Moods and Modalities for *Will* and *Would*

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1   Introduction

Aims

- propose a unitary semantics of *will/would* as a necessity modal

  - provide some of the ingredients for a compositional analysis of counter-factual *would/would have*

- motivate a modal account of the 'plain future' use: what are the alternative possible worlds *will* quantifies over?

- account for the temporal properties: when is temporal reference to the future obligatorily and when is temporal reference to the present or to the past allowed?

- account for the modal properties: how is the type of modality expressed tied to the temporal reference?

Motivation

- forward shifting is part of the semantics of modals in general

- need to distinguish between epistemic and metaphysical modality for so-called epistemic modals

- constraints on modal assertions

Variety of modal and non-modal readings

In English and in many other languages futurity is marked by the same element that, in different contexts, has a modal meaning.

(1) a. I <u>will</u> present in her class tomorrow. (future)

  b. She <u>will</u> leave the island by next week. (future)

  c. She <u>will have</u> left the island by next week. (future perfect)

  d. She wrote a book. It <u>would</u> later become a bestseller. (future in the past)

(2) a. He <u>will/must</u> be in his room right now. (epistemic modal)

  b. That <u>will/would</u> be the postman at the door. (epistemic modal)

  c. Otherwise, he <u>would</u> be at home right now. (counterfactual modal)

(3) a. She <u>will/must have</u> left the island yesterday. (epistemic modal)

  b. *She <u>will</u> leave the island yesterday.

  c. (In that case) she <u>would have</u> left the island yesterday. (counterfactual modal)

Predictive conditionals: open question whether *will* is a plain future auxiliary or a modal.

(4) a. If she asks him, he <u>will</u> present in her class tomorrow.

  b. If he is already at home, he <u>will</u> cook dinner this evening.

Epistemic conditionals: *will* is uncontroversially a modal.

(5) a. If he is already at home, he <u>will</u> be cooking dinner right now.

  b. If she asked him, he <u>must/will have</u> presented in her class yesterday.

Counterfactual conditionals: *would* is a modal (or, at least, not a future auxiliary); open question whether it simply signals counterfactuality or whether a compositional analysis can be given to counterfactuals.

(6) a. If he were already at home, he <u>would</u> be cooking dinner right now.

  b. If she had asked him, he <u>would have</u> presented in her class yesterday.

Variety of temporal readings

- future *will* and *will have* (future perfect) locate an event description after the time of utterance

- epistemic *will* locates an event description at the time of utterance or later

- epistemic *will have* locates an event description before the time of utterance

- factual *would* locates an event description in the past of the time of utterance

  - e.g. a child that would later become king

- counterfactual *would* (without *have*) locates an event description at the time of utterance or later

    – e.g. I would be home now/tomorrow/*yesterday

- counterfactual *would have* locates an event description at, before or after the time of utterance

    – e.g. I would have been home now/tomorrow/yesterday

- limit attention here

    – to unembedded occurrences of *will/would*
      (e.g., will not consider *will/would* in the scope of attitude predicates)
    – combining with simple sentence radicals
      (e.g., will not consider effect of *will/would* on embedded tenses)

Main question

- descriptively, *will* is a future auxiliary as well as a modal

- morphosyntactically there is no distinction between future auxiliary *will* and modal *will*

- is *will* semantically ambiguous?

In favor of ambiguity: Wekker 1976, Davidson-Nielsen 1988, Hornstein 1990, Declerck 1991, Declerck & Depraetere 1995, von Stechow 1995a

Against ambiguity: Jespersen 1924, Boyd & Thorne 1969, Binnick 1971, 1972, Lyons 1977, Palmer 1979, Smith 1978, Yavaş 1982, Haegeman 1983, Huddleston 1995, Enç 1996, Gennari 1998, Steedman 2000, Stowell 2003

Prima facie argument against ambiguity

- uniformity

    – crosslinguistic data: e.g., (7)
    – other modals and intensional predicates involve future reference, e.g., (8)
    – conditionals

In Cappadocian Greek *na* can be an epistemic or a deontic necessity modal; it is also used as a future tense marker.

