

What the Future ‘Might’ Brings

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It is easy to talk about what we know right now, what we knew yesterday and what we will come to know tomorrow. We can also talk about what might be now and what might have been the case yesterday. But what about what might be tomorrow? I argue that we can indeed talk coherently about future epistemic possibilities, but not as we might have expected. In cases where information is lost, they cannot simply be used to talk about our future evidence. In light of this, I argue we need a new theory of the domains of quantification for epistemic modals.

Epistemic modals are often thought of as tools for describing a given body of evidence. Specifically, a sentence like

(1) It might be raining.

means roughly

(2) The current evidence doesn’t rule out that it is raining.

Most theories of epistemic modals formalize this thought as follows:¹

Evidence: $[[\textit{might } \phi]]^{c,w,t} = 1$ iff ϕ is compatible with the evidence of the relevant agent(s) in c in w at t .

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¹Something like this view originates in Moore (1962) and can be traced through Hacking (1967), Teller (1972), DeRose (1991) and Kratzer (1981).

Theories differ over *whose* evidence is relevant. But they agree on the central point: what is epistemically possible at a given time is whatever is compatible with the evidence of a certain set of agents at that time.

I test the predictions of **Evidence** against cases of *predictable forgetting*. In such cases, speakers cannot describe their future states of mind with epistemic modals under future tense even though they know that they *will* be able to do so. Moreover, no similar barrier exists for past epistemic modal claims. **Evidence** can't predict these data.

I propose replacing **Evidence** with **History**:

History. 'might ϕ ' is true at a world w and time t iff ϕ is compatible with the evidence in the relevant interval before and up to t .

According to **History**, epistemic modals collect information that agents gather *over time*, not just their evidence *at a particular time*. This makes epistemic modals sensitive to evidence agents used to have, as well as evidence they have now. Epistemic modals never lose information: once something becomes necessary, it remains necessary. They are tools to describe information obtained over time in abstraction from the deficiencies of the agents who gather it.

1 Predictable Forgetting

An agent *predictably forgets* some proposition p just in case she knows p at some time t and knows that she will forget p by some later time t' .

Predictable forgetting is not uncommon. I can predict that I will forget that the person I just met is called John, that John lives in Apartment 211, that his phone number is such and such. The structure of my cases will be somewhat more involved. But we do well to remember that the basic phenomenon is pervasive.

Here's an example.

Keys on Monday. On Monday night, Alice leaves her keys in the kitchen. But she always forgets where she has left the keys overnight. She foresees that tomorrow morning she will look for them in her bedroom.

What kinds of epistemic modal claims can Alice make? Three observations.

First, Alice cannot report her future ignorance by saying:

- (3) # Tomorrow my bedroom will be one of the places that the keys might be in.
- (4) # Tomorrow my keys might be in the bedroom.
- (5) # Tomorrow it will be possible that the keys are on the nightstand.
- (6) # Tomorrow I'll look in my bedroom because the keys might be on the nightstand.
- (7) # Tomorrow I'll look in my bedroom because it will be possible that the keys are on the nightstand.
- (8) # Tomorrow I will search every drawer in my room which might contain the keys.

These sentences should have true readings where the tense scopes over the modal. Nevertheless, they sound marked. Observation 1 sums this up:

Observation 1. Whenever a speaker knows that ϕ , they cannot assert '*FUT* might $\neg\phi$ ', even if they know they will no longer know ϕ at some later time.²

What can Alice's future, less informed self say? Consider

Keys on Tuesday Alice wakes up Tuesday and has forgotten where the keys are. She looks for them upstairs.

²This markedness also projects under supposition. Imagine Alice supposes the scenario above held. The following is then true:

- (i) Alice supposes that she knows the keys are not in her bedroom, but that she will forget this.

Can she *suppose* that it will in the future be possible that they are somewhere else? It seems not. Consider:

- (ii) Alice supposes that she will search every drawer in her room which might contain the keys.

Now Alice seems to be contradicting her initial supposition.

Alice says

(9) The keys might be on the nightstand.

