker is not lying, all assertions are true subjectively (while also having objective truth values, with the exception of predicates of personal taste). As we said, the main addition of the future and other epistemic modals is that the speaker signals that s/he does not know that *p*, that she is not fully certain. In this general framework, being *correct* and being wrong become a matching (and non-matching) relation between the value of *p* in the subjective and the objective space.

When uttering a future sentence, the speaker cannot be accused of being incorrect once the objective truth is revealed (either at a future time or at the time of utterance):

his epistemic modal base is non-homogeneous, which means it cannot be either correct or incorrect, as both notions require settledness in the subjective space.

Let us consider the strategies of denial returning to the scenario in which Susan is dead and Mary does not know it. She has just uttered "I will meet Susan tomorrow." Once Mary is informed that Susan is dead the most normal reaction would be the "I did not know that!"

(76)   a.   Me: Susan è morta. (Italian)
                 'Susan is dead.'
         b.   Mary: Oddio non lo sapevo!
                 'Oh my god! I did not know that!'

It is unlikely Mary will be willing to say that "she was wrong" or at least in Italian and Greek, (77) are somehow unnatural dialogues.

(77)   a.   Me: Susan è morta. (Italian)
                 'Susan is dead.'
         b.   Mary: #Oddio mi sbagliavo!
         c.   Mary: #O thee mou. Ekana lathos! (Greek)
                 '#Oh my god! I was wrong!'

The "I was wrong" reply becomes natural with a non-modalized assertion, where p is both settled in the entirety of the epistemic space M(i) and in an objective manner.

(78)   a.   A: Gianni é a casa. (Italian)
                 'Gianni is at home.'
         b.   B: No, é in Olanda.
                 'No he is in Holland.'
         c.   C: Ah, mi sbagliavo allora.
         d.   C: A, ekana lathos. (Greek)
                 'Oh, I was wrong then.'

The impression of epistemic commitment with FUT arises because the speaker is quantifying over the Best set of worlds. Although Mary did not know that Susan was dead, she was somehow committed to the belief that she was meeting her tomorrow (although she signaled, by using FUT, that she did not know for sure). But again, the dialogue in (77), although not unforeseeable, it is less natural than the one on (76), where Mary will have the tendency of distancing by recalling that her statement was based on her own knowledge and that her epistemic state was a partitioned one.

A deeper study of the strategies for denials is certainly needed, and experimental evidence may be able to shed more light. It is our hope that our initial comments here pave the way for such research driven by the idea that correctness is a relation between the value of p in the subjective and in the objective spaces, and suggesting that correctness applies to cases in which there is at the very least a support set of p in the epistemic modal base.

We move in Sect. 5 to the final piece of our analysis, the role of inner tense.

5 Syntax-semantics: Modality and lower tense

In the meaning we defined for *tha* and *futuro*, they are pure epistemic modals. As such, they rely on knowledge at the utterance time, which is a parameter of evaluation. When they combine with PAST or PRES, as we saw, there is no prediction. The predictive reading arises when the lower temporal component is NON-PAST. The separation between the modal component and the temporal one is particularly visible in Greek where FUT is a particle that appears above the lower tensed verb. We address the combination with perfective non-past which is responsible for producing the prediction, as well as combinations with pasts, first in Greek and then Italian.

5.1 The Greek non-past as a polarity item: Giannakidou (2009)

In Greek, the future is separated from the tense system and appears above the tensed verb (TP), as we mentioned in Sect. 2. Besides *tha*, above TP we can have the subjunctive and optative particles. The morphological tense can be, again, a past or non-past:

(79) Na/   As/   Tha figi   o   Janis. (Greek)
      SUBJ/ OPT/ FUT leave.PERF.NON-PAST.3SG the John
      'Let John go/John will go.'

(80) Na/   As/   Tha efige   o   Janis. (Greek)
      SUBJ/ OPT/ FUT leave.PERF.PAST.3SG the John
      It's OK that John left! (optative, subjunctive)
      'John must have have left.'

The particles *na, as* have clause typing and speech act properties and move further to C (Giannakidou 1998, 2009; Roussou 2000). Generalizing, we can say that the modal and temporal information are dissociated in the Greek clause, and the perfective non-past is responsible for the prospective orientation with FUT. The tensed verb appears in T. Modal particles are heads above TP in what we call MODP (see also Philippaki-Warburton 1998 that *tha* embeds TP). We assume that this differentiation of tense and modality is true also for Italian, and holds perhaps even universally.

Giannakidou (2009) treats the morphological perfective non-past as a *semantic* non-past below:

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

(Following standard practice, we use "(" in the left interval to show that t is excluded from the interval, hence P will be true at a time later than t). NON-PAST introduces a prospective interval (like Abusch's 2004 WOLL, a work Giannakidou draws on)—but unlike WOLL and other morphological non-pasts that can forward shift by default, the left boundary t of the Greek NON-PAST is *dependent* variable t (Giannakidou 1998, 2009): it cannot be interpreted as a free variable, and remains ill-formed if free. This necessitates that t_u be syntactically present in the higher structure so that

the t variable of NON-PAST be identified with t_u. (The other forms like WOLL and perfective non-pasts that forward shift by default do not contain a dependent variable.)

Giannakidou ([2009]) claims that the particles *denote* t_u, thus rendering them (including FUT) temporal operators. We modify that analysis here, and argue that t_u is introduced syntactically in Greek in the higher structure by default.

5.2 Non-past and FUT

Recall the truth conditions we gave for prediction:

(82) $[\![$FUT/*tha*/*futuro* (NON-PAST (p))$]\!]^{M,i,\mathcal{S},t_u}$ will be defined only if the modal base $M(i)(t_u)$ is nonveridical; if defined,
$[\![$FUT/*tha*/*futuro* (NON-PAST (p))$]\!]^{M,i,\mathcal{S},t_u} = 1$ iff $\forall w' \in \text{Best}_{\mathcal{S}} : \exists t' \in (t_u, \infty) \land p(w', t')$

We show now how we reach these truth conditions by computing the role of the lower tense. We assume a lexical entry for FUT as follows:

(83)   Lexical entry for FUT/tha/futuro
$[\![$FUT$/tha/futuro]\!]^{M,i,\mathcal{S},t_u} = \lambda p \forall w' \in Best_{\mathcal{S}} : p(w')$; p is the prejacent proposition.

All epistemic modals, as we suggested, have t_u as a parameter of evaluation, and epistemic modals tend to scope above the verbal tense (Hacquard [2010]; Portner [2009]); hence the position of FUT (and subjunctive etc.) is justified syntactically as belonging to the class of epistemic modals. Adding t_u as a parameter of evaluation of the modal means that the modal base is anchored to t_u. We call anchoring to t_u *Now*-anchoring.
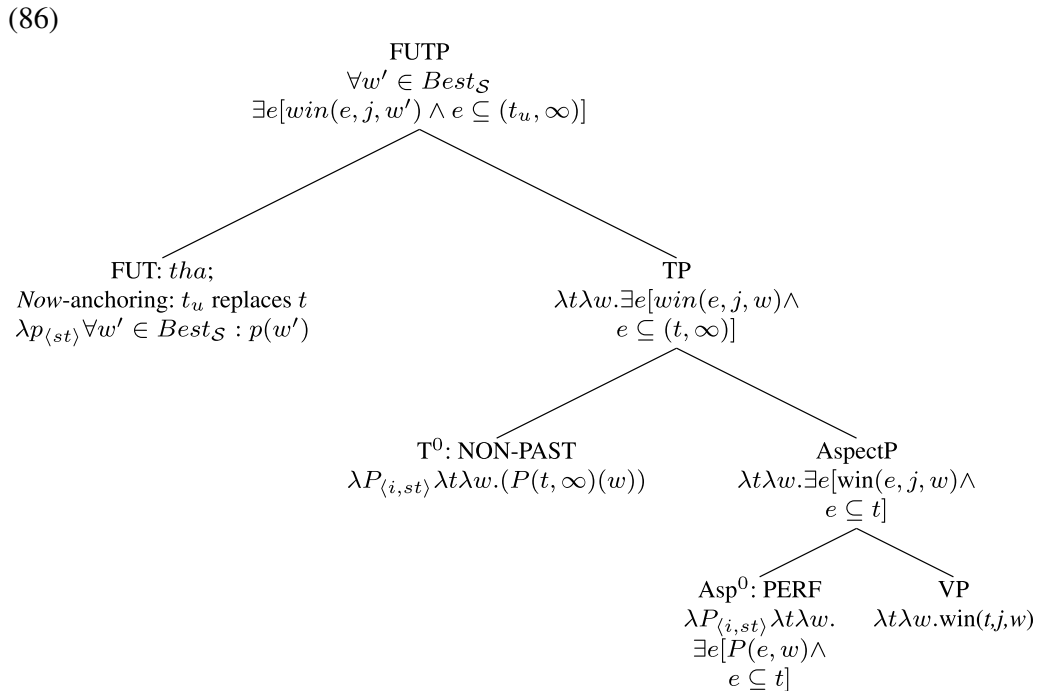
How is *Now*-anchoring done? There are two possible implementations. One way is to say that FUT actually adds t_u in the syntax. This is essentially the view pursued by Giannakidou ([2009]). If we take that view, then we must concede that t_u is added also by the other particles that appear in MOD, namely the subjunctive and the optative (and others, see Giannakidou [2009] for fuller exposition). But if we say that, we end up saying that the modal particles *as a class* denote t_u, and this is a bit strange given that they are modal particles and that t_u is always a parameter of evaluation for them anyway. Assuming that t_u is introduced syntactically, in addition to being a parameter of evaluation, is akin to saying that the judge is both a parameter of evaluation (à la Lasersohn [2005]) and an argument (à la Stephenson) with predicates of personal taste. We do not believe that this is a position that anyone in the literature on personal taste would be willing to take. Consider also that, when combining with PAST, t_u would be redundant, and we would have to somehow cancel it (which is what Giannakidou [2009] does).