(7)   a. ato to les as to melo z <u>na</u> to vgalis
        that which say-2sg from the mind yours NA it take out
        'You must have made up what you are saying.' (epistemic)

    b. to fšah as karj z <u>na</u> t agapisis
       the child from heart yours NA it love-2sg
       'You must love the child from your heart.' (deontic)

    c. Dere vava m <u>na</u> ert, ge <u>na</u> se rotiš . . .
       now father my NA come-3sg and NA you ask-3sg
       'Now my father will come and will ask you.' (future)

(8)   a. I may present in her class tomorrow.

       b. *She may leave the island yesterday.

This talk

- further motivate analysis of *will/would* on their plain future use as modals

- address the arguments against such an analysis

Main claims

- *will/would* on their plain future use express metaphysical modality

    – just like counterfactual *would/would have*

- *will* gets a unitary temporal interpretation in *all* its uses

Prima facie arguments for ambiguity

- variety of temporal readings

    – *will* as future tense makes temporal reference to the future obligatorily but modal *will* allows temporal reference to the present or to the past (Hornstein 1990)

    – *will* as future tense combined with the perfect has a different temporal interpetation from modal *will* combined with the perfect: (10a) vs. (10b) (Hornstein 1990)

- apparent lack of modal force

    – assertions with future *will/would* have the strength of non-modal assertions: (9a) and (9b) are on a par; similarly, (11a) appears equivalent with (11b).

    – if future *will* expresses modality, it is trivial modality: future *will* simply does not make reference to alternative possible worlds (Comrie 1985, von Stechow 1995a)

(9)   a. I presented in her class yesterday.

       b. I will present in her class tomorrow.

(10)   a. He will have finished by next week. (future perfect)

         b. He will have finished last week. (epistemic modal)

(11)   a. She wrote a book. It would become a best-seller two year later.

         b. She wrote a book. It became a best-seller two year later.

Alternative modal accounts

- *will* is a modal of prediction

    - but (12a) is stronger than (12b)
    - does not generalize to *would*

- epistemic *will* refers to a future epistemic state about the present or the past (e.g., Bennett & Partee 1978): e.g., (13) asserts that it will be known that he was here now.

- full epistemic route (e.g., Crouch 1993): assertion and verification time

(12)   a. I will present in his class tomorrow.

         b. I predict that I will present in his class tomorrow.

(13) He will be here now.

2   Future *Will*: Modal or Extensional?

- future *will* is a tense vs. *will* is uniformly a modal composing with tense

- future *will* is a non-modal temporal/aspectual operator vs. *will* is uniformly a modal temporal/aspectual operator

Sequence of tense phenomena

Decomposition into tense plus *woll*: *will* involves a present tense in logical form, while *would* involves a past tense (Abusch 1988, 1997, 1998, Ogihara 1995, 1996, von Stechow 1995a,b).

(14)   a. A week ago he said that in ten days he <u>would</u> buy a fish that <u>was</u> still alive. (fish alive at time of buying)

         b. He <u>will</u> buy a fish that <u>is</u> alive.
                 (fish alive at time of buying)

         c. He <u>will</u> buy a fish that <u>was</u> alive.
                 (fish alive prior to the time of buying)

- present tense component of *will*

- past tense component of *would*

- *will/would* are not tenses but temporal operators shifting the time of evaluation forward

- are they modal operators?

Extensional semantic view

- even if you assume that future *will* is a necessity modal, it is a modal with a singleton domain, consisting of the world of evaluation, hence the modality is trivialized

  "Obviously, this universal quantification over worlds with the same future as the evaluation world w is nothing but a tortuous way of speaking about the future of w. The rule is fully equivalent with the extensional rule given above. In other words, the modalization is spurious in the same way as the universal quantification in Rooth's rule. Nevertheless, the rule might grasp a conceptual reality." (von Stechow 1995a:28)

- this talk: universal quantification is over worlds with the same past as the evaluation world

Related philosophical controversy (Thomason 1970, 1984 Burgess 1978)

- Occhamist/Actualist view: 'it (simply) will be the case that p (in the *actual* future)' is a meaningful statement that has a truth value already now; Law of Bivalence holds for future statements

