Evidence for two types of future semantics by negation[*]

Sihwei Chen
Academia Sinica

1   Introduction

In English there is only one sentential negator *not*. In (1a), it is not immediately clear whether the negation scopes over or under the future auxiliary *will*. Compare (1a) with *It is not going to rain*. If we assume with Copley (2009) that *be going to* consists of a progressive over a prospective operator *woll*, which is realized as *go*, the order in which the negator precedes *go* suggests that it has scope over *go*. Does the scope relation of *will not* also follow the surface scope as in the case of *be not going to*?

In the literature, it is well-established that future statements do not exhibit scope in relation to negation (Copley 2009; Cariani & Santorio 2018). This property is demonstrated by the law of excluded middle: $p \lor \neg p$, meaning that p is either true or its negation is true. Future statements, much like non-future ones, adhere to this law, as seen in a comparison with modal statements involving negation. For example, (1a) and (1b) share identical truth conditions, while (2a) and (2b) do not. This implies that *will*, if considered a future modal, must be scopeless, distinguishing it from other modals.

(1) a. It **will not** rain.

     b. It is **not** the case that it **will** rain.

(2) a. Sam **must not** lock the door.

     b. It is **not** the case that Sam **must** lock the door.

There are two key assumptions in this comparison: (i) *will* lexically encodes quantification over possible worlds, and (ii) *will* takes scope over *not* in (1a), similar to how *must* takes scope over *not* in (2a). The question that arises is whether both assumptions hold. Cariani and Santorio (2018) challenge the first assumption. They argue that *will* is a modal that takes as argument a modal base pronoun but does not quantify over worlds; instead, it selects a unique world within the modal base, which by default is the evaluation world (due to certain closeness conditions). This analysis renders *will* semantically vacuous with respect to the world parameter and leads them to the desired result that *will not p* (1a) and *not will p* (1b) are equivalent.

　　However, Cariani and Santorio do not address the question of how the temporal semantics of *will* interacts with negation since it is not their focus. They assume that *will* existentially quantifies over future times, while noting that an alternative approach is an interval extending forward from the evaluation time. Even if we adopt their analysis that *will* is a vacuous modal (see their review of earlier approaches),[1] an existential operator can still potentially take scope above or below a sentential negator, the result of which would not be equally predicted by the postulation of an unbounded interval.

　　In this paper, I present data from two languages, Atayal and Mandarin, to demonstrate the necessity of distinguishing between the two types of forward-shifting semantics mentioned above. Atayal is an Austronesian language spoken in northern Taiwan, and the data presented here primarily come from my own fieldwork, unless stated otherwise. The Mandarin data exclusively pertain to the dialect spoken in Taiwan and are based on my own intuitions and consultations with native speakers. Atayal follows a predicate-initial word order, while Mandarin employs an SVO word order, akin to English. Both languages fall under the

---

[1] Alternatively, we can decompose *will* into a covert modal and a prospective aspect *woll*. In this analysis, the negation can take scope above *woll* but below the modal, thus avoiding the negation of universal quantification over worlds.

category of morphologically tenseless languages with overt future morphemes, which usually cannot be omitted in future contexts.

While it is not always easy to determine the scope between *will* and *not* in English, the interaction between future and negation becomes clear in languages where the negator is syntactically constrained to appear either above or below a future marker. In Section 2, I show that there are distinct syntactic negators in Atayal, with one taking scope over future modals and the other appearing below various circumstantial modals but not below the future modals. In Section 3, I propose an explanation for these patterns by assigning existential quantification over times to the future modals and an open interval to the circumstantial modals. This proposal is supported by Mandarin, which has an internal negator solely for negating the existence of events and cannot take scope under the future modal. Section 5 concludes with a semantic typology.

2 The interaction between standard negators and future-oriented modals in Atayal

2.1 External and internal negators

In Atayal, there are two standard negators that function similarly to sentential negation: *iyat* and *ini'.* Both negators are auxiliaries that attract bound pronouns (in the absence of another higher auxiliary), but they exhibit significant morphosyntactic differences. One of the most striking is the voice inflection of the verb following the negator: *iyat* requires that the following verb be in the indicative (which is unmarked in glosses) (3–4), while *ini'* requires it to be in the dependent (5) (i.e., *kita'* instead of *mita'*).[2]

(3)   a.   **iyat p-qwalax**   rihay 'nyal.
          NEG   AV.FUT-rain   week   come.NMLZ
          'It will not rain next week.'

        b.   **iyat**=nya'   **niq-un**   qu   hi'   bzyuwak hiya'.
          NEG=3SG.ERG   eat-PV.FUT   ABS   body   boar   EMP
          'He will not eat the pork.'