The other way of understanding Now anchoring would be to treat it as a substitution rule for free variables. (This was the spirit of Abusch's rule for WOLL: "In the substitution operator, t is a bound variable that corresponds to the tense argument of WILL. For a top-level occurrence of WILL, the effect is to substitute (n, ∞) for n." (Abusch [2004]:ex. (39)). We can thus posit the following rule:

(84)   *Now*-anchoring rule, triggered at MOD
        Substitute any free variables t in TP with t_u

This rule will be triggered only if there are free variables in TP, and it will not apply to lower PAST, for instance, as we indicate in 5.3, since the past contains no free variables (for Italian see Sect. 5.4). The rule will enable the free variable t of NON-PAST to be identified with t_u. As a result, the interval provided by NON-PAST will then be anchored to t_u, which is what we want. The advantage of having this rule is that it allows us to keep the semantics of modality clear of time—and it avoids the undesirable position that all modal particles introduce t_u, and that t_u is dually present both as a parameter of evaluation *and* an argument of FUT. Introducing t_u appears to be a property of the higher structure, therefore positing the *Now*-anchoring rule seems to be the better option. The analysis for (85) is provided in (86).

(85)   O Janis tha kerdisi.
        the John FUT win.PERF.NON-PAST.3SG
        'John will win.'

(86)

$$
\begin{array}{c}
\text{FUTP} \\
\forall w' \in Best_{\mathcal{S}} \\
\exists e[win(e, j, w') \wedge e \subseteq (t_u, \infty)]
\end{array}
$$

FUT: tha;
Now-anchoring: t_u replaces t
$\lambda p_{\langle st \rangle} \forall w' \in Best_{\mathcal{S}} : p(w')$

$$
\begin{array}{c}
\text{TP} \\
\lambda t \lambda w. \exists e[win(e, j, w) \wedge \\
e \subseteq (t, \infty)]
\end{array}
$$

T^0: NON-PAST
$\lambda P_{\langle i, st \rangle} \lambda t \lambda w.(P(t, \infty))(w))$

$$
\begin{array}{c}
\text{AspectP} \\
\lambda t \lambda w. \exists e[\text{win}(e, j, w) \wedge \\
e \subseteq t]
\end{array}
$$

Asp^0: PERF
$\lambda P_{\langle i, st \rangle} \lambda t \lambda w.$
$\exists e[P(e, w) \wedge$
$e \subseteq t]$

VP
$\lambda t \lambda w. \text{win}(t, j, w)$

Meaning is represented explicitly at LF, and semantic composition is limited to function application, variable binding, and type raising. Starting from the bottom, perfective aspect applies yielding a statement that there is a winning event. Following Giannakidou (2009), PERF and NON-PAST are modifiers: their input is a property P and give back the same property with the addition of the event argument, and replacement of t by (t, ∞). PERF introduces the event argument and existentially closes it (as in, e.g. Hacquard 2006). This event has to be located at t, which itself must be placed within the interval provided by NON-PAST. At TP, the t variable remains unbound. At FUT, the *Now*-anchoring rule applies, resulting in identifying the t provided by NON-PAST with t_u. The interval at FUTP is set to (t_u, ∞). The modal meaning can be thus properly computed.

Our analysis of non-past embedded under FUT is very similar to the idea of a prospective marker under FUT, found in recent literature in Kush (2011), and Matthewson (2012) for Gitksan which actually has overt prospective aspect marker *dim*, see (87).

(87) da'akxw[-i]-'y   dim   ayee=hl   bax-'y   (Gitskan)
      circ.poss[-tra]-1SG.II PROSP go.fast=CN run-1SG.II
      'I can run fast.'

We want to make clear that Greek does not have a prospective aspect, but a morphological and semantic NON-PAST form. Kush (2011), further, studies the Hindi modal particle *gaa*, which, like FUT, shows a flexibility between epistemic and predictive readings. The future reading arises with the bare verb (no tense or aspect) (88), and the epistemic with perfective (past) (89a) or progressive aspect (89b) (examples and glosses from Kush 2011:ex. (5), (6a) and (6b)):

(88) ve   bacce   do din=mẽ aa-ẽ-gee.   (Hindi)
      dem.3PL child.M.PL two day=in come-SBJ.PL-MOD.M.PL
      'Those children will come in two days.'

(89) a. ve   log ab^hi=tak pahũc^h-ee   hõ-Ø-gee. (Hindi)
          dem.3.PL people now=by arrive-PFV.PL aux-SBJ.PL-MOD.M.PL
          'They must have arrived by now.'
     b. ve   log ab^hi naac   rah-ee   (Hindi)
          dem.3.PL people now dance PROG-M.PL aux-SBJ.PL-MOD.M.PL
          hõ-Ø-gee.
          'They must be dancing now.'

Kush analyzes *gaa* as a modal operator, but posits metaphysical modality for the future reading. Future/metaphysical modal base arises with no tense in Kush's account, and the epistemic reading relies on aspect: "from the ungrammaticality of auxiliaries in Future constructions we can conclude that Tense is absent." (Kush 2011:417).

