The future in Greek and Italian: metaphysical and epistemic dimensions

Abstract

While the question of whether future morphemes in languages denote temporal or modal operators has been central in formal semantics, most analyses agree that such morphemes convey modality, and do not simply make reference to future times. The modality is often assumed to be purely metaphysical (e.g. Thomason 1984, Kaufmann, 2005). In this paper, we present novel data from Greek and Italian showing a systematic availability of purely epistemic readings with the future morphemes (FUT) alongside the predictive readings. We propose a fully Kratzerian account (following closely Portner 2009), and argue for a common semantic core. FUT is nonveridical in both cases: the modal space is partitioned into p and $\neg p$ worlds, and FUT universally quantifies over the Best p worlds established by the ordering sources, which are reasonability and knowledge relevant to the sentence (called the *future criterion*). With universal quantification over Best worlds an underlying bias is revealed towards those worlds; therefore in our analysis the future is both weak (nonveridical metaphysical and epistemic space) and strong, because of the bias. Our analysis enriches the metaphysical modality of the future with epistemic components, captures the common core of the predictive and epistemic FUT, and provides simple tools for dealing both with the novel facts of Greek and Italian, as well as apparent Moore paradoxical effects observed with future expressions and MUST.

Contents

1 Introduction: predictive and epistemic future

Whether apparent expressions of future in human language are best modeled as temporal or modal operators is a question that received considerable attention in linguistic semantics. Future markers typically have modal readings that do not entail future reference. Notice, for instance, English *will*:

(1) a. That will be the postman.
b. Ed will lay in bed all day reading trashy novels. (Huddleston 1995)
c. Oil will float on water. (Haegeman 1993)

In these and other well-known examples (see more in Palmer 1987, Tsangalidis 1998), *will* does not move the event time of the clause forward; rather, the sentences have purely modal reading: epistemic and law-like, as we see. As a consequence, *will* has been analyzed as a future marker that also encodes modality (e.g. Enç 1996, Copley 2002, Kaufmann 2005, Klecha 2013).[1] One finds modal (or at least partly modal) accounts for futures in languages besides English such as Italian (Bertinetto, 1979; Squartini, 2004; Pietrandrea 2005; Mari 2009), Greek (Tsangalidis 1998, Giannakidou 2012, Giannakidou and Mari, 2013a, to appear), Dutch (Broekhuis and Verkuyl, 2014) among others. There is, in other words, more or less consensus in the literature that modality is inextricably involved in the semantics of the future, and the major question is how to exactly model the modality in order to provide appropriate truth conditions that can capture both the future as well as the non-predictive use of future expressions.

In this paper, we study the Greek and Italian future morphemes. Data from these languages, though relatively well known in mostly descriptive and typological works in Greek and Italian (Rocci, 2001; Squartini, 2004; Pietrandrea, 2005, Mari, 2009,2010; Giannakidou and Mari, 2013a, Tsangalidis 1998, Chiou 2012), are not very well known or widely discussed in the formal semantics literature, in contrast to English. Unlike *will*, which is a modal verb, the future markers (which we call FUT in this paper) in Greek and Italian are a bound morpheme (Italian) and a particle (Greek). They admit a purely epistemic reading, and this use is quite widespread. We will refer to this as the *epistemic* future. Epistemic future recruits the imperfective aspect (2-a), as we see in Greek, and the progressive in Italian (2-b), non-past statives (3) or past (4-b) below FUT:

(2) a. I Ariadne tha troi tora.
the Ariadne FUT eat.imperf.non-past3sg now
'Ariadne must be eating now'
b. Giacomo ora starà mangiando.
Giacomo now FUT.be.3sg eating.
'Giacomo must be eating now'

(3) a. I Ariadne tha ine arrosti (ji'afto dhen ine edo).
the Ariadne FUT be.3sg.nonpast sick (for-this not is here)
'Giovanni must/#will be sick (that's why she's not here).'

[1] Even in an analysis such as Kissine 2008, which purports to be purely temporal, *will* is embedded under an external epistemic modal triggered by the context whenever *will* is present.

b. Giovanni sarà malato.
Giovanni FUT-be.3sg sick.
'Giovanni must/#will be sick (that's why he's not here).'

(4) a. I Ariadne tha itan arrosti xthes (ji'afto dhen irthe sto
the Ariadne FUT be.past.3sg sick yesterday (for-this not came.3sg to-the
meeting).
meeting.
'Ariadne must/#will have been sick yesterday (that's why she didn't come to the meeting).'

b. Giovanni sarà stato malato ieri.
Giovanni FUT.be.3sg been sick yesterday.
'Giovanni must/#will have been sick yesterday (that why he didn't come to the meeting).'

(5) a. I Ariadne tha milise xthes.
the Ariadne FUT talk.past.3sg yesterday.
'Ariadne must have spoken yesterday.'

b. Gianni avrà parlato ieri.
Gianni have.fut.3sg spoken yesterday.
'Gianni must have spoken yesterday.'

The epistemic future of Greek and Italian is not identical to modal *will* in (1), and in the translation we use *must* as the best paraphrase, as *will* appears to be problematic as a purely epistemic modal.[2] The past sentences contain the adverb *yesterday* which makes it clear that the reading is not about the future. The reading we get is, to all intends and purposes, equivalent to epistemic *must*, and it is fully productive.

The purely epistemic reading is also found with Dutch (Broekhuis and Verkuyl 2014, Giannakidou 2014), and German future. The Dutch (due to Jack Hoeksema, reported in Giannakidou 2014) and German (from Lederer 1969) examples below give an illustration:

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

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

The Dutch future modal *zullen* and the German *werden* pattern with Greek and Italian FUT, allowing a purely epistemic reading, and unlike *will* which, with embedded past, tends to force future shifting and is therefore incompatible with past adverbials. Lederer 1969 states that in such use

[2]It must also be noted, however, that there is considerable variability in judgements among native English speakers, and some accept purely epistemic readings of *will*, as in the Greek and Italian cases above. We have also encountered speakers that accept epistemic *will* with past adverbs. It remains true, however, that although the Greek and Italian epistemic futures are unexceptional and widely attested, purely epistemic *will* is harder to find, and its existence has been contested in the literature (see e.g. Copley 2002). Another relevant fact is that in English there is competition between *will* and *must* but in Greek and Italian, MUST equivalents can co-occur with FUT (Giannakidou 2012, Giannakidou and Mari 2013). We present some of these data later, and revisit the competition in the conclusion.

the future auxiliary expresses "a probability or likelihood which took place entirely in the past" (Lederer1969: 98), and similarly such "probability or likelihood" readings also arise in the present. The wealth of examples given in Lederer are very similar to examples found in the descriptive literature on Greek and Italian. Broekhuis and Verkuyl, in turn, argue for a purely epistemic analysis of *zullen*.[3] Given how extensive the epistemic use of FUT is crosslingusitically, the question of whether FUT in Greek, Italian, Dutch and German is a temporal or modal operator receives a straightforward answer: FUT cannot be a just temporal operator in these languages, since it receives systematically purely epistemic readings. In English, *will* can't be purely temporal either, since *will* also exhibits modal readings.[4] Moreover, the systematic association of FUT expressions with epistemic modality in particular seems to suggest that the notional category 'future' must contain somehow an epistemic component.

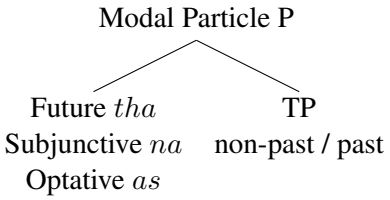
The 'true' future, predictive reading of FUT arises with future adverbs and an embedded perfective non-past form, and is illustrated in (8):

(8) a. Tha vrexi avrio. (Greek)
FUT rain.perf.nonpast.3sg tomorrow.

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

The perfective non-past is a forward shifting form— and this seems to support Condoravdi's correlation of the eventive vs. stative distinction and forward-shifting (see section 3). The Greek structure is particularly revealing, as it allows us to see the distinct contributions of lower tense and modality. In Greek, the particle *tha* appears external to the tensed verb (like the future modal in English), and takes the tensed verb as its complement; therefore, the future morpheme FUT appears in a position separate from the tense, and in this position we may also find (though not concurrently) other modal particles such as the subjunctive and the optative (Giannakidou 2009).

(9)



We assume a similar abstract structure for Italian, and we come back to the syntax-semantics in section 3. For now, it becomes clear that in Greek at least, temporal and modal information are dissociated, and FUT aligns with modal particles rather than tenses. In the present paper, we focus mostly on the predictive reading. Our goal is to provide a new design for the predictive modal FUT that integrates an epistemic ordering source, in addition to a normality ordering source. Specifically, we ask the following questions:

[3] Another relevant fact here is that the canonical form for prediction in Dutch and German is the present form, which Broekhuis and Verkuyl analyze as denoting a forward looking interval (an analysis that we ascribe later to the Greek and Italian non-past (section 3)). The use of present in lieu of future is an important systemic contrast with English, but another similarity with Greek and Italian which also allow unremarkably the use of present in lieu of future; see more in Giannakidou 2014.

[4] See also Tasmowski and Dendale (1998) for French.

1. What are the truth conditions of the predictive reading of the future?
2. What is the common core in the epistemic and the predictive reading?

Our proposal, in a nutshell, is the following. FUT p conveys a prediction the speaker makes about an event that hasn't happened yet. FUT is therefore non-factual and nonveridical (Giannakidou 1998, 1999, 2013a, 2014; Zwarts 1995). The FUT modal is a universal modal combining with a metaphysical modal base (following usual assumptions). We add two ordering sources: the *future criterion*, which includes knowledge of the speaker, and reasonability (following Portner, 1998; Mari, 2013). We have a metaphysical modal base from which 'normal worlds' *and* worlds in which facts known by the speaker are true, are carved out. The two ordering sources produce a nonveridical, partitioned modal space, with a set of worlds that rank as Best (à la Portner, 2009). These are worlds in which the prejacent p is true. The actual world cannot be known at the time of the prediction to belong to the Best worlds (as the actual world to come does not exist yet). But universal quantification over this set produces *projected truth* in the Best-set, and this in turns produces bias towards p, since Best-worlds are those in which p is true.

In its epistemic use, FUT quantifies over an epistemic modal base producing the epistemic reading, akin to epistemic MUST. Reasonability is an ordering source also in this case, a function that operates on the modal base and returns a subset of worlds, the Best worlds. FUT universally quantifies over this set, while the ordering source does not guarantee that the actual world is in the Best worlds. As in the predictive reading, the actual world cannot be known at the time of the conjecture to belong to the Best worlds. But universal quantification over this set produces *projected truth* in the Best-set, and this in turns produces bias towards p, since Best-worlds are those in which p is true. The epistemic reading of FUT also has an evidential component similar to MUST, discussed in Giannakidou and Mari (to appear), and which we will not address here.

We discuss, finally, a number of new sentences indicating a Moore-like effect with FUT and MUST, and suggest that they reveal informational, not veridicality conflict. We appeal to the simple fact that nonveridical spaces with ordering sources convey more information than nonveridical spaces without ordering sources, and are therefore informationally stronger.

The discussion proceeds as follows. We discuss the predictive use of future in section 2; we then present the syntax-semantic interface in section 3 and our analysis of the epistemic reading in section 4. We discuss Moore's paradoxical sentences in section 5. Section 6 concludes.