---

[2] Abbreviations that are not in the Leipzig Glossing Rules: ABIL, ability; AV, actor voice; CIRC, circumstantial; COS, change of state; CTF, counterfactual; CV, circumstantial voice; DEON, deontic; DEP, dependent; EMP, emphatic; EPIST, epistemic; E.PST, existential past; EXP, experiential; LV, locative voice; NAV, non-actor voice; NEC, necessity; POS, possibility; PRT, particle; PV, patient voice.

(4) **iyat**=maku'   **k\<in\>i'-an**   ngasal qani.
     NEG=1SG.ERG   live\<E.PST\>-LV house   this
     'I have not/never lived in this house.'

(5) **cyux**   **ini' kita'**   biru'   qu   hiya'
     PROG.DIST   NEG   see.AV.DEP   book   ABS   3SG.N
     'He is not reading books.'

A brief introduction to the voices of Atayal is needed here. Atayal has a typical Philippine-type voice system, i.e., each verb must be marked with one of the four voices that vary in the macro-thematic role of the subject (i.e., Actor Voice, Patient Voice, Locative Voice, and Circumstantial Voice). At the same time, the voice also varies with three mood groups that roughly correspond to what is called sentence mood: indicative, dependent, and hortative. Only in the indicative, but not in the dependent mood, can future and past affixes be present (i.e., *p-* in (3a) and *-in-* in (4)). The examples in (3) also illustrate a morphological peculiarity that in sentences that are not in AV, the future prefix *p-* disappears, making the sentence appear in the same form as non-future sentences (Chen 2018:279ff.); hereafter I refer to them as p-$_{AV}$ and $\emptyset_{NAV}$.

While the voice inflection of the main verbs after the negators may simply reflect their morphological difference, other distinctions suggest that the two negators have different syntactic positions. For example, *ini'* directly precedes the verb, so a freely distributed adverb cannot intervene between them, and *ini'* must follow an overt aspect marker (5), while *iyat* lacks these features. The examples in (3) to (5) establish the syntactic hierarchy of the two negators within the clause: *ini'* is below AspP, and *iyat* is above TP, where TP is conventionally above AspP.[3] The resulting hierarchy is presented as (6).

(6)   *iyat* > TP > AspP > *ini'* > VP

Based on the above and other evidence, I assume that *iyat* negates the entire proposition by taking a TP of type $\langle s,t \rangle$ as an argument, while *ini'* negates the event denoted by the predicate by taking an eventuality of

---

[3] The overt temporal morphemes that are supposed to occupy the tense head, p-$_{AV}$ and *-in-*, do not co-occur with aspect markers; sentences with aspect are usually morphologically tenseless.

type ⟨*l,st*⟩ (7); such a distinction is often called external and internal negation.[4]

(7)   a. $[\![iyat]\!]^{g,c} = \lambda P_{\langle s,t \rangle} \lambda w. \neg[P(w)]$

 b. $[\![ini']\!]^{g,c} = \lambda P_{\langle l,st \rangle} \lambda e \lambda w. \neg[P(e)(w)]$

2.2   Ways of interaction with future-oriented modals

As expected from their syntactic position, the two negators interact differently with epistemic and circumstantial modals, which are also in a higher and lower position, respectively (Chen 2018:425ff.). The examples in (8) show that epistemic modals asymmetrically precede both negators. In contrast, circumstantial modals may precede the internal negator *ini'* (9), but do not co-occur with the external negator *iyat* in either order (e.g., *iyat nway ... or *nway iyat ...). The same pattern holds for the counterfactual/irrealis marker *aki* 'would' (10), the habitual/generic marker *mutux*, and markers used specifically in purpose clauses or contexts of apprehensive/timitive modality (e.g., *teta'*/*tayta'* and *hala*).