What Alice says is perfectly assertable; she's not making some mistake in uttering this sentence. In Alice's situation, you might say something like (9), too. This pattern is general and gives us our second observation:

Observation 2. At the later time when the speaker has forgotten ϕ , she may assert 'might $\neg\phi$ '.

Finally, consider what Alice can say about her past self. As von Fintel and Gillies (2008) note, agents *can* use past 'might'-claims to talk about times when they had less knowledge. Continue the case:

Keys on Monday Again. On Monday night Alice's partner asks her what she was doing rummaging around in their bedroom on Sunday morning. Alice was in fact looking for the keys, which her partner had placed in the living room.

Imagine Alice replies

(10) Yesterday I was searching our bedroom because the keys might have been in there. (It turned out they were in the living room.)

(11) Yesterday I was searching every drawer that the keys might have been in.

Strikingly, this is perfectly natural, even though Alice knows that the keys were not in the bedroom. Thus:

Observation 3. If they know they previously did not know ϕ , even a speaker who currently knows that ϕ can assert 'PAST might $\neg\phi$ '.

There are two surprises here. First is the combination of Observations 1 and 2. In these cases, why is there a difference between what I *will* be able to say about myself using an epistemic modal and what I can *now* say about my future self?

This is not how things usually go. If I foresee that tomorrow I will correctly say ‘It is raining in Topeka’ then it should be correct for me *now* to say ‘It will rain in Topeka’. Why are epistemic modals different?

The second surprise is the combination of Observations 1 and 3. They show that there is an asymmetry between past- and future-tensed epistemic modals. Present information that ϕ interferes with our assessment of ‘*FUT* might $\neg\phi$ ’ but not ‘*PAST* might $\neg\phi$ ’. Why does the direction in time matter?

2 What Evidence Predicts

We will now make precise why predictable forgetting is a challenge for **Evidence**.

To make **Evidence** precise, we will use a broadly Kratzerian account, which posits a *modal base*, B_c , a contextually-supplied function from a world and a time to a set of propositions. The modal quantifies over the intersection of $B_c(w, t)$.³

$$(12) \quad \llbracket \text{might } \phi \rrbracket^{c,w,t} = 1 \text{ iff } \exists w' \in \cap B_c(w, t) : \llbracket \phi \rrbracket^{c,w't} = 1$$

We treat tenses as operators, shifting the time of evaluation:

$$(13) \quad \llbracket \text{PAST } \phi \rrbracket^{c,w,t} = 1 \text{ iff } \exists t' : t' < t \wedge \llbracket \phi \rrbracket^{c,w,t'} = 1$$

$$(14) \quad \llbracket \text{FUT } \phi \rrbracket^{c,w,t} = 1 \text{ iff } \exists t' : t < t' \wedge \llbracket \phi \rrbracket^{c,w,t'} = 1$$

where $t < t'$ just in case t is earlier than t' .⁴

Combining these assumptions yields this schematic entry for future ‘might’-claims:

$$(15) \quad \llbracket \text{FUT might } \phi \rrbracket^{c,w,t} = 1 \text{ iff } \exists t' : t < t' : \exists w' \in \cap B_c(w, t') : \llbracket \phi \rrbracket^{c,w',t'} = 1$$

‘*FUT* might ϕ ’ is true at time t iff there is a ϕ -world in the modal base as evaluated at some point later than t . Similarly, for past ‘might’-claims:

³This is von Stechow and Gillies (2008)’s formulation, which adds a time-parameter to Kratzer (1977), Kratzer (1981) and Kratzer (1991).

⁴We could equally well use a referential theory of tense, as in Partee (1973) or Abusch (1997), or a modal theory of ‘will’, as in Enc (1985), Abusch (1997) and Cariani and Santorio (forthcoming). (See Ogihara (2007) for more on these issues.)

$$(16) \quad \llbracket \text{PAST might } \phi \rrbracket^{c,w,t} = 1 \text{ iff } \exists t' : t' < t : \exists w' \in \cap B_c(w', t') : \llbracket \phi \rrbracket^{c,w',t'} = 1.$$

‘PAST might ϕ ’ is true at a time t just in case there is a ϕ -world in the modal base as evaluated at some point earlier than t .

