RESEARCH ARTICLE

Irrealis as modality: evidence from Gɪsɪɖa Anii

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Abstract
Using data from the understudied language Gɪsɪɖa Anii, we provide a formal analysis of irrealis that builds on the framework of modality proposed in Giannakidou and Mari. In particular, we propose that Anii has an irrealis modal morpheme whose meaning is that the speaker does not believe that the proposition is true at a particular time. This gives irrealis, at least in Anii, a negatively biased meaning. Giannakidou and Mari propose that the subjunctive in European languages is a positively biased modal but find no evidence in their data for a corresponding negatively biased one. However, in expanding their approach to a completely unrelated language, we show that modal bias can also be negative, filling in the paradigmatic gap left open by Giannakidou and Mari's work. We also illustrate the utility of analyzing irrealis (in relation to the concept of veridicality) as a morphosyntactic and semantic category with a status similar to tense and aspect. Our formal analysis accounts for the obligatory realization of irrealis in a wide range of semantic contexts in Anii, including future tense, negation, and wishes, and shows how irrealis can be composed with other clausal elements. We suggest that reality status, which we analyze as (non)-veridicality, is obligatorily present in the Anii clause and discuss the implications of this for other languages.

1. Introduction

Anii is a Ghana-Togo Mountain Language (possibly Kwa), spoken on the border between Togo and Benin in West Africa. There are many dialects of Anii, possibly as many as one for each village (cf. Tompkins and Kluge 2009), but the only dialect that has yet been studied by linguists is that of the town of Bassila, called Gɪsɪɖa (e.g. Morton 2014, Schwartz and Fiedler 2011).

Gɪsɪɖa Anii has many interesting properties, including the morphological realization of the linguistic phenomenon often referred to as *irrealis*, exemplified here, in a traditional greeting form[1]:

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[1] For expository purposes, the data in this paper are given in Anii orthography (Zaske and Atti Kalam 2014), unless otherwise noted. The use of orthography allows us to illustrate the relevant information without introducing complex yet orthogonal linguistic information such as the interaction of lexical and grammatical tone in verb stems. More information on the phonetics and phonology of Anii verbs can be found in Morton (2014).

(1) Ga-ja   **ga**   **lâa**   m-búmó
     CL.C-God   SUBJ.CL.C.IRR lift.IRR   CL.F.tiredness
     'May God take away your tiredness.'

In this example, a particular subject marker form, combined with a grammatical high (H) tone on the verb (marked here with an orthographic ˆ), marks irrealis.

What is the semantic contribution of this morpheme? More generally, what exactly does the term *irrealis* mean? This question has been subject to much debate in the literature. One problem that researchers have pointed out is that morphemes categorized as irrealis in different languages do not always occur in the same types of contexts or provide the same semantic contribution (e.g. Bybee 1998). This problem has been well-addressed recently by von Prince et al. (2022), who propose that these differences are only apparent and, further, that a realis/irrealis distinction may actually be central to the clausal architecture of many languages.

These widescope observations about irrealis have been made on the basis of a wide variety of cross-linguistic data using different methodological approaches (e.g. Cristofaro 2012, de Haan 2012, von Prince et al. 2022). This paper instead takes a more specific empirical focus, zooming in on the usage of irrealis only in Gɩsɩɖa Anii. This allows us to build a model-theoretic semantic analysis that makes explicit both the meaning of irrealis and its relation to other elements in the clause, and to make specific testable predictions regarding the use of irrealis in this particular language. Our goal is to capture the facts of Anii, and to explore the extent to which the tools of a particular formal approach to modality more generally can be used to model the specific meaning of irrealis in Anii.

Building on the idea that irrealis is a modal (as has been previously suggested by e.g. McGregor and Wagner 2006), we propose a compositional analysis that applies and extends the theory of modality presented in Giannakidou and Mari (2021). Focusing on data from Gɩsɩɖa Anii, we account for the fact that irrealis obligatorily occurs in an apparently wide variety of semantic contexts (e.g. future, negation and wishes) in this language. We show that all of these contexts share the unifying property of being anchored to the speaker's belief about the truth of the irrealis-marked proposition.

More specifically, we propose that irrealis in Anii fills a gap in a paradigm emerging from Giannakidou and Mari's (2021) work. They propose a model of the subjunctive and necessity modals in a number of European languages that rely on the idea of a speaker's belief being biased toward a given subjunctive-marked proposition being true. This bias is crucially understood to be independent of the actual truth or falsehood of that proposition. Our analysis extends this idea, proposing that the semantic contribution of irrealis in Anii is that a speaker's belief is biased toward a given irrealis-marked proposition being false but does not directly assume or imply the proposition's falsity.

Additionally, many previous authors have shown that temporal reference and reality status are conceptually intertwined (recently Giannakidou and Mari 2021, von Prince et al. 2022). We present Anii data that illustrates this interaction in that language, and our analysis accounts for this by showing that in Anii, temporal reference actually follows in part from the meaning of irrealis itself. Our analysis suggests that the realis/irrealis distinction in Anii is on par with categories such as tense and aspect in terms of the central role they play in the syntax and semantics of clauses (see also von Prince et al. 2022).

Before presenting our data and analysis of irrealis, we describe our methods and provide key linguistic and theoretical background.

1.1. Methods

The data presented here come from fieldwork conducted in Bassila, Benin, by both authors. Original data comes from both natural texts (written or recorded, including stories and conversations) and from elicitation sessions, including some using the SNAP paradigm (Mahowald et al. 2016). Sessions were conducted mainly in French by the authors (native English speakers who are fluent in French) and involved both translations from French to Anii and judgments of constructed sentences and contexts. All elicitation sessions were audio-recorded, and the data were later transcribed and double-checked by the authors. All of the examples reported in this paper were also checked for acceptability and orthographic correctness by at least one of the language consultants. The data are mostly reported in the orthography that was officially accepted by the community in 2012 (Zaske and Atti Kalam 2014), except in cases where the orthography obscures relevant linguistic points.

Data collection was highly collaborative between the researchers and language consultants, who have studied their language for many years and have high levels of metalinguistic awareness. The consultants are members of a team of Anii speakers who work for a local nongovernmental organization (LINGO-Bénin) that publishes material in Anii and promotes literacy for Anii speakers. All team members are multilingual, and although this paper focuses only on the Bassila dialect (Gɪsɪɖa), many speak more than one dialect of Anii. They learned French primarily as an academic language but report occasionally switching between Anii and French (among other languages) in their daily lives.

2. Background

This section provides information on aspects of the grammar of Gɪsɪɖa Anii relevant to our analysis, as well as key components of the Giannakidou and Mari (2021) framework on which our analysis is built.

2.1. The structure of Gɪsɪɖa Anii

Anii is different from the European languages used to develop Giannakidou and Mari's (2021) framework. Understanding key differences is thus crucial to understanding how Anii contributes to the development of this approach to modality. Here we focus on two of these: the tense-aspect system and the ways in which modality is expressed, particularly in relation to modal adverbs.

2.1.1. Aspect and tense in Anii

Our analysis places irrealis as a modal phrase within the clausal architecture where it interacts with other elements such as tense and aspect. Because tense and aspect are instantiated differently in the Anii system compared with better-studied languages such as Greek and Italian, we provide a brief overview of the Anii tense-aspect system here.

The prominent role of aspect in the Gɩsɩɖa Anii clause is well-documented (Morton 2014, 2018). The aspectual reference of Anii clauses comes from both aspect markers and from the lexical aspect of predicates, in particular, the difference between stative and eventive predicates. This difference is shown in (2), where there is no tense or aspect morphology, but the lexical aspect affects interpretation:

(2) a. Eventive Predicate[2]:
      N   jəm
      1.SG jump
      'I jumped.'
   b. Stative Predicate:
      N   shɛɖɛ
      1.SG be.sick
      'I am/was sick.'

With overt aspect markers, lexical aspect still plays a role in the interpretation, as shown in (3) with the imperfective marker, and (4) with the perfect[3] marker:

(3) a. Eventive Predicate:
      N   tì   jəm
      1.SG IMPFV jump
      'I am/was jumping/ I (regularly) jump.'
   b. Stative Predicate:
      N   tì   shɛɖɛ
      1.SG IMPFV be.sick
      'I am/was (regularly) sick.'

(4) a. Eventive Predicate:
      N   cee   jəm
      1.SG PERF jump
      'I have/had jumped.'
      (must be non-continuative, i.e. jumping is finished)
   b. Stative Predicate:
      N   cee   shɛɖɛ
      1.SG PERF be.sick
      'I have/had been sick.'
      (can be non-continuative or continuative, i.e. the person may or may not be still sick)

The aspectual system is summarized in Table 1.

As you can see, different temporal references can be expressed in Anii by the same sentence. In many cases, Anii does not require tense marking. At first glance, then, we might consider classifying Anii as 'tenseless' (see e.g. Bittner 2005, Tonhauser 2011).

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[2] As this is a brief overview, minimal semantic and contextual detail is provided. For more information on any of these types of sentences, see Morton (2014, 2018).
[3] This is truly a perfect marker, not a perfective. Recall from (2) that perfective aspect is morphologically null in Anii. For more on the perfect, see Morton (2014).

Table 1. Summary of the aspectual system of Gɪsɪɖa Anii

Aspect marking	Aspectual reference (eventive clauses)	Aspectual reference (stative clauses)
Unmarked	Perfective	Imperfective
tɩ̀[4]	Imperfective (progressive and habitual)	Imperfective (habitual only)
cee	Perfect (noncontinuative)	Perfect (continuative or noncontinuative)

There are, however, two morphemes that suggest Anii has a tense projection: the far-past *bʊŋa* and the future *tə*. The use of these markers is illustrated below. Note that the lexical aspect has no effect on their interpretation:

(5) a. N   (bʊŋa) jəm
        1.SG FAR.PST jump
        'I jumped long ago.'
     b. N   (bʊŋa) shɛɖɛ
        1.SG FAR.PST be.sick
        'I was sick long ago.'

Note here that *bʊŋa* is not required. Sentences can be used in far-past contexts without *bʊŋa*, and in fact, *bʊŋa* is often only used in the first sentence of a story to set the scene. Nevertheless, the position of this morpheme coincides with what might be expected for a tense projection, as seen in the following example in which it precedes the aspect marker:

(6) N   (bʊŋa) tɩ̀   jəm
     1.SG FAR.PST IMPFV jump
     'I was jumping/(regularly) jumped long ago.'