Given the Greek system we outlined above, we cannot say that tense is absent with non-past. Morphologically, non-past is a tense in Greek. So, when FUT selects a perfective non-past, it selects a tense/aspect combination, which is assigned the denotation of NON-PAST. At the same time, the non-predictive epistemic reading in Greek and Italian rely on PAST and PRES, and this creates a parallel with Hindi; but, unlike Kush and Giannakidou and Mari (2013b), we do not claim that there is a shift in modal base, as FUT uniformly quantifies over epistemic alternatives in our account. Overall, and this is worth emphasizing, looking at Kush (2011), Matthewson (2012), and the analysis we propose here, we find systems where modality and tense/aspect are dissociated, and the modal particle scopes above tense/aspect. Therefore the data from Greek, Italian, Gitksan, and Hindi jointly suggest that future modals at least in these languages are not mixed modal/temporal operators (thus challenging the generality of Condoravdi 2002).
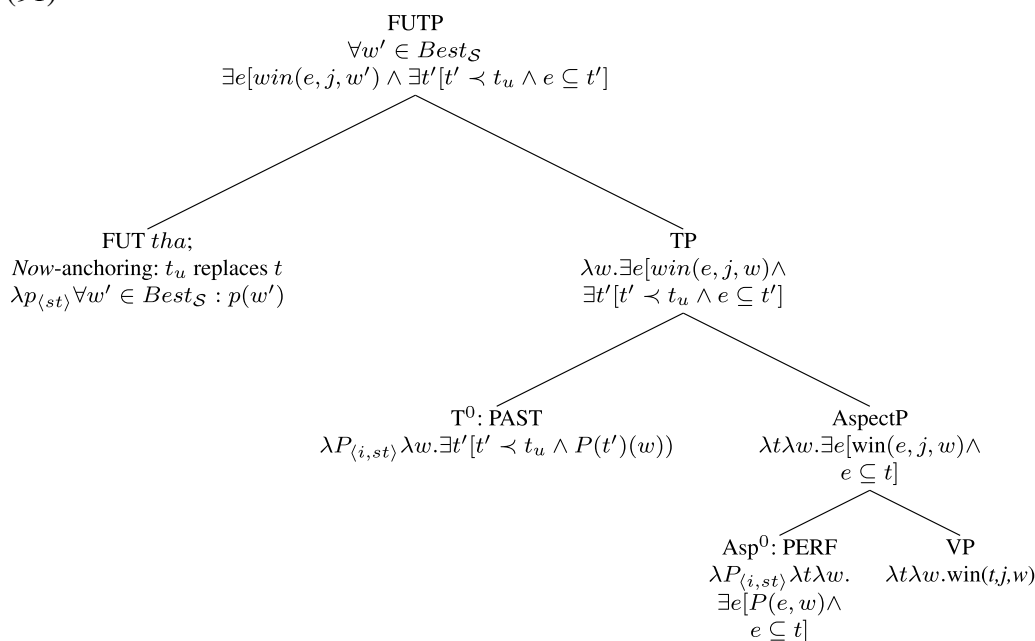
5.3 FUT with PAST

Before turning to Italian, we are now ready to provide the analysis for FUT with PAST. We distinguish a morphological perfective and a past layer.

(90)   O Janis tha kerdise.
       the John FUT win.PERF.PAST.3SG
       'John must have won.'

Here, the embedded time is a PAST which is deictic, therefore it denotes the anteriority relation wrt t_u: t' $\prec t_u$. The Now anchoring rule does not apply since there are no free variables.

(91)

FUTP
$\forall w' \in Best_{\mathcal{S}}$
$\exists e[win(e, j, w') \wedge \exists t'[t' \prec t_u \wedge e \subseteq t']$

FUT tha;
Now-anchoring: t_u replaces t
$\lambda p_{\langle st \rangle} \forall w' \in Best_{\mathcal{S}} : p(w')$

TP
$\lambda w. \exists e[win(e, j, w) \wedge$
$\exists t'[t' \prec t_u \wedge e \subseteq t']$

T^0: PAST
$\lambda P_{\langle i, st \rangle} \lambda w. \exists t'[t' \prec t_u \wedge P(t')(w))$

AspectP
$\lambda t \lambda w. \exists e[win(e, j, w) \wedge$
$e \subseteq t]$

Asp^0: PERF
$\lambda P_{\langle i, st \rangle} \lambda t \lambda w.$
$\exists e[P(e, w) \wedge$
$e \subseteq t]$

VP
$\lambda t \lambda w. win(t, j, w)$

To conclude, FUT is an epistemic modal and it does not provide tense. With a lower NON-PAST we get future orientation and a prediction, but with a lower PAST, the FUT sentence is equivalent to a MUST sentence with embedded PAST. The temporal information, in both cases, comes form the tense below FUT. As noted in Sect. 2 (ex. (14) and (15)), FUT plus PAST does not have the future of a past reading, which supports our analysis that FUT provides modality and not futurity.

5.4 Syntax-semantics of Italian

In Italian, *futuro* appears on the verb (92b), like present (92a) and simple past (92c).

(92)   a.   Arriv- a.   (Italian)
            arrive PRES.3SG
            'He arrive any moment soon.'
       b.   Arriv- erà.   (Italian)
            arrive FUT.3SG
            'He will arrive.'
       c.   Arriv- ò.   (Italian)
            arrive SIMPLE-PAST.3SG
            'He arrived.'

We propose that abstractly the structure is similar to Greek, with FUT being expressed higher than TP. The order of application of the semantic functions is the same as in Greek—and it is merely a morphological fact that future is a Tense, and must therefore stay within the V-form in Italian. In Greek, FUT is a particle and stays outside the V. In other words, in Italian there is a mismatch between the function of *futuro* (modal) and its status as a verbal category. The same, by the way, holds for subjunctive, which in Italian, unlike Greek, also appears on V.

The main difference between Italian and Greek, is that, in Italian, Aktionsart determines the aspectual information—since in Italian there is no grammatical aspectual distinction. We note with previous literature (and most notably Bertinetto 1979), that, in Italian, the eventive/stative distinction plays a role, just as in a variety of other languages (see Cipria and Roberts 2000; Condoravdi 2002; Copley 2002; Laca 2008; Mari 2015a, 2015b). With eventive predicates embedded under present (93b) or future (94b), the time of evaluation of the prejacent is forward-shifted—unlike with stative predicates (93a)–(94a). Such data can be replicated for English, and extend beyond present and future (e.g. see Copley 2009).

(93)   a.   Gianni è   malato. ((Italian) stative, present reading)
            Gianni be.PRES.3SG ill
            'John is ill.'
       b.   Gianni arriva.   (eventive, future reading)
            Gianni arrive.PRES.3SG
            'John will arrive immediately.'

(94)   a.   Gianni sarà   malato.
            Gianni be.FUT.3SG ill
            ((Italian) stative, present epistemic reading)
            'John must be ill.'
       b.   Gianni arriverà.   (eventive, predictive reading)
            Gianni arrive.FUT.3SG
            'Gianni will arrive.'

Condoravdi (2002) notes the same pattern for modals (see (95)) and proposes an account that relies on aspectual differences between statives and eventives, from which it follows that the time of evaluation of the prejacent is forward-shifted only with eventive ones.[24]

(95)   a.   John might be ill. (stative, present orientation)
       b.   John might become ill. (eventive, future orientation)

According to Condoravdi (2002) the modal itself bears the temporal information and provides a forward-shifting interval. We cannot adopt this view here, since forward-shifting with eventives is independent of modal embedding, see (93b). Our proposal builds on a parallelism between grammatical and lexical aspect, according to which lexical statives are standardly imperfective, whereas eventives are

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[24]When the prejacent is stative (and the time of evaluation is not forward-shifted), the modal has an epistemic interpretation. According to Condoravdi (2002) the modal has a metaphysical interpretation in (95a).
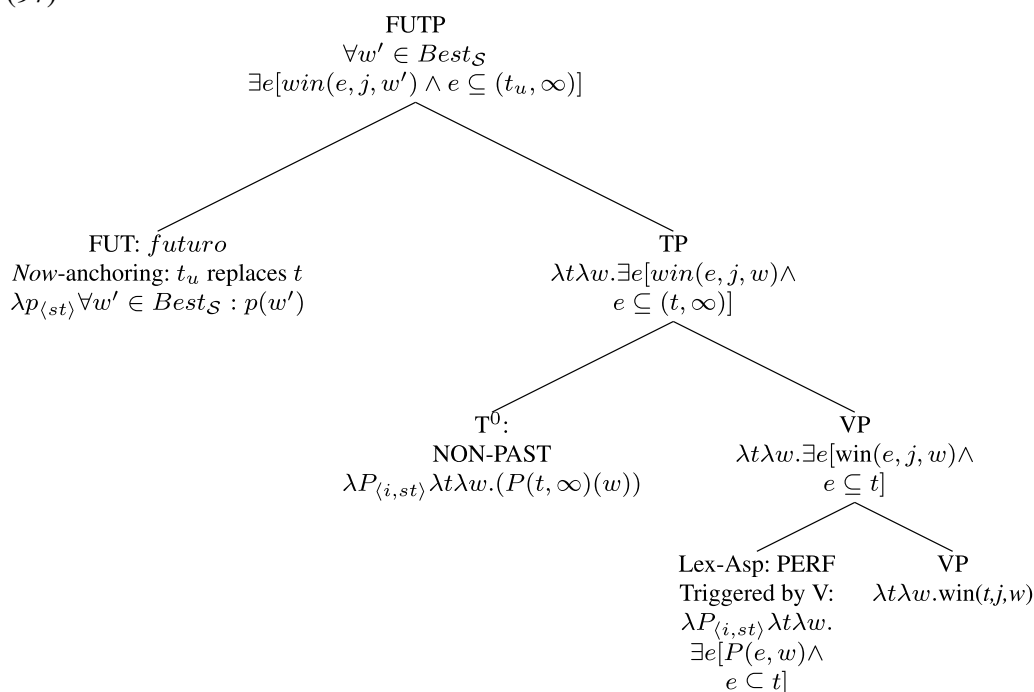
perfective unless they are marked by a progressive verb form (see Smith 1991; Boogaart and Trnavac 2011). In this line of thought, lexical eventives provide aspectual information—perfectivity—and perfectivity, in absence of PAST, triggers futurity (NON-PAST, $\lambda P \lambda t \lambda w (P(t, \infty)(w)))$. Aspect is thus contributed in the VP.