2 Predictive future

The starting point of discussions of the future is often Aristotle's famous sea battle examples (*De Interpretatione*, Book IX)[5]. A major goal of Aristotle is to discuss the thesis that, of every contradiction, one member must be true and the other false (the 'Law of the Excluded Middle'). Regarding future sentences, Aristotle posits that their truth or falsity will, in time, be fully determined by how things will turn out: there will either be or not be a sea battle. Aristotle also acknowledges that, at

[5]It would obviously be an impossible enterprise to do justice to the vast philosophical literature on this topic, which has seen a great variety of solutions. We focus here on the contemporary analysis of natural language, addressing the difficult question of how, across languages, the problem of future contingents is solved.

present (i.e., at the speech time), it is not known, in the sense that a past sentence can be known, that there will be a sea battle tomorrow.

In recent literature, the problem of the indeterminacy has been spelled out in two different manners. On one view, the future sentences, at the utterance time, are *objectively nonveridical* (Giannakidou 1997, 1998), or metaphysically unsettled (Thomason, 1984; Kaufman et al 2006)—objective nonveridicality and metaphysical unsettledness being the same thing. The future in this view is non-deterministic (Giannakidou and Zwarts 1999). On the second, deterministic view, there is no unsettledness, just one future but we lack knowledge of it (Kissine, 2008).

2.1 Branching times, ordering sources

The interpretation of future sentences involves indeterminacy, as mentioned, and while the question of future contingents underlies any possible theory of future, it seems evident that languages may construct future in different manners and solve the puzzle in different ways.

There is a set of parameters emerging from the current literature. The future indeterminacy can be epistemic, or metaphysical if the future is truly open. Both solutions have been explored in relation with natural language semantics. Starting with the latter, branching time (Thomason, 1984; McFarlane, 2003; see also van Fraassen, 1966) is the most widely used theory to talk about an open future. Thomason himself provides a supervaluationist theory of the future (for a recent use of the supervaluationist view, see Del Prete, 2011). On the assumption of the existence of a fixed past (deterministic past), present and an open future, a future sentence is true iff 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 in all branches opening up at the time of the utterance there is a time at which p is false.

(10) At the utterance time t_u:
(i) FUT(p)) = 1 iff $\forall w' \in \text{Fut}(t_u)$: $\exists t' \in [t_u, \infty) \wedge p(w', t')$, i.e.
for all worlds there is a time at which p is true.
(ii) FUT(p)) = 0 iff $\forall w' \in \text{Fut}(t_u)$: $\exists t' \in [t_u, \infty) \wedge \neg p(w', t')$, i.e.
for all worlds 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 further asks the question of how we can be so certain when we talk about the future while the future is open, and initiates a discussion of whether *all* branches are p or $\neg p$.[6] We will consider Copley's account later, given that ours builds on partitioning of the modal base.

Quantification over p metaphysical branches allows assigning truth conditions to future sentences at the time of the utterance; and identifying within the metaphysical modal base a subspace of worlds where p comes out true is a premise that we will adopt. Crucial for our argument is the idea that, once ordering sources are added, the space is partitioned into p and not p (nonveridicality), and one can no longer guarantee the actual world to come will be in the p-space. One can only specify what the actual world to come must be like in order to be a p world; but $\neg p$ branches are out there too, and the actual world to come can evolve into one of these.

Before we proceed with our analysis of the predictive future, we first set the stage by introducing the notion of (non)veridicality.

[6]This idea is also known as 'homogeneity' (see von Fintel, 1997).

2.2 Veridicality and Nonveridicality

The term *veridicality* has been used in formal semantics in three ways. Montague 1969 uses it first to characterize sentences with direct perception verbs such as *see* (see Giannakidou 2013 for a formal connection between truth and existence, especially as it reveals itself in relative clauses and with progressives). Authors have also used other labels, e.g. factivity, factuality to refer to veridicality (Kartunnen 1971, Kartunnen and Zaenen 2005, Kiparksy and Kiparsky 1970), as well as actuality (Bhatt 2006, Hacquard 2010). Veridicality in this second use is understood objectively as truth in the actual world: a sentence is veridical if the proposition it denotes is true in the actual world (Zwarts 1995, Giannakidou 1997, Egré 2008). Veridicality is thus defined objectively as a property of expressions such that if an expression entails the truth of its embedded sentence it is veridical. This was the original conception of Zwarts (1995), and Giannakidou (1997, 1998):

(11) Def 1. *Objective veridicality*.
A function F is objectively veridical iff Fp entails p; otherwise F is objectively nonveridical.

Functions that have veridicality and nonveridicality, as can be seen, are propositional functions (but see Bernardi 2001 for type-flexible definitions). A veridical or nonveridical function F takes the denotation of a sentence, i.e. a proposition p, as an argument and creates a veridical or nonveridical proposition. Sentences that denote veridical and nonveridical propositions can then also be called veridical and nonveridical:

(12) Def. 2. *Objective (non)veridicality of sentences.*
   a. A sentence that denotes a proposition of the form Fp, where F is objectively veridical, is an objectively veridical sentence.
   b. A sentence that denotes a proposition of the form Fp, where F is objectively nonveridical, is an objectively nonveridical sentence.

Veridicality objectively is equivalent to the traditional *realis*: a veridical sentence is true in the actual world, i.e. it refers to a something that is actually true, i.e. a fact. Any sentence that does not refer to a fact is nonveridical. Unmodalized, non-negated, sentences in the simple past or present (which is the present progressive in English) are objectively veridical:

(13) Nicholas brought dessert.

(14) Nicholas is washing the dishes.

The sentences here refer to events that happened in the past or are happening right now; in the present, the speaker actually may be witnessing the event unfolding. PAST is an objectively veridical function. PASTp entails p. The same for PRES p. Veridical sentences are therefore *actually* true— and the actuality entailments discussed in the literature (Bhatt 2006, Hacquard 2010) are veridicality entailments. The future sentence *Nicholas will wash the dishes*, on the other hand, is objectively nonveridical, i.e. it does not entail actual truth. All prospective domains (future, subjunctive, optative, bouletic and deontic domains), and traditional $irrealis$ domains, lack veridicality (see e.g. Condoravdi, 2002; Copley, 2002; Kaufmann, 2005; Giannakidou 1998,1999, 2014). Modal statements as a class are nonveridical (Giannakidou 1997, 1998, 2013), and likewise Beaver and Frazee 2011, crediting Giannakidou, present nonveridicality as a defining property of the cate-

gory modality. Consider:

(15) Nicholas might/must bring dessert.

(16) Nicholas might/must have brought dessert.

Nicholas bringing dessert is not, and cannot, be an actual fact under a modal. Notice that temporal orientation doesn't matter. Possibility modals are simply not factual and therefore nonveridical. Logically, *possibly* p does not entail p. And *must* is also non veridical, since $must\ p$ does not entail that p is actually true, i.e. in the actual world. MUST does not validate the veridicality principle T that is valid for knowledge and aleithic modality (see Giannakidou 1998, 1999). As de Marneffe et al. 2012 put it: 'declaratives like *Ariadne left* convey firm speaker commitment, whereas qualified variants with modal verbs or embedded sentences imbue the sentence with uncertainty' (deMarneffe 2012: 102). Similarly, Trnavac and Taboada 2012 use modals as nonveridical markers of uncertainty.

This notion of objective veridicality is equivalent to actuality, as noted, and in the veridical sentence, there is no choice for the speaker between p and $\neg p$, since the actual world is a p world (if the sentence is true). Now, from the perspective of assertion, apart from this objective dimension, veridicality is often discussed in the context of what is called in the literature *commitment* of the speaker. The speaker is said to be "fully committed" to the truth of an unmodalized sentence in the present or simple past, but is not fully committed in the case of a modal sentence. Therefore, when we talk about the truth of a sentence, we talk about it in two ways: objectively, by appealing to what is the case in the actual world, and subjectively by appealing to speaker's commitment to the truth of the sentence. Giannakidou tries to capture the connection between veridicality and speaker commitment, by making the veridicality judgement relative to *individual anchors*. The truth of a sentence is now anchored to the individual asserting it. In main clauses the anchor is by default the speaker.[7] Giannakidou defined *models of evaluation* to describe the information states of anchors. These models are sets of worlds, relative to i, corresponding to what i believes or knows.[8] We call these models epistemic states in our definition below:

(17) Def. 3. *Epistemic state of an individual anchor* i (Giannakidou 1999: (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.

Given the epistemic state, we identify (non)veridicality *subjectively*. Truth is defined not with respect to the actual world but with respect to the anchor's epistemic state:

(18) Def. 4 *Subjective veridicality*

[7]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 2010). The individual anchor is a parameter of evaluation similar to Lasersohn's (2005) *judge*. In embedded sentences, the main clause subject is also a potential anchor and this has repercussions for mood, as shown in Giannakidou's work.

[8]The difference between knowledge and belief is not so important for our purposes here, and in many other cases, e.g. for mood choice, it doesn't matter either—- as verbs of knowledge and belief both select the indicative in many languages. Belief makes a difference for an agent typically when it is contrasted with knowledge, i.e. when the agent is aware that she doesn't have enough information to support a proposition. In this case, we can say that we have semantic narrowing (Geurts and van Tiel 2013). In the case of the future, the speaker reasons with the whole body of information we call epistemic state, and there doesn't seem to be a decisive distinction between knowledge and belief.

A function F that takes a proposition p as its argument is subjectively veridical with respect to an epistemic state $M(i)$ iff $M(i) \subseteq p$.

From (18), it follows that $\forall w[w \in M(i) \rightarrow w \in \{w'|p(w')\}]$. As mentioned earlier, PAST is an objectively veridical function, i.e. PAST(p) entails p. PAST is also subjectively veridical: p is true in all worlds in the speaker's epistemic state. Subjectively veridical functions such as PAST or PRES impose homogenous epistemic states which are included in p.

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

If the speaker asserts *John won the race*, she must believe or know that John won the race, hence all worlds in M(speaker) are John-won-the race worlds: $M(\text{speaker}) \subseteq p$. The past sentence is therefore equivalent to *the speaker knows that p*, and the same holds for present. This is also useful when we think of evidential contrasts in e.g. languages that have so-called "indirect" evidentials, and which form minimal pairs with simple past or present. The simple past or present draws on "direct" evidence in the sense that it gives the more reliable, undisputed knowledge (see Giannakidou and Mari to appear for more discussion).

Subjective nonveridicality, on the other hand, comes with epistemic states that only intersect with p, and therefore contain $\neg p$ worlds:

(20) Def. 5. *Subjective nonveridicality*
A function F that takes a proposition p as its argument is subjectively nonveridical with respect to an epistemic state $M(i)$ iff $M(i) - p \neq \emptyset$.

From (20), it follows that $\exists w' \in M(i) : \neg p(w')$. Hence, a subjectively nonveridical function imposes non-homogeneity on the epistemic state, since there is at least one $non\ p$ world. Again, a subjectively (non)veridical function F creates a subjectively (non)veridical proposition, which characterizes a (non)veridical sentence:

(21) Def. 6. *Subjective (non)veridicality of sentences*
a. A sentence that denotes a proposition of the form Fp, where F is subjectively veridical, is a subjectively veridical sentence.
b. A sentence that denotes a proposition of the form Fp, where F is subjectively nonveridical, is a subjectively nonveridical sentence.

Modals and the FUT are objectively nonveridical, as mentioned earlier, but also subjectively: the modal bases (which are subsets of M(speaker) interact with p but are not included in it, and M(speaker) is also not included in p.