The future marker is more like a traditional tense in the sense that it is obligatory for all clauses with future temporal reference. The future is exemplified in (7):

(7) a. N   tə   ma   jə̂m
        1.SG FUT 1.SG.IRR jump.IRR
        'I will jump.'
     b. N   tə   ma   shɛ̂ɖɛ
        1.SG FUT 1.SG.IRR be.sick.IRR
        'I will be sick.'

It is important to note that the future marker always occurs in combination with irrealis morphology and thus includes a second subject marker. The form and structure of irrealis marking in Gɪsɪɖa Anii are discussed in more detail in Section 3.1.

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[4] Note that in certain contexts (likely involving some kind of focus, and including negative and future contexts), the imperfective marker is *nà* rather than *tɩ̀*. The semantics of these markers is the same. For more on this issue, see Morton (2014)

The future marker also precedes aspect marking, as shown in (8), supporting the analysis that it instantiates a tense projection above the aspect:

(8) N   tə   ma   cee jə̂m
     1.SG FUT 1.SG.IRR PERF jump.IRR
     'I will have jumped.'

Given data such as these, our analysis will assume that Anii has aspect and tense projections (see also Morton 2014). In this paper, we expand on this architecture to integrate irrealis as a modality, using the formalism in Giannakidou and Mari (2021). However, although tense plays a central role in the languages these authors analyze (Indo-European languages), in Anii, aspect and, as we will show, the realis/irrealis distinction itself are more prominent. This creates an illuminating contrast that leads to some key differences in how Giannakidou and Mari's analysis can be applied to Anii. We will show that, in fact, for some sentences, the semantic role that tense plays in many Indo-European languages can be derived in Anii from the semantics we propose for irrealis. We will show how this approach may help explain typological differences in cross-linguistic realizations of tense, aspect and modality.

2.1.2. Modal adverbials

Looking ahead to our analysis, where we propose that in Anii, irrealis is a modal, one question that arises is whether Anii has modal adverbs like English *possibly*, *probably*, and the like as such forms can play an important role in modal systems (Giannakidou and Mari 2018b). Our research suggests that there are no direct equivalents to such terms in Anii. Instead, there are a number of strategies that can communicate similar meanings, as shown in the following examples[5]:

(9) Context: Someone is really hungry for yams and doesn't have any at home. They want to go buy them, and ask their friend if they think there are any in the market:
     K'   á   yɔ̂   na, ʊ   ta ce gʊyá   nɪ, ʊ   taá   ŋə̂
     NEG 2.SG.IRR know FOC 2.SG if go market in   2.SG FUT.2.SG.IRR see
     'You don't know, if you go to the market you might find [them].'
     (More literally: 'You don't know, if you go to the market you will find [them].')

(10) Context: You know your friend eats regularly around 1 PM every day. It is 1 PM, and you don't know exactly what your friend is doing because he is not with you. But when another person asks you what your friend is doing, you could say:
     a   taa   sə̂ra   na   jɪ   ʊjʊ
     3.SG FUT.3.SG.IRR be.able.to IMPFV eat food
     'It is possible he is eating food'
     (More literally: 'He will be able to be eating food.')

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[5] Interestingly, the example in (9) can be used any time the speaker does not have current direct experience (i.e. is not currently in the market). It doesn't matter if the person is only 5% sure there will be yams (because it's right before the yam harvest starts, so last year's yams are gone), or 95% sure (because it is the height of yam season), so this strategy doesn't distinguish between strong and weak existential modal meaning. Neither does the example in (10). That example could be equivalent to 'possibly' OR 'probably'.

In both of these cases, modal meaning is communicated with a full clause: 'You don't know' in (9) and 'he will be able' in (10). There are, however, two cases of possible nonverbal modals in Anii, though neither has an existential interpretation.

(11)   Context: You are trying to find out whether someone went to the market or not.
      Yaa   ʊ   ce
      YAA   2.SG   go
      'Or did you go'? (or 'Maybe you went?')[6]

(12)   Context: Speaking to a friend who was supposed to go to the market and buy some food for you, but they did not.
      Maa   ʊ   ce
      MAA   2.SG   go
      'You should have gone.'

The terms *yaa* and *maa* do not have direct English translations, and unlike English modal adverbs or Anii adverbial modifiers, they appear only in this fixed clause-initial position. It is likely that *maa*, in particular, is a modal, specifically a deontic modal, perhaps best translated into English as 'should.' We return to this in Section 4.5, where we discuss counterfactuals, which also contain *maa*.

In sum, attempts to elicit modal adverbs such as *probably* or *possibly* yielded the data above or just simple questions. We are, therefore, fairly convinced that Anii does not have equivalent terms. This will affect how our analysis is implemented since we will posit a null equivalent to these adverbial forms in Anii to remain consistent with Giannakidou and Mari (2021), but there is no Anii-specific reason for doing this. This issue is discussed further in Section 2.2.2.

2.2. Theoretical background: Giannakidou and Mari 2021

Subjunctive mood has often been related to irrealis in the literature (Cristofaro 2012, de Haan 2012, Auwera and Devos 2012, McGregor and Wagner 2006, van der Auwera and Schalley 2004, von Prince et al. 2022). This makes intuitive sense, given that sentences with subjunctive moods often express unrealized meanings; that is, they do not entail the truth of the subjunctive proposition. Building on this line of thinking, we adapt Giannakidou and Mari's (2021) analysis of the subjunctive and modality, in general, to account for irrealis in Gɪsɪɖa Anii. A key insight is that "humans anchor reality not only to truth but to their own subjective understanding of truth" (3). We will show how anchoring the notion of irrealis to the speaker's perspective accounts for patterns related to its interpretation and morphosyntactic realization in Anii.

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[6] The French translation provided by our consultants is:
(i)   Ou bien tu es.allé ?
    Or good 2.SG went

Given how 'ou bien' tends to be used elsewhere, the meaning is akin to the English 'did you go or not?' The consultants also mentioned that this phrase was like asking a question even though it does not have typical sentence structure. All of this suggests that *yaa* is potentially a disjunction.

2.2.1. The subjunctive in Giannakidou and Mari 2021

A foundational concept in Giannakidou and Mari (2021) and much of Giannakidou's earlier work (Giannakidou 1994, 1998, 2002, and 2013; see also Zwarts 1998) is the notion of *veridicality.* Veridical expressions are functions that, when applied to a proposition, entail its truth. Building on this notion is the concept of *nonveridicality.* Unlike veridicality, when applied to a proposition, a nonveridical function does not entail its truth (Giannakidou and Mari 2021:4). At the opposite end of the scale from veridical functions are *antiveridical* functions, which, when applied to a proposition, entail its falsity (Giannakidou 1998). Negation is an example of an antiveridical function.

As Giannakidou and Mari (2021:8) note, since antiveridical functions entail the falsity of a proposition, they necessarily do not entail its truth. This makes antiveridical functions compatible with nonveridical ones (more specifically, antiveridical functions are subsets of non-veridical functions). This fact allows us to account for an interesting puzzle in Anii, wherein negation and irrealis obligatorily co-occur. As a preview of our analysis, we will apply the notion of (non/anti-) veridicality to generate a formal analysis of irrealis, proposing that irrealis is a type of nonveridical operator. Because nonveridical operators are compatible with but not identical to antiveridical operators, these notions will help us explain the Anii data.

Formal semantic theories of modality typically employ the concepts of a modal base and an ordering source (Kratzer 1977, 1981; see also Portner 2009). The type of modal base Giannakidou and Mari (2021) use in their analysis of the subjunctive also plays a key role in our analysis of irrealis. It consists of a nonveridical epistemic information state $M(i)$, referring to the set of worlds compatible with what an individual i knows or believes in the context of a given utterance. $M(i)$ thus serves as a formal representation of an individual's knowledge and beliefs about the world (Giannakidou and Mari 2021:59).

The fact that the modal base of a subjunctive is both nonveridical and dependent on the speaker's subjective knowledge leads to the notion of *subjective nonveridicality* as defined in (13), where w is a variable ranging over worlds, and $\neg$ is a negation operator:

(13)   Subjective nonveridicality (Giannakidou and Mari 2021: 64)
         A function F that takes a proposition p as its argument is subjectively nonveridical with respect to an individual anchor i and an epistemic state $M(i)$ iff $F(p)$ does not entail p, i.e. iff $\exists w' [w' \in M(i) \wedge w' \in \{w'' \mid p(w'')\}] \& \exists w'''[w''' \in M(i) \wedge w''' \in \{w'''' \mid \neg p(w'''')\}]$.

This definition encodes the idea that an individual i's information state $M(i)$ contains worlds in which the proposition p is true (p worlds) and worlds in which it is not true ($\neg p$ worlds). In other words, the subjectively nonveridical modal base is necessarily partitioned into p and $\neg p$ worlds based on the speaker's knowledge of and belief about the world. In unembedded sentences, i is always the speaker.

In addition to being anchored to an individual's subjective beliefs, information states may also be anchored to a particular time interval. This is intuitive because an individual's knowledge and beliefs tend to change over time. In Giannakidou and Mari's (2021) analysis of modality, the information state introduced by the modal base is anchored to the proposition's utterance time. We apply this aspect of their analysis to account for the distribution of irrealis in Anii, proposing that the modal base for irrealis is also a nonveridical information state anchored to the utterance time (or other relevant time in certain cases discussed below).

2.2.2. Giannakidou and Mari's analysis of MUST

Here, we illustrate Giannakidou and Mari's (2021) approach to analyzing the modal MUST, a positively biased modal. We will ultimately extend this analysis to model the negatively biased irrealis in Anii with relatively few modifications. The modal base for MUST is a finite information state defined as follows (69):

(14) $M(i)(t_u)(w_0) = \lambda w'$ (w' is compatible with what is known by the speaker i in w_0 at t_u)

Following Portner (2009) and others, Giannakidou and Mari include in their model a set of propositions, S, which represent typical or expected conditions (often referred to as *stereotypicality*). They further add to their ontology a function Ideal$_S$, which, when applied to the modal base, generates a subset of worlds in which all the propositions in S are true at the utterance time:

(15)   Ideal$_S$ ($M(i) (t_u)(w_0)$) = {$w' \in M(i) (t_u)(w_0)$ such that $\forall q \in S (w' \in q)$}
        (Giannakidou and Mari 2021: 80)

Note that at this stage of the analysis, there is no preference for Ideal$_S$ over its complement, ¬Ideal$_S$. For the semantics of MUST, that preference comes from an ordering source, $\mathcal{O}$, which is a meta-evaluation designed to capture the speaker's confidence in the truth of what is typical or expected. $\mathcal{O}$ contains world knowledge that allows the speaker to evaluate the likelihood of the proposition to which MUST applies. For example, in the sentence 'Lucy must have gotten COVID', $\mathcal{O}$ would contain propositions such as 'Lucy went to a maskless indoor gathering', 'People at the gathering had COVID', and 'Lucy is now sick'.