(8)   a.   **ki'a**   **iyat**   p-swal   wah.
            EPIST.POS   NEG   AV.FUT-promise   PRT
            'He might not agree.'

 b.   **ki'a**   **ini'**   swayal   qu   Tali'.
            EPIST.POS   NEG   promise.AV.DEP   NOM   Tali'
            'Tali' might not have agreed.'

(9)   **nway**=ta'   **ini'**   p-qsya'-i   kira'   la.
      DEON.POS=1PL.ERG   NEG   CAUS-water-PV.NEG   later.today   COS
      'We don't need to water the vegetables today.' or 'We may not water the vegetables today.'

---

[4] The terms 'external' and 'internal' simply refer to the sentence-external vs. -internal modification, and not to the semantic sense 'it is not the case that...' as in (1b) and the lack thereof. They are sometimes used depending on whether the negation negates a presupposition (i.e., a metalinguistic negation; cf. Horn 2001). However, the Atayal negation sentences in my data do not involve the cancelation of a presupposition, so it is less likely that *iyat* and *ini'* are specialized for metalinguistic negation.

(10) pung   ke'=maku'   ki.   **aki**=su'   **ini'**
      listen.AV.IMP word=1SG.GEN   PRT   CTF=2SG.ABS   NEG
         ktakuy.
         fall.down.AV.DEP
      'You should listen to my words. You would not fall down.'

Interestingly, future modals (i.e., those used for prediction) do not behave either like epistemic or circumstantial modals in their interaction with the two negators. We have seen the future affix p-$_{AV}$/$\emptyset_{NAV}$ necessarily after *iyat* in (3), and because of the requirement for a different mood, p-$_{AV}$/$\emptyset_{NAV}$ does not co-occur with *ini'*. An auxiliary grammaticalized from the verb of going, which I refer to as *musa'*$_{FUT}$, can often alternate with p-$_{AV}$/$\emptyset_{NAV}$ in affirmative contexts of prediction (Chen 2018:311ff.) (11), but unlike p-$_{AV}$/$\emptyset_{NAV}$, *musa'* cannot co-occur with *iyat* in either order (12).

(11) a.   ki'a   **p-**qwalax   hazi'.
           EPIST.POS   AV.FUT-rain   EPIST.POS
           'It might rain.' or 'It will possibly rain.'

      b.   kt-an   kayal ga,   hazi'   **musa'** m-qwalax.
           see-LV sky   TOP   EPIST.POS FUT   AV-rain
           'It looks like it might rain.'

(12) * {**iyat musa'** / **musa' iyat**}   m-qwalax rihay 'nyal.
         NEG FUT   FUT   NEG   AV-rain   week come.NMLZ
         Intended: 'It will not rain this week.'

The incompatibility with external negation makes *musa'*$_{FUT}$ resemble circumstantial modals. However, unlike circumstantial modals, e.g., (9), *musa'*$_{FUT}$ is also incompatible with internal negation (13a). To render the reading 'will not', the future marker p-$_{AV}$/$\emptyset_{NAV}$ must be used under external negation (13b).[5]

(13) a. # **musa' ini'**   pawng-i   k~kayal=su'.
             FUT   NEG   listen-LV.DEP CV.NMLZ~say=2SG.GEN
             'Your words will not be heard.'

---

[5] The sequence *musa' iyat* in (13b) does not contradict the generalization that *musa'*$_{FUT}$ cannot co-occur with *iyat* (as in (12)). This is because in this case, 'must' functions as an epistemic modal and occupies a higher position, allowing it to be used with a present prejacent. As an epistemic modal, *musa'*$_{EPIST}$ behaves similarly to the epistemic modal *ki'a* in (8a) by preceding *iyat*.

b. musa' **iyat** **pawng-an** kay'=su'.
    EPIST NEG listen-LV.FUT word=2SG.GEN
    'Your words will probably not be heard.'
    Consultant: "They might mute your microphone."