From the above it becomes clear that subjective veridicality can be extended to characterize the epistemic states themselves. A veridical epistemic state is a non-partitioned, homogenous epistemic state. A nonveridical epistemic state, on the other hand, is a space partitioned into p and $\neg p$ worlds.

(22) Def. 7 *Veridical, nonveridical epistemic states*
a. An epistemic state (a set of worlds) M(i) relative to an individual anchor i is *veridical* with respect to a proposition p iff all worlds in M(i) are p-worlds. (*full commitment*).

b. If there is at least one world in M(i) that is a $\neg p$ world, then M(i) is nonveridical (*weakened commitment, uncertainty*).
c. If all worlds in M(i) are $\neg p$ worlds, then M(i) is antiveridical (*counter-commitment*).

A veridical epistemic state is a non-partitioned, homogenous epistemic state, a state of full commitment. A knowledge state is veridical; as we said, umodalized sentences in the past reveal veridical states. A nonveridical state M(i), on the other hand, is defined as one that contains at least one $\neg p$ world. It is a non-homogenous, partitioned state; it allows uncertainty, and in this case we talk about *weakened* commitment. All epistemic modals convey weakened commitment, and states of indirect evidentials are also nonveridical (as discussed in Giannakidou and Mari 2014, to appear). Importantly, with modals, weakened commitment and nonveridicality arise because the modal base is ordered, and p is true only in the Best worlds conforming to the ordering source (Portner 2009). Modal ordering create nonveridical spaces generally.

When all the worlds are $\neg p$, the state is *antiveridical*, as with negative and counterfactual assertions, which express *counter-commitment* of the anchor. Antiveridicality characterizes generally non-assertion, i.e. optative and imperative sentences, since at the issuing of optative and imperative p clearly doesn't hold. Counter-commitment and weakened commitment are non-commitment to p, though only weakened commitment operators carry uncertainty.

From the epistemic domain, we can move to generalize veridicality and nonveridicality to all kinds of modal spaces (sets of worlds), including various kinds of modal bases. Veridicality and nonveridicality are now properties of modal spaces:

(23) Def. 8. *Veridical, nonveridical modal spaces*
a. A set of worlds M is *veridical* with respect to a proposition p iff all worlds in M are p-worlds. (Homogeneity).
b. A set of worlds M is *non veridical* with respect to a proposition p iff there is at least one world in M that is a $\neg p$ world. (Non homogeneity).
c. A set of worlds M is *antiveridical* with respect to a proposition p iff M and p are disjoint.

Veridical spaces are homogenous whereas non veridical spaces are non-homogenous (a fact emphasized in Giannakidou 2013b). All modal bases are non veridical spaces in this sense, since they are partitioned by their ordering in the Kratzerian semantics (see also Portner 2009, and Condoravdi's 2002 *diversity* condition on modals). Likewise, bouletic and deontic domains are nonveridical since they are also ordered. Ordering (Kratzer, 1981/1991) creates a partition, therefore necessarily a nonveridical modal space. (Anti-veridical states, on the other hand, are homogenous. A typical such example is the model of the speaker when interpreting a negative sentence.).

Given nonveridical spaces, we must distinguish the cases in which we have ordering sources (Kratzer, 1981,1991; Portner, 2009) from those in which we do not. Ordering sources characterize stronger modals such as *must*. With Portner we define ordering sources and Best worlds.

(24) Def. 9 *Ordering of worlds* - Portner, 2009, p.65.
For any set of propositions X and any worlds $w, v : w \leqslant_X v$ iff for all $p \in X$, if $v \in p$, then $w \in p$.

(25) Def. 10. Best worlds as per X. Best$_X$: $\{w' : \forall q \in X(w' \in q)\}$

Now we define *Support Set*:

(26) Def. 11. *Support Set of a proposition* p. In a nonveridical modal space M, the support set $W \subset M$ of a proposition p is the non-singleton set of worlds that rank as Best, and is such that all worlds w' in W are p-worlds.

Given the notion of support set, we can now define projected truth with respect to that set.

(27) Def. 12. *Actual truth.* p is actually true iff p is true in the actual world.

(28) Def. 13. *Projected truth.* p is *projectively* true iff p is true in all the worlds of the support set W: $W \subseteq p$.

In other words, a nonveridical modal space M supports a proposition if the there is a support set W for the proposition in M. Since the support set is the set of Best worlds, this structure reveals a *bias* towards Best worlds. Modals that come with support sets, such as MUST and FUT, as we will argue, are 'stronger' than possibility modals, while at the same time raining nonveridical. Strength does not mean that the modals entail actual truth (veridicality).

As a result, there are two kinds of non veridical spaces: those that convey bias, and the weaker modals that convey nonveridical equilibrium between p and $\neg p$ (Giannakidou 2013):

(29) Def 14. *Nonveridical equilibrium* (Giannakidou 2013b). An epistemic state M is in nonveridical equilibrium iff M is partitioned into p and $\neg p$, and there are no Best worlds.

A nonveridical state with equilibrium reveals no preference of the speaker. Take for example *It might rain tomorrow*. This is a possibility statement and there is no ordering that would create a support set for the proposition 'it rains tomorrow'. Ordering sources add information restricting sets of possibilities and privileging one subset of the modal base over its complement. This reveals a bias towards the restricted set and disruption of equilibrium.

As we show in section 5, bias allows us to better understand the so-called strength of universal modals (Giannakidou and Mari to appear), including, as we will argue, the FUT. We are ready now to proceed to the analysis of the predictive reading.

2.3 The notion of reasonability

The notion of reasonability has been introduced by Landman (1992), in response to Dowty (1979) and in contrast with the notion of *inertia*. This notion has been subsequently adopted in a number of works— by Portner (1998), who treats it as an ordering source, and Mari (2013), who treats it as a domain restriction over the common ground. We begin by presenting the analysis of reasonability in Mari (2013), a framework that adds reasonability to the standard branching time framework (Thomason, 1984; Condoravdi, 2002; Kaufmann et al. 2006).

Specifically, Mari (*ibid.*) uses 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 $w' \simeq_t w$ (we use the symbols $\prec$ and $\succ$ for temporal precedence and succession, respectively). 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 an equivalence class comprising worlds with identical pasts but different futures.

Let w_0 be the actual world.

For any time $t \in T$, we define the *common ground* $cg(t)$ as the set of worlds that are identical to the actual world w_0 at least up to and including t. Worlds identical up to and including t are called *historical alternatives* (Thomason, 1984).

(30) $cg(t) := \{w \mid w \simeq_t w_0\}$

The common ground included the worlds with common history. In the case depicted in Figure 1, the common ground at t is the set given in (31).

(31) $cg(t) = \{w_1, w_2, w_0, w_3, w_4\}$

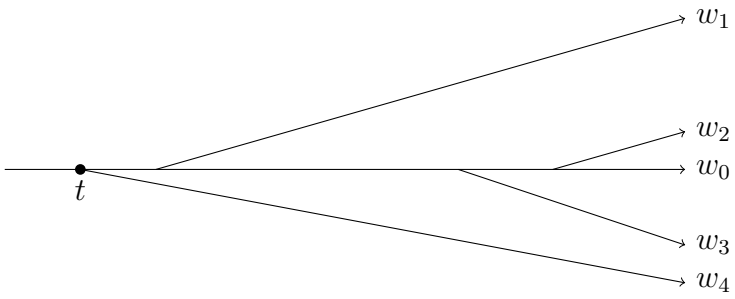


Figure 1: *cg(t)* Mari, 2013, p.17, fig. 3

So defined, for any time t, the common ground includes any world branching from the actual world at a time equal to or after t, including those worlds that are highly different in their causal laws from the actual world as well as those worlds in which current causal and social laws malfunction.

Let us now introduce the notion of *reasonable future*.

(32) a. Gianni arriverà alle 5.
John arrive.fut.3sg at 5
'Gianni will arrive at five.'

Mari 2013 defines reasonable futures as those that strange things do not happen and causal/social laws and behaviors continue uninterrupted. For any $t \in T$,

(33) ReasFut(t) := $\{w_i \in cg(t) \mid w_i$ is such that the set of rules fixed at t continue to hold in $w_i\}$

Reasonable futures are different from inertia words, as we clarify soon. To understand reasonability, let us assume that w_3 in Figure 1 is a world in which causal and social laws malfunction. The set of reasonable futures defined at time t does not include w_3. In the case depicted in Figure 2, the set of reasonable futures fixed at t is given in (34), excluding the malfunctioning world w_3.

(34) ReasFut(t) $= \{w_1, w_2, w_0, w_4\}$

Let us consider the utterance time t_u. At t_u, one can state what the reasonable futures of time t_u are; however, one cannot state whether the actual-world-to-come belongs to the set of reasonable

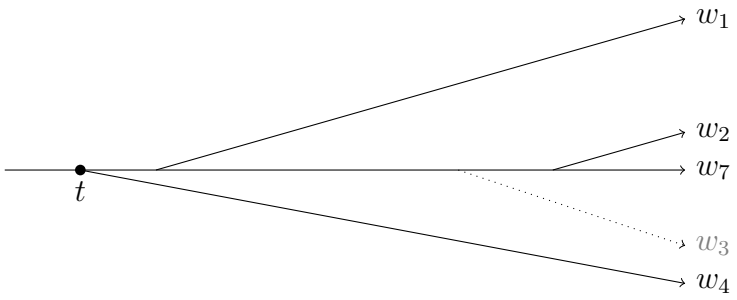


Figure 2: Reasonable Future Worlds (ReasFut) Mari, 2013:18, fig 4

possibilities, since the actual-world-to come does not exist yet at t_u.

Let $t_u \prec t' \prec t''$ be three times in the set T, with t_u being the time of the utterance. A set of reasonable worlds is determined at t_u, which for (32), we assume, is the time at which Gianni gets into the car. Given the rules that govern traffic, we consider that those worlds in which no accidents occur are reasonable, whereas those in which accidents occur are not reasonable. Accidents are typically a disruption of rules of traffic (they happen because someone has violated a rule - high speed, crossed a continuous line, passed at a red light, etc.). Consider the world w_0 at t'. At this time, no car accidents have occurred (see Figure 3).

The actual world w_0 coincides with world w_1 until at least t' (the '=' sign in Figure 3 and 4 is to be read 'coincides with'). The branch that represents the actual world is in bold in the two figures that follow.

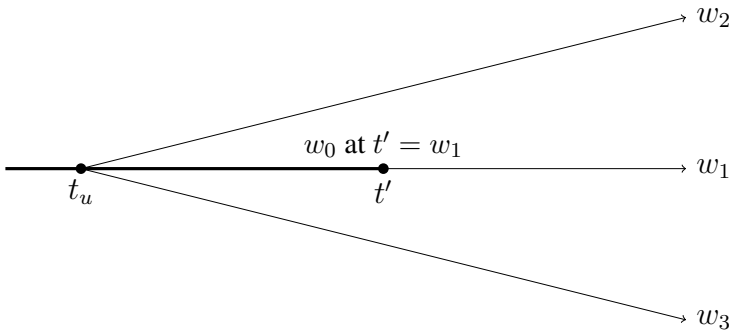


Figure 3: The actual world at t' coincides with a reasonable future determined at t (Mari, 2013:19, fig.5)

Now imagine that between t' and t'', a car accident occurs in w_0. A lady has bumped into Gianni, because she was looking at her phone while driving. From that moment on, the actual world follows a branch w_4, which is not part of the reasonable futures of t_u (see Figure 4, where w_4 is marked by a dotted line).