Importantly, for MUST, $\mathcal{O}$ only operates over Ideal$_S$, which creates positive bias: Ideal$_S$ is thus a weak necessity with respect to ¬Ideal$_S$, relative to $M(i)$ and $\mathcal{O}$ (Giannakidou and Mari 2021: 84). In Giannakidou and Mari's analysis, $\mathcal{O}$ is instantiated in the modal structure by a modal adverb which can be overt (e.g. *probably*) or covert (∅).

With these key elements in place, we include Giannakidou and Mari's (2021) complete lexical entry for MUST below.

(16)   Giannakidou and Mari's definition of MUST (2021: 89)
        $[\![∅ \text{ MUST}(\text{PRES}(p))]\!]^{\mathcal{O}, M, i, S}$ is defined only if the modal base $M(i)$ is nonveridical and it is partitioned into Ideal$_S$ and ¬Ideal$_S$ worlds.
        If defined,
        $[\![∅ \text{ MUST}(\text{PRES}(p))]\!]^{\mathcal{O}, M, i, S} = 1$ iff Ideal$_S$ is a weak necessity wrt ¬Ideal$_S$ relative to $M(i)$ and $\forall w' \in$ Ideal$_S : p(w', t_u)$

Looking ahead to our analysis, we note that although in (16), the modal takes scope over tense (PRES), we will not strictly adhere to this relationship in our analysis due to the patterns found in Anii. We discuss this further in Section 4.

In the context of our analysis of irrealis, the major advantage of Giannakidou and Mari's (2021) approach is that it captures the intuition that modality encodes the speaker's view of the likelihood of a set of propositions. Recalling our informal definition of irrealis, which refers specifically to a speaker's belief that an eventuality is likely not true at the utterance time, our analysis requires the encoding of bias, though for us, it is biased toward falsity. In Section 4, we extend Giannakidou and Mari's (2021) encoding of speaker bias in modals to account for the negative bias in Anii irrealis sentences. First, however, we present the data on how irrealis works in Anii.

3. Irrealis in Anii

3.1. The morphology of future, negation and wishes in Anii

In this section, we illustrate how certain sentence types require a particular morphological form, which we will ultimately classify as irrealis. Example (17) is a simple Gɪsɪɖa declarative. It reflects the typical SVO word order and has no tense or aspect morphology but is interpreted with past temporal reference and perfective aspectual reference (Morton 2014, see Section 2.1).

(17)   Context: answering the question "what did you do yesterday?"

    n   sara[7]
    1.SG.SUBJ   walk
    'I walked'

The sentence in (17) is true if the walking event has occurred at the utterance time. Compare (17) with the following sentence, which has future temporal reference:

(18)   Context: The speaker's mother asks them about their plans for meeting a friend the following morning, and how they will get there. The speaker says:

    n   tə   ma   sâra[8]
    1.SG.SUBJ   FUT   1.SG.SUBJ.IRR   walk.IRR
    'I will walk'

Contrasting (17) with (18), we see that when the walking event has not yet occurred, the verb has grammatical tone marking (indicated in the orthography by a circumflex symbol) and there is an additional subject marker, 'ma'.[9]

The sentence in (18) is not acceptable without both the *ma* subject marker and the grammatical tone on the verb, as shown in (19):

(19) (a) *n   tə   n   sâra
           1.SG.SUBJ   FUT   1.SG.SUBJ   walk.IRR
           Intended meaning: 'I will walk'
    (b) *n   tə   ma   sara
           1.SG.SUBJ   FUT   1.SG.SUBJ.IRR   walk
           Intended meaning: 'I will walk'

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[7] Orthographic convention is to write the subject marker and verb with a space between them, but there is phonological evidence (e.g. from vowel harmony phenomena) that the subject marker is probably a bound morpheme or clitic. We also describe these as subject markers rather than pronouns as they are found in the same 'slot' as noun-class agreement markers, and do not really replace nouns.

[8] The orthographic tone mark ˆ actually marks two different surface tone patterns depending on if the verb is lexically H-toned or not. The mark here represents meaning, not an actual falling tone. The phonological form of the grammatical tone represented by ˆ is a H tone, which can be pronounced on the first or second mora of the verb depending on phonological factors. A detailed description of the phonology of this tonal morpheme is found in Morton (2014).

[9] The irrealis subject marker here is added in addition to the continued presence of the default subject marker *n*. We discuss this further in our analysis in Section 4.

Sentence (19a) is syntactically ill-formed because the second instance of *n* is incompatible with the grammatical tone of the verb. Similarly, (19b) is ill-formed because the subject marker *ma* requires grammatical tone marking on the verb.[10] We, therefore, assume that irrealis is marked with a complex morpheme consisting of a particular set of subject markers in combination with a grammatical H tone instantiated on the verb.[11] This may appear to be unusual morphologically, but it is just verbal morphology that happens to have a tonal element, a common occurrence in African languages.

Both the *n* and *ma* forms change when the subject is not the first-person singular. The full conjugation for future forms is in (20), with the irrealis forms bolded. Although the phonological form of the future marker changes, this is phonologically conditioned and does not affect the meaning (see Morton 2014 for more details).

(20)   n tǝ **ma sâra**   'I will walk'
       ʊ ta **á sâra**[12]   'You (sg) will walk'
       a ta **à sâra**   'He/she/they(sg) will walk'
       gí tɪ **gì sâra**   'We will walk'
       í tɪ **ì sâra**   'You (pl) will walk'
       ba tǝ **ba sâra**   'They (pl) will walk'

For expository purposes, this paper focuses on first-person singular forms, but the analysis can be easily extended to other subject forms as well.

The *ma sâra* form, with its grammatical tone and subject marker, also occurs in sentences like (21), which is the negated form of the simple declarative in (17):

(21)   Context: Answering the question "did you walk yesterday?"
       kǝ[13]   ma   sâra[14]   na
       NEG   1.SG.SUBJ.IRR   walk.IRR   FOC
       'I did not walk'

In (21), the verb displays the same grammatical tone marking and *ma* subject marker as in the future sentence in (18). As with the future, a negated sentence is unacceptable without both *ma* and the grammatical tone of the verb:

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[10] We have chosen to maintain the word breaks used in Anii orthography. However, Morton (2014: 22–24) presents phonological evidence that strongly suggests that the subject markers are bound morphemes. In examples like (17), for example, a more linguistic representation of the verbs would be *nsara*.

[11] By 'complex morpheme' here, we mean simply that the tonal element of the morpheme is instantiated on the following word. This is likely just due to the fact that the tonal element is underlyingly unassigned to any segmental content, and is thus pronounced on the first available tone-bearing unit following the position in which it is introduced. This is common for tonal morphemes in African languages, and therefore the most likely analysis.

[12] The subject markers here are written phonetically rather than orthographically to make the forms clear, as the orthography obscures some details.

[13] The vowel in this form changes or is deleted depending on the subject marker that follows it. More details on the full conjugation and phonological complications involving this morpheme can be found in Morton (2014). We will generally refer to the morpheme as *kV* because of uncertainty as to which vowel is underlyingly present (if any).

[14] For ease of exposition, we have modified the orthography of negative sentences. The Anii orthography only uses the circumflex accent in future sentences, but we use it everywhere this particular tone pattern is used. Remember that despite the orthographic circumflex, this grammatical tone is a H tone, not a HL falling tone.

(22) a. *kə n   sâra   na
          NEG 1.SG.SUBJ   walk.IRR   FOC
          Intended meaning: I did not walk
      b. *kə ma   sara   na
          NEG 1.SG.SUBJ.IRR walk   FOC
          Intended meaning: I did not walk

Example (22) provides further support for the fact that *n* cannot be combined with *sâra* and that ma cannot be combined with *sara.*

Additionally, the simple declarative form *n sara* cannot be used in future or negated sentences, which are exactly the contexts in which the *ma sâra* form is used. Compare (23a) with (18) and (23b) with (21):

(23) (a) *n   tə   n   sara
           1.SG.SUBJ FUT   1.SG.SUBJ walk
           Intended meaning: 'I will walk'
      (b) *kə   n   sara   na
           NEG   1.SG.SUBJ walk   FOC
           Intended meaning: 'I did not walk'

Neither (23a) nor (23b) are acceptable Gısıɖa sentences – they do not have any meaning in the language.

The *ma sâra* forms can also occur as sentences in their own right. These sentences can be interpreted as wishes, or as immediate futures, depending on context. This is shown in (24), where (24a–b) are the same sentence in different contexts:

(24) (a) Context: The speaker is about to start a walking race, and is expressing their confidence:
           ma   sâra[15]
           1.SG.SUBJ.IRR   walk.IRR
           'May I walk (well) /I hope to walk (well)'
      (b) Context: I am leaving the office and my friend is on his motorcycle and sees me leave. They ask if I want a ride. To refuse the offer, I say:
           ma   sâra
           1.SG.SUBJ.IRR   walk.IRR
           'I am about to walk'[16]

These *ma sâra* forms cannot be interpreted with simple declarative meaning like the sentence in (17) and are infelicitous in contexts like those in (25a–b):

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[15] The subject here must be *ma* and not *n*, and these forms have only one subject. Forms like **n sâra* or **n ma sâra* are ungrammatical. We will discuss our analysis of *n* and how it relates to *ma* more specifically in Sections 3.2 and 4.

[16] An anonymous reviewer asks whether, since this form is used as an immediate future, the future forms with *tə* (as in example [20]) are actually a distant future. This is not the case, and the *tə* future form (*n tə ma sâra*) could also be used in the context in (24b). It is possible to get a distant future reading by adding another morpheme (*tí*, as in *n tə ma tí sâra*). See Morton (2014) for more details.