Note that, just as in Greek morphological perfectivity combines with either l nonpast or past to produce PERF, NON-PAST and PERF PAST, in Italian lexical perfectivity is also compatible with PAST or NON-PAST leading to PERF PAST and PERF NON-PAST, as is the case here to produce the predictive reading.[25]

Above the VP, the derivation in Italian is parallel to the one in Greek. We see that, by being parametric to the time of utterance, FUT provides *Now*-anchoring in Italian as well. Consider (96).

(96)   Flavio vincerà.
         Flavio win.FUT.3SG
         'Flavio will win.'

(97)

$$\text{FUTP}$$
$$\forall w' \in Best_{\mathcal{S}}$$
$$\exists e[win(e, j, w') \wedge e \subseteq (t_u, \infty)]$$

FUT: $futuro$
Now-anchoring: t_u replaces t
$\lambda p_{\langle st \rangle} \forall w' \in Best_{\mathcal{S}} : p(w')$

TP
$\lambda t \lambda w . \exists e[win(e, j, w) \wedge e \subseteq (t, \infty)]$

T^0:
NON-PAST
$\lambda P_{\langle i, st \rangle} \lambda t \lambda w . (P(t, \infty)(w))$

VP
$\lambda t \lambda w . \exists e[win(e, j, w) \wedge e \subseteq t]$

Lex-Asp: PERF
Triggered by V:
$\lambda P_{\langle i, st \rangle} \lambda t \lambda w.$
$\exists e[P(e, w) \wedge e \subseteq t]$

VP
$\lambda t \lambda w . win(t, j, w)$

Why in non-past environments the perfective triggers futurity has been the object of much study—but there is no final answer (Copley 2009; Mari 2015a; Boogaart and Trnavac 2011). Here we tend to align with Boogaart and Trnavac who espouse the classical view from Comrie (1976): "a perfective verb form instead presents a situation, 'from the outside,' as a completed whole, thus including both its starting point and endpoint." Perfectivity thus establishes a distance between the boundaries of the event and the perspectival point, which in the case of future is t_u. For this reason perfectivity can combine with past or non-past, but does not provide PRES.

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[25] As often noted, forward-shifting is observed with statives too, e.g. as in 'Domani sarà malato' (*Tomorrow he will be ill*), see Giannakidou and Mari (2016b) for details.

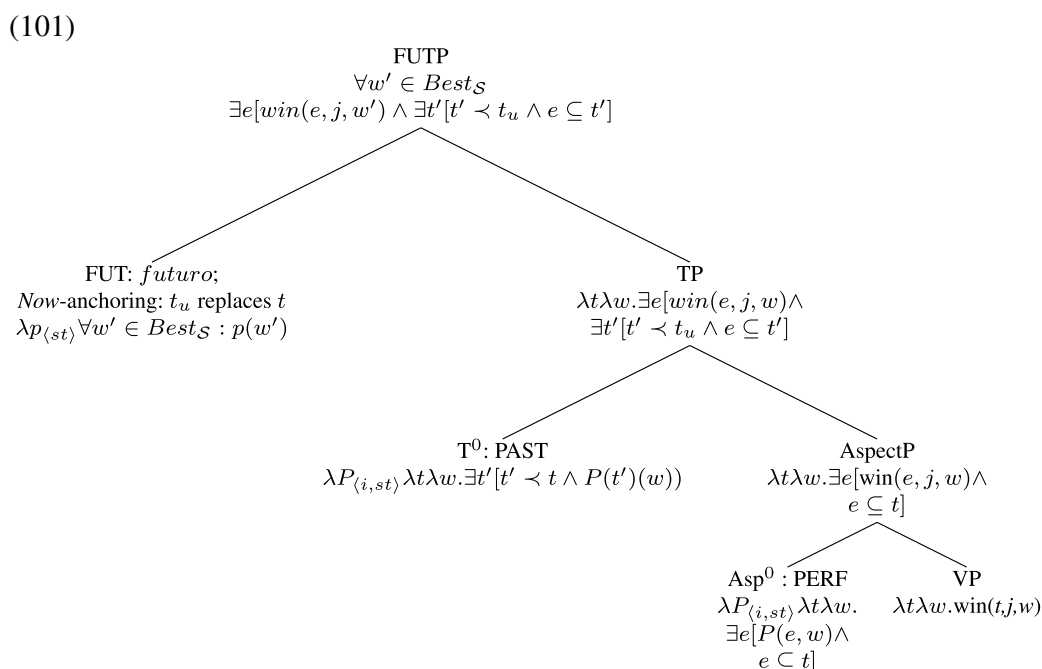Let us now turn to the morphological future anterior in Italian.

(98) Gianni sarà   andato al   cinema ieri.
      Gianni be.FUT.3SG gone   to-the theatre yesterday
      'Gianni must have gone to the theatre, yesterday.'

Recall that the corresponding sentence is a simple past, i.e. past perfective, in Greek. In Italian, FUT is in complementary distribution with a variety of auxiliaries bearing different tenses (99), thus entering apparent Perfect constructions (see de Swart 2007).

(99) è,fu,sarà   andato.
      BE.PRES.SIMPLE-PAST.FUT.3SG gone

We decompose the perfect component as a combination of PAST and PERF, as in Greek. PERF provides the temporal boundaries of the eventuality; the PAST expresses anteriority. But given the possibility of combining with a variety of tenses, we must concede that the PAST we are positing is *not* deictic as in Greek but *relative* (Verkuyl 2011; Broekhuis and Verkuyl 2014): it does not express anteriority with respect to t_u but with regard to a time t which is a free variable TP. This triggers the *Now*-anchoring rule. The derivation of (100) follows in (101).

(100) Flavio avrà   vinto.
       Flavio have.FUT.3SG won
       'Flavio must have won.'

(101)

FUTP
$\forall w' \in Best_{\mathcal{S}}$
$\exists e[win(e,j,w') \wedge \exists t'[t' \prec t_u \wedge e \subseteq t']]$

FUT: $futuro$;
Now-anchoring: t_u replaces t
$\lambda p_{\langle st \rangle} \forall w' \in Best_{\mathcal{S}} : p(w')$

TP
$\lambda t \lambda w. \exists e[win(e,j,w) \wedge$
$\exists t'[t' \prec t_u \wedge e \subseteq t']]$

T^0: PAST
$\lambda P_{\langle i,st \rangle} \lambda t \lambda w. \exists t'[t' \prec t \wedge P(t')(w)]$

AspectP
$\lambda t \lambda w. \exists e[win(e,j,w) \wedge$
$e \subseteq t]$

Asp^0 : PERF
$\lambda P_{\langle i,st \rangle} \lambda t \lambda w.$
$\exists e[P(e,w) \wedge$
$e \subseteq t]$

VP
$\lambda t \lambda w.win(t,j,w)$

We can thus generalize that, regardless of whether the embedded PAST under FUT is a simple past or a perfect, the anteriority relation is expressed—only in the case of the simple past (Greek) it makes reference to t_u, but in the case of the perfect (Italian, English, Dutch, German) we have relative anteriority and reliance on the

Now-anchoring rule. What is important is that the anteriority relation is in the scope of FUT. Our analysis of Italian can be extended to cover Dutch, German and English apparent perfects under FUT and MUST.