Start with *solipsistic contextualism*, according to which the modal talks about the speaker’s evidence. More specifically, when given a world w and a time t , B_c outputs the set of propositions that make up *the speaker’s* evidence in w at t . In **Keys**, Alice’s only evidence about the keys is what she remembers about their location, so Alice’s evidence and her knowledge are interchangeable here. So $B_c(w, t)$ is the set of propositions that Alice knows in w at t .

This semantics fails to predict Observation 1. We said Alice will forget the location of the keys. So when (3) – (8) are read as future ‘might’-claims, they are predicted true. And *Alice* knows this. She should be able to tell that (3)-(8) are true. **Evidence** predicts that (3) - (8) should be *sensible* things for Alice to say.

I have focused on solipsistic contextualism, a theory thoroughly undermined by MacFarlane (2011)’s problem of disagreement. Nevertheless, proposals for treating disagreement do not help.

Take Dowell (2011)’s proposal: the speaker can select whatever modal base she likes, so long as she can reasonably expect her audience to figure out what she means. In predictable forgetting cases, it *would* be reasonable to take the relevant knowledge to be the speaker’s. This interpretation makes (3) - (8) true and relevant. This view won’t *rule out* the problematic readings of (3)–(8); it just *adds* possible readings. This problem generalizes to other sophisticated contextualisms.⁵

What about relativism? Relativists add a parameter to the index—a *context of assessment* parameter. It supplies the relevant knowledge. Where B_a is the set of propositions known by the *assessor* in w at t , we have:

$$(17) \quad \llbracket \text{might } \phi \rrbracket^{c,w,t,a} = 1 \text{ iff } \exists w' \in \cap B_a(w, t) : \llbracket \phi \rrbracket^{c,w',t,a} = 1^6$$

‘might ϕ ’ is true at $\langle c, w, t, a \rangle$ just in case the the assessor’s evidence in a at t is consistent with ϕ .

⁵For instance, von Fintel and Gillies (2011)’s cloudy contextualism faces the same issue.

⁶I add a time parameter to MacFarlane (2011).

What does relativism predict about ‘*FUT* might ϕ ’ in **Keys**? That depends on what *the assessors* will know the next day. Plausibly, we expect *our* current knowledge to persist through Tuesday, so relativism predicts the ‘*FUT* might ϕ ’ examples are false in our context of assessment: since we won’t forget $\neg\phi$, ‘might ϕ ’ will be false when fed times from Tuesday. But then ‘might ϕ ’ is false as said on Tuesday too: the same information is used to assess it. Relativism wrongly predicts ‘might ϕ ’ as said on Tuesday should sound just as bad to us as ‘*FUT* might ϕ ’ as said on Monday.⁷

The problem is clear. **Evidence** can’t predict *both* Observations 1 and 2. It seems to make the ‘might’ claim made in the future true only if it makes the future tensed ‘might’ claim made in the present true, too. Likewise, **Evidence** can’t predict both Observation 1 and 3. According to **Evidence**, modals simply track the evolution of some body of information: present information is irrelevant in the past *and* the future.

3 Tensing Modals

We’ve assumed that tense can scope over epistemic modals. Some, like Groenendijk and Stokhof (1975), Iatridou (1990) and Hacquard (2006), reject this assumption. I argue that they are mistaken. There *are* examples of past- and future-shifted epistemic modals.

3.1 Evidence of Shifting

To be sure, epistemic modals at least *seem* to have tensed readings.

As noted in Observation 3, epistemic modals have *backwards*-shifted readings: past ‘might’s there are felicitous. We also find forward-shifted readings. Consider this case:⁸

Shortlist. You and I are trying to figure out who got the job at our university. We don’t know very much about who the candidates might

⁷Stephenson (2007) and Egan (2007) face the same problem.

