

# A two dimensional analysis of the future: modal adverbs and speaker's bias

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## Abstract

Whether future morphemes in languages are temporal or modal operators is a central question in the semantics of the future. Most analyses (with the exception of [14]; see its rebuttal in [14]), agree that future morphemes do convey modality, and do not always make reference to future times. We study here the temporal (future time) reading of the future (*John will arrive at 5pm*), which we call ‘predictive’. The modality of the predictive reading is often assumed to be purely metaphysical (e.g. [13]). Based on novel Greek and Italian data with modal adverbs, we argue that prediction involves both a metaphysical and an epistemic dimension, and we offer an analysis that relies on knowledge of the speaker at the utterance time  $t_0$ . This knowledge restricts the set of the futures (metaphysical branches) only to reasonable ones (in the sense of [18]). In these branches the prejacent comes out true. We also propose that when predicting the speaker has a degree of *bias* that the actual world-to-come at  $t_0$  will be reasonable. This bias, to our knowledge not observed before, is reflected in the use of adverbs, and although by default it expresses high confidence, it can be quite variable, from very strong to relatively weak— as is evidenced by the wide range of modal adverbs that can co-occur with the future morpheme.

## Contents

<b>1</b>	<b>Introduction</b>	<b>1</b>
<b>2</b>	<b>The predictive reading: basic data with modal adverbs</b>	<b>3</b>
<b>3</b>	<b>Future: metaphysical alternatives and speaker's bias</b>	<b>5</b>
<b>4</b>	<b>Conclusion: what is common in epistemic and predictive future</b>	<b>7</b>

## 1 Introduction

The question of whether the category ‘future’ in natural languages is a tense or modality has received a lot of attention in linguistic semantics, and both answers have been explored (for modal accounts, see e.g. [4]; [13], [9], [16], [19], [11]; [2]; [15]; for a defense of the temporal analysis see [14]). In previous work ([19], [9], [11]) we showed that Greek and Italian future morphemes have non-temporal, epistemic modal uses with past and present, such as:

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- (1) a. I Ariadne tha ine arrosti.  
the Ariadne FUT be.3sg sick  
b. Giovanni sarà malato.  
Giovanni FUT-be sick  
'Ariadne/Giovanni must be sick.'
- (2) a. I Ariadne tha itan arrosti.  
the Ariadne FUT be.past.3sg sick  
b. Giovanni sarà stato malato.  
Giovanni FUT-be been. PERF. sick  
'Ariadne/Giovanni must have been sick.'

As we see, Italian and Greek employ future morphemes - which we will call FUT in this paper: a bound one (Italian), and a particle that precedes the tensed verb (Greek). FUT is followed by a nonpast or a past tense form in the sentences above, and produces an epistemic, non-predictive reading- notice that in the translation we use "must". *Will* would have been inappropriate in this use. This link of the category 'future' to epistemic modality appears to be explored quite productively in languages (see also [2] for Dutch, and [4] for similar ideas about Dutch *zullen* and *will*). Given this purely epistemic usage and the lack of future reference, it becomes appealing to treat the future morphemes in Greek and Italian like epistemic modals, which we did in our earlier work (cited earlier). In the present paper, we want to address the canonical, predictive reading of the future. We argue that the future in this reading conveys an assessment, based on knowledge and reasonability, that the speaker makes about an event that hasn't happened yet. In the end, we discuss briefly how the purely epistemic and the predictive reading are related, and what is the semantics they share (see for extended discussion [10]). A typical predictive use is illustrated in (3):

- (3) a. Tha vrexí avríο. (Greek)  
FUT rain tomorrow  
b. Domani piovera. (Italian)  
Tomorrow rain.FUT.3sg  
'It will rain tomorrow'

Epistemically, what will happen in the future is unknown at the present time, therefore the future is non-veridical [7] and allows for *p* and *not p* (i.e. to rain or not rain tomorrow). However, speakers have knowledge at the speech time that determines what would count as reasonable course of events, and, we argue, they use that knowledge when they make predictions to create a bias towards *p*. A bias towards *p* for the future does not imply commitment of the speaker to *p*, as is the case in veridical unmodalized past and present assertions. Our proposal in a nutshell is that in reasonable worlds (i.e. those worlds in the metaphysical modal base in which nothing unexpected happens, see [18]), the prejacent is true at a future time. So, although the future is objectively and epistemically non veridical (or 'unsettled' [13]), speakers project their knowledge to carve out the metaphysical alternatives, into reasonable and unreasonable ones, i.e. *p* worlds and *non p* worlds. After this clean-up, FUT *p* conveys the semblance of veridicality because it universally quantifies over the reasonable worlds. This, however, breaks down once we add modal adverbs.