6 Further comparisons, cross linguistic predictions

6.1 More arguments against metaphysical future

We argued that the predictive future involves knowledge, based on the observation that one can disagree about the future. We showed that the metaphysical modal base can be antiveridical. *A fortiori*, then, a purely metaphysical account of prediction should be rejected. For completeness, let us provide further arguments. One can argue, for example, that there are no stereotypicality conditions for cases like (102), inspired by Bonomi and Del Prete (2008).

(102)   Il   dado cadrà   sul 6. (Italian)
           the dice come-up.FUT.3SG on 6
           'The dice will come up 6.'

This sentence is infelicitous under normal circumstances: the speaker cannot utter (102) because she does not have *any* knowledge to favor this one possibility, 6, over all possible others. Notice that with the possibility modal *The dice might come up 6* there is no problem for exactly this reason. (102) can be uttered by a magician who tampered with the die, and therefore has reason to believe that it will come up six. Although the epistemic space of the magician can be understood as veridical (s/he knows that six is the only option) s/he nonetheless uses the future to *pretend* that s/he is making a prediction. In other terms, s/he can pretend that her/his own space is non-veridical (contrary to fact, since the die is tampered with).[26] Alternatively, (102) might be used to express a hope, akin to Veltman's expectedness. This flavor t may be present also in what we called indeterminate predictions, and can be easily accommodated in our system. Hopes have been argued to be a special type of doxastic modality (Portner and Rubinstein 2012).

The same sentence (102) has been used to argue that FUT features a 'wait and see' interpretation, with no truth conditions assigned at the time of the utterance (MacFarlane 2005; Bonomi and Del Prete 2008).We have not adopted this position here, as one would not be able to capture the systematic cross-linguistic relation between the epistemic and predictive future. It would also lead one to posit ambiguity for the predictive future which, according to Bonomi and Del Prete (2008) would feature modal

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[26]Note that metaphysical modality also involves knowledge, just like any statement, including non-modalized ones. However, a metaphysical modal as in *The Western underground orchid can grow here* does not involve a non-veridical epistemic state. Just as the non-modalized version *The Western underground orchid grows around here*, it involves subjective veridicality (recall Sect. 3.2): the speaker knows that the conditions for having orchids growing here are met. This is subjective veridicality. On the other hand, the metaphysical modality is not implicative: it is not entailed that the orchid actually grows here (the modality is only compatible with orchid growing here). In our terms, metaphysical modality presupposes non-veridicality in the metaphysical space. It does not presuppose non-veridicality in the subjective space, which is the one targeted by future sentences and epistemic modals.

meanings (regular prediction, e.g. (68)), on the one hand, and truth value gaps (102), on the other, thus multiplying the lexical entries for FUT.

Kaufmann (2005) proposes that metaphysical options are open and ordered by Kratzerian ordering sources. The ordering source used by Kaufmann is 'likelihood' and, for future, Kaufmann does not consider the role of knowledge (he discusses knowledge in relation with the modal future oriented present instead). Just like Giannakidou and Mari (2013b), Kaufmann (2005) suffers from the problem of metaphysical options, and no ordering sources can rescue this type of account. Ordering sources are also used in accounts which treat *will* as a bouletic modal, which we consider next.

6.2 Bouletic future?

Copley (2002) is a well-known account of *will*, but does not address the epistemic future. As far as we can see, it does not have the tools to address it. Copley discusses the predictive reading, and the criteria for partitioning the metaphysical modal base are inertia, abilities and commitment to bring about *p*. Copley's commitment is related to volition.

A central question for Copley, just like with us, is how the speaker can be confident about her prediction when in fact the future is metaphysically open. She advances the following claim.

> "One way is to be confident that someone (the agent of the sentence or some other person) has the ability to determine whether an eventuality happens or not, and is committed to making it happen. The other is to be confident that non-accidental properties of the world entail that it will happen. These two options were reflected in bouletic and inertial orderings on a metaphysical modal base, with universal quantification over the set of worlds." (Copley 2002:59)

Here we have a distinction between bouletic and inertial futures, a difference that Copley traces back to Dahl (1985). Desires and inertia are two criteria to partition the modal base. Let us consider an example from Copley, a case where two friends are discussing:

(103)   Don't worry, she'll be there at 5:00 p.m. (Copley 2002:ex. (124))

Consider now the following example, paying attention to the restriction on the worlds of the modal base, which are *p* worlds. (104) is an example of bouletic future, according to Copley.

(104)   Don't worry, it'll snow tomorrow; it always snows on my birthday. (Copley 2002:ex. (144))

The truth conditions Copley provides for (104) are in (105) and are paraphrased as: 'in all situations overlapping the present, a contextually specified director wants *p* at some future time.' (Copley 2002:69). Note that the notion of director includes those of ability to carry about *p*.

(105) $\text{ALL}_t(\text{ALLb}(d)(q))(w)(t) = 1$ iff
           $\forall t' \supset t : [\forall w'$ metaphysically accessible from w at t' and maximally con-
           sistent with d's commitments in w at t':
           $\exists t'' > t' : [q(w')(t'')]]]$
           Presupposed: d directs q in w at t'

This example is emblematic of the deep differences between our and Copley's account. In our account, the truth conditional content comprises only an epistemic modal base and a stereotypicality ordering source. Nothing more. In our view, to utter (104), the speaker considers a set of propositions: e.g. what happened the previous years and that, if everything goes normally given that knowledge, it will snow this year too. There is no director, ability or commitment to carry about *p*, and the metaphysical branches are not partitioned according to ability or volition. Note that bouletic modals do allow entertaining two contradictories desires, given one individual anchor.

(106)   I want to marry John and I do not want to marry John.

But this does *not* hold for FUT.

(107)   #I will arrive at 4 and I will not arrive at 4.

The sentence is ruled out in our account because of the stereotypicality conditions determining the set of Best worlds. A speaker cannot at the same time consider ideal *p* and ¬*p* worlds. A potentially useful observation is that *will* relates historically to volition. Cross-linguistically, paths from volition to future have been documented— *tha* has also been claimed to derive from *thelo na* 'want' plus the subjunctive *na* (Tsangalidis 1998; Joseph and Pappas 2002; Markopoulos 2009). But the historical path does not entail volitional meaning synchronically. And while it may be conceivable that there are volitional futures (perhaps along the lines of Copley 2002; see also Del Prete 2014 on a root interpretation of *will*), it has not been shown in any of the works we have seen that *will* synchronically conveys volition in its future use. The evidence amassed with purely epistemic usage of *will* doesn't seem to support a volitional analysis, and an argument based on diachronic volition would be tenuous at best. If the diachronic path of Greek *tha* from volition to future led to meaning change, we see no reason not to assume the same for *will*.

6.3 Cross-linguistic variation in epistemic futures: Ratificational *will*

As we have reached the end of the paper, let us think now a little bit more about English. There is variability in judgements among native English speakers, and some accept easily the non-predictive epistemic reading of *will*; we even encountered speakers that accept epistemic *will* with past adverbs (thanks to Chris Kennedy and Jason Merchant for their judgements and data). It remains true that although the Greek and Italian epistemic futures are unexceptional and widely attested, epistemic non-predictive *will* may not be as routine, and its existence has been contested in the literature (see e.g. Copley 2002). Cariani (2014), on the other hand, develops an analysis where *will* is, as he puts it "a kind of epistemic modal," and in our own analysis

of Greek and Italian, we found *will* to behave very similarly and pattern with the epistemic futures.

Regarding English, sometimes one hears that epistemic modality is *not* compatible with future orientation, e.g. for Condoravdi (2002), the future oriented modal shifts to a metaphysical modal base. As can be seen below, however, *might*, an epistemic modal, receives easily future orientation with non-past. We include below eventive and stative predicates:

(108) a. If John continues to smoke like this, he might be ill in a few years.
   b. For all I know, John might bring his friend to the party.

Hence, there is no incompatibility of epistemic modality with future temporal orientation. Enç (1996) discusses future orientation with *may* and suggests that "if *will* is treated not as a tense but as a necessity operator quantifying over possible worlds consistent with predictions, then future shifting *may* is the dual of *will*" (Enç 1996:356). In our analysis, Italian and Greek future morphemes are the dual of *might*, all epistemic modals.