Crucially, worlds in which someone bumps into someone else's car because she was looking at her phone *are inertia worlds* à la Dowty (1979) but they are *not* reasonable futures (à la Landman, 1992, Portner, 1998, Mari, 2013). Inertia worlds are those worlds in which all the facts holding

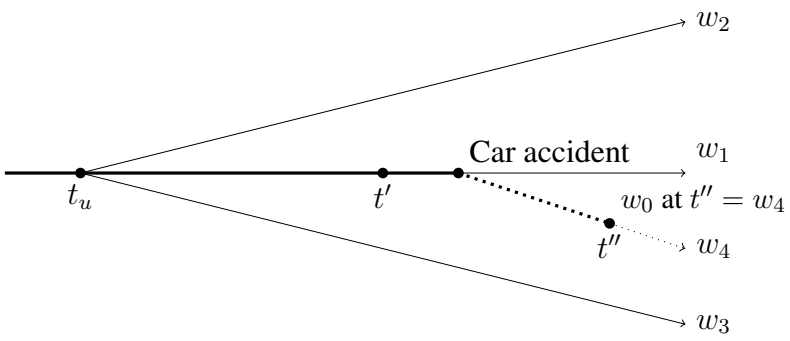


Figure 4: The actual world at t'' does not coincide with a reasonable future determined at time t (see Mari, 2013:19 fig.6)

at the time of the utterance continue normally (including the driver looking at her phone). The car accident is part of the inertia worlds, but not of the reasonable futures. Worlds in which a car accident happens because someone was looking at her phone, are worlds in which rules are disrupted (as it is forbidden to look at one's phone while driving), and are thus not reasonable futures *but they are* inertia futures.

The discussion about the differences between inertia and reasonability goes back to Landman, who shows that Dowty's inertia runs into problems:

(35) Mary was crossing the street, when the truck hit her.

On Dowty's view, the event of Mary crossing the street continues in worlds that are most compatible with the actual world at 'now'. In those worlds there are both Mary and the truck approaching. As Landman points out, Mary being hit by the truck is already part of the normal course of events. Only a miracle could save Mary even in an *inertia* world. Landman (*ibid.*) uses this example to justify a theory for the progressive that considers what is internal to an event for determining reasonable continuations. The progressive considers those non-actual worlds in which a given event (e.g., Mary crossing the street) continues (in virtue of what this event is, i.e., in this case, an event of crossing the street such that the person crossing the street reaches the other side) if interrupted in the actual world.

In Mari (2013), ReasFut applies directly to the common ground. As we show in the next section, for future sentences, we need to further restrict the domain of quantification by appealing to an epistemic ordering source. We will proceed by showing why this is necessary, and then define reasonability as a second, normativity ordering source.[9] Importantly, we also restate reasonability adopting Landman (1992) and Portner (1998), so that reasonability amounts to non-interruption of the event described in the prejacent (see discussion below and (44) in particular).

[9]Note, although it should be clear, the notion of reasonability does not mean in any way that we can only make predictions about 'reasonable' facts, in a commonsense way. For instance we can say *John will jump from this tower without a parachute* and talk about crazy enterprises. The notion of reasonability just means 'absence of disruptions in the course of event that is described in the prejacent'

2.4 Knowledge as ordering source: the future criterion

What a speaker knows or believes at the time of prediction plays a key role in the future sentence. This becomes evident in the fact that two different individual anchors can make different predictions, given their current epistemic states.[10] Consider the case in which Mary and Susan are waiting for Gianni. Mary utters (36):

(36) Gianni arriverà alle 4.
John arrive.3sg.fut at 4.
'John will arrive at 4.'

In making the prediction, Mary is using her knowledge. Her epistemic state M_{Mary} includes 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. This is not a fact, but a generalization based on experience, and it is of course refutable. But when she makes a prediction about Gianni's arrival time, Mary carves out the space of alternatives into those that are consistent with what she knows, and those that are not. Is she using her entire knowledge? Her entire epistemic state? Probably not, as she clearly knows stuff that doesn't have to do with the Gianni's arrival. Mary uses a portion of her epistemic state that is relevant for the future sentence. We will call this set of propositions the *future criterion*, and use $\mathcal{E}$ to refer to it. Since $\mathcal{E}$ is a subset of M_{Mary}, it is also anchored to Mary. Mary's future criterion is thus the following set of propositions:

(37) 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'}

Crucially, the set above functions as an ordering source. Better worlds are those where the future criterion is met, i.e. worlds where as many of the propositions in the set above are true.

Now, Susan knows something more. Her future criterion includes the set Mary's does, but also the proposition that there is the marathon that day, and the rule of thumb that when there is a marathon, traffic is slow:

(38) 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 the marathon that day', 'when there is a marathon, traffic slows down'}

Given (38), Susan utters (39).

(39) Gianni arriverà alle 5.
John arrive.3sg.fut at 5.
'John will arrive at 5.'

[10] We are grateful to Fabrizio Cariani for discussion about this entire section.

Because Susan's ordering source contains the marathon information, her prediction about Gianni's arrival is for a later time. So, clearly what we know affects what we predict. The way we will model this is by saying that the future criterion, functioning as the ordering source, ranks as best those futures that are consistent with it. FUT then universally quantifies over these worlds.

We define now an ordering wrt the future criterion:

(40) Better with respect to future criterion $\mathcal{E}_i$.
For any set of propositions $\mathcal{E}_i$, where i is the individual anchor and any world w, w': $w \leqslant_{\mathcal{E}_i} w'$ iff for all $q \in \mathcal{E}_i$, if $w' \in q$, then $w \in q$.

The more propositions in the ordering source a world satisfies, the better it is. We then define the set Best, relatively to the ordering $\mathcal{E}$.

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

Let us return to (36). $\text{Best}_{\mathcal{E}_{Mary}}$ does not include w_2.

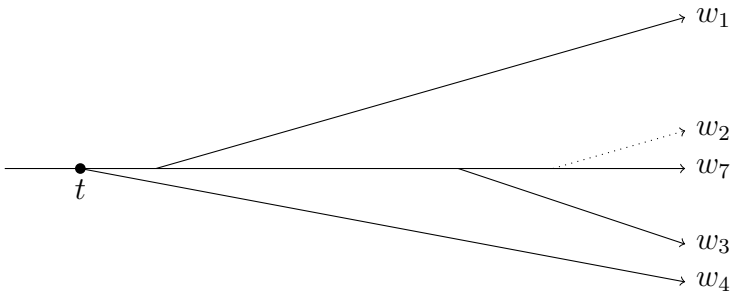


Figure 5: Futures in which the propositions considered by Mary are true after t_u

Are the propositions in $\mathcal{E}$ facts? As the set of worlds in $\text{Best}_{\mathcal{E}_i}$ is a subset of the common ground, that is to say a set of possible futures, these cannot be facts, as these worlds do not exist yet. These are *generalizations* based on past facts, rules of thumb and generalizations, and beliefs. So, the future criterion comprises generalizations based on knowledge, but it can also be doxastic (Portner 2009: 72).

But this is not all we need. When Mary makes the prediction that Gianni will arrive at 4, she is not considering worlds in which Gianni has no gas, the Lake invades the Lake Shore Drive, and Martians are stealing Gianni. She is thus considering only a *subset* of the $\text{Best}_{\mathcal{E}}$ worlds, the reasonable ones:

(42) Better reasonable worlds, given the future criterion $\mathcal{E}$. For any set of propositions $\mathcal{S} \subset \mathcal{E}_i$ and any world $w, w' : w \leqslant_{\mathcal{S}} w'$ iff for all $q \in \mathcal{S}$, if $w' \in q$, then $w \in q$.

(43) Best reasonable worlds as per $\mathcal{S}$ given the future criterion $\mathcal{E}_i$.
$\text{Best}_{\mathcal{S}\mathcal{E}i}$: $\{w' \in \text{Best}_{\mathcal{E}_i} : \forall q \in \mathcal{S}(w' \in q)\}$

So we now look at the $\text{Best}_{\mathcal{E}}i$ (those worlds in which the propositions constituting the future criterion are true) and also consider, among $\text{Best}_{\mathcal{E}_i}$ those worlds in which the event described by the

prejacent continued uninterrupted. In words, (43) can be restated as in (44).

(44) $\text{Best}_{\mathcal{S}\mathcal{E}i} = \{w' \in \text{Best}_{\mathcal{E}_i} : w'$ where the propositions in $\mathcal{E}_i$ are true and the event described by the prejacent continues uninterrupted.$\}$

Note that the modal base remains metaphysical. But now we have a set of reasonable worlds that are consistent with the anchors future criterion. Let us again return to example (36). Now $\text{Best}_{\mathcal{S}\mathcal{E}Mary}$ does not include w_3. In w_3 Gianni runs out of gas, and this possibility is not taken into account by Mary.

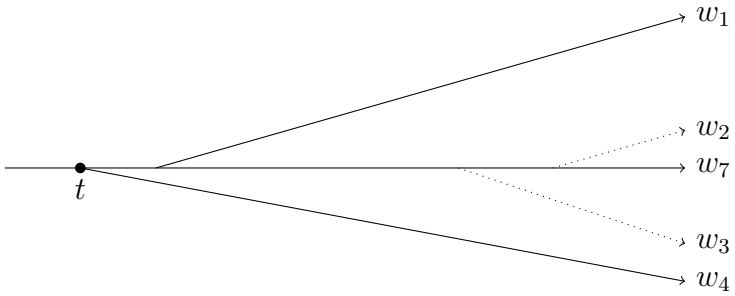


Figure 6: Futures in which the propositions considered by Mary are true after t_u

It is important to emphasize that *reasonability is not a notion that applies independently from the future criterion*. In the example (36), *Mary's reasonable worlds*, typically include those in which there is *no marathon*, the occurrence of a marathon would be a disruption of the course of the event of Gianni arriving. Instead, the worlds in which there is a marathon are reasonable given Susan's future criterion. We cannot thus define reasonability independently of the future criterion.

With these elements in place, we are now ready to provide the truth conditions for FUT with non-past.

(45) Truth conditions for predictive FUT.
At the utterance time t_u,
$[\![\text{FUT(NON-PAST (p))}]\!]^{\mathcal{S},\mathcal{E},i}$ is 1 iff
$\forall w' \in Best_{\mathcal{S}\mathcal{E}i}$: $\exists t' \in [t_u, \infty) \wedge p(w', t')$
p is true in all futures in $Best_{\mathcal{S}\mathcal{E}i}$, at a time that is in the right open interval starting at the time of the utterance.

Let us now comment on the metaphysical and epistemic nature of the modal space under consideration.

2.5 Metaphysical and epistemic uncertainty

Ordering sources, as we see, create a nonveridical space that supports p, i.e. p is true in the worlds in $Best_{\mathcal{S}\mathcal{E}i}$. In our view, this space is primarily metaphysical, and nonveridicality is objective. Note that even the future criterion acts as an ordering source in a metaphysical modal base, selecting those branches which are candidates for being the actual world to come and in which the facts known are true.