Our analysis is in line with [4] and [13], who also treat the future as a universal quantifier over a restricted set of alternatives (most normal ones, or bouletic, etc). *But this is not the whole story for us*: we present new data where FUT co-occurs with modal adverbs of variable force and texture (meaning *possibly*, *probably*, *definitely*, *really*, or containing numerals). What

is the function of these adverbs? We will argue that they reveal a supplementary component of the future: a presupposition that *the speaker is assessing how likely it is that the actual world to come will be a reasonable p world*. We suggest that these two components, truth conditional and presuppositional, are also at play in the epistemic reading, thus adding a presuppositional layer in epistemic modality within Kratzer's semantics, while keeping the same ontological structure.

In section 2 we present the adverbs data, and in section 3 our analysis for prediction. Section 4 concludes the paper.

## 2 The predictive reading: basic data with modal adverbs

Reference to a future event (the 'predictive reading') is done with the particular combination of FUT plus a lower non-past (which in Greek must additionally be perfective; [8], [9]).

- (4) a. O Janis tha ftasi avrio.  
The John FUT arrive.perfective.nonpast.3sg tomorrow.  
b. Gianni arriverà domani.  
Gianni FUT-arrive tomorrow.  
'Gianni will/#must arrive tomorrow'.

As we see, the paraphrase with *must* is pretty odd in this case. Because of the adverb, the speaker has specific temporal information about where to place the eventuality. She might, for instance, be knowledgeable, at the time of utterance, about Gianni's schedule for the day, or she might know that Gianni every day takes the train from Gare du Nord at 4:30 which will place him at the Jean Nicod at 5 pm. So, the future reading is forward shifting of the eventuality time - not of the evaluation time of FUT - which remains PRES [11] - due to the adverb scoping above the TP but lower than the FUT:

- (5) FUT > alle 5 del pomeriggio > arrive

The forward shifted, predictive reading of FUT is non-veridical - at the time of knowledge/assessment, the future event has't happened yet, so FUT *p* does not entail *p* [7]. FUT *p*, however, does seem to express, as we said earlier, a positive bias of the speaker that the event will happen. Crucially, this bias is not full commitment of the speaker to *p* in the sense that an unmodalized past or present assertion is (which are veridical). FUT *p* does not commit the speaker to *p*, does not add *p* to the common ground. So FUT *p* is weaker than PAST *p*, and the modal adverbs are important in bringing about this weakness as we see next.

FUT (including *will*) appears to be compatible, in addition to the temporal adverbs, also with modal adverbs- and these can be of various strength, including some really weak ones.

- (6) a. Arriverà forse/certamente/probabilmente alle 4.  
b. O Janis tha erthi isos/sigoura/malon/isos stis 4.  
'John will maybe/definitely/probably/maybe arrive at 4.'

The appearance of those modal adverbs- which are also observed in the non-predictive, purely epistemic reading of the future [11], makes us pause and think immediately of 'modal concord', as was indeed suggested by [9]:

- (7) I Ariadne malon/profanos/sigoura tha ine jatros.  
the Ariadne probably/obviously/certainly FUT be.3sg doctor  
'Ariadne must probably/obviously/certainly be a doctor.'

However, in current theories of modal concord (e.g. [12]), there is matching force of the modal and the adverb. [16], [17] after [1], notes that in the non-predictive use, in Italian, the future is compatible with adverbs of very weak force like *forse*. With a weak adverb such as *isos*, *forse* 'maybe', the force of the future – which is that of a universal modal – seems incompatible.