Still, there is a tendency to interpret future oriented *must* deontically:

(109) a. Next month, Ariadne must move to Paris.
   b. Next month, Ariadne will move to Paris.

With the mention of *next month* we have an explicit future context. In such a context, there will be competition between *must* and the designated (thus unmarked) modal *will*. A speaker is expected to use *will* for future. In not using it, it is understood via Gricean reasoning that something else is intended, and this 'dooms' *must* to the non-predictive realm in explicit future contexts. In Greek and Italian, on the other hand, MUST and FUT are not in competition; they can combine, as we mentioned earlier in the paper. Recall here an example:

(110) I Ariadne tha prepi na milisi   avrio.
   the Ariadne FUT must.3sg SUBJ talk.PERF.NON-PAST.3SG tomorrow
   (Greek)
   'For all I know, it must be the case that Ariadne will speak tomorrow.'

The sentence has the expected epistemic predictive reading with future orientation "it must be the case that Ariadne will speak tomorrow." *Tha* and futuro combine with MUST, perhaps a real case of modal concord (Giannakidou 2012; Giannakidou and Mari 2016b). Universal modals are therefore not in competition with FUT in Greek and Italian, and this explains the contrast regarding MUST between these two languages and English.

Here is now the million dollar question: Is *will* an epistemic future? There is no doubt that *will* has epistemic uses, as the numerous examples we discussed here prove. However, it is equally correct to observe that the epistemic uses of *will* may be less common than the epistemic uses of Greek and Italian future. As a matter of fact, while speakers do acknowledge that *That will be the postman* has an epistemic reading, the sentence below is odd:

(111) He is not at school. ??He will be ill.

In Greek and Italian, this example is absolutely fine; in English, *must* must be used:

(112)   a.   Dhen ine sto sxolio. Tha ine arrostos. (Greek)
                not   be at school. FUT be ill
        b.   Non é a scuola. Sarà   malato. (Italian)
                not is at school. be.FUT.3SG ill
                'He is not at school. He *must* be ill.'

Crucially, *will* patterns with French future (see Mari 2015b). Observe:

(113)   a.   La sonnette sonne.   Ce sera   le facteur. (French)
                the doorbell ring.PRES.3SG. that be.FUT.3SG the postman
                'The doorbell is ringing. It will be the postman.'
        b.   Il n'est   pas à l'école.   ??Il sera   malade.
                he not-be.PRES.3SG   at the-schoold. he be.3SG.FUT ill
                (French)
                'He is not at school. ??He will be ill.'

(114)   a.   La sonnette sonne.   Ca doit   être le facteur.
                the doorbell ring.PRES.3SG. that must.PRES.3SG be the postman
                (French)
                'The doorbell is ringing. That must be the postman.'
        b.   Il n'est   pas à l'école.   Il doit   être
                he not-be.PRES.3SG   at the-school. he must.PRES.3SG be
                malade. (French)
                ill
                'He is not at school. He must be ill.'

    The contrast between *will* (111) and French future (113-b), on the one hand, and Greek/Italian future, on the other, can be understood within the context of a recent study by Mari (2015b). Mari identifies a subclass of epistemic futures that she calls *ratificational*. A ratificational future is epistemic, but requires further that there be a time of verification (no matter how far into the future). A ratificational future won't be used if there is no verification time in the future. This is shown below, with a very clear minimal pair in Italian–French in (115). Here two friends are speculating about the shape of the universe.

(115)   a.   Sarà   sferico. (Italian)
                be.FUT.3SG sferical
        b. ??Il sera   sphérique. (French)
            it be.FUT.3SG sferical
            'It must/#will be spherical.'

(Mari (2015b) presents multiple differences between Italian and French futures and French future and *devoir*, 'must' in French.) Note the translation with *must*, as *will* is odd patterning with French future. According to Mari (2015b), the oddness is due to the impossibility of the verification of the shape of the universe (see also de Saussure and Morency 2011). Ratification is not required for the Greek and Italian FUT, hence (115a) is not odd in Italian. Most importantly, the ratification time must be in the

future, and this explains why *will* resists epistemic uses in the past (unlike Greek, Italian, German and Dutch futures).

Verification at a future time, then, appears to be a factor constraining further the distribution of certain epistemic futures, and crucially for our purposes, *will* appears to be one of those futures. A tentative truth condition in line with Mari's proposal for French future (Mari forthcoming-b) can be given below—where the existence of a future verification time t_{ver} is cast as a presupposition:

(116)   Adapted from Mari (2015b, forthcoming-b)
        $[\![\text{WILL (NON-PAST } (p))]\!]^{M,i,\mathcal{S},t_u}$ will be defined only if:
        (i) the modal base $M(i)(t_u)$ is epistemic and nonveridical; and (ii) $\exists t_{ver} \in (t_u, \infty)$ such that p will be verified in t_{ver}. If defined,
        $[\![\text{WILL (NON-PAST } (p))]\!]^{M,i,\mathcal{S},t_u} = 1$ iff $\forall w' \in \text{Best}_{\mathcal{S}} : \exists t' \in (t_u, \infty) \wedge p(w',t')$

We will not be able to embark on a fuller consideration of *will* in the present paper, and we realize that our tentative semantics above needs to be tested against various challenges, including e.g. the indeterminate futures *Giacomo will be a journalist someday*. We feel that in such cases there is belief or expectation that there will be a t_{ver} although such a time is not identifiable. These cases show that the ratificational future does not require the existence of a *specific* or *identifiable* time (in the sense of Farkas 2002), yet the connection between verifiability (propositional domain) and identifiability (the nominal domain) appears to be a fruitful one to explore.

Finally, treating *will* as an epistemic future that depends on the existence of a verification time also resonates with MacFarlane's 'time of assessment.' (Note that for MacFarlane 2005 no truth conditions can be assigned at the utterance time, but for us *will*, like all epistemic futures, conveys truth$_i$ at the time of assertion.). It appears therefore that epistemic futures are not only common cross-linguistically, but also diverse along the verification parameter. The plausibility, implications, and further coverage of ratificational futures will have to be left for future research.

7 Conclusions

Our goal in this paper was to offer an analysis of what it means to make a prediction using a future morpheme. Our novel strategy was to address this question by examining the behavior of Greek and Italian future morphemes which happen to have extensive, unmarked, epistemic use along with the predictive use. We pursued the null hypothesis, and offered a unified analysis of Greek *tha* and Italian *futuro* as epistemic necessity modals. In so doing we pointed out numerous important parallelisms between predictive future and epistemic modals suggesting that metaphysics cannot be the right foundation for the prediction. We found the predictive statements to be subjective, just like epistemic modal statements. As such, both epistemic and predictive statements depend on what the predictor knows or believes—and not on what will actually be the case.

In our analysis, it is no surprise that future morphemes systematically show in a number of languages (including English) epistemic and predictive use. The two readings are essentially the same. The prediction is an epistemic modal sentence about

an eventuality that the speaker has reason to believe will happen at a future time, and the temporal information comes from the tense below, *not* from the future morpheme itself. If, as we argue, prediction is an epistemic category, the need for metaphysical modality loses much of its motivation, and this is an implication of our analysis worth thinking about.

References

Abusch, Dorit. 2004. On the temporal composition of infinitives. In *The syntax of time*, eds. Jacqueline Guéron and Jacqueline Lecarme, 1–34. Cambridge: MIT Press.

Arregi, Karlos, and Peter Klecha. 2015. The morphosemantics of past tense. In *North East Linguistic Society (NELS)* 45, eds. Thuy Bui and Deniz Özyıldız, 53–66. Amherst: GLSA.

Asher, Nicholas, and Michael Morreau. 1995. What some generics mean. In *The generic book*, eds. Gregory Carlson and Francis Jeffry Pelletier, 224–237. Chicago: Chicago University Press.

Aristotle. De Interpretatione Book IX. Oxford: Oxford University Press.

Beaver, David I., and Jonathan Frazee. 2014. Semantics. In *The handbook of computational linguistics*, 2nd edn., ed. Ruslan Mitkov. Oxford: Oxford University Press.