⁸Dorr and Hawthorne (2013) discuss a similar case.

be, but we know we will see the shortlist tomorrow. We will contact everyone on the shortlist to see if they got the job.

You say to me:

(18) Let's drop this matter for now. Tomorrow we will contact everyone who might have been hired.

(19) Tomorrow we will contact every possible hire.

These sentences aren't about who might have been hired given our *current* evidence, but about who might have been hired given our *future* evidence. Suppose today we think John might have been hired, but tomorrow we discover he wasn't. If we didn't contact John, it would be bizarre for me to claim that you are not following up on what you said in (18) or (19). This is because you were talking about your future evidence, not your evidence at the time of utterance.

This is an important point. We can't explain the badness of future 'might'-sentences (3)-(8) by denying that forward-shifting is possible. This makes our situation much more puzzling. If future shifted readings exist, why are they not available in **Keys**?

3.2 Explaining away shifting

Some claim that past-shifting is merely apparent. Can we say the same about future-shifting? One thought is that the examples from the last section involve an elided attitude ascription. When we hear sentences like

(20) The keys might have been in the drawer.

(21) We will interview everyone who might have gotten the job.

we are really evaluating sentences like

(22) I thought that the keys might have been in the drawer.

(23) We will interview everyone who we will think might have gotten the job.

Then we could say, as Abusch (1997) and Hacquard (2006) do, that it is the *attitude verb* that shifts the time of the modal, not tense. So perhaps we can explain apparent tense-shifting, while still denying the key assumption in my statement of the puzzle.⁹

But this account makes exactly the wrong predictions in predictable forgetting: allowing tacit attitude verbs *overgenerates* felicitous future ‘might’s. In **Keys on Monday**, Alice cannot say

- (3) #Tomorrow (I’ll look in my bedroom because) the keys might be on the nightstand.

But she can say

- (24) Tomorrow I will think the keys might be on the nightstand.

If we countenance elided attitudes, this contrast is puzzling. Why is there no elided attitude in (3)? After all, if it were interpreted this way, it would not be marked, but perfectly intelligible.

And there is no obvious reason why elision should happen in von Fintel and Gillies’s cases as well as **Shortlist** but not cases like **Keys**. In both kinds of cases, speakers are heard as trying to explain past or future actions in terms of what they know at the time; but in only one of them are they successful. The elision strategy gives no insight as to why this should be. The elision idea doesn’t dissolve the puzzle; indeed, the puzzle is evidence against the elision approach in the first place.¹⁰

Before moving to my proposal, I want to address the reasons that are taken to motivate skepticism about tense shifting. In Hacquard (2006) and Hacquard (2011)

⁹Hacquard (2011) suggests apparent tense shifting is due to a tacit, modal base-shifting ‘because’. But in (18) and (19), there is nowhere to put the ‘because’ that gets right reading.

¹⁰Another issue is the following contrast:

- (i) a. I thought the keys might have been in the drawer and I was right: they might have been.
b. I thought the keys might have been in the drawer and I was right: # I thought they might have been.

The elision approach predicts no contrast here.

it is noted that certain sentences seem to lack the expected tensed readings. Take:

(25) Mary must have taken the train.

(26) Tomorrow Marikos might be dead.

Out of the blue, the only epistemic reading of (25) is one which talks about our *present* knowledge; and it is hard to get any epistemic reading of (26). Likewise it is hard to get epistemic readings when modals are embedded under temporal adverbials:

(27) #Usually Mary might take the train.

Hacquard and others think that the absence of such readings is readily explained if we say tense is barred from *ever* shifting the relevant knowledge.¹¹

But what about a *pragmatic* explanation? If the syntax and semantics of *modals* are supposed to explain the data, we should not expect to see similar data for knowledge attributions. But note that even tensed knowledge attributions can sound odd out of the blue. Consider for instance:

(28) Q. How did Mary leave town?
a. [A.] ?? I knew she took the train.

(29) ?? Tomorrow I won't know whether Marikos is dead.