- Non-Occhamist/Peircian/Antactualist view: it is not meaningful to talk of the actual future: 'it will be the case that p' can only mean 'it will *necessarily* be the case that p'; Law of Bivalence does not hold for future statements

Temporal properties of modals

The temporal properties of *will* are like those of modals in general; e.g., (15) exhibits the same pattern as (1)–(3)

(15) a. I may present in her class tomorrow.

  b. She may leave/have left the island by tomorrow.

  c. He may be in his room right now. (epistemic)

  d. *She may leave the island yesterday.

  e. She may have left the island yesterday. (epistemic)

  f. She might have left the island yesterday (or not/but she didn't).
     (ambiguous: epistemic/counterfactual)

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Will as a modal verb for feature deletion

Same interpretation for embedded present and past tense in the scope of future *will* and in the scope of modal verbs.

> "Verbs of attitudes, modals and the future auxiliary *will* are variable binders that delete features under agreement" (von Stechow 2002:2)

> "Formally, *will* can be treated like a modal verb which abstracts over world and time and thereby deletes the features of the bound variables." (*ibid.*:38)

> "The embedded w_1 variable is formally bound but the semantics makes sure that it is evaluated with respect to the actual world. So *will* looks like a genuine modal verb, but it doesn't really quantify over worlds." (*ibid.*:39)

Evidence from *unless*

Future *will* patterns with modals and the generic operator in providing a domain of quantification, with *unless* functioning as a domain subtractor (e.g., von Fintel 1991). *Unless* with non-modal assertions provides a qualification of the assertion.

(16)   a. He (usually) eats fish unless there's steak available.

   b. He will eat the fish unless there's steak available.

   c. He must have eaten the fish unless there was steak available.

   d. ! Yesterday he ate the fish unless there was steak available.
      Yesterday he ate the fish, well, unless there was steak available.

   e. ! He is at home now unless he decided to go on that trip after all.
      He is at home now, well, unless he decided to go on that trip after all.

Asymmetries between past and future with respect to temporal clauses

Temporal clauses are implied true when in a past tense sentence but are not necessarily implied true when in a future tense sentence: (17a) implies that his demands were in fact granted while (17b) implies that his demands may be granted; similarly for (17c) and (17d).

(17)   a. He kept the hostages until his demands were granted.

   b. He will keep the hostages until his demands are granted.

   c. I resigned when/after I found a better job.

   d. I will resign when/after I find a better job.

Counterfactual *before*: without the modal, (18a) implies that they fired me, as well as that I resigned; in (18b), by contrast, *before* can have a counterfactual reading without use of a modal in the temporal clause.

(18)   a. I resigned before they could fire/#fired me.

   b. I will resign before they fire me.

3   Tense and Modals

Temporal perspective vs. time of instantiation

- distinction traditionally taken to indicate that modals are outside the scope of tense and combine with tensed sentences (Groenendijk & Stokhof 1975, Steedman 2000): 'perspective set by modal, time of instantiation set by tense' approach

- Condoravdi 2002: 'perspective set by tense, time of instantiation set by modal' approach

    - modals appear in the scope of tense
    - a modal in the direct scope of tense gets its temporal perspective set by tense
    - time of instantiation is set by the modal or other temporal operators (the perfect)

Epistemic modals have the perspective of the time of utterance. Evidence from adverbial modification: the adverbials specify when his getting/being sick occurs/holds, not when the possibility or necessity arises.

(19)   a. He must/ought to/should/may/might get sick
           tomorrow/*yesterday.

        b. He must/ought to/should/may/might be getting sick
           now/*yesterday.

        c. He must/ought to/should/may/might be sick
           now/tomorrow/*yesterday.

(20)   a. He must/ought to/should/may/might have gotten sick yesterday/*tomorrow.

        b. He must/ought to/should/may/might have been sick yesterday/*tomorrow.

Non-epistemic modals (e.g., abilitative or metaphysical) modals can have a past perspective, though only few modals in English can be construed with semantic past tense: *could, would*. Use of the perfect is the default way of shifting the temporal perspective to the past of the time of utterance.