Bernardi, Raffaella. 2002. Reasoning with polarity in categorial type logic. PhD diss., University of Utrecht.

Bertinetto, Paolo. 1979. Alcune Ipotesi sul nostro futuro (con alcune osservazioni su potere e dovere). *Rivista di grammatica generativa* 4: 77–138.

Bonomi, Andrea, and Fabio Del Prete. 2008. Evaluating future-tensed sentences in changing contexts. Ms., University of Milan.

Boogaart, Roni, and Radoslava Trnavac. 2011. Imperfective aspect and epistemic modality. In *Cognitive approaches to tense, aspect and epistemic modality*, eds. Adeline Patard and Frank Brisard, 217–248. Amsterdam: Benjamins.

Broekhuis, Hans, and Henk Verkuyl. 2014. Binary tense and modality. *Natural Language and Linguistic Theory* 32: 973–1009.

Cariani, Fabrizio. 2014. Predictions and modality. Ms., Northwestern University.

Cariani, Fabrizio, and Paolo Santorio. 2015. Selection function semantics for will. In *20th Amsterdam Colloquium*, 80–89.

Chiou, Michael. 2014. What is the 'future' of Greek? Towards a pragmatic analysis. *Research in Language* 12. doi:10.1515/rela-2015-0004.

Cipria, Alicia, and Craige Roberts. 2000. Spanish imperfecto and pretérito: Truth conditions and Aktionsart effects in a situation semantics. *Natural Language Semantics* 8: 297–347.

Coates, Jennifer. 1983. *The semantics of the modal auxiliaries*. London: Croom Helm.

Comrie, Bernard. 1985. *Tense*. Cambridge: Cambridge University Press.

Comrie, Bernard. 1976. *Aspect*. Cambridge: Cambridge University Press.

Condoravdi, Cleo. 2002. Temporal interpretation of modals: Modals for the present and for the past. In *The construction of meaning*, eds. David I. Beaver, Luis D. Cassillas Martínez, Brady Z. Clark, and Stefan Kaufmann, 59–88. Stanford: CSLI.

Copley, Bridget. 2002. *The semantics of the future*. PhD diss., MIT.

Copley, Bridget. 2009. Temporal orientation in conditionals. In *Time and modality*, eds. Jacqueline Guéron and Jacqueline Lecarme, 59–77. Dordrecht: Springer.

Dahl, Östen. 1985. *Tense and aspect systems*. Oxford: Blackwell.

Dendale, Patrick. 2001. Le futur conjectural versus devoir épistémique: Différences de valeur et restrictions d'emploi. *Le Français Moderne* 69(1): 1–20.

Del Prete, Fabio. 2014. The interpretation of indefinites in future tense sentences: A novel argument for the modality of will? In *Future Times, Future Tenses*, eds. Mikhail Kissine, Philippe de Brabanter, and Saghie Sharifzadeh, 44–71. Oxford: Oxford University Press.

Dowty, David. 1979. *Word meaning and Montague grammar*. Dordrecht: Kluwer Academic.

Enç, Murvet. 1996. Tense and modality. In *Handbook of contemporary semantic theory*, ed. Shalom Lappin, 345–358. Oxford: Blackwell.

Farkas, Donka F. 1992. On the semantics of subjunctive complements. In *Romance languages and modern linguistic theory*, ed. Paul Hirschbühler, 69–105. Amsterdam: Benjamins.

Farkas, Donka F. 2002. Varieties of indefinites. *Semantics and Linguistic Theory (SALT)* 12: 59–83.

von Fintel, Kai, and Anthony Gillies. 2010. *Must... stay... strong! Natural Language Semantics* 18: 351–383.

Giannakidou, Anastasia. 1994. The semantic licensing of NPIs and the Modern Greek subjunctive. In *Language and Cognition 4, Yearbook of the Research Group for Theoretical and Experimental Linguistics*, eds. Ale de Boer, Helen de Hoop, and Henriëtte de Swart, 55–68. Groningen: University of Groningen.

Giannakidou, Anastasia. 1997. The landscape of polarity items. PhD diss., University of Groningen.

Giannakidou, Anastasia. 1998. *Polarity sensitivity as (non)veridical dependency*. Amsterdam: Benjamins.

Giannakidou, Anastasia. 1999. Affective dependencies. *Linguistics and Philosophy* 22: 367–421.

Giannakidou, Anastasia. 2009. The dependency of the subjunctive revisited: Temporal semantics and polarity. *Lingua* 120: 1883–1908.

Giannakidou, Anastasia. 2012. The Greek future as an epistemic modal. In *International Conference on Greek Linguistics (ICGL)* 10. Komotini: University of Thrace.

Giannakidou, Anastasia. 2013a. Inquisitive assertions and nonveridicality. In *The dynamic, inquisitive, and visionary life of ϕ, ?ϕ and possibly ϕ—A festschrift for Jeroen Groenendijk, Martin Stokhof and Frank Veltman*, eds. Maria Aloni, Michael Franke, and Floris Roelofsen, 115–126.

Giannakidou, Anastasia. 2013b. (Non)veridicality, epistemic weakening, and event actualization: Evaluative subjunctive in relative clauses. In *Nonveridicality and Evaluation: Theoretical, computational, and corpus approaches*, eds. Radoslava Trnavac and Maite Taboada. Leiden: Brill.

Giannakidou, Anastasia. 2014a. The futurity of the present and the modality of the future: A commentary on Broekhuis and Verkuyl. *Natural Language and Linguistic Theory* 32(3): 1011–1032.

Giannakidou, Anastasia. 2014b. The prospective as nonveridical: polarity items, speaker commitment, and projected truth. In *The black book. Feestschrift for Frans Zwarts*, eds. Dicky Gilberts and Jack Hoeksema, 101–124.

Giannakidou, Anastasia, and Alda Mari. 2012. Italian and Greek futures as epistemic operators. *Chicago Linguistics Society (CLS)* 48: 247–262.

Giannakidou, Anastasia, and Alda Mari. 2013a. The future of Greek and Italian: An evidential analysis. *Sinn und Bedeutung* 17: 255–270.

Giannakidou, Anastasia, and Alda Mari. 2013b. A two dimensional analysis of the future: Modal adverbs and speaker's bias. In *Amsterdam Colloquium 2013*, 115–122.

Giannakidou, Anastasia, and Alda Mari. 2016a. Epistemic future and epistemic MUST: Non-veridicality, evidence and partial knowledge. In *Mood, aspect and modality revisited*, eds. Joanna Blaszczack, Anastasia Giannakidou, Dorota Klimek-Jankowska, and Krzysztof Migdalski. Chicago: University of Chicago Press.

Giannakidou, Anastasia, and Alda Mari. 2016b. Emotive predicates and the subjunctive: A flexible mood OT account based on (non)veridicality. In *Sinn und Bedeutung* 20, 288–305.

Giannakidou, Anastasia, and Frans Zwarts. 1999. Aspectual properties of temporal connectives. In *Greek Linguistics '97: 3rd International Conference on Greek Linguistics*, ed. Amalia Mozer, 104–113. Athens: Ellinika Grammata.

Giorgi, Alessandra, and Fabio Pianesi. 1997. *Tense and aspect: From semantics to morphosyntax*. Oxford: Oxford University Press.

Hacquard, Valentine. 2006. Aspects of modality. PhD diss., MIT.

Hacquard, Valentine. 2010. On the event relativity of modal auxiliaries. *Natural Language Semantics* 18(1): 79–114.

Harris, Jesse A., and Christopher Potts. 2009. Perspective-shifting with appositives and expressives. *Linguistics and Philosophy* 32(6): 523–552.

Haegeman, Liliane. 1983. *The semantics of will in present-day English: A unified account*. Brussels: Royal Academy of Belgium.

Heim, Irene. 1994. Comments on Abusch's theory of tense. Ms., MIT.

Hintikka, Jakko. 1962. *Knowledge and belief*. Cornell: Cornell University Press.

Holton, David, Peter Mackridge, and Irene Philippaki-Warburton. 1997. *Greek: A comprehensive grammar of the modern language*. London: Routledge.

