The Scope of Futures

James N. Collins

Stanford University

jamesnc@stanford.edu

Linguistic Society of America, Washington DC

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Main points

1. The scope taking properties of English future tense expressions like will, going to, about to.
2. These expressions introduce both a modal and temporal component.
3. These components should be understood as *scoping independently*.
4. Future tense expressions introduce a *homogeneity/settledness presupposition*, which distinguishes them from similar expressions like sure to and guaranteed to.
Forward shifting

- **In focus:** English modal expressions which serve to locate the time of their prejacent at some point after the time of evaluation, e.g., *will, be going to, be about to.*

1. He will pass the exam *yesterday/today/tomorrow*

**Forward-shifting operators**

\[ F(\phi) \text{ is true at } t \text{ iff there is a } t' \text{ such that } t < t' \text{ and } \phi \text{ is true at } t' \]

They behave like modal operators in the following respects:

- Participation in modal subordination (Klecha 2013)
- Non-veridicality/counterfactuality in past tense uses (Condoravdi 2002, Klecha 2013)
- Interaction with predicates of personal taste (Klecha 2013)
- Licensing nonspecific interpretation of indefinites (del Prete 2014)
Historical modality

- Thomason 1984, Condoravdi 2002: *will* universally quantifies over the ways that the world may turn out: the *historical alternatives* of \( w \).

\[
\text{MB}_{\text{historical}}(w, t) = \text{worlds which agree with } w \text{ on the truth of all propositions evaluated at times prior to } t, \text{ they ‘share histories’}.
\]

- Worlds in \( \text{MB}_{\text{historical}}(w, t) \) may disagree on the truth of propositions evaluated at times after \( t \).
Historical modality

Future modal

\( \text{will}(\phi) \) is true at \( \langle w, t \rangle \) iff for all \( w' \) in \( MB_{\text{historical}}(w, t) \), there is a \( t' \) such that \( t \prec t' \) and \( \phi \) is true at \( \langle w', t' \rangle \).

\( \begin{align*}
&\quad \quad \quad \text{\( w_0 \)} \\
\quad \quad \quad \text{\( w_1 \)} \\
&\quad \quad \quad \text{\( w_2 \)} \\
\quad \quad \quad \text{\( w_3 \)} \\
\end{align*} \)

- “There’s a \( \phi \)-time on every branch.”
Scope taking properties of futures

- This semantics for futures combines the modal and temporal components into one operator:

**Future modal (non-decomposed)**

\[ \text{will}(\phi) \text{ is true at } \langle w, t \rangle \text{ iff for all } w' \text{ in } MB_{historical}(w, t), \]
\[ \text{there is a } t' \text{ such that } t \prec t' \text{ and } \phi \text{ is true at } \langle w', t' \rangle \]

- We can separate it out into two operators:

  1. \[ \Box \phi \text{ is true at } \langle w, t \rangle \text{ iff for all } w' \text{ in } MB_{historical}(w, t), \phi \text{ is true at } \langle w', t \rangle \]
  2. \[ F \phi \text{ is true at } \langle w, t \rangle \text{ iff for some } t' \text{ s.t. } t \prec t', \phi \text{ is true at } \langle w, t' \rangle \]
Scope taking properties of futures

- This semantics for futures combines the modal and temporal components into one operator:

**Future modal (non-decomposed)**

$\text{will}(\phi)$ is true at $\langle w, t \rangle$ iff for all $w'$ in $MB_{historical}(w, t)$, there is a $t'$ such that $t \prec t'$ and $\phi$ is true at $\langle w', t' \rangle$

- We can separate it out into two operators:
  1. $\Box \phi$ is true at $\langle w, t \rangle$ iff for all $w'$ in $MB_{historical}(w, t)$, $\phi$ is true at $\langle w', t \rangle$
  2. $F \phi$ is true at $\langle w, t \rangle$ iff for some $t'$ s.t. $t \prec t'$, $\phi$ is true at $\langle w, t' \rangle$

- **Key question:** Do the modal ($\Box$) and temporal ($F$) components of futures decompose and take scope independently?
The temporal component and negation

Temporal component of futures

$F\phi$ is true at $\langle w, t \rangle$ iff for some $t'$ such that $t \prec t'$, $\phi$ is true at $\langle w, t' \rangle$

- The existential quantifier over times $F$ always scopes under negation.

2 Mary will not drink tea, #but she will.
   a. $\Box F \neg (\text{Mary drink})$  
      Xa non-drinking time on every branch but maybe a drinking time too
   b. $\Box \neg F (\text{Mary drink})$  
      ✓no drinking times on any branch

now $\neg$drink drink

a model where scoping (a) is true.
**Scope and subject quantifiers**

- The existential quantifier over times also scopes under subject quantifiers (most evident with negative quantifiers).