(21)   a. At that point I could fly.

        b. He would return two hours later.

        c. At that point he might (still) have won. (counterfactual)

Speculative remarks

- The restriction on the perspective of epistemic modals may be a deeper semantic fact.

- The (un)availability of past tense for non-epistemic modals is a language specific morphosyntactic fact.

'Decomposition and scope' approach (Condoravdi 2002):

- there are two deictic tenses: present and past

- modals appear in the scope of tense

- their temporal perspective is fixed externally (by tense or the perfect)

- decompositional analysis of modals for the past (modal + perfect)

- scopal ambiguity for some modals: *Modal > Perf* and *Perf > Modal*

- epistemic modals for the present have a future time of instantiation optionally with stative predicates and obligatorily with eventive predicates

Tense and mood features

- tense feature indicates the kind of tense scoping over the modal (possibly with other operators intervening)

  - the feature [present] indicates that the modal is in the scope of (semantic) present tense

  - the feature [past] indicates that the modal is in the scope of (semantic) past tense

- mood feature indicates the kind of alternatives the modal quantifies over

  - the feature [indicative] is compatible with epistemic modality and a particular kind of metaphysical modality

  - the feature [subjunctive] indicates metaphysical modality

- *will* is the morphosyntactic manifestation of *woll* [present, indicative]

- *would* the morphosyntactic manifestation of *woll* otherwise: *woll* [past, indicative], [present, subjunctive]

The logical representation of the sentences in (22) is as in (23).

(22)   a. He must/should/might/may/will return tomorrow.
       perspective: now, time of instantiation: tom
       modality: epistemic or metaphysical (*must* only epistemic)

       b. He must/should/might/may/will be sick now.
       perspective: now, time of instantiation: now
       modality: epistemic

    c. He must/should/might/may/will have returned yesterday.
perspective: **now**, time of instantiation: **yest**
modality: epistemic
with *should/might have* also:
perspective: some time earlier than **yest**, time of instantiation: **yest**
modality: metaphysical

    d. He would return. (factual reading)
perspective: some past time, time of instantiation: some later past time
modality: metaphysical

    e. He would be here tomorrow. (counterfactual reading)
perspective: **now**, time of instantiation: **tom**
modality: metaphysical

(23)   a. *Pres*(*Modal*(*At*(*Tomorrow*)(he return)))
Modal corresponds to a [present, indicative] modal

    b. *Pres*(*Modal*(*At*(*Now*)(he be sick)))
Modal corresponds to a [present, indicative] modal

    c. *Pres*(*Modal*(*Perf*(*At*(*Yesterday*)(he return))))
Modal corresponds to a [present, indicative] modal

    d. *Pres*(*Perf*(*Modal*(*At*(*Yesterday*)(he return))))
Modal corresponds to a [present, subjunctive] modal

    e. *Past*(*At*(*Then*)(*Modal*(he return))
Modal corresponds to a [past, indicative] modal

    f. *Pres*(*Modal*(*At*(*Tomorrow*)(he-be-here))
Modal corresponds to a [present, subjunctive] modal

4 Temporal Interpretation

Basic Setup

Let W be a domain of worlds, $\mathcal{E}$ a domain of eventualities, and $\mathcal{T}$ a domain of non-null temporal intervals (with points as a special case) partially ordered by the relation of temporal precedence $\prec$ and by the subinterval relation $\subseteq$. A partial function τ from $\mathcal{E} \times W$ to $\mathcal{T}$ gives the time span of an eventuality that occurs in a given world. The operation $\cap$ on $\mathcal{T}$ gives the intersection of two intervals and is defined only for those intervals that overlap.

- Sentence radicals denote properties of eventualities

- Untensed sentences modified by frame adverbials, modals, or temporal operators (e.g., the perfect, negation) denote properties of times.

- Tensed sentences denote propositions.