(25) (a) Context: Answering the question "what did you do yesterday?"
    #ma   sâra
    1.SG.SUBJ.IRR   walk.IRR
    Intended Interpretation: 'I walked'

(b) Context: The speaker is on the phone with a friend, and the friend asks what she is doing while talking on the phone. The speaker answers:
    #ma   sâra
    1.SG.SUBJ.IRR   walk.IRR
    Intended Interpretation: 'I am walking'

One of the most common use of this subject marker and verb tone combination in simple sentences is in traditional greetings, like example (1), repeated here.

(26) Context: A wish expressed at the end of a traditional greeting
    Ga–ja   ga   lâa   m–búmó
    CL.Đ–God   SUBJ.CL–Đ.IRR   lift.IRR CL.F–fatigue
    'May God take away your fatigue'

Note that the subject marker is still present when there is a full nominal subject, though it changes form to agree with the noun. The verb has the same grammatical tone marking as the forms in (18) and (21). Sentences like that in (26) are an important element of daily standard greetings, expressing positive hopes for the addressee.

A key feature of Gɪsɪḍa Anii grammar, then, is a morphological and semantic contrast between forms like *n sara* and those like *ma sâra*. Crucially, the meaning difference corresponding to this morphological contrast must lie in an element of meaning held in common between sentences with future temporal reference, negated sentences, and sentences expressing wishes or hopes. These meanings can be unified under the notion of *irrealis*, which we take to denote the idea that the speaker believes that an irrealis-marked proposition is unlikely to be true at the time of utterance. Thus, an irrealis-marked proposition is nonveridical but not anti-veridical. This definition differs slightly from a common notion of *reality status* (Elliot 2000, as cited in de Haan 2012:108), that is, whether a given eventuality is realized or unrealized (Bybee 1998, Cristofaro 2012, de Haan 2012, Givón 1994). We thus have a slightly different definition of the concept of reality status that is more compatible with the facts of Anii and provides the basis for the formal analysis presented below.

3.2. Reality status in Anii

As we have shown, Gɪsɪḍa Anii has a basic distinction between realis and irrealis, as in examples (17) and (24a), repeated here as (27a–b):

(27) (a) Context: answering the question "what did you do yesterday?"
    n   sara
    1.SG.SUBJ walk
    'I walked'

(b)   Context: The speaker is about to start a walking race, and is expressing their confidence:

ma   sâra
1.SG.SUBJ.IRR   walk.IRR
'May I walk (well) /I hope to walk (well)'

In contrast with example (27a), the sentence in (27b) is morphologically marked for irrealis, with the subject marker *ma* and a grammatical high tone on the verb.

Unlike irrealis, realis meaning is not expressed with consistent overt morphology. Examples (28a–b) are both realis sentences, and although the subject marker is the same, the verb has a different tone pattern in each case:

(28) (a)   Context: The speaker is on the phone with a friend, and the friend asks what she is doing while talking on the phone. The speaker answers:

n   tɪ   sara[17]
1.SG.SUBJ   IMPFV   walk
'I am walking'

(b)   Context: The speaker is telling a story about their childhood.

n   bʊŋa   sará[18]
1. SG.SUBJ   FAR.PST   walk
'I walked long ago'

Whereas the irrealis morpheme (which never occurs in realis sentences) consists of a particular subject marker and a grammatical tone, which always occur together, (28a–b) show that this is not the case for realis.

Given the data above, it would be reasonable to conclude that the default first-person subject marker *n* is a realis marker. However, the data do not support this conclusion. As the following sentence (repeated from [18]) shows, this marker can co-occur with irrealis marking in future sentences:

(29) Context: The speaker's mother asks them about their plans for meeting a friend the following morning, and how they will get there. The speaker says:

n   tə   ma   sâra
1.SG.SUBJ   FUT   1.SG.SUBJ.IRR   walk.IRR
'I will walk'

Because both markers can occur in this sentence, which has irrealis meaning, it is probably not the case that *n* marks realis meaning.

In this section, we have shown that there is a clear morphological distinction in Anii between realis and irrealis. When the interpretation is irrealis, the sentence is marked as such, but realis remains unmarked morphologically. In our analysis, we will posit that reality status (or, more specifically, [non]veridicality) is always semantically and syntactically present in the Anii clause, even when there is no overt morphological marking.

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[17] The tone pattern on the verb here is low-low
[18] The high tone on the verb here is linked to the far-past marker, and is not written in the orthography, but is included here to make our point clear.

4. A Formal Analysis of Irrealis in Gɩsɪɖạ Anii

Our analysis is given in the framework of Montague semantics (Dowty et al. 1981) and uses logical types *i* for individuals, *ι* for time intervals, *t* for truth values, *ε* for eventualities, and *ω* for possible worlds.[19] We also use logical constants, predicates and lambda abstraction.

4.1. Future clauses

In this section, we model the meaning of future clauses in Anii, which are obligatorily marked as irrealis. We propose that the future selects for irrealis modality for both semantic and syntactic reasons. Semantically, future meaning includes the concept that the proposition is not true at utterance time (see e.g. Giannakidou and Mari 2018a). Morphosyntactically, future morphology systematically co-occurs with irrealis marking. Following Morton (2014), we assume that tense and aspect, in particular nonfuture tense and perfective aspect, may be phonologically null in Anii. We further assume that the morpheme *n* (the first-person singular subject marker) is introduced as part of the lexical verb and where possible, raises to the highest edge of the verb's extended projection.[20]

We begin with a step-by-step analysis of *n tə ma sâra*, 'I will walk'. This sentence has perfective aspectual and future temporal references. Aspect is morphologically null, and tense is marked with the future marker *tə*. The predicate introduces eventualities and individuals. The variable *e* ranges over eventualities (type *ε*)[21], *sp* denotes the speaker of the utterance and is a contextually defined variable ranging over individuals (type *i*), and *w* is a variable ranging over possible worlds (type *ω*).

The verbal predicate *n sara* is of type $<<\omega, <\varepsilon, t>>$, meaning that it is an eventuality of the speaker walking (type $<\varepsilon, t>$) that needs to be interpreted in a particular world (type $<\omega>$). Thus, the meaning of the predicate can be expressed in predicate logic (in a model *M*, under a variable assignment function *g* and context function (*c*), and in a given world (*ω*)) as in (30):

(30) $[\![n\ sara_{<<\omega, <\varepsilon, t>>>}]\!] = [\![\lambda w_{<\omega>}\lambda e_{<\varepsilon,t>}[\mathrm{walk}'(e,\ sp,\ w)]]\!]^{M,\ g,\ c,\ \omega}$

This predicate needs to combine with aspectual reference, which situates the eventuality at a time interval, which is then further specified by temporal reference. To do this, we follow Reichenbach (1947) and Klein (1994) in understanding tense and aspect as referring to three time intervals: (i) the eventuality time, which is the time during which the eventuality referred to by the verbal predicate holds true, (ii) the topic time (also known as reference time), which is the specific time that a clause is about, and is determined either from context or from adverbials (e.g. *yesterday* in *I walked home yesterday*), and (iii) the utterance time, which is the time at which a sentence is spoken. In this framework, aspectual reference is modeled as the inclusion or precedence relation between the topic time and the eventuality

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[19] Some of the symbols in this analysis are used differently from those employed in Giannakidou and Mari (2021), as described in Section 2.2. This is so that our analysis is more compatible with other work on Anii such as Morton (2014). In an attempt to avoid confusion, we define each variable as it is being used, both in our description of Giannakidou and Mari's work as well as in our own analysis.

[20] In subsequent sections, we discuss cases where this raising appears to be blocked.

[21] Technically, this would be a variable ranging over eventive eventualities only, as stative eventualities in Anii are interpreted differently with reference to temporal and aspectual reference. See Morton (2014) for more detail.

time, and temporal reference is modeled as the precedence relation between the utterance time and the topic time.

We propose that the aspect selects for the verbal predicate in Anii and define the perfective aspect as follows:

(31) $[\![\text{PERF}_{<<\varepsilon,\ t>,\ <\iota,\ t>>}]\!]^{M,\ g,\ c,\ \omega} = [\![\lambda P_{<\varepsilon,\ t>}\lambda i_{<\iota>}\exists e[P(e) \wedge \tau(e) \subset i]\ ]\!]^{M,\ g,\ c,\ \omega}$

Aspect crucially introduces τ, a temporal trace function, which maps eventualities to their eventuality times (sets of time intervals). Aspect also introduces the variable i, which ranges over time intervals ($<\iota>$) and will be defined by the tense marker as the contextually determined topic time (represented as the variable t_t). The definition in (31) specifically shows that perfective aspectual reference means that the topic time of the clause is included in the eventuality time.

Aspect is then selected for by irrealis modality.[22] Under our definition of irrealis, the relevant worlds for modal interpretation are those in which the speaker does not expect the clause to be true at the utterance time. As a modal, irrealis has a modal base M(sp, t_u, w_0), which is an information state as shown in (32) (Giannakidou and Mari 2021:59):

(32)   M(i)(t_u)(w_0) = $\lambda w'$ (w' is compatible with what is known by the speaker i in w_0 at t_u)

This information state is a set of worlds associated with the speaker (sp) representing what the speaker knows or believes at the utterance time (the contextually-defined variable t_u), in a world.

The modal also has an ordering source $\mathcal{O}$, which takes into account how the speaker expects the world to work. Recall that in Giannakidou and Mari's (2021) analysis, the ordering source is an overt or covert modal adverb. Since Anii does not have overt modal adverbs (see Section 2.1.2), we assume this element is present but invariably null. This allows us to maintain a core aspect of Giannakidou and Mari's analysis and potentially allows for an easier extension of our analysis to other languages.

Our claim is that irrealis in Anii is akin to MUSTN'T,[23] adapted from Giannakidou and Mari's MUST (2021:89, and above in [16]), although a key difference is that we assume the modal base is defined in relation to the speaker and the utterance time, and there is no tense operator within the modal[24]:

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[22] In the context of a formal analysis, the assumption that modality selects for aspect requires that reality status always be projected in Anii sentences, even those that are realis. This assumption is supported by the Anii data, as discussed in Section 3.2. The question of whether this applies in other languages is worth investigating further.

[23] We use this form for illustrative purposes, but importantly, we are not assuming the presence of the semantics of 'not' or 'n't' within the modal, despite the English negation form in the name.