As the marking of the above data reveals, I suggest that (12) is ungrammatical and (13a) is infelicitous. The former is based on the observation that *iyat* cannot precede or scope over any modal in Atayal.[6] However, the non-acceptance of (13a) is surprising when compared to other circumstantial modals, as in (9) and (10). Across languages, both types of modals are future-oriented (Condoravdi 2002), and future modals are often regarded as circumstantial. While some suggest 'realis' negation for *ini'* (e.g., Su 2004:66), its compatibility with circumstantial modals calls for a different explanation. In Section 3, I explore an explanation rooted in semantic (in)felicity arising from the distinct future semantics of *musa'*$_{\text{FUT}}$ and the circumstantial modals.

Table 1 summarizes the discussion by listing the possible order and marking unattested co-occurrences for grammatical reasons as 'N/A'. Focusing on circumstantial and future modals, we can identify three patterns A–C, highlighted in different colors. The main question here is why *musa'*$_{\text{FUT}}$, unlike the circumstantial modals, cannot take scope over *ini'*.

Table 1: Interaction between standard negators and modals in Atayal

|		*iyat* 'external NEG'	*ini'* 'internal NEG'	Pattern
Epistemic	*ki'a* 'might'	*ki'a > iyat*	*ki'a > ini'*	
Circumst.	*nway* 'can'	N/A	*nway > ini'*	A
	aki 'would'	N/A	*aki > ini'*	
Future	*musa'*$_{\text{FUT}}$	N/A	**# *musa'*$_{\text{FUT}}$ *> ini'***	B
	p-$_{\text{AV}}$/$\emptyset_{\text{NAV}}$	*iyat > p-*$_{\text{AV}}$/$\emptyset_{\text{NAV}}$	N/A	C

---

[6] One possible explanation is that Atayal modals are grammaticalized into auxiliaries through the restructuring of complex clauses, such as conditionals or embeddings (Chen 2018:425ff.; Wu 2013:112ff.), and may occupy a similar syntactic position to external negation.

3   Proposal

As mentioned earlier, two types of forward-shifting semantics have been used in the literature: existential quantification and a right open interval. The latter is proposed in Abusch (1998) for English future modals and extended by Condoravdi (2002) to all circumstantial modals, which she argues are all future-oriented. I propose that in Atayal, the future modals *p-*$_{\text{AV}}$/*Ø*$_{\text{NAV}}$ and *musa'*$_{\text{FUT}}$ encode the first option, while the circumstantial modals encode the second option. This proposal is illustrated by the formulas in (14), where following Condoravdi, I use *[t, _)* to represent an interval that has *t* as its initial subinterval and extends to the end of time. I simplify the modal semantics in the circumstantial modal as *MB*$_{Circ}$, representing Kratzer's conversational background.

(14)   a. $[\![p\text{-}_{\text{AV}}/Ø_{\text{NAV}}/musa'_{\text{FUT}}]\!]^{g,c} = \lambda P_{\langle i,st\rangle}\ \lambda t\ \lambda w.\ \exists t'\ [t < t'\ \&\ P(t')(w)]$

   b. $[\![nway]\!]^{g,c} = \lambda P_{\langle i,st\rangle}\ \lambda t\ \lambda w.\ \exists w'\ [w' \in MB_{Circ}(w, t))\ \&$
 $P(w')([\mathbf{t}, \_))]$

   Let us start with pattern C in Table 1. In (15), we have the structure of (3a) with the lexical entry of VP and AspP in (16a, b). Here the external negator *iyat* scopes over the existential quantifier in the future prefix *p-*$_{\text{AV}}$, resulting in the desired meaning: 'there is no time in the next week when it rains' (17).

(15)
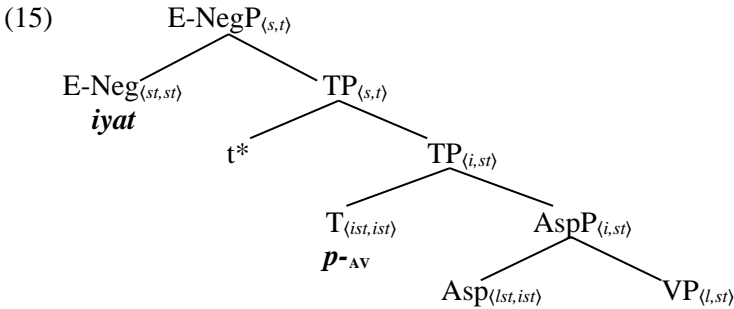
(16)   a. $[\![VP]\!]^{g,c} = \lambda e\ \lambda w.\ \lambda P(e)(w)$

   b. $[\![PFV]\!]^{g,c} = \lambda P\ \lambda t\ \lambda w.\ \exists e\ [P(t)(w)\ \&\ \tau(e) \subseteq t]$