With Condoravdi's 2002, we also assume that metaphysical nonveridicality entails epistemic nonveridicality (in Condoravdi's words, metaphysical diversity entails epistemic diversity). The worlds in $Best_{\mathcal{S}^{\varepsilon i}}$ can be considered *qua* metaphysical alternatives. But since the future is not settled, they can also be considered *qua* epistemic alternatives, and in this case, they can be called 'expectations', echoing Veltman (1996). Veltman uses the notion of expectation and defines 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). The worlds in $m_{\langle \epsilon, s \rangle}$ are the Best worlds in s, from the point of view of the ordering. 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. In our account, alternatives in $Best_{\mathcal{S}^{\varepsilon i}}$ are metaphysical. These are possibilities out there, alternatives into which the actual world to come can develop. Expectedness as an epistemic notion is an ancillary one, that depends on the future not being settled and thus also epistemically nonveridical.[11]

Since epistemic uncertainty depends on metaphysical uncertainty, we claim that the alternatives on which FUT quantifies are metaphysical rather than epistemic. With this in mind, let us now return to the notion of projected truth, defined in section 2.2. We explained in section 2.3 that at the time of the utterance (which is the time of the prediction), we don't, and cannot, know whether the actual word will be in the support set, as the actual world does not exist yet. Recall also the displacement property of modals, i.e. their inability to make a claim about truth in the actual world (see also Portner, 2009). Our best guess, as Portner's puts it (Portner, 2009:100) is that the actual world will be in the set of Best worlds, but our knowledge at the time of the utterance only guarantees that it is in the modal base $cg(t_u)$. But even if we cannot know whether the actual world will be a p world, as we have explained in section 2.2, with universal quantification over a set of Best worlds, truth of p is projected onto the support set, in our case, $Best_{\mathcal{S}^{\varepsilon i}}$. This reveals that that anchor has bias towards these worlds.

This bias creates the flavor of so-called strength with FUT and universal epistemic modals generally (see Giannakidou and Mari 2013 for an early expression of this idea). Bias helps us explain the Moore paradoxical effect we observe with FUT in section 5. But before getting there, we want to offer a clear outline of the syntax-semantics (section 3), and of the epistemic reading (section 4). After our analysis is completed we will also offer brief comments on how it differs from Copley 2002.

[11] We have to mention that consideration of facts known by the speaker can sometimes lead to vacuous quantification, and renders the sentence false. Consider the scenario in which Mary is dead and I do not know it. Statement 11 is false in our framework, as there are no metaphysical branches in which I meet Mary, and which are continuations of the actual world. There are maybe unreasonable branches, in which Mary comes back to life. But, since FUT quantifies over reasonable branches, the sentence comes out false.
(i) Incontrerò Maria, domani.
'I will meet Mary, tomorrow.'

3 FUT and non-past: syntax-semantics

As we mentioned at the beginning, we assume a structure such as: FUT > non-past, following Giannakidou 2009, for both Greek and Italian. The non-past gives the temporal information, and FUT gives modality. As also mentioned, FUT can also be followed by past tense, in which case we only have the epistemic reading. Following Giannakidou, we will assume a node in the tree that introduces the utterance time (PRES). This is necessary for Greek because otherwise the form perfective nonpast is ungrammatical.

We won't go into the details of the assumptions we are adopting since they rely on earlier work. What is important is that the Greek FUT is *not* a mixed modal (*pace* Condoravdi 2002), it does not contain both temporal and modal information. In a recent paper, Matthewson 2012 expresses very similar ideas about Gitksan epistemic modals, namely that they are only modal operators while the temporal, prospective information, comes from lower prospective aspect. Matthewson's prospective aspect is what we call here, following Giannakidou 2009, non-past. Hence in that language too, modal and temporal information are dissociated.

Let us remind the reader that the node where FUT is hosted also hosts modal particles, e.g. the subjunctive and the optative as mentioned earlier:[12]

(46) Na/As kerdisi o Janis.
subjunctive/optative win.perf.nonpast.3sg the John.
'May John win/Let John win!'

These particles can also be followed by past tense:

(47) Na/As kerdize o Janis.
subjunctive/optative win.past.3sg the John.
'It would have been great if John won!'

As with FUT, (a) modal and temporal information are dissociated, and (b) the perfective nonpast (PNP) is responsible for the prospective, future orientation. We can thus generalize that structurally the subjunctive, optative, and future convey just modal information (see Giannakidou to appear for an analysis of optative and subjunctive as existential modals), and the prospective orientation comes from the lower tense plus aspect (perfective nonpast). Greek allows us to see the distinct functions very neatly, and we assume that the structure is in Italian abstractly the same as in Greek. In Matthweson't paper, as we mentioned, a similar distinction is reported for Gitskan.

Giannakidou 2009, 2014 applies Abusch's theory of WILL to non-past, and argues that nonpast (*not* FUT) is the substitution operator. Perfective nonpast cannot function as a present because of perfectivity, hence one could view this as the Greek counterpart of prospective aspect. It is assigned the denotation of the substitution operator, i.e. a prospective interval— but unlike WILL in Abusch's analysis, whose left boundary is a default PRES, the left boundary of the nonpast is undefined. It contains a dependent variable t.

(48) *Nonpast*).
$[\![\text{non-past}]\!] = \lambda P \lambda t \lambda w(P[t, \infty)(w))$ (adapted from Giannakidou 2009)

A dependent variable cannot remain free, but must be valued by some higher value (Giannakidou

[12] Subjunctive and optative also contain non-assertoric illocutionary force which we do not address here.

1998, 2011). According to Abusch (2004:39): "In the substitution operator, t is a bound variable that corresponds to the tense argument of WILL [which is n, coming from an implied higher PRES; clarification ours]. For a top-level occurrence of WILL, the effect is to substitute (n, ∞) for n". In Greek, PRES is not triggered by default but needs to be introduced syntactically: without the particle, the PNP is illicit (**Kerdisi o Janis*).

For (49) we give the following LF following Giannakidou 2009. Aspectual information applies to VP first, then tense, then FUT. FUT is actually decomposed into two structural positions, PRES— where t_u is introduced in the syntax— and FUT, where we find the semantics of modality. Meaning is represented explicitly at LF, and semantic composition is limited to function application, variable binding, and type raising. The types we are assuming, following Abusch and Giannakidou are: VP $\langle i, st\rangle$ (tenseless clause), IP $\langle st\rangle$ tensed clause, CP $\langle i, st\rangle$ complement clause.

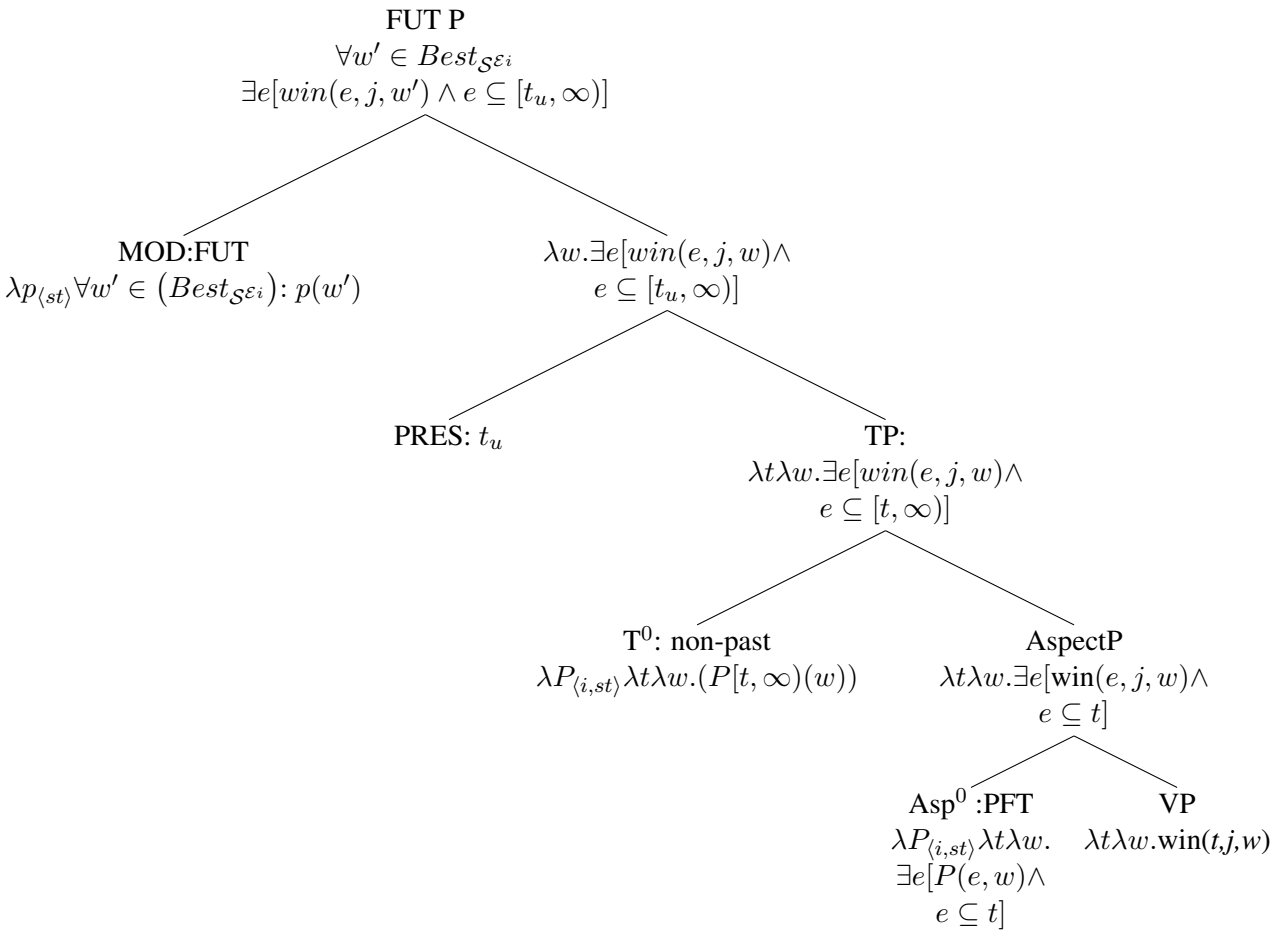
The lexical entry of FUT, based on our truth conditionals earlier is as follows:

(49) Lexical entry for FUT.
$[\![\text{FUT}]\!] = \lambda p \forall w' \in Best_{\mathcal{S}\varepsilon i} : p(w')$; where p the prejacent proposition.

The composition proceeds as follows:

(50) Tha kerdisi o Janis.
FUT win.perf.nonpast.3sg the John.
'John will win.'

(51)



Aspect applies to the VP meaning first, introducing and existentially closing an event variable. Then nonpast applies and now the event is places in the interval following some time t. This variable is in need for identification by PRES, which introduces t_u. FUT is interpreted at the particle position MOD where the modal information is cast. We extend this analysis to Italian, where lexical aspect plays the role of perfective and future sets the perspective at present. As we have already noted, we cannot have, in Italian, future of a past, and future always scopes above past. It thus contributes also PRES, just like all Greek particles.

We want again to remind that this analysis, with nonpast embedded under MOD, is very similar to the idea of having a prospective marker under MOD (Matthewson 2012); the non-past is a prospective interval. We also want to emphasize that this analysis is different from Kissine 2008. Kissine also has modality over nonpast, but future is non-past and the modality is contextually triggered. The Greek and Italian data do not allow us to adopt a purely temporal view of FUT (we do not obtain a future of a past reading as expected on the temporal analysis of FUT); moreover, they show that FUT aligns with modal particles syntactically (it appears in the same position). The forward-shifting component is independent of FUT itself, which, recall, can embed a past in the epistemic use.

We do not discuss the aspectual properties further, but 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 Condoravdi, 2002; Copley, 2002; Laca, 2008). With eventive predicates embedded under present (52-a) or future (53-a), the time of evaluation of the prejacent

is forward-shifted— unlike with stative predicates (52-b)-(53-b). Such data can be replicated for English, and extend beyond present and future (e.g. see Copley, 2009).