Without context, both sentences sound odd. We notice the same pattern with temporal adverbials:

(30) ??Usually I don't know whether Mary will take the train.

There is a natural explanation of these data: without context, it's hard to see why anything other than our current ones would be *relevant*. When we are wondering how Mary left town or whether Marikos is dead, why care about what I knew in the past or will know in the future?

This explanation naturally extends to modals. We search for readings of (25)

¹¹Note also these data hold only for the *auxiliaries* 'might' and 'must' and not 'it is possible'. But my data include epistemic 'possible' too.

and (26) that aren't just true but also *relevant*. Since the missing readings are irrelevant, we do not select them. And when context makes clear *why* other knowledge states would be relevant, those shifted readings should appear. This is exactly what we observe: our *prima facie* cases of shifting are precisely cases that make clear why other knowledge states would be relevant.

Our original observations do not derive from some general problem about combining epistemic modals and tense. Tense *can* scope above epistemic modals. It just does not always produce the results we would expect.

4 An Interval-Based Solution

I now give a semantic solution to our puzzle. I give a new kind of modal base to predict our three observations.

4.1 The modal base

I make two innovations to how modal bases work.

First, I replace **Evidence** with

History. 'might ϕ ' is true at a world w and time t iff ϕ is compatible with all the evidence acquired in w in the relevant interval before and up to t .

Instead of simply collecting together the propositions that make up the agent's evidence at a given time, as **Evidence** does, epistemic modal bases will also collect those propositions at times within a certain interval before the input time. Thus, while epistemic modals still have something to do with the evidence of the relevant agents, they can also come apart from that evidence as we go forward in time. (Again, in our cases the only relevant evidence is what the agent knows, so I will treat evidence and knowledge as interchangeable.)

Second, I give a theory about which intervals are relevant. I say the relevant interval starts with the most recent episode of information loss. Given a time t , define \mathcal{I}_t , which we'll call a *partial history*, as follows:

$$(31) \quad \mathcal{I}_t = \{t' : \text{either } t < t' \text{ or } t' < t \text{ and } t' \text{ is not earlier than the most recent episode of information loss to relative to } t.\}$$

Intuitively, to construct a partial history for a given t , we take an agent's entire history and remove the part before the most recent (relative to t) episode of information loss.¹²

The modal base is defined relative to a partial history. Where \mathcal{I}_{t_c} is the partial history corresponding to the time of the context c :

(32) **(Partial History)**

$$B_c(w, t) = \{p : \text{the relevant agent knows } p \text{ at some } t' \text{ where } t' \leq t \text{ and } t' \in \mathcal{I}_{t_c}\}$$

(The output of the modal base at w and t is the set of propositions known in w at any point in \mathcal{I}_{t_c} up to t)

When fed a time t (and world w), an epistemic modal base delivers the set of propositions known at times up to t (in w) in the partial history \mathcal{I}_{t_c} . In other words, modal bases collect the facts known within a given partial history up until t . To find the domain of quantification $\cap B_c(w, t)$ we find all the propositions known at any time in \mathcal{I}_{t_c} before t and intersect that set.

Note two important features of this account. First, the modal base is *monotonic*: when t' is later than t , if p is in the modal base at t then it must also be in the modal base at t' . So the set of epistemic possibilities cannot grow as time passes.

Second, moving between partial histories introduces a context-shift. Whenever information is lost, the relevant partial history changes; and since the modal bases are anchored to partial histories, the modal base changes, too. And this seems right. Were the context not to shift, information would continue to accumulate in the modal base across contexts of utterance even though the relevant agents do not have access to it. This is undesirable: the more time passes, the fewer epistemic modal claims an agent would be justified in making. (I would not, for instance, be justified in telling you that on this day a year ago, I might have eaten cornflakes for

¹²Really this should be the most recent episode of *relevant* forgetting. We don't want, say, Alice's forgetting what she had for breakfast to trigger a context-shift. At a first pass, a relevant proposition is a (partial) answer to a *question under discussion* (in the sense of Roberts (1996)).

breakfast, for I know my past knowledge settles the matter one way or the other!)
 If the modal base collects what is known from some point closer to the context of utterance, context-shifting solves the problem.