[24] An updated version of this theory (Giannakidou and Mari 2024) proposes that in some languages, there may be inferential modals that allow for either a (positively) biased or an unbiased interpretation depending on context. It is possible that this approach could be applied in Anii, where IRR could be interpreted as either unbiased (e.g., in future sentences), or negatively biased (e.g., in negative sentences, as discussed below). This is an interesting possibility for future research, although it might require a different approach to tense in Anii than that taken here. In either approach, the fundamental components of the analysis in the current paper remain: IRR is analyzed as an epistemic modal that interacts with the speaker's belief about the truth of a given proposition.

(33) $[\![\text{IRR}]\!] = [\![\varnothing\ (\text{MUSTN'T}(Q))]\!]^{O,\ \text{M},\ i,\ S}$
       $[\![\varnothing\ (\text{MUSTN'T}(Q))]\!]^{O,\ \text{M},\ i,\ S}$ is defined only if the modal base $\text{M}(sp,\ t_u)$ is nonveridical and it is partitioned into Ideal_S and $\neg\text{Ideal}_S$ worlds.
       If defined,
       $[\![\varnothing\ (\text{MUSTN'T}(Q))]\!]^{O,\ \text{M},\ i,\ S} = 1$ iff $\neg\text{Ideal}_S$ is a weak necessity wrt Ideal_S relative to $\text{M}(sp,\ t_u)$ and $\forall w' \in \neg\text{Ideal}_S\ ,\ Q(w')$

The information state $\text{M}(sp,\ t_u)$ is necessarily partitioned into worlds in which 'I walk' is true at the utterance time (Ideal_S worlds) and those in which it is not ($\neg\text{Ideal}_S$ worlds). The irrealis sentence can only be uttered in a context in which the ordering source prefers $\neg\text{Ideal}_S$ worlds to Ideal_S worlds.

The speaker's expectation of a $\neg\text{Ideal}_S$ world does not completely discount the possibility that the actual world is, in fact (or will be a future time) an Ideal_S world. Irrealis marking, therefore, allows the speaker to hold open the possibility that their expectations will not be met. In Giannakidou and Mari's (2021) terms, irrealis is, therefore, *nonveridical.* This aspect of our analysis clearly distinguishes irrealis from negation, which is *antiveridical.* This is crucial to account for the fact that, as shown above, irrealis and negation co-occur in Gɩsɩɖa Anii.

Note that, unlike the Giannakidou and Mari (2021) definition of MUST (see Section 2.2.2), there is no tense operator under the modal in our MUSN'T definition. This is due to the tense-aspect system of Anii. In Giannakidou and Mari's (2021) analysis, the future orientation of subjunctives is derived from a NONPAST operator within the modal. This analysis builds on the fact that the languages they analyze appear to have an important past/nonpast distinction. This distinction cannot be used easily in Anii because Anii instead has a future/nonfuture distinction with no clear past/nonpast tense division. Evidence for this includes the fact that the only overt required tense marker in Anii is the future, and also that many Anii phrases can be understood as present or past, depending on context (see Section 2.1.1). Indeed, we do not want to assume the presence of a nonpast operator within Anii irrealis because irrealis forms are also found in past contexts in negative sentences. Instead, we simply assume that in Anii, irrealis modality does not contain any tense elements and rather combines with tense outside of the modal phrase.

Note that our analysis of irrealis as a nonveridical modal makes tense, in a sense, redundant. This is because, given our claim that reality status is a fundamental clausal category in Anii, (non)veridicality is central to the semantics of Anii clauses. This makes tense redundant because the future/nonfuture tense distinction is also a nonveridical/veridical distinction, as a speaker has no way of knowing whether the future is true at the utterance time.

The languages Giannakidou and Mari (2021) build their analysis on are not only tense-heavy but also center around a past/nonpast distinction. This distinction does not align with a veridicality distinction since both past and nonpast contain veridical meanings (i.e. both past and present, which are part of nonpast, are veridical). For this reason, although it makes sense for Giannakidou and Mari to include tense within their representation of the modal, we do not. Instead, our modal phrase is simply veridical or nonveridical, and specific temporal information comes from the actual tense projection outside the modal.

In the form *n tə ma sara* 'I will walk', the future orientation clearly comes from the future marker *tə*, which appears before the irrealis form. In our analysis, this marker relates the topic

time to the utterance time of the clause. Future tense denotes that the topic time follows the utterance time:

(34) $[\text{FUT}_{<i>}]^{M,\ g,\ c,\ \omega} = [t_i]^{M,\ g,\ c,\ \omega}$
      only defined if $g(t_i) > [t_u]^{M,\ g,\ c,\ \omega}$

In (34), the variable assignment function g defines the variable i as the topic time (t_t), but states that this can only be done for topic times that follow the utterance time (t_u), restricting the clause to future temporal reference.

Our complete analysis for the sentence *n tə ma sâra* is given in (35):

(35)
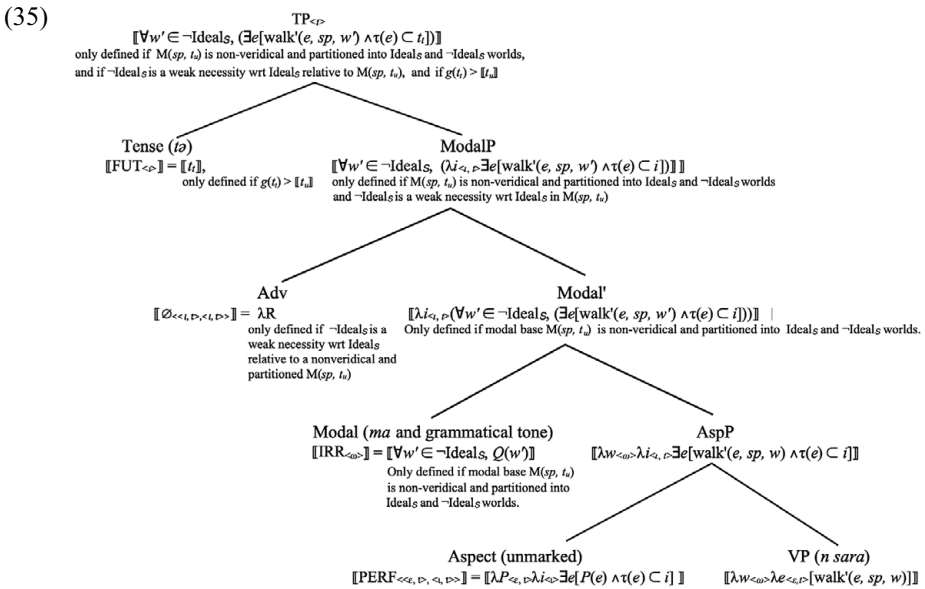
With respect to the syntax, we assume that the subject marker *n* raises to the edge of the verb's extended projection, procliticizing to the tense marker. This captures the fact that the surface word order of this sentence is *n tə ma sâra* instead of *tə ma n sâra*.[25] For more discussion on the syntax of these sentences, see Blanchette and Morton (2024).

4.2. Negation

Like future sentences, negated sentences in Gɪsɪɖa Anii also obligatorily occur with the subject marker and verb tone characteristic of irrealis (example [36] is [18] repeated):

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[25] As an anonymous reviewer suggests, the presence of two subject markers, *n* and *ma* could be related to the future being grammaticalized from a clause subordination structure where the future marker *tə* was a verb. As this would involve two verbs, it would have been natural for there to be two subject markers. More diachronic data would be needed to investigate this possibility further.

(36) Context: Answering the question "what did you do yesterday?"
    kə   ma   sâra   na
    NEG   1.SG.SUBJ.IRR   walk.IRR   FOC
    'I did not walk.'

(37) Context: a folktale talking about a wrestling match.
    K'ʊ–shilé   kə   ba   ŋə̂   a–kulka   na.
    POSS CL.Ð–day NEG 3.PL.SUBJ.IRR see.IRR CL.A–knocked.down.person. FOC
    'That day, they didn't see a loser.'

The subject markers *ma* and *ba* in (36) and (37), respectively, together with a high tone on the verb (orthographically represented with the circumflex), mark the sentences as irrealis. Without these two components of irrealis morphology these negative sentences are judged unacceptable.

Another small detail to note is that the subject marker *n* is no longer present at the left edge of the verb extended projection in (36) or (37), as it would be in future clauses such as those discussed in Section 4.2. We assume this is due to the fact that the negation *kV* blocks the raising of this element. This may have something to do with the fact that *kV* is obligatorily the leftmost element in a negated Anii verb phrase, which may also affect the form of negated future clauses, as discussed below. A fuller syntactic analysis of the mechanisms behind this issue is left for future research.

Why would negation obligatorily co-occur with irrealis in this way? Under our definition, irrealis expresses the speaker's bias toward the predicate being untrue at the utterance time. Importantly, a speaker may be biased toward the predicate being untrue without ruling out its truth entirely. As discussed above, this is precisely what distinguishes the semantics of irrealis from the semantics of negation, which, when applied to a proposition, reverses its truth value. In Giannakidou's (1998, 1999, 2000) terms, irrealis would be nonveridical, whereas negation is antiveridical. Irrealis is, therefore, semantically distinct from yet compatible with negation.[26] Negation and irrealis are thus predicted to readily compose with one another in the semantics, and in our formal analysis below, we illustrate how this might be captured.

We can account for why negation and irrealis are allowed to co-occur, but we have not yet offered an explanation as to why they must co-occur in Gısıɖa Anii. Our explanation for this co-occurrence requirement is formal in nature, building on the argument that veridicality is a core component of the verb's extended projection in Gısıɖa Anii clauses. We illustrate with a step-by-step derivation of example (34) (*kə ma sâra na* 'I did not walk').

For our analysis of Gısıɖa Anii negative sentences, we adopt the definition of negation given in Collins and Postal (2014:25)

(38) If X has a semantic type ending in $<t>$, then
    NEG takes X with semantic value $\lambda P_1 \ldots \lambda P_n [\ldots]$
    And returns Y with semantic value $\lambda P_1 \ldots \lambda P_n \neg [\ldots]$

Importantly, under this definition, negation is not a type-changing operation. This allows negated predicates to compose with tense, aspect, and modality in the same way that non-negated predicates do, including in future-marked clauses.