- (8) Giacomo sarà forse/probabilmente/sicuramente un dottore.  
 Giacomo be.FUT.3sg maybe/probably/certainly a doctor  
 'Giacomo must maybe/probably/certainly be a doctor.'

The same observation holds for the predictive reading, as we just saw, in both Greek and Italian. In the predictive reading, FUT is compatible with adverbs of very weak force. A prediction with *isos*, *force* 'maybe' is hardly a strong one, and if the future morpheme is a universal it seems inaccurate to talk about 'concord'. *Will*, crucially, shows the same pattern, and can combine, just like the Greek and Italian futures, with something as weak as *maybe*, as we see. Things get even more 'loose' when we consider low-probability adverbials (like *10% chance*, *30% chance*):

- (9) a. Ine 10%, 30%, 90% sigouro oti o Janis tha erthi stis 5.  
 is 10% 30% 90% certain that the John FUT come at 5  
 b. Gianni arriver, al 30%, 30%, 90%, alle 5.  
 Gianni arrive.FUT.3sg, at 30%, 30%, 90%, at 5pm  
 'There is 10%/30%/90% probability that John will come at 5.'

So, when we predict, we seem to be in a paradoxical situation: on the one hand, we feel secure enough to make the prediction, but on the other, we are aware that our prediction is not fullproof. The adverb is there to signal that the prediction is not commitment to *p*, but rather bias toward *p*. We will argue that it is used as a probability measure, as a way for the speaker to indicate the degree of confidence she has in her prediction. This is an important point to make, and to our knowledge it has not been noticed before. The indication of confidence is highly sensitive to what the speaker knows or takes as a reliable information, and is suggestive of an epistemic layer in the prediction.

What will happen in the future is objectively unsettled at the speech time [13] and therefore objectively non-veridical: the future event hasn't happened yet. But knowledge at the present time creates bias, i.e. it allows the speaker to project alternatives in which *p* is true, as we propose next (we will call these metaphysical alternatives 'reasonable futures' using a notion of normality borrowed from [18]). Reasonable futures are metaphysical alternatives, not yet realized, and nothing guarantees that they will be. So, clearly, we are not proposing an account in which the future can be, or is, known; FUT *p* does not commit the speaker to *p*, as is the case of know *p* and other veridical operators. We are proposing an account where the speaker (a) has enough knowledge to propose *p* as being true in a reasonable future, (b) has high confidence the the actual world will be a *p* world (what we called bias towards *p*), while (c) remaining uncertain as to whether the actual world will in fact be a *p* world.

The flexibility observed with adverbs allows us to say that the predictions (how likely is that the actual world to come belongs to the set of alternatives in which *p* is true) fall generally into two categories: predictions of high confidence (based on adequate knowledge that allows such high confidence), and predictions based on low confidence (based on less adequate knowledge). One can think of such low confidence predictions as *guesses*. In our semantics next, we will try to capture these ideas in a precise way, by using the notion of reasonable future [18]. Once we define reasonable futures, we will claim that the future morpheme universally quantifies over these, and that the adverbs measure how confident the speaker is that the actual world to come is in the set of reasonable futures.

### 3 Future: metaphysical alternatives and speaker's bias

Let us introduce the notion of *reasonable future* (from [18]). Consider an example:

- (10) Gianni arriverà a Roma con la macchina alle 4pm.  
*John will arrive in Rome by car at 4pm*

When uttering this sentence, the speaker considers only reasonable futures and states that the event of arrival at 4pm will take place in these futures. What is a reasonable future?