(52) a. Gianni è malato. (stative, present evaluation)
Gianni be.3sg.pres sick.
'John is sick.'
b. Gianni arriva. (eventive, future evaluation)
Gianni arrive/3sg.pres.
'John will arrive immediately.'

(53) a. Gianni sarà malato. (stative, present evaluation)
Gianni be.3sg.FUT sick.
'John must be sick.'
b. Gianni arriverà. (eventive, future evaluation)
Gianni arrive.3sg.FUT.
'Gianni will arrive.'

Condoravdi 2002 noted the same pattern for modals (see (54)) 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. Condoravdi establishes a correlation between lexical aspect, forward-shifting and the interpretation of the modal. When the prejacent is stative (and the time of evaluation is not forward-shifted), the modal has an epistemic interpretation; when the prejacent is eventive the modal obtains a root interpretation.

(54) a. John might be sick (stative, epistemic)
b. John might become sick (eventive, root)

This idea also applies to Greek, although here grammatical aspect is relevant (Giannakidou 2009, 2012), since statives can in fact easily forward shift if in perfective aspect.

(55) O Giannis tha arrostisi. (stative, perfective non-past, future evaluation)
the John FUT sick.perf.nonpast.3sg
'John will be sick.'

We will not discuss these data further, but echo previous views that boundedness (either lexically or via perfectivity as in Greek) is responsible for shifting to the future the time of evaluation of the prejacent of modals.

We adopt Condoravdi's premise that with eventive prejacents the time of evaluation is forward-shifted and the predictive interpretation of FUT is obtained. Our account shares the ingredients needed to obtain the predictive interpretation with eventives and epistemic interpretation with statives as Condoravdi predicts. The needed ingredients are (i) the presupposition of diversity, namely that the modal base contains p and $\neg p$ worlds (this is nonveridicality in our account); (ii) a right open interval (which for us is contributed by non-past). Since the diversity condition must be fulfilled no matter what the time of evaluation of the prejacent is, when the prejacent is evaluated at t_u or at a time preceding t_u, given metaphysical settledenss of the past and present, only the epistemic interpretation of the modal is allowed. When the time of evaluation of the prejacent is forward-shifted, in virtue of eventivity, the predictive interpretation is obtained and diversity is metaphysical. These predictions are compatible with our analysis and in fact we are keen to

subscribe to this proposal to derive the two interpretations.

Here our focus is in studying the modal nature of a prediction and the common features between the predictive and the epistemic interpretation of FUT. As we have argued, there is an epistemic ordering at work in the predictive reading which accompanies the reasonability ordering source; as we argue now, there is a common core in the predictive and epistemic reading, which pertains to the presence of ordering sources, an ingredient that is not integrated into Condoravdi's account.

4 Common core in predictive and epistemic future

4.1 Epistemic future

As noted at the beginning of the paper, FUT has extensive epistemic use in Greek and Italian. We repeat the basic data. The epistemic use arises with non-past and with past, statives and eventives:

(56) a. I Ariadne tha milise xthes.
the Ariadne FUT talk.past.3sg yesterday.
'Ariadne must have spoken yesterday.'
b. Gianni avrà parlato ieri.
Gianni have.fut.3sg spoken yesterday.
'Gianni must have spoken yesterday.'

(57) a. I Ariadne tha ine arrosti.
the Ariadne FUT be.3sg sick.
'Ariadne must be sick.'
b. Giovanni sarà malato.
Giovanni FUT-be sick
'Giovanni must be sick.'

(58) a. I Ariadne tha itan arrosti.
the Ariadne FUT was.3sg sick.
'Giovanni/Ariadne must have been sick.'
b. Giovanni sarà stato malato.
Giovanni must been sick.
'Giovanni must have been sick.'

These are all epistemic statements, with no future reference. FUT is equivalent to epistemic MUST. In all cases, the speaker is considering information she has and draws an inference based on that information. Given our analysis of the predictive reading, it is now easy to see what the two have in common, and therefore explain why future morphemes cross linguistically (including Dutch FUT and to a certain extent *will*) tend to exhibit this apparent 'ambiguity' between predictive and epistemic readings.

The predictive and epistemic reading are parallel, in spite of asymmetric structures of the possibilities (with a fixed past and present, and an open future). Their common nature is revealed in the truth conditions: the epistemic FUT/MUST modal base is also nonveridical, i.e., a non-homogenous modal base is projected, so negative continuations are possible, as illustrated below:

(59) a. I Ariadne ine arosti, #ala dhen ime ke endelos sigouri.
the Ariadne is sick, but not be.1sg and absolutely sure

b. Giacomo è malato, #ma non sono sicura.
Giacomo is sick, but not am certain.
'Ariadne/Giacomo is sick, #but I am not entirely sure.'

(60) a. I Ariadne tha ine arosti, ala dhen ime ke endelos sigouri.
the Ariadne FUT is sick, but not be.1sg and absolutely sure

b. Giacomo sarà malato, ma non sono sicura.
Giacomo be.3sg.fut, but not am sure.
'Ariadne must be sick, but I am not entirely sure.'

In contrast to an unmodalized sentence, the FUT sentence is compatible with a continuation revealing uncertainty. This supports our truth conditions, i.e., that not all worlds in the modal base are p worlds. We come back to these sentences in section 5. With unmodalized past sentences, on the other hand, the uncertainty continuation is not possible, as we see, since these convey un-partioned, veridical, epistemic states that are included in p.

In the literature, *must* is known to be 'weaker' than the unmodalized assertion, and the idea that MUST is weak goes back to Kartunnen 1971 (see also discussion in von Fintel and Gillies 2010 and references therein, as well as Giannakidou 1997, Giannakidou and Mari to appear). Below, we give examples, in Greek and Italian with the verb equivalents of MUST (in Greek *prepi* takes a subjunctive *na*-complement, like all modal verbs; Giannakidou 2009). We note that they pattern with FUT, and contrast with unmodalized assertions:

(61) a. I Ariadne prepi na troi tora ala dhen ime ke endelos sigouri.
the Ariadne must subj eat.non-past3sg now but not be.1sg and absolutely sure

b. Giacomo deve star mangiando, ma non sono totalmente sicura.
Giacomo must be eat-gerund, but not am totally certain.
'Giacomo/Ariadne must/will be eating now, but I am not entirely sure.'

(62) a. I Ariadne prepi na milise xthes, ala dhen ime ke endelos
the Ariadne must subj talk.past.3sg yesterday, but not be.1sg and absolutely
sigouri.
sure
'Ariadne must have spoken yesterday, but I am not entirely sure.'

b. Gianni deve aver parlato ieri.
Gianni must have spoken yesterday, ma non sono totalmente sicura.
'Gianni must have spoken yesterday, but I am not entirely sure.'

The sentences with MUST and the sentences with epistemic FUT are equivalent in the speaker's intuitions. FUT and MUST can actually combine— an instance of modal concord (Huitink 2014 and references therein). The reading remains the same:

(63) I Ariadne tha prepi na milise xthes, ala dhen ime ke endelos
the Ariadne fut must subj talk.past.3sg yesterday, but not be.1sg and absolutely
sigouri.
sure.

'Ariadne must have spoken yesterday but I am not entirely sure .'

(64) Giacomo dovrà aver parlato ieri.
Giacomo must-FUT.3sg have spoken yesterday.
'Giacomo must have spoken yesterday, but I am not entirely sure'.

Given the epistemic non-predictive usage of FUT and the parallel with MUST, it becomes very appealing to argue that with the epistemic future the reading can be derived parallel to *must* (see Giannakidou and Mari to appear for more discussion). Here, we want to show that the analysis of the epistemic reading of MUST runs parallel to the analysis of FUT in the predictive reading, differing only in the modal base.

In the epistemic use, FUT associates with an epistemic, not metaphysical, modal base, and following previous discussion about reasonability, we use the latter as the ordering source (see also Portner 1998). Specifically, the modal base is the set of propositions known by the speaker (w_0 is the actual world): $\cap f_{epistemic}(w_0) = \lambda w'.w'$ is compatible with what is known by i (the speaker) in w_0. Note that $\cap f_{epistemic}(w_0) \subset M(speaker)$. (Our epistemic modality is thus *subjective*, see the objective vs. subjective distinction of Papafragou 2006. In fact, given that we relativize with respect to individual anchors, there can be no objective modality, strictly speaking, in our system). Given what the speaker knows, the modal base contains p worlds, but also $\neg p$ worlds; it is nonveridical, non-homogenous.

Let us define the ordering and then Best worlds given the ordering.

(65) For any set of propositions $\mathcal{S}$ and any world w, w': $w \leqslant_{\mathcal{S}} w'$ iff for all $q \in \mathcal{S}$, if $w' \in q$, then $w \in q$.

(66) Best worlds given the ordering $\mathcal{S}$.
$\text{Best}_{\mathcal{S}} : \{w' \in \big(\cap f_{epistemic}(w_0)\big) \colon \forall q \in \mathcal{S}(w' \in q)\}$.

$\text{Best}_{\mathcal{S}}$ are a subset of worlds in the epistemic modal base, in which *strange things do not happen* (see Portner, 1998, Mari 2013 and our earlier discussion about reasonable futures above). For instance, if I have red cheeks and sneezing nose, then, under normal circumstances, I have the flu. However, circumstances are not necessarily normal. In such extraordinary circumstances these symptoms are secondary and indeed indicative of a potentially much worse disease.

The modal base is partitioned, just as in the case of the predictive future, in the way depicted in (66). The modal space is thus subjectively nonveridical. One of the subsets of the modal base is ranked as the set of Best worlds given the ordering $\mathcal{S}$.

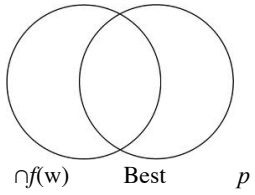


Figure 7: Epistemic space for *FUT*

As in the predictive case, FUT universally quantifies over the set $Best_{\mathcal{S}}$ (which is a subset of the modal base, see (66)).

Epistemic future:

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

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

So, the truth-conditional structures of FUT are the same in both the predictive and the epistemic use (both nonveridical), the only difference being that in the epistemic case the modal base is epistemic, but in the predictive FUT the modal base is metaphysical. In the predictive case, however, we have two ordering sources, which include an epistemic one.

How about the actual world? Best worlds are those in which strange things do not happen. Typically the actual world tends to be non-extraordinary (Portner, 2009), but we also know that strange things happen. As a consequence, we do not claim that the epistemic agent actually *knows* that the actual world belongs to the set of best worlds. Given that the accessibility relation is epistemic and therefore reflexive, it is ensured that the actual world is in the modal base (see Matthewson et al. 2007; Portner, 2009), but it is not guaranteed that the actual world belongs to the p worlds. With universal quantification over the set of Best worlds, however, truth is projected within the support set, and therefore bias is revealed towards the p worlds, as in the case of the predictive reading.

So, the epistemic and predictive reading boil down to the same source: reasoning with uncertainty, i.e. nonveridicality (only, in addition, the future is metaphysically open) and ordering sources determining a set of Best-worlds. In both cases, the speaker does not know for sure that the actual world is in the set of Best worlds, though quantification over Best-worlds reveals the speaker's bias towards these worlds.