4.2 Predictions

Now recall our case:

Keys. On Monday night, Alice leaves her keys in the kitchen. But she always forgets where she has left the keys overnight. In fact, she can foresee that tomorrow morning she will go looking for them in her bedroom.

Alice says

- (3) #Tomorrow I'll look in my bedroom because the keys might be on the nightstand.

Keeping the semantics from earlier, we still have:

$$(15) \quad \llbracket \text{FUT might } \phi \rrbracket^{c,w,t} = 1 \text{ iff } \exists t' : t < t' : \exists w' \in \cap B_c(w, t') : \llbracket \phi \rrbracket^{c,w',t'} = 1.$$

Let B_{Monday} be the modal base supplied by Monday's context of utterance. To evaluate (3), we need to see whether $\cap B_{Monday}(w, t_{Tuesday})$ contains worlds where the keys are on the nightstand.

Partial History tells us that $B_{Monday}(w, t_{Tuesday})$ contains all propositions known by Alice at any time in *Monday's* partial history up until Tuesday. Since she knows on Monday that the keys are in the kitchen, $B_{Monday}(w, t_{Tuesday})$ contains the proposition that the keys are in the kitchen. In Monday's context, $\cap B_{Monday}(w, t_{Tuesday})$, the domain for the modal evaluated at Tuesday will *not* contain worlds where the keys are on the nightstand. So (3) is false. Moreover, Alice's semantic knowledge, together with her knowledge of the case, guarantees that she *knows* (3) is false. Hence (3) is marked. This explains Observation 1.

We also rightly predict that Alice's knowledge only gets carried *forward*. Consider again:

Keys on Monday Again. On Monday night Alice’s partner asks her what she was doing rummaging around in their bedroom the previous morning. Alice was in fact looking for the keys, which her partner had placed in the living room.

Alice says

(10) Yesterday I looked in our bedroom because the keys might have been there.

Again, we give past ‘might’-claims the following semantics:

(16) $\llbracket \text{PAST might } \phi \rrbracket^{c,w,t} = 1$ iff $\exists t' : t' < t : \exists w' \in \cap B_c(w, t') : \llbracket \phi \rrbracket^{c,w',t'} = 1$.

To see whether (10) is true, we need to see whether for some time t on Sunday $\cap B(w, t_{\text{Sunday}})$ contains worlds where the keys are in the bedroom.

Partial History predicts that it will. $B(w, t_{\text{Sunday}})$ will contain just the propositions known by Alice up until Sunday (within Monday’s partial history). Until the point at which she found them, Alice did not know where the keys were. So $\cap B(w, t_{\text{Sunday}})$ will contain worlds where the keys were in the bedroom. Hence (10) is true. This explains Observation 3.

Partial History predicts the asymmetry brought out by Observations 1 and 3 precisely because it is monotonic: past information is carried forward, but future information is not carried backwards. (This feature will be shared by any **History**-based view.)

Finally, we want to explain the contrast between what Alice can say on Monday and what she can say on Tuesday. Consider the continuation of the case:

Keys on Tuesday Alice wakes up on Tuesday morning and has indeed forgotten where the keys are. She goes looking for them upstairs.

We noted Alice can now say

(9) The keys might be on the nightstand.

We predict this by appeal to partial histories. Since something is forgotten overnight, different partial histories correspond to Monday and Tuesday, so B_{Monday}

will be different from $B_{Tuesday}$. Moreover, since on Tuesday Alice does not know where the keys are, $B_{Tuesday}(w, t_{Tuesday})$ will not contain the proposition that the keys are in the kitchen. So $\cap B_{Tuesday}(w, t_{Tuesday})$ will contain worlds where the keys are on the nightstand. Thus, (9) as said by Alice on Tuesday is true and assertable. This explains Observation 2.