Following [18], a reasonable future determined at time  $t$  is such that the rules that hold at  $t$  are maintained. As FUT sets the time of the perspective at present, the time at which reasonable futures are considered is the time of the utterance. Reasonable futures are such that also habits and behaviors do not change there. Of course habits can change. However, those futures in which they change are discarded (for a comparison between the notion of ‘reasonability’ and inertia ([5], see [18])). Our notion of reasonability borrowed from [18] is reduced to the total *absence of interferences* that would disrupt the course of the law/habit/behavior that holds at the time at which reasonable futures are considered. The future, we propose, is a universal quantifier over reasonable alternatives (as these are metaphysical alternatives). *However, the actual world to come is not known at the utterance time to belong to the set of reasonable future at a later time  $t'$ . We claim that the future presupposes confidence of the speaker that the actual world to come belongs to the set of reasonable ones, i.e. presupposes confidence that the actual world to come is a  $p$  world.*

We use the framework designed in [18]. We use a  $W \times T$  forward-branching structure [20] [3]. 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  $t$ .

$$(11) \quad cg(t) := \{w \mid w \simeq_t w_0\}$$

In the case depicted in Figure 1, the common ground at  $t$  is the set given in (12).

$$(12) \quad cg(t) = \{w_1, w_2, w_0, w_3, w_4\}$$

So defined, 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.

[18], p.17 defines ‘reasonable futures’ as in (13). For any  $t \in T$ ,

$$(13) \quad \text{ReasFut}(t) := \{w_i \in cg(t) \mid w_i \text{ is such that the set of rules fixed at } t \text{ continue to hold in } w_i\}$$

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 (14).

$$(14) \quad \text{ReasFut}(t) = \{w_1, w_2, w_0, w_4\}$$

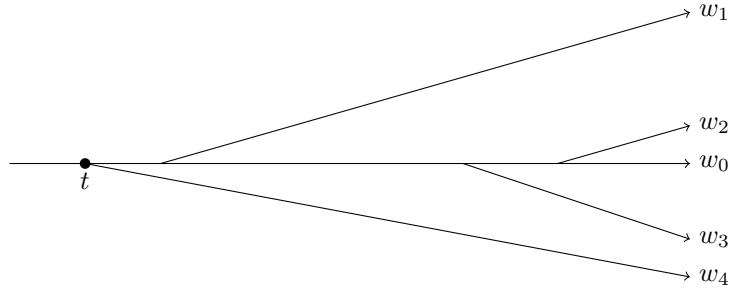


Figure 1:  $cg(t)$  [18], p.17, fig. 3

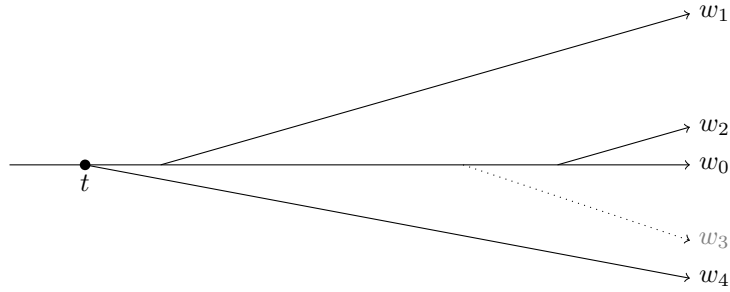


Figure 2: Reasonable Future Worlds (ReasFut) [18], p. 18, fig 4

As we have explained, however, the set of reasonable worlds determined at a certain time  $t$  is different according to different epistemic agents. Hence, amending (13), we define (15), where epistemic agents are added as parameters.

- (15) Given the epistemic agent  $i$ ,  $\text{ReasFut}(t) := \{w_i \in cg(t) \mid w_i \text{ is such that the set of rules fixed at } t \text{ and considered by } i \text{ continue to hold in } w_i\}$

Reasonable futures are not a projection of speakers' preferences and beliefs; *they are metaphysical alternatives* that do not exist yet at the time of the utterance. Let us recall with [18], p. 18, that, 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 possibilities, since the actual-world-to-come does not exist yet at  $t_u$ . Yet the speaker has positive bias, i.e. confidence that the actual world to come will be a reasonable one. In the bare case (*John will come at 4pm*), the assumption that the actual world to come will coincide with a reasonable future at 4pm is ranked very highly, which means, associated with a high degree of confidence. The adverbs are the measures of this confidence.

How can this dimension of bias/confidence be captured? One thing seems clear: the adverbs do not directly compose with  $p$  or  $\text{FUT } p^1$ . Given the variability in force we observed in section 2, especially given that we have even existential adverbs such as *forse*, and in English *maybe*

<sup>1</sup>The adverbs directly compose with  $\text{FUT}$  at least in the purely epistemic reading in Greek (see [9]), they do not in Italian, even for the epistemic reading, see [19].