- Frame adverbials, modals and temporal operators map eventive/temporal properties to temporal properties

- Tense maps eventive/temporal properties to propositions

- Frame adverbials, modals, temporal operators and tense operate on properties of eventualities or on temporal properties and instantiate them relative to a world and a time

- Frame adverbials have an intersective semantics (for this talk)

- The definedness condition of $\cap$ introduces a semantic presupposition

Notation

$\mathcal{E}_{w,t} = \{e \in \mathcal{E} \mid \tau(e, w) \subseteq t\}$.

Instantiation

(24) $\text{INST}(P, w, t) \;=\; \begin{cases} (\exists e \in \mathcal{E}_{w,t})P(w)(e) & \text{if } P \text{ eventive} \\ P(w)(t) & \text{if } P \text{ temporal} \end{cases}$

Temporal Elements

Past tense relative to a fixed context

(25) *Past*: $\lambda P \lambda w.\text{INST}(P, w, (-\infty, \mathsf{now}))$

Present tense relative to a fixed context

(26) *Pres*: $\lambda P \lambda w.\text{INST}(P, w, \mathsf{now})$

Individual-denoting temporal expressions

(27) *Yesterday*: yest, *Tomorrow*: tom, *Then*: then

Frame adverbials

(28) *At(Yesterday)*: $\lambda P \lambda w \lambda t.\text{INST}(P, w, \mathsf{yest} \cap t)$

(29) *By(Tomorrow)*: $\lambda P \lambda w \lambda t.(\exists t' \preceq \mathsf{tom})\text{INST}(P, w, t' \cap t)$

Negation (can scope over or under a modal)

(30) *Not*: $\lambda P \lambda w \lambda t. \neg\text{INST}(P, w, t)$

Existential perfect (can scope over or under a modal)

(31) *Perf*: $\lambda P \lambda w \lambda t.(\exists t' \prec t)\text{INST}(P, w, t')$

(32)   a. He left.

b. $Past$(he-leave)

c. $\lambda w.(\exists e \in \mathcal{E}_{w,(-\infty,\mathsf{now})})\text{he-leave}(w)(e)$

(33)   a. He left yesterday.

b. $Past(At(Yesterday)(\text{he-leave}))$

c. $\lambda w.(\exists e \in \mathcal{E}_{w,\mathsf{yest}})\text{he-leave}(w)(e)$
   $(\mathsf{yest} \cap (-\infty, \mathsf{now}) = \mathsf{yest})$

(34)   a. He has left.

b. $Pres(Perf(\text{he-leave}))$

c. $\lambda w.(\exists t \prec \mathsf{now})(\exists e \in \mathcal{E}_{w,t})\text{he-leave}(w)(e)$

Modals

- modals uniformly expand the time of evaluation forward

- they need to be in the direct scope of an expression that supplies the temporal perspective (needs to be an interval with a left bound)

  - therefore, they can be in the direct scope of present tense, the perfect, or a frame adverbial (with a salient time)

  - they cannot be in the direct scope of past tense

- the right bound of the expanded interval is restricted by tense

  - only past tense genuinely restricts the right bound given by a contextual parameter r

- the modal base MB is a contextually determined function from world-time pairs to sets of worlds

- if MB is a metaphysical modal base, $MB(w,t)$ consists of the metaphysical alternatives of w at t

- if MB is the epistemic state of a particular agent, $MB(w,t)$ consists of the set of worlds compatible with what that agent believes in w at t.

- graded modality can be built on top of (35) and (36) by making reference to an ordering between worlds.

(35) May_{MB}: $\lambda P \lambda w \lambda t.(\exists w' \in MB(w,t))\textsc{Inst}(P, w', [t, r))$

(36) $Woll_{MB}$: $\lambda P \lambda w \lambda t.(\forall w' \in MB(w,t))\textsc{Inst}(P, w', [t, r))$

(37) r is $\begin{cases} +\infty & \text{if modal [present]} \\ \mathsf{now} & \text{if modal [past]} \end{cases}$

Woll **in the direct scope of present tense**

(38)   a. He will/would be here now.

   b. $Pres(Woll(At(Now)(\text{he-be-here})))$

   c. $\lambda w.(\forall w' \in MB(w, \mathsf{now}))(\exists e \in \mathcal{E}_{w',\mathsf{now}})\text{he-be-here}(w)(e)$
   $(\mathsf{now} \cap [\mathsf{now}, +\infty) = \mathsf{now})$