Under the definition of negation in (8), our analysis of *kə ma sâra na*, 'I did not walk' is nearly identical to our analysis of the future sentence presented above in section 4.1. The

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[26] See also Verstraete (2005), which argues that *nonactualization* is the shared semantic element between irrealis and negation.

only differences are that the tense is nonfuture, and a negation is added that reverses the truth value of the predicate without changing its type. The analysis is given in (39)[27,28]:

(39)

TP
$\llbracket \forall w' \in \neg\text{Ideal}_S, \exists e[\neg\text{walk}'(e, sp, w') \wedge \tau(e) \subset t_i] \rrbracket$
only defined if M(sp, t_u) is non-veridical and partitioned into Ideal$_S$ and ¬Ideal$_S$ worlds,
and if ¬Ideal$_S$ is a weak necessity wrt Ideal$_S$ relative to M(sp, t_u), and if g(t_i) ≤ $\llbracket t_u \rrbracket$

Tense (unmarked)
$\llbracket \text{NONFUT}_{\langle i \rangle} \rrbracket = \llbracket t_i \rrbracket$
only defined if g(t_i) ≤ $\llbracket t_u \rrbracket$

NegP
$\llbracket \forall w' \in \neg\text{Ideal}_S, \lambda i_{\langle i, l \rangle} \exists e[\neg\text{walk}'(e, sp, w') \wedge \tau(e) \subset i] \rrbracket$
only defined if M(sp, t_u) is non-veridical and partitioned into Ideal$_S$ and ¬Ideal$_S$ worlds
and ¬Ideal$_S$ is a weak necessity wrt Ideal$_S$ in M(sp, t_u)

NEG
$\llbracket kV \rrbracket = \neg$

ModalP
$\llbracket \forall w' \in \neg\text{Ideal}_S, \lambda i_{\langle i, l \rangle} \exists e[\text{walk}'(e, sp, w') \wedge \tau(e) \subset i] \rrbracket \rVert$
only defined if M(sp, t_u) is non-veridical and partitioned into Ideal$_S$ and ¬Ideal$_S$ worlds
and ¬Ideal$_S$ is a weak necessity wrt Ideal$_S$ in M(sp, t_u)

Adv
$\llbracket \varnothing_{\langle\langle t, l \rangle, \langle t, l \rangle\rangle} \rrbracket = \lambda R$
only defined if ¬Ideal$_S$ is a weak necessity wrt Ideal$_S$ relative to a nonveridical and partitioned M(sp, t_u)

Modal'
$\llbracket \forall w' \in \neg\text{Ideal}_S, \lambda i_{\langle i, l \rangle} \exists e[\text{walk}'(e, sp, w') \wedge \tau(e) \subset i] \rrbracket \rVert$
Only defined if modal base M(sp, t_u) is non-veridical and partitioned into Ideal$_S$ and ¬Ideal$_S$ worlds.

Modal (*ma* and grammatical H tone)
$\llbracket \text{IRR}_{\langle i \rangle} \rrbracket = \llbracket \forall w' \neg\text{Ideal}_S, Q(w') \rrbracket$
Only defined if modal base M(sp, t_u) is non-veridical and partitioned into Ideal$_S$ and ¬Ideal$_S$ worlds.

AspP
$\llbracket \lambda w_{\langle \omega \rangle} \lambda i_{\langle i, l \rangle} \exists e[\text{walk}'(e, sp, w) \wedge \tau(e) \subset i] \rrbracket$

Aspect (unmarked)
$\llbracket \text{PERF}_{\langle\langle \varepsilon, l \rangle, \langle i, \omega \rangle\rangle} \rrbracket = \llbracket \lambda P_{\langle \varepsilon, l \rangle} \lambda i_{\langle \omega \rangle} \exists e[P(e) \wedge \tau(e) \subset i] \rrbracket$

VP (*n sara*)
$\llbracket \lambda w_{\langle \omega \rangle} \lambda e_{\langle \varepsilon, l \rangle}[\text{walk}'(e, sp, w)] \rrbracket$

As illustrated in (39), negation selects the modal phrase that introduces irrealis. The fact that negation selects for irrealis modality falls out from the assumption that reality status is always projected in Gɩsɩɖa Anii, and only irrealis (which is nonveridical) is compatible with the antiveridical negation. Realis, which is veridical, cannot be combined with negation.[29] Because the tense here is veridical (nonfuture), it is only the negation that allows for irrealis in this case. A non-negated version of this sentence would be realis (veridical), as shown in Section 2. This approach allows us to capture the fact that negation obligatorily co-occurs with irrealis marking in this language, even when the tense is veridical.

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[27] With respect to the clause-final marker *na* in negative sentences, we follow Aboh (2010) in assuming that such markers may reside in a projection within the peripheral C-domain, outside of the verb's extended projection (see also Biberauer 2015). The C-domain is the locus for elements such as force, topic, and focus (Rizzi 1997). We propose that in Gɩsɩɖa Anii, the sentence final marker *na* in negative sentences is in fact purely a focus marker. To derive the clause-final surface position of *na*, we propose that the focus particle is generated in the head of a Focus Phrase (FocP), and that in negated sentences the entire TP raises to its specifier. See Blanchette and Morton (2024) for a more detailed syntactic analysis.

[28] Recall from Section 2.1.1 that the reason this sentence cannot be interpreted as present is because perfective aspect is incompatible with present tense. When nonfuture tense occurs with imperfective aspectual reference, for example, it can be interpreted as either past or present tense, depending on context.

[29] We assume that realis sentences such as 'I walk' have a structure similar to (39) without the negation. Since the modal is realis, the modal base (i.e. what the speaker knows at the utterance time), would not be partitioned, and would consist of only Ideal$_S$ worlds. This would also be compatible with the veridical nonfuture tense. A full analysis of realis sentences is beyond the scope of this paper.

4.3. Combining future and negation

When Gɪsɪɖa sentences with future temporal reference are negated, the future marker *tə* is not present. Instead, the tense is marked by a high tone pronounced on the preverbal negation marker *k*V, as shown in (40):

(40) Context: Someone who does not like walking to get places is answering the question "when you come tomorrow, will you walk?"

aaɪ,	kə́[30]	ma	sâra	na
no	NEG.FUT	1.SG.SUBJ.IRR	walk.IRR	FOC

'I will not walk'

It is a puzzle as to why the future tense is indicated only with a high tone here rather than the future marker. We assume that this is a syntactic puzzle related to the fact that the negation marker *k*V is always VP-initial. The fact that neither the subject marker *n* nor the future marker *tə* is present in future negated sentences is a syntactic puzzle that is beyond the scope of this paper. A key point here is that the semantics of sentences such as (40) clearly contain both negation and future temporal reference, and it is those semantics that license irrealis modality.

We analyze sentences like (40) in a manner analogous to our analysis of nonfuture negative sentences. In particular, we assume that the presence of negation prevents the subject marker *n* from rising to the edge of the verb's extended projection. Instead, it stops at the modal level and remains unpronounced. Something similar may be happening with the future marker, as well, to leave it only pronounced as a H tone. The semantic derivation is given in (41) (abstracting away from the focus marker *na*; see fn. 23):

(41)

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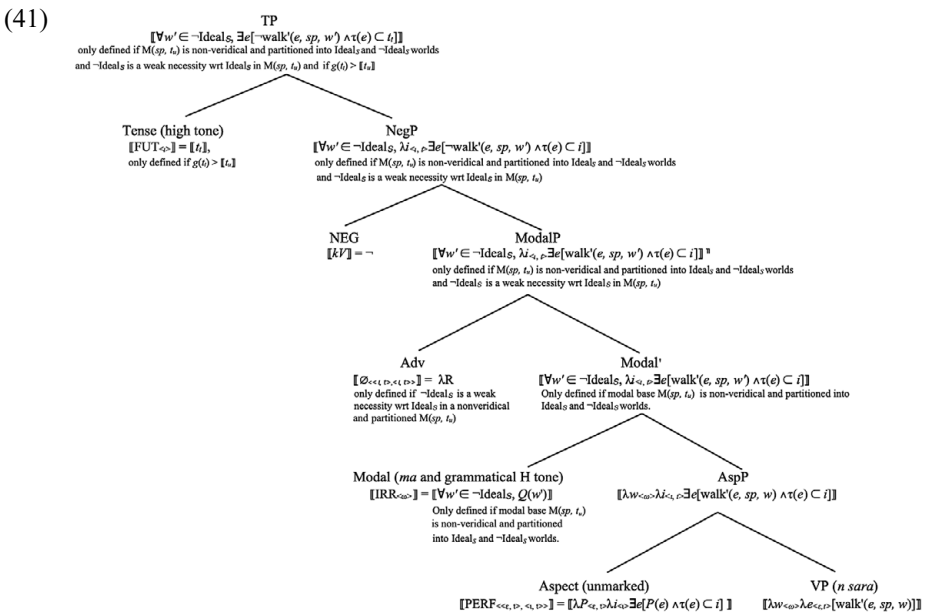
[30] This high tone on the negation marker is there in speech, but not written in the orthography. It is included here for clarity.

4.4. Matrix irrealis clauses

In the analyses provided above, negation and future tense both select for irrealis modality. However, there seems to be a different type of sentence where the presence of irrealis is not driven by the selectional properties of other clausal elements. These sentences are distinct from the sentences analyzed above because they appear to contain only an irrealis marked subject and predicate. Examples are given in (42) (repeated from [24]):

(42) (a)   Context: The speaker is about to start a walking race, and is expressing their confidence/hope for doing well:
        ma   sâra
        1.SG.SUBJ.IRR   walk.IRR
        'May I walk (well) /I hope to walk (well)'

      (b)   Context: I am leaving the office, and my friend is on his motorcycle and sees me leave. They ask if I want a ride. To refuse the offer, I say:
        ma   sâra
        1.SG.SUBJ.IRR   walk.IRR
        'I am about to walk'

The sentence in (42) is an irrealis sentence, which is usually interpreted as expressing a wish, as in (42a), but in certain contexts, can be interpreted as an immediate future (42b). Note that these sentences consist of only an irrealis subject marker and verb, and there is no evidence for the presence of irrealis-selecting elements such as future tense or negation. We, therefore, refer to these forms as matrix irrealis clauses.