3 No student will drink tea, but some will.

a \( \Box (F(\text{no student } x(\text{drink}(x)))) \)

- On every branch, there’s a time where no student drinks and maybe another time where some do drink

b \( \Box (\text{no student } x(F(\text{drink}(x)))) \)

- On every branch, no students have any drinking times

Now none drink  John and Mary drink

A model where scoping (a) is true.
The existential quantifier over times also scopes under subject quantifiers (most evident with negative quantifiers).

3 No student will drink tea, but some will.

a \( \Box (F(\neg \text{ student } \times (\text{ drink}(x)))) \)

on every branch, there’s a time where no student drinks and maybe another time where some do drink

b \( \Box (\neg \text{ student } \times (F(\text{ drink}(x)))) \)

on every branch, no students have any drinking times

now none drink John and Mary drink

a model where scoping (a) is true.

Temporal component \( F \) consistently takes narrow scope.
The modal □ may take variable scope wrt subject quantifiers.

4. Someone will fail the exam, (due to the grading scale).

□∃x(x fail) identity of x varies across outcomes
The modal □ may take variable scope wrt subject quantifiers.

5 Someone will fail the exam, (Mary’s been slacking off).

∃x□(x fail) identity of x fixed across outcomes
Scope and subject quantifiers

- Evidence that quantifier > modal scopings must be available.
- Bound readings of pronouns in conditional restrictors of will are ok (following von Fintel and Iatridou 2003 on must).

6. Every boy; will pass if he; works hard.

- Assume conditional antecedents restrict quantificational domain of modals (Kratzer 1986, Klecha 2013 on will, gonna).
- Bound reading only ok if every boy can scope over modal.

a. \( \text{will}(\lambda w. x \text{ works}_w)(\lambda w. \text{every boy } y \text{ pass}_w) \)
   pronoun out of scope of every boy, no binding possible

b. \( \text{every(boy)}(\lambda y. \text{if } y \text{ works } y \text{ will pass}) \)
   pronoun may be bound by every boy
Evidence that modal > quantifier scopings must be available.

Nouns in subject quantifiers can be relativized to a world bound by the future modal.

7 Every winner will be excited.
   - so let’s find out who will win. identities of winners not settled.
   - namely Kim, Sandy, and Alex. identities of winners settled.

a \( \text{will}(\lambda w. \text{every winner}_w \text{ is excited}) \)
   identity of winners evaluated at every possible future

b \( \text{every}(\text{winner@})(\lambda x. x \text{ will be excited}) \)
   identity of winners evaluated at world of evaluation

Thus, subject quantifiers take variable scope wrt the modal component of futures □.
The modal component and negation

- Future necessity modal □ always appears to scope over negation.

8 Mary will not drink tea, # but she may.

a $\neg \Box (Mary \text{ drink tea})$ × there may be some branches where she drinks

b $\Box \neg (Mary \text{ drink tea})$ ✓ no branches where she drinks

- Excluded middle: Prejacent either holds on all branches, or on none (see also Cariani and Santorio 2015). Diagram fails this condition.
The modal component and homogeneity


- **Homogeneity**: On uttering *will*(\( \phi \)), the speaker commits herself to either \( \phi \) or \( \neg \phi \) holding uniformly across future branches.

  \[
  \text{Mary will not drink tea} \\
  \text{a} \quad \Box (\text{Mary drink}) \lor \Box \neg (\text{Mary drink}) \quad \text{presupposition} \\
  \text{b} \quad \neg \Box (\text{Mary drink}) \quad \text{assertion} \\
  \text{c} \quad \therefore \Box \neg (\text{Mary drink})
  \]

- Negation and future modals can scope in either order, we derive a strengthened \( \Box \neg \) interpretation either way via homogeneity.
Interim summary

- The modal component takes variable scope with respect to subject quantifiers, but seemingly fixed wide scope over negation.
- The temporal component takes narrow scope with respect to subject quantifiers and negation.
Elements of analysis:

- **Decomposition:** Future modals *decompose* into a *modal component* (a universal quantifier over possible outcomes), and a *temporal component* (an existential quantifier over future times).

- **Split scope:** The *modal* component may *scope independently* from the *temporal* component.

- **Homogeneity:** Future modals introduce a *homogeneity* presupposition, deriving the modal’s apparent wide scope over negation.
The issue of non-monotonic quantifiers

- **Complication:** Non-monotonic quantifiers *(exactly one student)* appear to *invariably* scope below the modal component.
- Does this require an additional stipulation?