(17) $\llbracket(4a)\rrbracket^{g,c} = \llbracket iyat\rrbracket^{g,c} (\llbracket\lambda w.\ \exists t'\ [t^* < t'\ \&\ t' \subseteq \text{next week}\ \&\ \exists e$
$[\text{rain}(e)(w)\ \&\ \tau(e) \subseteq t']\ \rrbracket^{g,c}) = \lambda w.\ \neg\exists t'\ [t^* < t'\ \&\ t' \subseteq \text{next week}$
$\&\ \exists e\ [\text{rain}(e)(w)\ \&\ \tau(e) \subseteq t']]]$

Pattern B is exemplified by the infelicitous example in (12), and its structure is provided in (18).

(18)
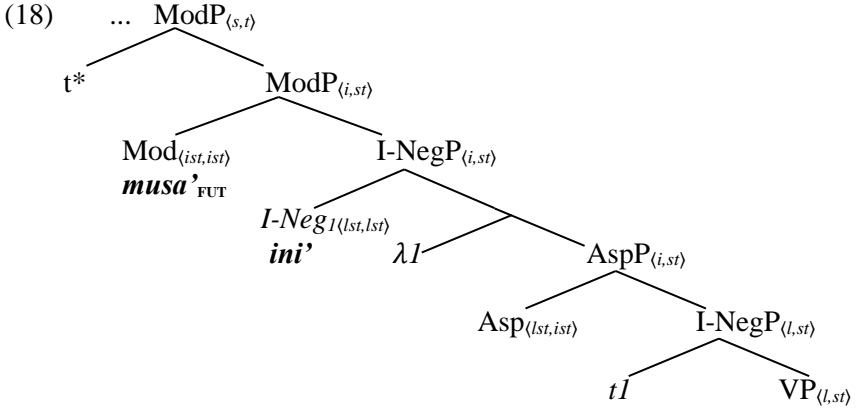
Despite the internal negator *ini'* being adjacent to VP (5) and its denotation in (7b), I analyze that it undergoes raising to a higher position than AspP. This is because the event variable of the VP is quantified over only after the Asp head is combined, and the VP argument does not denote an operator for *ini'* to negate; rather, *ini'* would only negate a relation. For example, the negation of a raining event in world *w* is true iff the relation does not hold. This is equivalent to saying that there is no raining event in *w*. In fact, in Mandarin, we observe that negation invariably precedes progressive aspect, as in (23) below. I assume that internal negation modifying VP or AspP produces a similar outcome.

The meaning of (12) is computed as shown in (19), which asserts that there exists a time *t'* in the coming week when there is no instance of raining events with their temporal trace included. This interpretation clearly differs from a negative future statement as in (17) or an even more concise paraphrase: 'there is no raining event in the next week.'

(19) $\llbracket(13)\rrbracket^{g,c} = \llbracket\text{ModP}\rrbracket^{g,c}(t^*) = \llbracket musa'_{\text{FUT}}\rrbracket^{g,c}(\llbracket\text{AspP}\rrbracket^{g,c})(t^*) = \lambda w.\ \exists t'$
$[t^* < t'\ \&\ t' \subseteq \text{next week}\ \&\ \neg\exists e\ [\text{rain}(e)(w)\ \&\ \tau(e) \subseteq t']]$

In fact, the semantic infelicity here closely resembles the well-known problem raised for an existential interpretation of the English past tense (Partee 1973:602). An existential past taking scope over negation results in a trivial reading. Similarly, when the existential operator in the semantics of *musa'*$_{\text{FUT}}$ scopes over negation, the sentence becomes trivially true, that is, (12) would be true as long as we find a time next week at which it does not rain.

In contrast, in pattern A, when the modal scoping over *ini'* encodes the interval [t, _) instead of an existential quantifier, as exemplified by (9), the sentence is felicitous. As computed in (20), (9) asserts that in worlds that align with the actual world in terms of relevant circumstances and are ranked by norms, there is no event of us watering vegetables at any time following the present moment.