Our analysis overall covers the future in Greek and Italian, and given the similarities with Dutch (Broekhuis and Verkuyl 2014, Giannakidou 2014) and German that we mentioned at the beginning, we believe it can be extended easilyto these languages. For reasons of space we cannot undertake this task here, but our analysis is compatible with what is proposed in Broekhuis and Verkuyl. English *will*, in the predictive use is not much different, though regarding the epistemic use it is not fully clear to us that there is consensus in the literature that it has a purely epistemic reading (see Copley, 2002; Kaufmann 2005, Wolf 2013) — recall that in the translations we used epistemic *must* and not *will*. With this in mind, we now turn to Copley's account, which has used bouletic and inertial modal bases, and is thus very different from what we proposed here.

4.2 Brief comparison with Copley (2002)

Copley 2002 is a well-known account of English data and does not address the epistemic future. As far as we can see, the account 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 notion of commitment is understood differently than in our discussion in section 2.2., and is related to volition. Unlike us, Copley relies crucially on the speaker being confident about the future. In our account, we have not talked about speaker's

confidence. Therefore in these central aspects Copley's theory and ours seem to be making quite distinct assumptions. Let us see how.

A central question for Copley is how the speaker can be confident when in fact the future is metaphysically open, and 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:

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

According to Copley, the speaker has two possible reasons for asserting this: either he believes that some fact about the world will ensure that she is there (she has some obligation just before 5:00 in the same room, she always walks by there at 5:00, etc.), or he believes some person will personally ensure that she is there, and has the power to do so (ability and commitment component. For Copley, commitment is a bouletic notion, as we said). The first reason seems to reflect an inertial ordering, the second a bouletic ordering.For us, there is no bouletic (or ability) component.

Consider now the following example paying attention to the restriction on the worlds of the modal base, which are p worlds. (70) is an example of bouletic future, according to Copley.

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

The truth conditions Copley provides for (70) are in (71) 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.

(71) ALL_t(ALLb(d)(q))(w)(t) = 1iff
$\forall t' \supset t : [\forall w'$ metaphysically accessible from w at t' and maximally consistent 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 a metaphysical modal base and an epistemic/reasonability ordering source. Nothing more. In our view, to utter (70), the speaker considers a set of propositions (the future criterion, which includes the proposition that it always snows on my birthday) and carves out those metaphysical alternatives in which the worlds develop according to what is known.[13] There is no director, ability or commitment to carry about p, and the metaphysical

[13]Recall again that these are not intertial properties of the world— crazy things might happen the day of my birthday,

branches are not partitioned according to ability and volition. For the bouletic cases, Copley also uses inertia. However, our notion of reasonability (which relates, but does not coincide with inertia) is relativized to the future criterion, which is an epistemic notion. Since the metaphysical modal base is partitioned according to desires and abilities in Copley (plus inertia), and according to knowledge (plus reasonability) in ours, the two accounts greatly different with respect to the truth conditions.

Note, again, that (70) illustrates the bouletic case in Copley. Regarding inertial cases, we could not find in Copley 2002 a passage with truth conditions assigned specifically to this case. Also, in relation to (70), Copley states that 'Futures, though, are much more permissive, allowing future reference even when the eventuality's happening follows from mere accidental facts.' (Copley, 2002:68). It is unclear to us how this observation can be translated into her formal analysis. Unless Copley can show that inertial futures can be modeled as a mix of epistemic and metaphysical modality of the kind we suggested here, our truth conditions remain formally quite distinct.

Copley does not predict association with a purely epistemic modal base, and, at the same time, an analysis along the lines we propose here for the epistemic future would over-generalize for *will*, since its purely epistemic reading is not as uncontroversial as epistemic FUT for Greek, Italian, and Dutch. A potentially useful observation is that *will* relates historically and synchronically to volition expressions. Cross-linguistically, it is conceivable that the modality of future is not a unified notional category and that there maybe futures that relate to volition (perhaps along the lines of Copley; see also Del Prete, 2011 on a root interpretation of *will*), alongside futures that relate to the epistemic realm as the Greek, Italian, German, and Dutch futures.

5 Moore-like effects with FUT and informational conflict

In this last section, we want to discuss a potential challenge for our analysis: FUT can give rise to effects that appear to be Moore-paradoxical. The literature on the Moore paradox is vast, and we will not attempt a general analysis of it here, since our topic is not the paradox itself. Our new observations are that we find Moore-effect with FUT, but different variants of Moore's paradox affect in different manner future sentences. To explain the variation, we propose that Moore-effects do not necessarily reveal an epistemic (veridicality) conflict, but manifest also sensitivity to informational flow that previously has escaped attention.

The classical Moore paradox itself arises with sentences like below:

(72) #It is raining and I don't know that it is raining.

(73) #It is raining and I don't believe it.

Moore and others have used for the sentences above characterizations like odd, contradictory-sounding, and unassertable. In the literature, the sentences are treated as defective in that they involve the speaker in some kind of epistemic conflict. In our terms: as we said in section 2.1, a positive unmodalized assertion is subjectively veridical, i.e. the speaker is typically understood as knowing that p is true. If this is so, then in the sentences above the speaker's epistemic state M(speaker) is presented as both being included in p and allowing $\neg p$ worlds. This is contradictory

totally unexpected given normal inertial properties, this is why we used also 'reasonability', which allows those worlds in which crazy things happen but are totally normal 'given what happens the day of my birthday'.

epistemic state, and the sentences are defective because of this veridicality conflict imposed by the two conjuncts.

Yalcin in a more recent discussion (Yalcin 2007) coins the term *epistemic contradictions* for Moore variants with logical forms such as ϕ *and it is not possible that* ϕ, e.g:

(74) #It is raining and it might not be raining.

(75) #It is raining and it is possible that it is not raining.

These sentences are epistemic contradictions. Again, the conflict appears to be between a veridical epistemic state established by the unmodalized first conjunct (where all worlds are raining worlds), and a non-veridical state, allowing raining and non-raining worlds, in the second conjunct. So, both Yalcin's examples and the classic Moore paradox examples involve an epistemic conflict which reveals a veridicality conflict.

Interestingly from our perspective, future sentences (epistemic and predictive), as well as MUST, give rise to what appears to be a Moore-like effect. We observe it below. (We replace and with but to make the sentences more natural sounding, but as can be seen, the effect is observed):

(76) #It must be raining, but it might not be raining.

(77) a. #Tha vreksi, ala ine pithano na min vreksi.
FUT rain.perf.non-past.3sg but is possible subj not rain.perf.non-past.3sg
'#It will rain, but it is possible that it will not rain.' (predictive)

b. #Tha vrehi, ala ine pithano na min vrehi.
FUT rain.imperf.non-past.3sg ala is possible subj not rain.imperf.non-past.3sg
'#It must be raining, but it is possible that it it might not be raining. (epistemic)'

(78) a. Gianni arriverà, #ma è possibile che non arriverà. (predictive)
John arrive.3sg.fut, but is possible that not arrive.3sg.fut.
'John will arrive, but it is possible that he will not arrive'.

b. Gianni sarà arrivato, #ma è possibile che non sia arrivato.
John be.3sg.fut arrived, but is possible that not be.subj.3sg arrived.
'John must have arrived, but it is possible that he has not arrived' (epistemic).

If FUT is non veridical, as we argue, and conveys a partitioned epistemic (and metaphysical) state, how can the data above be explained? At first sight, they seem to pose a challenge for our proposal, since the conflict in the classical cases, as we just mentioned, appears to be due to a veridicality conflict. If the nonveridical spaces associated with FUT and epistemic MUST are nonveridical (thus alloying $\neg p$ worlds), as we are arguing, why aren't they compatible with a continuation that raises that possibility? (Though the effect is treated in the literature as concerning strictly epistemic modality, we included the predictive reading here too, since that one also contains a knowledge component coming from the future criterion; but we focus, for the rest, on the epistemic reading to keep the data more constrained.)

As we proceed to show how the Moore effect of FUT can be explained in our account, we want to recall first the new set of data, of similar structure, that we mentioned earlier and which in fact support the nonveridical analysis. Recall that we used them as evidence *for* it. Here is a sample of the earlier sentences we considered in section 4:

(79) a. I Ariadne tha ine arosti, ala dhen ime ke endelos sigouri.
the Ariadne FUT is sick, but not am and completely sure

b. Giacomo sarà malato, ma non sono completamente sicura.
Giacomo be.3sg.fut sick, but not be.1sg entirely certain.
'Ariadne/Giacomo must be sick, but I am not entirely sure.'

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

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

With continuations like *but I am not entirely sure*, the Moore effect seems to be removed. Crucially, the effect remains with an unmodalized veridical sentence:

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

(82) Giacomo è/era malato, #ma non sono completamente sicura.
Giacomo is/was sick, but not be.1sg completely certain.
'Giacomo is/was sick, #but I am not entirely sure.'

The present and past sentences are subjectively and objectively veridical. When the speaker utters them, as far as she knows, Ariadne and Giacomo were sick, and knowledge of that cannot be cancelled by a continuation that questions it. All worlds in M(speaker) are worlds in which Ariadne and Giacomo are sick, so the second conjunct induces epistemic contradiction that comes from this veridicality conflict (all worlds in M(speaker) are p worlds in the first conjunct, while not all worlds in the same space are p worlds in the second conjunct).

The epistemic future and MUST, on the other hand, are fine with *but I am not entirely sure*. Why? Because both conjuncts are not veridical, and they there're both of equal informational strength, so there is no conflict between them. The first conjunct establishes a nonveridical modal base which allows $\neg p$ worlds, i.e. the worlds that are not Best. In the second conjunct, we move from the modal base, to the larger space, i.e. the speaker's epistemic state. The speaker is in a nonveridical epistemic state: *I am not entirely sure that p* is equivalent to *I am committed to p but not fully*, which means that my epistemic state is also biased toward p but allows $\neg p$ worlds. The presence of *entirely* is crucial in the sentence as it reveals the bias (as opposed to *I am not sure* which is a neutral sentence with no bias towards p[14]). Hence, the two conjuncts make reference to nonveridical modal spaces which are in agreement and not in conflict, since they are both nonveridical and biased. We will call this situation informational harmony. We do not get a Moore-paradox situation with informational harmony, unlike with the positive unmodalized assertion where *I am not entirely sure that p* creates exactly the kind of contradiction the classical Moore continuation gives (a contradictory epistemic state). Hence, *I am not entirely sure* fully supports our nonveridical treatment of epistemic FUT and MUST.

What we just said relied on the notion of informational strength. The two sentences were of

[14]Note that the 'I am not sure' continuation is odd.

equal informational weight, we said. What goes wrong in the classical Moore cases and in our FUT/MUST variants of them is that the sentences do not have the same informational weight. This creates informational conflict that manifests itself in two ways: (a) as breakdown of information flow, which *normally* proceeds from weaker to stronger (as we define it below), and (b) as an "informational contradiction". The Moore effects with FUT and MUST are due to these. Consider first how the classical case illustrates breakdown of information flow:

(83) #It is raining and/but it might not be raining.

The first conjunct *It is raining* presents the rain as an actual fact (objective veridicality). The statement is also subjectively veridical, i.e. in all worlds compatible with the speaker's knowledge it is raining. The second conjunct conveys a weaker information, i.e. that the speaker considers it possible that it is not raining. This discourse is odd, and the hearer must conclude that the speaker is not being co-operative. She said something false either in the first or in the second conjunct, in both cases violating quality, thus being misleading. We end up with a conflict, as well as a breakdown of what can be thought of as normal information flow.