Huddleston, Rodney, and Geoffrey Pullum. 2002. *The Cambridge grammar of the English language*. Cambridge: Cambridge University Press.

Iatridou, Sabine. 2010. The grammatical ingredients of counterfactuality. *Linguistic Inquiry* 31(2): 231–270.

Joseph, Brian, and Panayiotis Pappas. 2002. On some recent views concerning the development of the Greek future system. *Byzantine and Modern Greek Studies* 26: 247–273.

Karttunen, Lauri. 1972. Possible and must. In *Syntax and Semantics*, Vol. 1. Cambridge: Academic Press.

Kaufmann, Stefan. 2005. Conditional truth and future reference. *Journal of Semantics* 22(3): 231–280.

Kissine, Mikhail. 2008. From predictions to promises. *Pragmatics and Cognition* 16: 169–189.

Klecha, Peter. 2013. Diagnosing modality in predictive expressions. *Journal of Semantics* 31: 443–455.

Kratzer, Angelika. 1991. Modality. In *Semantics: An international handbook of contemporary research*, eds. Arnim von Stechow and Dieter Wunderlich, 639–650. Berlin: de Gruyter.

Kush, Dave. 2011. Height-relative determination of (non-root) modal flavor: Evidence from Hindi. *Semantics and Linguistic Theory (SALT)* 21: 413–425.

Laca, Brenda. On modal tenses and tensed modals. Ms., Université Paris 8 / CNRS.

Landman, Fred. 1992. The progressive. *Natural Language Semantics* 1: 1–32.

Lasersohn, Peter. 2005. Context dependence, disagreement, and predicates of personal taste. *Linguistics and Philosophy* 28: 643–686.

Lassiter, Dan. 2014. The weakness of must: In defense of a Mantra. In *Semantics and Linguistic Theory (SALT)* 24, 597–618.

Lederer, Herbert. 1969. *Reference grammar of the German language*. New York: Charles Scribner's Sons.

Lyons, John. 1977. *Semantics*. Cambridge: Cambridge University Press.

Mari, Alda. 2005a. Sous-spécification et interprétation contextuelle. In *Interpréter en contexte*, eds. Francis Corblin and Claire Gardent, 81–106. Paris: Hermès.

Mari, Alda. 2005b. Intensional and epistemic wholes. In *The compositionality of meaning and content*, eds. Markus Werning, Edouard Machery, and Gerhard Schurz. Frankfurt: Ontos Verlag.

Mari, Alda. 2009a. Disambiguating the Italian future. In *Generative Lexicon*, 209–216.

Mari, Alda. 2009b. The future: How to derive the temporal interpretation. In *JSM 2009*, Paris: University Paris-Diderot.

Mari, Alda. 2009c. Future, judges and normalcy conditions. *Selected talk at Chronos 10*, Austin, Texas. Available at https://halshs.archives-ouvertes.fr/ijn_00354462/. Accessed 4 April 2017.

Mari, Alda. 2014. Each other, asymmetry and reasonable futures. *Journal of Semantics* 31(2): 209–261.

Mari, Alda. 2015a. *Modalités et Temps*. Bern: Peter Lang Ag.

Mari, Alda. 2015b. French future: Exploring the future ratification hypothesis. *Journal of French Language Studies* 26(3): 353–378.

Mari, Alda. 2016. Assertability conditions of epistemic (and fictional) attitudes and mood variation. *Semantics and Linguistic Theory (SALT)* 26: 61–81.

Mari, Alda. forthcoming-a. Actuality entailments: When the modality is in the presupposition. In *Lecture notes in computer science*, Dordrecht: Springer.

Mari, Alda. forthcoming-b. The French future: Evidentiality and incremental information. In *Empirical approaches to evidentiality*, eds. Ad Foolen, Helen de Hoop, and Gijs Mulder. Amsterdam: John Benjamins.

Markopoulos, Theodore. 2009. *The future in Greek: From ancient to medieval*. Oxford: Oxford University Press.

de Marneffe, Marie-Catherine, Christopher Manning, and Christopher Potts. 2012. Did it happen? The pragmatic complexity of veridicality assessment. *Computational Linguistics* 38: 300–333.

Matthewson, Lisa. 2012. On the (non)-future orientation of modals. In *Sinn und Bedeutung*, Vol. 16, 431–446.

MacFarlane, John. 2005. Future contingents and relative truth. *The Philosophical Quarterly* 53: 321–336.

MacFarlane, John. 2014. *Assessment sensitivity: Relative truth and its applications*. Oxford: Oxford University Press.

McCawley, James D. 1988. *The syntactic phenomena of English*. Chicago: University of Chicago Press.

Montague, Richard. 1969. On the nature of certain philosophical entities. *Monist* 53: 161–194.

Partee, Barbara. 1984. Nominal and temporal anaphora. *Linguistics and Philosophy* 7: 243–286.

Palmer, Frank. 1987. *Mood and modality*. Cambridge: Cambridge University Press.

Papafragou, Anna. 2006. Epistemic modality and truth conditions. *Lingua* 116: 1688–1702.

Pietrandrea, Paola. 2005. *Epistemic modality: Functional properties and the Italian system*. Amsterdam: Benjamins.

Philippaki-Warburton, Irene. 1998. Functional categories and Modern Greek syntax. *The Linguistic Review* 15: 159–186.

Portner, Paul. 1998. The progressive in modal semantics. *Language* 74(4): 760–787.

Portner, Paul. 2009. *Modality*. Oxford: Oxford University Press.

Portner, Paul, and Aynat Rubinstein. 2012. Mood and contextual commitment. In *Semantics and Linguistic Theory (SALT)* 22, 461–487.

Prior, Arthur. 1967. *Time and modality*. Oxford: Oxford University Press.

Rocci, Andrea. 2000. L'interprétation épistémique du futur en Italien et en Français: une analyse procédurale. *Cahiers de Linguistique Française* 22: 241–274.

Roussou, Anna. 2000. On the left periphery; modal particles and complementizers. *Journal of Greek Linguistics* 1: 63–93.

de Saussure, Louis, and Patrick Morency. 2011. A cognitive-pragmatic view of the French epistemic future. *Journal of French Language Studies* 22: 207–223.

Smith, Carlota. 1991. *The parameter of aspect*. Dordrecht: Kluwer.

Smirnova, Anastasia. 2013. Evidentiality in Bulgarian. *Journal of Semantics* 30(4): 1–74.

Squartini, Marco. 2004. Disentangling evidentiality and epistemic modality in Romance. *Lingua* 114: 873–895.

Stephenson, Tamina. 2007. Judge dependence, epistemic modals, and predicates of personal taste. *Linguistics and Philosophy* 30(4): 487–525.

de Swart, Henriëtte. 2007. A cross-linguistic discourse analysis of the perfect. *Journal of Pragmatics* 39: 2273–2307.

Tasmowski, Liliane, and Patrick Dendale. 1998. Must/will and doit/futur simple as epistemic modal markers. Semantic value and restrictions of use. In *English as a human language*, ed. John van der Auwera, 325–336. Munich: Lincom Europa.

Thomason, Richmond. 1984. Combination of tense and modality. In *Handbook of philosophical logic: Extensions of classical logic*, eds. Dov Gabbay and Franz Guenthner, 135–165. Dordrecht: Reidel.

Todd, Patrick. 2016. Future contingents are all false! On behalf of a Russellian open future. *Mind* 125(499): 775–798.

Tsangalidis, Anastasios. 1998. *Will and tha: A comparative study of the category future*. Thessaloniki: University Studio Press.

Veltman, Frank. 2006. Defaults in update semantics. *Journal of Philosophical Logic* 25: 221–261.

Verkuyl, Henk. 2011. Tense, aspect and temporal representation, 2nd edn. In *Handbook of Logic and Language*, eds. Johan van Benthem and Alice ter Meulen, 975–988. Amsterdam: Elsevier.

Zimmermann, Malte. 2011. Discourse particles. In *Semantics: An international handbook of meaning (HSK 33.2)*, eds. Claudia Maienborn, Klaus von Heusinger, and Paul Portner, 2011–2038. Berlin: de Gruyter.

Zwarts, Frans. 1995. Nonveridical contexts. *Linguistic Analysis* 25(3–4): 286–312.