(20) $[\![(9)]\!]^{g,c} = [\![\text{ModP}]\!]^{g,c}(\text{t*}) = [\![\textit{nway}]\!]^{g,c}([\![\text{AspP}]\!]^{g,c})(\text{t*}) = \lambda w. \exists w' [w' \in \text{MB}_{\text{Circ}}(w, \text{t*})) \ \& \ \neg\exists e [\text{water}(e, \text{we, vegetables})(w') \ \& \ \tau(e) \subseteq [\text{t*}, \_)]]$

4 A parallel in Mandarin

The proposed semantic explanation for why internal negation does not scope under a future marker encoding an existential quantifier can be directly tested by Mandarin, which has an internal negator compatible only with the existence of events.

Similar to Atayal, Mandarin also employs two sentential negators, *bù* and *méi,* but their use is not solely determined by syntactic height. *Bù* is used to negate bare stative verbs, whether they are individual- or stage-level (21). In contrast, *méi* is the choice for negating bare eventives (22) as well as those marked with viewpoint aspects, e.g., *zài* 'PROG' (23) and *-guò* 'EXP'.

(21) tā   {**bù**/*****méi**}   {pàng/gāoxìng}.
      3SG   NEG   fat   happy
      '(S)he is not {fat/happy}.'

(22) zuótiān   {*****bù**/**méi**}   xiàyǔ.
      yesterday   NEG   rain
      'It didn't rain yesterday.'

(23) xiànzài {***bù**/**méi**} zài   xiàyǔ.
      now   NEG   PROG   rain
      'It is not raining now.'

Moreover, only *bù*, but not *méi,* can negate epistemic, deontic, ability, and future modals, (24a) vs. (24b).[7]

(24) a. **bù**   yīdìng / **bù**   kěnéng/ **bù** bì /   **bù**
          NEG EPIST.NEC NEG EPIST.POS NEG CIRC.NEC NEG
              kěyǐ /   **bù**   huì/ **bù**   huì
              CIRC.POS NEG   ABIL NEG   FUT

      b. * **méi**   yīdìng / **méi**   kěnéng / **méi** bì /   **méi**
             NEG EPIST.NEC NEG EPIST.POS NEG CIRC.NEC NEG
              kěyǐ /   **méi** huì / **méi** huì
              CIRC.POS NEG   ABIL NEG   FUT

Lin (2003) argues that *méi* selects eventive complements, while *bù* more strictly selects stative situations that 'require no input of energy'. As a result of this analysis, certain statives that opt for *méi* instead of *bù* (25a), durative sentences (25b), and progressive sentences (23) would not be considered stative, whereas most modal sentences would be categorized as stative in Mandarin (24a). Lam (2022) offers an alternative perspective based on dialectal comparison and grammaticalization. According to Lam, *bù* emerged earlier than *méi*, but *méi* underwent grammaticalization and expanded its use from being an existential verb to encompass standard negation, particularly negating the existence of events. In line with Lam's viewpoint, I assume that *bù* serves as the default negator, while *méi* is chosen over *bù* when it is internal *and* when there is an event variable in VP.

(25) a. tā   {***bù**/**méi**} yǒu   xiǎohái.
          3SG   NEG   have   child
          '(S)he does not have children.

      b. qiáng shàng {***bù**/**méi**} guà-zhe   yī   fú   huà.
          wall   above   NEG   hang-DUR one CLF   picture
          'There is not a picture hanging on the wall.' (Lin 2003:431)

---

[7] The physical ability and volitional modals appear to accept either negator, {***bù*/*?méi***} *néng* 'not physically able to', {***bù*/*?méi***} *kěn* 'not willing to', possibly because of the eventive nature of these modals.

Let us now consider our prediction concerning negation within the scope of future modals. The examples (26a, b) show that the future modal *huì*_{FUT} cannot scope above either negator (in comparison to (21) and (22), respectively). The intended reading is consistently conveyed when *bù* scopes over *huì*_{FUT}.[8] These two cases mirror the patterns C and B in Atayal, respectively (Table 1), differing only in the aspectual selection of the two negators. Notably, Atayal pattern A does not appear to exist in Mandarin, as seen in infelicitous examples like #*kěyǐ méi* '(intended) can not'.