(39)   a. He will/would leave.

   b. $Pres(Woll(\text{he-leave}))$

   c. $\lambda w.(\forall w' \in MB(w, \mathsf{now}))(\exists e \in \mathcal{E}_{w',[\mathsf{now},+\infty)})\text{he-leave}(w)(e)$

(40)   a. He will/would leave tomorrow.

   b. $Pres(Woll(At(Tomorrow)(\text{he-leave})))$

   c. $\lambda w.(\forall w' \in MB(w, \mathsf{now}))(\exists e \in \mathcal{E}_{w',\mathsf{tom}})\text{he-leave}(w)(e)$
   $(\mathsf{tom} \cap [\mathsf{now}, +\infty) = \mathsf{tom})$

(41c) entails (41d).

(41)   a. He may/will have left yesterday.

   b. $Pres(Modal(Perf(At(Yesterday)(\text{he-leave}))))$

   c. $\lambda w.(Qw' \in MB(w, \mathsf{now}))(\exists t \prec [\mathsf{now}, +\infty))(\exists e \in \mathcal{E}_{w',t\cap\mathsf{yest}})\text{he-leave}(w)(e)$

   d. $\lambda w.(Qw' \in MB(w, \mathsf{now}))(\exists e \in \mathcal{E}_{w',\mathsf{yest}})\text{he-leave}(w)(e)$

(42)   a. He will leave by tomorrow.

   b. $Pres(Woll(By(Tomorrow)(\text{he-leave})))$

   c. $\lambda w.(\forall w' \in MB(w, \mathsf{now}))(\exists t \preceq \mathsf{tom})(\exists e \in \mathcal{E}_{w',t\cap[\mathsf{now},+\infty)}\text{he-leave}(w')(e)$
   (in order for $\cap$ to be defined, $\mathsf{now} \preceq t \preceq \mathsf{tom}$)

(43)   a. He will have left by tomorrow.

   b. $Pres(Woll((By(Tomorrow)(Perf(\text{he-leave})))))$

   c. $\lambda w.(\forall w' \in MB(w, \mathsf{now}))(\exists t' \preceq \mathsf{tom})(\exists t \preceq t')(\exists e \in \mathcal{E}_{w',t\cap[\mathsf{now},+\infty)}\text{he-leave}(w')(e)$
   (wlg: $\mathsf{now} \preceq t \preceq \mathsf{tom}$)

Woll **in the scope of past tense**

(44)   a. He would leave (two days later).

   b. $Past(At(Then)(Woll(\text{he-leave})))$

   c. $\lambda w.(\forall w' \in MB(w, \mathsf{then}))(\exists e \in \mathcal{E}_{w',[\mathsf{then},\mathsf{now})})$

Temporal interpretation and modality

Why can *woll* be construed with a metaphysical modal base in (1a) but not in (2a)
or (3a)?

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- indicative modals have exclusively an epistemic reading when the property they apply to is instantiated at a time coinciding with, or in the past of, their temporal perspective

- they allow for a metaphysical reading when the property they apply to is instantiated at a time in the future of the temporal perspective of the modal

5 Metaphysical alternatives and historical necessity

- the decisive factor in excluding a metaphysical reading is whether an issue is *pragmatically presupposed* to be settled or not

- when the property a modal applies to is instantiated at a time coinciding with, or in the past of, the temporal perspective of the modal, settledness is always pragmatically presupposed

- the concept of an issue being settled at a given time corresponds to the notion of *historical necessity*

(45) Following Thomason's 1984 world-time model, we can fix, for every time t, an equivalence relation $\simeq_t$ on W such that

  whenever $w \simeq_t w'$ and $t' \prec t$, $w \simeq_{t'} w'$.