We propose that in sentences like (42a–b), the root of the clause is the modal itself, as shown in (43):
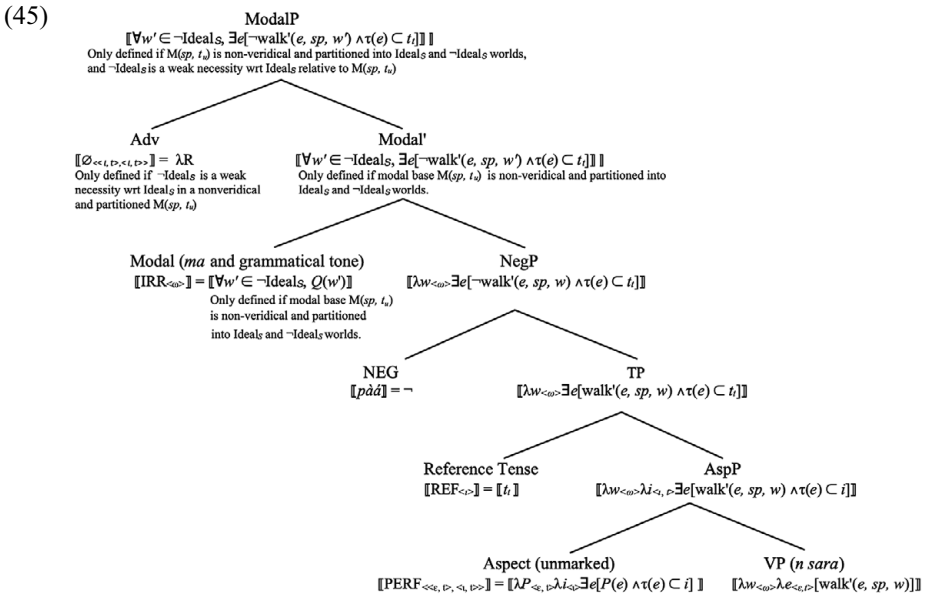
(43)
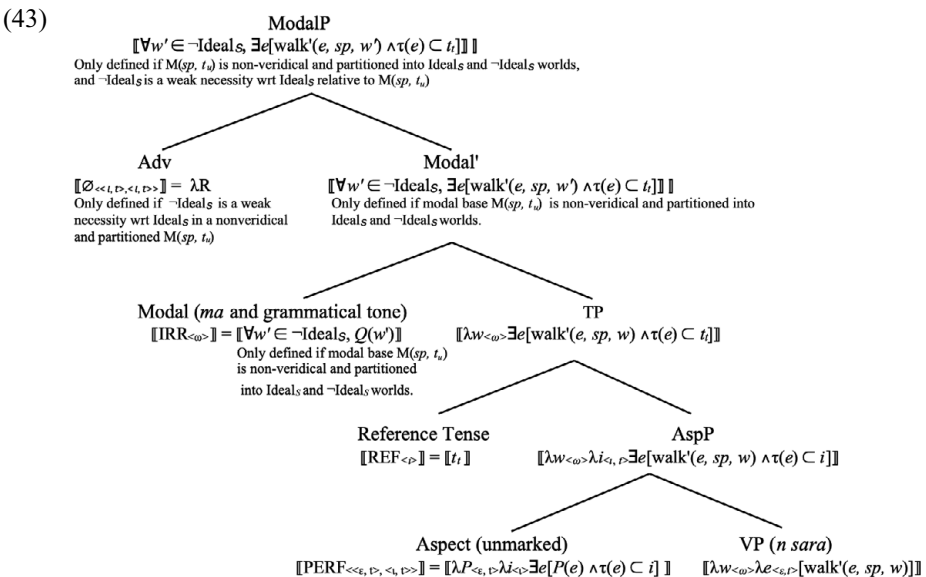
Note that the tense marker here is not restricted to any specific relationship between the reference time and the topic time. However, the irrealis modal above it will restrict the interpretation to temporal references that are compatible with non-veridical meaning (generally, future temporal references). Depending on the context, this restriction to only nonveridical interpretation gives either a wish or a near-future meaning. We refer to this type of tense as reference tense, or REF, and propose that the irrealis modality selects for REF rather than being selected by it. The meaning of irrealis modality remains unchanged.

Support for the analysis in (43) is found in the negation of matrix irrealis clauses, such as in (44), in which the negation is spelled out in a different form and location from what we have seen thus far:

(44) Ma   pàá   sâra   na.
      1.SG.SUBJ.IRR   NEG   walk.IRR   FOC
      'May I not walk.' / 'I am not about to walk.'

Note that in (36), the negation is *pàá*, rather than *k*V. It is also noteworthy that the surface order is different from other types of negative sentences, with *pàá* following the irrealis subject marker *ma* instead of preceding it as *k*V does. This suggests a distinct underlying syntax in which negation resides below modality, which results in a different morphological reflex of negation. Our proposed structure is shown in (45):

(45)

ModalP
$[\![\forall w' \in \neg \text{Ideal}_S, \exists e [\neg \text{walk}'(e, sp, w') \wedge \tau(e) \subset t_t]]\!]$
Only defined if M(sp, t_u) is non-veridical and partitioned into Ideal$_S$ and $\neg$Ideal$_S$ worlds, and $\neg$Ideal$_S$ is a weak necessity wrt Ideal$_S$ relative to M(sp, t_u)

Adv
$[\![\varnothing_{<<t, t>, <t, t>>}]\!] = \lambda R$
Only defined if $\neg$Ideal$_S$ is a weak necessity wrt Ideal$_S$ in a nonveridical and partitioned M(sp, t_u)

Modal'
$[\![\forall w' \in \neg \text{Ideal}_S, \exists e [\neg \text{walk}'(e, sp, w') \wedge \tau(e) \subset t_t]]\!]$
Only defined if modal base M(sp, t_u) is non-veridical and partitioned into Ideal$_S$ and $\neg$Ideal$_S$ worlds.

Modal (*ma* and grammatical tone)
$[\![\text{IRR}_{<\omega>}]\!] = [\![\forall w' \in \neg \text{Ideal}_S, Q(w')]\!]$
Only defined if modal base M(sp, t_u) is non-veridical and partitioned into Ideal$_S$ and $\neg$Ideal$_S$ worlds.

NegP
$[\![\lambda w_{<\omega>}.\exists e [\neg \text{walk}'(e, sp, w) \wedge \tau(e) \subset t_t]]\!]$

NEG
$[\![pàá]\!] = \neg$

TP
$[\![\lambda w_{<\omega>}.\exists e [\text{walk}'(e, sp, w) \wedge \tau(e) \subset t_t]]\!]$

Reference Tense
$[\![\text{REF}_{<t>}]\!] = [\![t_t]\!]$

AspP
$[\![\lambda w_{<\omega>}.\lambda i_{<t>}.\exists e [\text{walk}'(e, sp, w) \wedge \tau(e) \subset i]]\!]$

Aspect (unmarked)
$[\![\text{PERF}_{<<\varepsilon, t>, <t, t>>}]\!] = [\![\lambda P_{<\varepsilon, t>}.\lambda i_{<t>}.\exists e [P(e) \wedge \tau(e) \subset i]]\!]$

VP (*n sara*)
$[\![\lambda w_{<\omega>}.\lambda e_{<\varepsilon, t>}.[\text{walk}'(e, sp, w)]]\!]$

This type of structure may support the claim of Puskás 2018 that certain optatives or bouletics can never scope under negation, as this use of irrealis in Anii is typically interpreted as a wish.

Interestingly, negation with *pàá* also occurs in imperatives, although irrealis does not, as shown in (46):

(46) (a)   Sará!³¹[31]
             walk.IMP
             'Walk!'
      (b)   Pàá sará na!
             NEG walk.IMP FOC
             'Don't walk!'

There have been suggestions in the literature (e.g. Portner 2007) that commands may contain elements of deontic meaning (specifically deontic necessity). This can be modeled in our system through the introduction of a modal at the root of an imperative clause. Additionally, the use of *pàá* in imperatives suggests that in Anii, in negative imperatives, like in negative wishes such as in (44), there is a modal above negation. When the modal occurs above negation, the negation is spelled out as *pàá*. We leave a detailed analysis of the syntax of imperatives in Anii to future research.

4.5. Conditionals, counterfactuals, and the typology of irrealis in Anii

Conditional sentences have traditionally been important in the analysis of irrealis meaning. This is because, by their nature, conditionals contribute propositional content that is clearly unrealized at a given time. For example, in the Anii conditional in (47), the conditional clause 'if I go', which includes the conditional marker *ta*, refers to the fact that the act of going has not been realized:

(47) N ta   ce, n tǝ ma   shî   boɖoboɖo
      I if/when go I FUT I.IRR buy.IRR bread
      'If I go, I will buy bread.'

The consequent clause in (47) has irrealis morphology because of the future tense. However, it is noteworthy that the conditional clause itself is not marked for irrealis. At first glance, this seems unexpected since the propositional content here is unrealized. Recall, however, that the concept of negative bias is central to our definition of irrealis. We have proposed that irrealis contributes to the meaning that the speaker is biased toward the proposition not being true at utterance time. Conditional sentences, on the other hand, are unbiased.

In (47), the propositional content of the conditional is 'I go'. The meaning here is that it is equally likely that the speaker will go or not. There is no bias. In more formal terms, a conditional does involve the partition of a speaker's information state into p and $\neg p$ worlds, similar to the modal base for our definition of irrealis. However, in the case of conditionals like (47), the interpretation is that both p and $\neg p$ worlds are equally likely. Thus, the conditional *ta* may act as a modal whose ordering source is unbiased, and this lack of bias makes it incompatible with irrealis.

Negative conditionals do have irrealis, but that is due to the presence of negation, which is antiveridical and, therefore, creates an environment for the biased nonveridical irrealis modal. The conditional *na*³²[32] itself is still unbiased (the speaker considers it equally likely

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[31] The orthography has been slightly modified here for clarity.
[32] The change from *ta* to *na* as the marker of conditional is likely about focus, and is orthogonal to the issues in this paper.

that they will go as not go). The presence of irrealis in (48) is thus triggered by the negation, not by the conditional:

(48)   Context: Someone won't be able to buy bread if they go to work, but is telling their friend they will get the bread if they can:

Na	kə	ma	cê	n–təma	na,
If/when	NEG	1.SG.IRR	go.IRR	CL.F–work	FOC
n	tə	ma	shî	boɖoboɖo	
1.SG	FUT	1.SG.IRR	buy.IRR	CL.B.bread	

'If I don't go to work, I will buy bread.'