(*Maybe John will come*), it is impossible to combine FUT (a universal) with the adverbs in a concord like manner. Even the most flexible theories of modal concord (such as [12]) would require at least matching force. So, the adverb is forced to contribute at the non-at issue level, something consistent with the fact that modal adverbs are speaker oriented [6] and seem to ‘scope’ high in the sentence (Ernst therefore argued that they are positive polarity items).

We will claim that the modal adverbs contribute a presupposition that there is a measure of bias in the assessment of the epistemic agent  $i$  (in the default unembedded case, the speaker) which measures how committed  $i$  is that the actual world will be within the set of the reasonable worlds. For instance, if the adverb is *probably*, and the measure interval is between 1 and 100, then *probably* FUT( $p$ ) says that, according to the speaker, the probability of the actual world to be a reasonable future (where  $p$  is true) is between 85 and 100 percent. We are now ready to provide an analysis for the predictive use of the future.

- (16)  $\text{FUT}(\text{NON-PAST}(p)) = 1$  iff  $\forall w' \in \text{ReasFut}(t_u) : \exists t' \in [t_u, \infty] \wedge p(w't')$   
*Presupposition:* There is a probability measure  $\mu_{\text{likelihood}}$  that measures the likelihood, according to the speaker, that the actual-world-to-come will be in  $\text{ReasFut}(t_u)$ . The default value of  $\mu_{\text{likelihood}}$  is *probably*, above 80%. (positive bias towards  $p$ )  
*Truth condition:*  $p$  is true only in the the reasonable futures, given the evidence:  $\forall w' \in \text{ReasFut}(t_u) : p(w') = 1$ . All reasonable futures are  $p$  futures.

Hence the future, as a universal quantifier over the worlds in  $\text{ReasFut}$ , does express commitment of the speaker in that set. However, the speaker is still uncommitted about whether the actual world to come is in that set. This accounts for the non veridical nature of the predictive future, and allows us to unify it, as we suggest next, with the purely epistemic future.

## 4 Conclusion: what is common in epistemic and predictive future

We proposed here an analysis of the predictive reading of FUT using metaphysical, not epistemic alternatives. We said that the speaker carves out a set of metaphysical alternatives in which  $p$  comes out true in the future. We explained that these are the metaphysical alternatives in which ‘nothing goes wrong’, given present knowledge. Modal adverbs, at the same time, measure the speaker bias towards  $p$ , i.e. they measure how likely the speaker thinks is that the actual world to come will be a reasonable world. This bias, especially with weaker adverbs, appears to weaken the strength of the future. In [10], we offer a parallel analysis of the epistemic reading:

- (17) Epistemic FUT (= future as MUST exs 1,2 )  
 Epistemic-FUT  $p$  asserts *necessarily*  $p$ , relative to an epistemic modal base, an ordering source and an epistemic agent  $i$ .  
*Presupposition:* there is a probability measure function  $\mu_{\text{likelihood}}$  determined by  $i$  that measures the likelihood, according to  $i$  that the actual world is within the set of the best worlds. The default value of  $\mu_{\text{likelihood}}$  is *probably*, above 80%.  
*Truth condition:*  $p$  is true only in the best worlds, given the evidence:  $\forall w' \in \text{Best}_{g(w)}(\cap f(w)) : p(w') = 1$ .

Here, the modal domain is the set of best words (rather than reasonable future worlds). We can therefore generalize that future morphemes, in Greek and Italian at least, are modals of necessity in both uses. As such, they express commitment within the modal domain ( $\text{ReasFut}$  and best worlds), but it remains unclear, at the time of the utterance, whether the actual world

is, or is not, in the domain. This renders FUT in both uses non veridical, and explains why assertions with the future pattern with modal assertions (also non veridical) in not positively asserting  $p$  and in licensing polarity and free choice items ([7], e.g. *Ariadne will talk to anybody*, *Ariadne may talk to anybody*, etc).

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