(26) a. tā   yǐhòu   {#**huì bù** / **bù   huì**} pàng.
          3SG   in.the.future   FUT NEG NEG FUT   fat
          '(S)he will not be fat in the future.'

      b. míngtiān   {#**huì méi** / **bù   huì**} xiàyǔ.
          tomorrow   FUT NEG NEG FUT   rain
          'It will not rain tomorrow.'

This result aligns with our expectations if *huì*_{FUT} and all circumstantial modals in Mandarin function as a future operator encoding existential quantification, resulting in a trivial reading when combined with internal negation. Furthermore, we correctly anticipate that *méi* is acceptable in future contexts where *huì*_{FUT} cannot be used, including at least in the protasis of conditionals (27a) and predictions where the evaluation time is in the future, leading to an interpretation akin to a future perfect (27b).

(27) a. yào shì nǐ   **míngtiān méi** lái,   wǒmen jiù   huì
          if   be 2SG tomorrow NEG come 1PL   then FUT
              gēn   nǐ   māma   shuō.
              to   2SG mother   tell
          'If you don't come tomorrow, we will tell your mother.'

      b. míngnián zhè ge shíhòu,   wǒ hái   **méi** bìyè.
          next.year this CLF time   1SG still NEG   graduate
          'I won't have graduated by this time next year.'

---

[8] A remaining issue is that with a stage-level stative verb, the *huì > bù* order is possible, as in (i), compared to (26a). The difference in meaning is subtle; I suspect that the modal *huì* is more grammaticalized to resemble an epistemic modal or 'would'.
(i)   tā   {**huì bù** / **bù   huì**} gāoxìng.
      3SG   FUT NEG / NEG FUT   happy
      '(S)he will not be happy.'

5   Conclusion and typological implication

This paper argues that future-oriented modals can lexically encode either existential quantification over future times or a right unbounded interval. This is supported by their interaction with syntactically distinct types of negation. Our analysis suggests that external negation can scope over future modals with both denotations, one of which is attested in Atayal. In Mandarin, the default negator is also expected to precede and scope over future modals with an existential quantifier. In contrast, internal negation is restricted to future modals encoding an open interval, again attested in Atayal. In both languages, internal negation is not compatible with an existential future operator. Table 2 lists the proposed typology.

Table 2: Possible combinations of forward semantics
and two types of negation

	External	Internal
Existential	yes (Atayal)	**no** (Atayal, Mandarin)
Open interval	yes (?)	yes (Atayal)

References

Abusch, Dorit. 1998. Generalizing tense semantics for future contexts. In Susan Rothstein (ed.), *Events and Grammar*, (pp. 13–33). Dordrecht, Netherlands: Kluwer, 13–33.

Cariani, Fabrizio & Paolo Santorio. 2018. Will done better: Selection semantics, future credence, and indeterminacy. *Mind* 127(505): 129–165.

Chen, Sihwei. 2018. *Finding semantic building blocks: Temporal and modal interpretation in Atayal*. Doctoral dissertation, University of British Columbia.

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

Copley, Bridget. 2009. *The semantics of the future*. New York, NY: Routledge.

Horn, Laurence R. 2001. *A natural history of negation*. Stanford, CA: CSLI Publications.

Lam, Cherry C.-Y. 2022. Croft's Cycle in Mandarin and Cantonese throughout history and across varieties. In Ljuba Veselinova & Arja Hamari (eds.), *The negative existential cycle*. Berlin, Germany: Language Science Press, 357–401.

Lin, Jo-wang. 2003. Aspectual selection and negation in Mandarin. *Linguistics* 41(3):425–459.

Partee, Barbara H. 1973. Some structural analogy between tenses and pronouns in English. *The Journal of Philosophy* 70(18):601–609.

Su, Mei-Juan. 2004. *Taiyayu Taoshan fangyan foudingci yanjiu* [Negation in Taoshan Atayal]. Master's thesis, National Hsinchu University of Education.

Wu, Chunming. 2013. *The syntax of linking constructions in Mayrinax Atayal and Sinvaudjan Paiwan*. Doctoral dissertation, National Tsing Hua University.