Proceeding from weaker to stronger is the normal course of information flow, expected by Gricean pragmatics:

(84) *Normalcy conditions on information flow*
Information flow is considered $normal$ iff:
(i) Information goes from weaker information A to stronger information B. Or,
(ii) A and B do not informationally contradict each other.

These conditions are nothing extraordinary, but mere summary of run-of-the-mill versions of Gricean views of how information normally proceeds. Weaker and stronger are the informational alternatives compared, i.e. the propositions denoted by the sentences. The problem, crucially, in the second conjunct, comes from the fact that a stronger information was established first: a veridical sentence is informationally stronger than a non-veridical sentence. And within non-veridical sentences, S with bias is stronger that S with equilibrium. Recall that the ordering source reveals bias. With equilibrium, there is no ordering source. With ordering sources the domain of quantification is more restricted and is thus informationally richer (à la Stanaker). Below we give the relevant scale:

(85) Informational strength ordering relevant for Moore's contrasts
$\langle$ might $\neg p$, $MUSTp$, $p\rangle$

Let us represent Moore's sentences S as a pair of alternatives $\langle S1, S2\rangle$:

(86) Moore's variant: p and might $\neg p$
Alternatives: $\langle S1 : p, S2$:might$\neg p\rangle$

$S1$ is a stronger alternative than $S2$ because the veridical epistemic state is not partitioned: all worlds are p-worlds. $S2$ says something that is both informationally weaker and in veridicality conflict with $S1$. The reverse order, from weaker to stronger, is predicted to be fine, and this prediction is borne out:

(87) It might not be raining, but in fact it is raining.

Here, conversation proceeds normally, because the weaker S2 precedes S1 (and we added *in fact* to help the sentences connect; notice that *in fact* has no effect on the other order: *It is raining but in fact it might not be raining* remains odd). In the order above, the second sentence seems to correct the first one, to strengthen it; and, because information proceeds normally, the difference in veridicality is in harmony with the strengthening. There seems to always be a discourse function that strengthening serves, but it will lead us to far astray to develop this in more detail (see Geurts 2010 for a recent neo-Gricean pragmatic theory that addresses in detail informational strengthening, while also arguing that it doesn't always serve the same function.) For now, suffice it to raise awareness that the ill-formedness of the classic Moore sequence reveals both a veridicality conflict, *and* a violation of informational normalcy. If the latter gets fixed, the difference in veridicality becomes innocuous.[15]

To go now to our FUT sentences, consider first the case of a negated possibility modal in the second conjunct:

(89) a. #Tha vreksi, ala ine pithano na min vreksi.
FUT rain.perf.non-past.3sg but is possible subj not rain.perf.non-past.3sg
b. #Pioverà, ma è possibile che non piova.
Rain.3sg.fut, but is possible that not rain.3sg.subj.
'#It will rain, but it is possible that it will not rain.'

(90) a. #Tha vrehi, ala ine pithano na min vrehi.
FUT rain.imperf.non-past.3sg but is possible subj not rain.imperf.non-past.3sg
b. #Starà piovendo, ma è possibile che non piova.
Stay.3sg.fut rain.gerund, but is possible that not rain.3sg.subj.
'#It must be raining, but it might not be raining.'

In the cases where a universal modal is followed by the negation of a possibility modal, we have utterances of modalized sentences in both conjuncts. But we don't have the same informational weight in both conjuncts. *Must p* conveys bias towards p worlds, while the possibility utterance conveys equilibrium; hence $S1$ is the stronger alternative, while $S2$ is informationally weaker: we go from a stronger S1 (with ordering sources revealing bias) to a weaker $S2$ (with no ordering sources and equilibrium): $\langle$might, must$\rangle$, going from weaker to stronger:

(91) Moore's variant: MUST p and might $\neg p$
Alternatives: $\langle S1$:MUST p, $S2$: might $\neg p\rangle$

According to the normalcy condition, information flow requires the stronger statement to be second. The information flow in the Moore sentence is thus not normal, and the sentence is defective for this reason. Notice, crucially, that if we reverse the order as we do below, the sequence is improved,

[15] We think it is worth mentioning that the normalcy conditions we posited above are not specific to modality, but are general. Consider e.g. quantifiers:

(88) a. #Every linguistics student came to the Halloween party, and some linguistics students came to the party.
b. Some linguistics student came to the Halloween party; in fact, every linguistics student came to the party .

The odd sequence is not normal because it proceeds from strong (with universal quantification) to weak (with existential quantification). Here violation of normalcy leads to redundancy.

and shows no Moore effect :

(92) a. Ine pithano na min vreksi, alla tha vreksi, tha dhis.
is possible subj not rain.perf.non-past.3sg, but FUT rain.perf.non-past.3sg, FUT see.2sg

b. È possibile che non piova, ma pioverà, vedrai.
Is possible that not rain.3sg.subj, but rain.3sg.fut, see.2sg.fut.
'It is possible that it will not rain, but it will rain, you'll see.'

(93) a. Ine pithano na min vrexi, alla malon tha vrexi.
is possible subj not rain.imperf.non-past.3sg, but probably FUT rain.imperf.non-past.3sg.
'It is possible that is not raining, but most likely it must be raining.'

b. È possibile che non stia piovendo, ma starà piovendo, vedrai.
Is possible that stay.3sg.subj not rain.gerund, but stay.3sg.fut rain.gerund, see.2sg.
'It is possible that it is not raining, but I am pretty certain it is raining, you'll see.'

These discourses are normal because the stronger sentence follows the weaker one. This fact illustrates that the problem with the Moore sentences with strong modals in the first conjunct followed by negations of weaker modals, at least when we think of their Greek and Italian counterparts, is not a veridicality conflict, but breakdown of normal information flow. The two alternatives are not epistemically inconsistent but informationally not-normal.

Consider, finally, the continuations with *I don't believe it*:

(94) Gianni sarà arrivato, #ma non lo credo.
John be.3sg.fut arrived, but not that believe.1sg.
'#John must have arrived, but I do not believe it.'

Here, the alternatives are:

(95) Moore's variant: MUST p and *I do not believe that p*
Alternatives: $\langle S1$:MUST p, $S2$: *I do not believe that p* $\rangle$

The speaker establishes bias towards p with the use of a universal modal in the first conjunct. She continues then by saying that she does not believe that John arrived. Importantly, *believe* is a neg-raising verb, so *not believe that p* typically strengthens to *believe that not p*; (see Horn 1979 for a classical piece on neg-raising with belief verbs). In the strengthened reading, both conjuncts appear to be informationally equally strong, but, crucially, conflicting with each other: the first conjunct conveys bias towards the p set (*John arrived*) and the second alternative strengthens to the belief that John didn't arrive (there are no p worlds in the speakers epistemic state, counter commitment to p). This creates a conflict in the join utterance because the speaker is required to both have bias towards p and counter commitment to it. This is an informational "contradiction", a conflict that cannot be repaired. As we see below, change of order has no effect:

(96) a. Den pistevo oti irthe o Janis, #alla tha irthe.
not believe.1sg that FUT.came.3sg the John, but FUT came.3sg.

b. Non credo che John sia arrivato, #ma sarà arrivato.
Not believe.1sg.pres that John be.3sg.subj arrived, but be.3sg.fut arrived.
'#I do not believe it that John arrived, but he must have arrived.'

Here the speaker remains in an informationally contradicting state where she is required to both have bias towards p, and believe p to be false. This is an impossible informational state. Notice that in the sentence below, without negation in the second conjunct, we have again informational harmony:

(97) It must be raining and I believe that it is raining

We will close our discussion here, by summarizing the three cases of Moore-continuations for $FUT/MUSTp$ that we found:

(a) A continuation that creates no effect, revealed with *I am not entirely sure*; this continuation illustrates informational harmony.
(b) A continuation that violates informational normality from weaker to stronger information (with *might not p*); this effect can be fixed with reversing the order of conjuncts.
(c) A continuation that creates informational contradiction (with *I do not believe p*). Order has no effect on this one.

Certainly further study is required to understand better the interactions between modals in Moore sentences, and to refine how the notion of informational strength we proposed interacts with the semantics, and information flow in general. Here, we offered but a few initial, and we hope helpful, observations about the behavior of FUT/$must$ in Moore like sentences. In the light of our observations, it appears to be too simplistic to think of the Moore's contrasts as being due to veridicality conflict only. The improvements with order reversals from weak to strong were crucial in revealing the dimension of information flow. In case of no conflict, as with continuations *but I am not entirely sure* there is no Moore paradox. Such cases, in fact, and their contrast with unmodalized assertions, which are incompatible with *but I am not entirely sure*, can be used as a diagnostic of the nonveridical nature of the modalized first conjunct. In the case of informational contradictions, the conflict is irreparable, but it is not indicative of a veridicality conflict.

6 Conclusions

As we approached the end of the paper, let us summarize the main ingredients of our analysis of Greek and Italian future morphemes:

(a) Greek and Italian future morphemes are universal modals, both subjectively and objectively nonveridical.

(b) They combine with a metaphysical or an epistemic modal base, producing predictive and epistemic future respectively.

(c) Current knowledge and reasonability function as ordering sources in the predictive reading;

in the epistemic reading, we only have reasonability as ordering source.

(d) In both cases, the ordering produces projected truth onto the set worlds FUT quantifier over, and this reveals bias towards p. As a result of bias, future sentences appear to be 'strong'.

With future modals, in both cases the speaker has incomplete knowledge about the actual world, in particular she does not know whether the actual world will in fact be a p world (predictive), or whether it was or is a p world (epistemic). The epistemic and predictive reading boil down to the same source: reasoning with uncertainty, i.e. nonveridicality. The only difference is in the orientation: present and past orientation for the epistemic reading, and future orientation for the predictive (which we derive in a Condoravdi's style way). Our analysis therefore captures very simply the systematic availability of epistemic and predictive readings in FUT observed in Greek and Italian, and given the similarities with Dutch (Broekhuis and Verkuyl 2014), in Dutch.

How about English? Notice, first that epistemic modality is *not* incompatible with future orientation, as can be seen with *might*:

(98) a. If John continues to smoke like this, he might be sick in a few years.
b. For all I know, John might win the game tomorrow.

The epistemic *might* makes clear that there is no incompatibility of epistemic modality with future temporal orientation. This is an important point to make, especially because it is sometimes claimed that future and epistemic modality don't go together. As we see with *might*, this is not true (see also, among others Condoravdi, 2002). But it is true that *must*, with future orientation, is delegated to the deontic realm typically:

(99) Next month, Ariadne must move to Paris.

The reason why epistemic *must* is excluded from the future could be due to efficient Gricean reasoning. *Will* is the competing function-specific expression for prediction, it is therefore informationally stronger. When the speaker does not use it, the hearer is allowed to conclude that a prediction is not justified, and this 'dooms' *must* to the realm of the deontic modality. In Greek and Italian, as we saw, MUST and FUT are not in competition (since they are not both modal verbs), they can combine and, as we showed, we can thus see FUT plus epistemic modality together.

We will leave the explorations of further cross-linguistic predictions of our theory for another occasion. As we noted already, cross-linguistically, it is conceivable that the modality of future is not a unified notional category. There maybe futures that relate to volition (as perhaps *will* does), and we presented here futures that very clearly relate to the epistemic realm, such as the Greek, Italian, German, and Dutch futures. More work needs to be done to establish whether these are the main patterns crosslingustically, or whether we need more— but generally, the association of future markers with epistemic modality is very common across many language families. Our goal here was to offer a comprehensive and flexible enough framework where future patterns can be distinguished, and which can explain the hybrid nature of predictive future and its common core with the epistemic future.

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