9 Exactly one student will pass the exam, #the rest may pass too.

a □ > *exactly one*

in each outcome, the number of passing students is one

b *exactly one* > □

the number of students x s.t. x passes on every branch is one

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>OUTCOME 1 {a, b, c}</td>
<td>OUTCOME 1 {b}</td>
</tr>
<tr>
<td>OUTCOME 2 {b, c}</td>
<td>OUTCOME 2 {b}</td>
</tr>
<tr>
<td>OUTCOME 3 {a, c}</td>
<td>OUTCOME 3 {a}</td>
</tr>
<tr>
<td>false: □ &gt; <em>exactly one</em></td>
<td>true: □ &gt; <em>exactly one</em></td>
</tr>
<tr>
<td>true: <em>exactly one</em> &gt; □</td>
<td>false: <em>exactly one</em> &gt; □</td>
</tr>
</tbody>
</table>
**The issue of non-monotonic quantifiers**

- Compare similar modals *sure to, guaranteed to*, which don’t show the same restriction.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Model 1</th>
<th>Model 2</th>
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</thead>
<tbody>
<tr>
<td>Outcome 1</td>
<td>{a, b, c}</td>
<td>{b}</td>
</tr>
<tr>
<td>Outcome 2</td>
<td>{b, c}</td>
<td>{b}</td>
</tr>
<tr>
<td>Outcome 3</td>
<td>{a, c}</td>
<td>{a}</td>
</tr>
</tbody>
</table>

false: \(\square > \text{exactly one}\)  
true: \(\text{exactly one} > \square\)

10. Exactly one student will pass the exam.  
\(\rightsquigarrow\) wide scope modal, false in Model 1, true in Model 2

11. Exactly one student is sure to pass the exam.  
\(\rightsquigarrow\) ambiguous, may be true in either model

12. Exactly one student is guaranteed to pass the exam.  
\(\rightsquigarrow\) ambiguous, may be true in either model
Non-monotonic quantifiers, a solution

- Why do quantifiers like *exactly one student* necessarily take narrow scope but quantifiers like *every/some student* take variable scope?
- **Proposal:** This property is actually a prediction of the analysis of futures so far, assuming a homogeneity presupposition ($\Box p \lor \Box \neg p$).
- A standard semantics for *exactly n* quantifiers has an embedded negation (see, e.g., Keenan 1996).

13. Exactly one student passes ⇔
\[
\exists x[\text{student}(x) \& \text{pass}(x) \& \forall y [[y \neq x \& \text{student}(y)] \rightarrow \neg \text{pass}(y)]]
\]
Scoping exactly one student over will gives the unattested reading:

14  exactly one student \( x(\text{will}(\text{pass}(x))) \) \( \Leftrightarrow \)
\[ \exists x[\text{student}(x) \& \Box \text{pass}(x) \& \forall y[[y \neq x \& \text{student}(y)] \rightarrow \neg \Box \text{pass}(y)]] \]

But recall homogeneity gives us a “neg-raising” inference (\( \neg \Box \Rightarrow \Box \neg \))

Assume homogeneity in (14) is universally quantified (see Heim 1983):

15  \( \forall x[\Box \text{pass}(x) \lor \Box \neg \text{pass}(x)] \)

(14) and (15) jointly entail (16), the observed reading (one student is sure to pass but no others)

16  exactly one student(\text{will pass}) \( \Leftrightarrow \)
\[ \exists x[\text{student}(x) \& \Box \text{pass}(x) \& \forall y[[y \neq x \& \text{student}(y)] \rightarrow \Box \neg \text{pass}(y)]] \]
The fixed scope of exactly \( n \) under \( \textit{will} \) is due to homogeneity.

\textit{Sure to} and \textit{guaranteed to} can be understood as lacking a homogeneity presupposition, thus allowing variable scope.

This analysis predicts that \textit{sure to}, \textit{guaranteed to} fail to license a neg-raising inference (\( \neg \Box \Rightarrow \Box \neg \)).

Thus, (17) and (18) should be ok.

17 John is not sure to pass, but he may.

18 John is not guaranteed to pass, but he may.
Future tense expressions demonstrate some puzzling scopal properties:

- Both modality and temporality are encoded by future tense expressions, but **the two components scope independently**.
  - The modal component of futures may take variable scope with respect to some subject quantifiers.
  - The temporal component of futures obligatorily scopes low.

- Additionally, the fixed scope with respect to negation and non-monotonic quantifiers motivates a **homogeneity presupposition** for futures, of the kind assumed in analyses of neg-raising.

- Futures provide a valuable test case and comparison point for studies of homogeneity in the modal domain, and split scope phenomena.
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