- the basic idea of the world-time model is to have worlds be complete histories through time and bundle together worlds with an identical past

- worlds may *historically determine* the same set of facts up to a given time t

- any such two worlds are historical alternatives through t and may differ only in what is future to t

(46) *Historical Necessity*
  Truth of a temporal predicate P is subject to historical necessity in the following sense: for all w, t,

$$\text{INST}(P, w, t) \quad \Longleftrightarrow \quad (\forall w' \simeq_t w)\text{INST}(P, w', t)$$

- the 'plain future' use of *will* arises when it is construed with a metaphysical modal base with the metaphysical alternates of a world at a given time being its historical alternatives at that time

- on its 'plain future' reading then, *will* asserts that a given future fact is already settled at the time of utterance; speakers of English are, from a philosophical point of view, antactualists

- the grounds for speakers making such an assertion may be their own planned course of action, their beliefs about what is a normal course of events and whether (what they take to be) the actual world is normal, etc.

- similarly factual *would* asserts that a particular past fact was already settled at a contextually given past time

6 Modal Bases

(47) A set $W' \subseteq W$ of worlds is *t-coarse* if for all $w \in W'$, whenever $w' \simeq_t w$, $w' \in W'$.

For every $W' \subseteq W$,

(a) the $\subseteq$-least t-coarse set that $\subseteq$-contains W' is

$$W'[t] \quad = \quad \bigcup_{w \in W'} \{w' \mid w \simeq_t w'\}$$

(b) W' is t-coarse iff $W' = W'[t]$.

- a metaphysical modal base MB assigns to a world w and time t (a subset of) w's historical alternatives through t: $MB(w, t) \subseteq \{w\}[t]$

- take epistemic states to be (subsets of) unions of sets of equivalence classes of worlds with respect to a given time, i.e., $W'[t]$

- common grounds are $W'[\mathsf{now}]$

- a metaphysical modal base MB for an indicative modal are those historical alternatives in the common ground: $MB(w, t) = \{w\}[t] \cap W'[\mathsf{now}]$

- subjunctive modals indicate domain widening (Stalnaker 1975, von Fintel 1999)

Factual entailment of [past, indicative] *woll*

(48)   a. (She wrote a book.) It would become a best-seller two year later.

  b. (She wrote a book.) It became a best-seller two year later.

- for any word w and times $t < t'$, $\{w\}[t'] \subset \{w\}[t]$

- take $w \in W'[\mathsf{now}]$ and some $t < \mathsf{now}$: $w \in \{w\}[\mathsf{now}]$ and hence, $w \in \{w\}[t] \cap W'[\mathsf{now}]$

- therefore, (48a) entails (48b)

- those worlds $w' \in \{w\}[t] \cap W'[\mathsf{now}]$ that are not in $\{w\}[\mathsf{now}]$ are common ground epistemic alternatives to w

- however, on this account (48a) is stronger than (48b)

  - consider $w \in W'[\mathsf{now}]$, $t < \mathsf{now}$ and $w' \in \{w\}[t] \cap W'[\mathsf{now}]$ such that the book becomes a best-seller in w but not in w'
  - (48b) is true in w but (48a) is not

Asymmetry in temporal clause implications

- implications associated with temporal clauses are contextual entailments (Beaver & Condoravdi 2003)

  - temporal connectives introduce a semantic presupposition that the temporal clause is true
  - contextual update: retain only those worlds in which the sentence is true

- the semantic presupposition associated with the temporal clause acts as a domain restriction on a modal

Regulating modal base selection

A context c, with common ground cg, can assign to a modal with temporal perspective t and applying to contingent property P a modal base MB only if cg and MB satisfy (49):

(49) *Diversity Condition:*
There exist $w \in cg$ and $w', w'' \in MB(w, t)$ such that
$$\mathrm{INST}(P, w', [t, \infty))\text{and } \neg\mathrm{INST}(P, w'', [t, \infty)).$$

Relation between temporal and modal reading

- a metaphysical reading is excluded, in any context, when the modal takes scope over the perfect

- or when the modal takes scope directly under tense and combines with a stative predicate instantiated at a time including the time of utterance

- in these cases the modal can only be construed with an epistemic modal base

Obligatory forward shift with future *will* and factual *would*

- need to strengthen $[t, +\infty)$ to $(t, +\infty)$ indicates the need for a non-trivialization of the modality requirement