In (48), the conditional contributes the meaning that it is equally likely for it to be true that the speaker does not go to work as for it to be false. The presence of irrealis in the negated and future clauses in this example is a further illustration of the fact that these contexts trigger irrealis in support of the analysis above.

Counterfactual conditionals are often considered a prototypical context for irrealis morphology (see Cristofaro 2012, de Haan 2012, von Prince et al. 2022). In Anii, however, such forms do not exhibit irrealis morphology, as shown in (49):

(49)   Maa   n   ce   gʊ–ya,   maa   n   shɪ   ɪ–je
        MAA   1.SG   go   CL.Ɛ–market   MAA   1.SG   buy   CL.U–yams
        'If I had gone to the market, I would have bought yams.'
        Lit. 'I should have gone to the market, I should have bought yams.'

Logically, counterfactuals are antiveridical as the speaker knows that the proposition they are discussing did not occur. For example, in (49), the speaker did not go to the market, and this sentence cannot be used in contexts where they did. Because counterfactuals are antiveridical, we might expect them to be compatible with, or even trigger, irrealis, as negation does.

The answer to this puzzle seems to lie with how counterfactual conditionals are expressed in Anii, specifically in the use of *maa*, which is best translated as 'should' (see also example [12]), as shown in the literal translation of (49). In this language, the translation of French counterfactual conditionals uses deontic modality rather than conditional morphology. This deontic modality is instantiated by the term *maa* in (49), and similar sentences. In fact, there is no true counterfactual conditional in this language, as conditional morphology is not present in counterfactuals.

However, the question remains as to why there is no irrealis in examples like (49) since the meaning in these examples is still antiveridical. We suggest that because *maa* contributes deontic modal meaning, it is incompatible with an epistemic modal like irrealis. Further investigation of *maa* is left for future research.

On the surface, then, there are some contexts in Anii where, if we base our expectations on patterns found in other languages, the absence of irrealis is puzzling. However, close observation of how meanings such as counterfactuals are expressed in Anii, in conjunction with our analysis of irrealis as a negatively biased epistemic modal, readily accounts for the distribution of irrealis in Anii, and perhaps the unexpected differences between irrealis in Anii and similar phenomena in other languages.

4.6. Irrealis and nonveridical propositions

A remaining question raised by imperatives such as (46) is why irrealis marking does not occur there, as imperatives are nonveridical. A related point is the lack of irrealis morphology in interrogatives, which are also nonveridical. Example (50) illustrates both *wh-* (50a) and yes/no (50b) questions and shows that the irrealis subject marker and high tone are not present:

(50) a. aŋa   ce ka ?
          who GO foc
          'Who went?'
      b. ʊ   ce aa ?
          2.sg GO quest
          'Did you go?'

The lack of irrealis in these contexts falls out naturally if we consider that neither of them has a declarative force. All the sentences analyzed here that have irrealis marking also have declarative force. This suggests that the irrealis/realis distinction in Anii only applies to sentences with declarative force.

The difference between a declaration on the one hand and a command or a question on the other is that only declarations involve the evaluation of the truth of a proposition. Imperatives are, in some sense, a performative speech act (Condoravdi and Lauer 2012), and questions project a set of alternatives. Neither has propositional or declarative force. (Non)veridicality, which is at the heart of our analysis of irrealis, applies to declarative propositions whose truth can be evaluated based on a given set of circumstances in the world. The realis/irrealis distinction is therefore irrelevant for the interpretation of imperatives or questions.

Additionally, recall that our definition of irrealis is negative-biased. The questions in (50) are unbiased: the speaker considers the possibility of going and the possibility of not going to be equally likely. Therefore, these unbiased questions are incompatible with irrealis under our definition.

Questions that contain negation, like those in (51) below (which are negative versions of the questions in [50]), do contain irrealis, but again, this is predicted by the presence of negation, further demonstrating the inextricable link between negation and irrealis in Anii:

(51) a. aŋa   na k'   a   cê[33]   na ?
          who FOC NEG 3.SG.IRR go.IRR FOC
          'Who didn't go?'

---

[33] Recall that the circumflex is used in this paper to mark irrealis tone wherever it occurs, as was explained earlier in the paper, but in the orthography that marking would only be used for the future question. However, for consistency with the point of this paper, we are using the circumflex wherever the irrealis tone occurs. But to clarify, especially for anyone who knows the Anii orthography, this is the 'past' question (nonfuture temporal reference, perfective aspectual reference). In IPA (ignoring vowel harmony, but writing tone), the past question is [àŋá ná k à tsə́ ná], and the future question would be [àŋá ná ká à tsə́ ná]. The H tone on the negation marker in the future (which we have discussed previously) also causes a longer vowel here, likely for phonological reasons.

b. k'   á[34]   cê   aa ?[35]
    NEG   2.SG.IRR   go.IRR   QUEST
    'Did you not go/didn't you go?'

Anii questions, then, behave similarly to conditionals, illustrating that the presence of irrealis morphology is dependent on the presence of negative epistemic bias. As we have shown, this distribution falls out naturally from our analysis.

5. Irrealis in Embedded Clauses

So far, we have presented data on how irrealis is selected for by future and negation and how it is used in matrix irrealis clauses. In addition to these uses, there are some sentences in Anii where irrealis morphology is required in specific types of embedded clauses. Based on our preliminary observations, these seem to be divided into two classes: (i) contexts in which the embedded clause seems to reference the speaker's information state at the utterance time, in accordance with our analysis, and (ii) contexts in which it does not, in apparent disagreement with our analysis. Examples of type (i) are given in (52):

(52) (a) Context: You are on your way to school and you are late so your friend tells you that you need to run. You respond:
           n   tɩ   yɛɛ   ma   sâra
           1.SG.SUBJ   IMPFV   search   1.SG.SUBJ.IRR   walk.IRR
           'I want to walk'
           lit. 'I am looking that I might walk'
      (b) Context: Your motorcycle was broken so you had planned to walk to the office, but at the last minute you see that the mechanic fixed it, so you say:
           n   yɔ   wàà   ma   sâra
           1.SG.SUBJ   know   that   1.SG.SUBJ.IRR   walk.IRR
           'I would have walked (but now I do not have to)'
           lit. 'I know/knew that I might walk (but now I don't have to)'

Note that in both cases in (52), the event denoted by the predicate of the embedded clause (the walking event) is likely not true at the utterance time. These uses of irrealis are, therefore, straightforwardly compatible with our definition of irrealis, in which the speaker is biased toward the irrealis-marked event not being true at the utterance time.

Examples of type (ii), in which the embedded clause does not seem to reference the speaker's information state at the utterance time, are shown in (53):

(53) Context: you see your friend eating, even though it is Ramadan and the sun is up, and you thought they were fasting. When you ask them about it, they explain:

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[34] The difference between the second and third-person singular irrealis subject markers is simply a tone (H-tone for 2nd person, L tone for 3rd person)

[35] Note that there is no final *na* in this negative example, it is replaced by the question particle. Recall that the final *na* in negative sentences is a focus marker, not a negation marker, so analyzing this change in more detail will require a fuller analysis of focus in Anii.

a	lee	amʊ	təlashɪ	wàà	ma
3.SG.SUBJ	do	1.SG.OBJ	CL.B.obligation	that	1.SG.SUBJ.IRR

jî	ʊ–jʊ
eat.IRR	CL.Ð–food

'He/she made me eat food.'
Lit. 'He/she made to me an obligation that I should eat food'

This example, a causative construction, appears to be incompatible with our definition of irrealis because the eating event referred to by the irrealis marked embedded predicate has occurred at the utterance time. Crucially, however, that eating event had not yet occurred at the reference time of the main clause, which is when the speaker was being forced to eat. Our definition of irrealis could thus be expanded so that in embedded clauses, it may reference the speaker's information state at the topic time of the matrix clause:

(54) Irrealis marking denotes that the speaker is biased towards the predicate being untrue:
      (i)   at the time of utterance in matrix clauses, or
      (ii) at the topic time of the matrix clause in embedded clauses.

It is also worth noting that sentences such as (52b) and (53) are not overall nonveridical. The sentence in (52b) is antiveridical (the walking did not occur), whereas the sentence in (53) is veridical (the eating did, in fact, happen). In both cases, however, it seems that the subordinate irrealis clause is nonveridical, and the (anti-) veridical interpretation of the overall sentences is due to the matrix clauses.

Although further research is needed to establish when irrealis is required or possible in Anii embedded clauses (and how embedding works in Anii in general), the data presented here provide a starting point for future inquiry and make clear that the interpretation of irrealis in subordinate clauses is dependent on the semantics of the relevant matrix clauses.

6. Summary and Discussion

In this paper, we provided a formal analysis of irrealis in Gɪsɪɖa Anii, building on a theory of modality proposed in Giannakidou and Mari (2021), and extending their framework to a different language family and a different type of modality. A crucial component of our analysis is the idea that the meaning of irrealis is anchored to the speaker's expectations about the truth of a proposition. This idea effectively disassociates a speaker's expectations about truth from propositional truth itself. This disassociation allows for a unified meaning of irrealis that can be composed with a variety of clausal elements such as future and negative sentences, among others.

Additionally, our analysis shows that Anii may be a language in which veridicality is central to the interpretation of a clause. In other words, Anii speakers tend to orient themselves toward the truth of propositions, and temporal interpretation is, in some cases, secondary to this truth orientation. This type of orientation might also be present in other languages, particularly those where tense is not central, and our analysis provides a starting point for further investigation of possible influences of veridicality on tense, or the apparent absence of tense, in clausal structure.

The analysis we have presented in this paper can also contribute to long-standing debates about whether irrealis is a cross-linguistic semantic category or not (Bybee 1998, Cristofaro 2012, de Haan 2012, von Prince et al. 2022). Recently, von Prince et al. (2022) made the argument that irrealis is "real" on the basis of data from a wide range of Oceanic languages. Their analysis, though different from ours, also locates the irrealis/realis distinction as a central element of clausal architecture interacting with tense and aspect. This similarity between our analysis and theirs is notable, given the very different languages that the analyses address, particularly with regard to the extent to which elements like tense are morphologically marked. A fruitful avenue for future research would be to explore the compatibility of an analysis like von Prince et al with a language like Anii and whether and how our analysis could extend to the Oceanic languages they analyze. In either case, we hope to have shown that analyzing irrealis and veridicality as a fundamental component of the clause leads to interesting conclusions and questions about the nature of human language and thought.

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