On my proposal, modal bases are monotonic within a context, but not across contexts. This is why we predict the contrast between what Alice can say on Monday and on Tuesday but also the asymmetry between past and future ‘might’-claims.¹³

¹³A referee asks about cases where both the learning and the forgetting are predictable, like the following: I will learn this evening whether aliens landed at Roswell; but my memory will be wiped by the men in black overnight. Consider:

- (i) Tomorrow morning it will be possible that aliens landed at Roswell and it will be possible that they didn’t.

I predict that this is marked: either the proposition that they landed at Roswell or its negation will be in my future modal base.

I think this is the right prediction, but I grant that the intuitions are less clear here. To bolster my intuition, note that the judgements are clearer if the discourse highlights the information loss.

- (ii) Either I’ll forget that they landed at Roswell or I’ll forget that they didn’t land at Roswell. # On Tuesday morning, it’ll be true that the aliens might have landed in Roswell and that they they might not have.

Similarly, we are reluctant to describe ourselves as *knowing* either of these future ‘might’s:

- (iii) #Tomorrow morning, I’ll know that the aliens might have landed in Roswell and I’ll know that they might not have.

This is puzzling, if they are indeed true. Empirical investigation could be illuminating here; but hopefully these data make my predictions seem plausible.

The referee floats an alternative proposal, whereby the modal base just unions the information at the future time and the information at the context of utterance. This would correctly predict that future ‘might’s are marked in cases like **Keys**, as well as having the (possible) benefit of predicting that (i) is true.

The data above aside, I think it will be difficult to spell out this proposal in a way that both predicts and explains the past/future asymmetry. The simplest general formulation of the view is that $B_c(w, t)$ unions together the information at w and t and the information at the context c . But then information in the context should also get carried into *past* ‘might’s and so we do not predict Observation 3. A different view might say that if t is earlier than the time of the context, then $B_c(w, t)$ contains just the information at w and t ; otherwise, it also includes the information in c . This does predict Observation 3, but basically by stipulation. **History** derives this from more general properties of the modal base.

5 Problems of Context

Now for two objections, one about the judgements in **Keys on Monday** and one about monotonicity. My answers to both exploit the connection between time and the context-sensitivity of ‘might’.

5.1 Felicitous Future ‘Might’s?

There is a wrinkle in the data around Observation 1. Some report that we can improve future ‘might’s by tying them more explicitly to an explanation of our future behaviour. For example, as a referee points out, sentences like (6) and (7) may sound better than those without the ‘because’.¹⁴

Now, this is not a reason to think future ‘might’s are fine in cases of predictable forgetting. Even if (6) and (7) are better, sentences like (3) – (5) and (8) are still marked in **Keys**. But there certainly is something to be explained. I argue these judgements track a second, less prominent reading of a future ‘might’, a new kind of *exocentric* reading.

Exocentric readings are ones where ‘might’ does not have its default interpretation, but rather latches onto the information of some third party. Take a case from Egan et al. (2005):

The Bus: My friend Sally is avoiding Tara. Sally is on a bus and, worried that Tara might board it, goes to hide at the back. I’m watching all this from some nearby bushes but can see that Tara is not in fact on the bus.

On seeing Sally’s behaviour, I explain to a companion:

(33) Sally is hiding because Tara might be on that bus.

(33) is true, even though I clearly know that Tara isn’t on the bus. I am rather using ‘might’ to express what it normally does in Sally’s mouth.

¹⁴In my experience this opinion is not unanimous; hence, my original hash-mark. But for most, an improved reading is possible if enough contextual pressure is applied.

We get evidence for thinking the good readings of sentences like (6) and (7) are exocentrics by noting that they appear and disappear in some of the same contexts as exocentrics. Exocentrics tend to require explanatory contexts. In **The Bus**, I cannot simply turn my attention to Sally and say

(34) #Tara might be on that bus.¹⁵

The ‘because’ is necessary to elicit the exocentric reading. This is one point of similarity: the improved (6) and (7) explicitly involve some explanation; the marked (3) – (5) and (8) do not.

But even in explanatory contexts, certain continuations block exocentrics. Suppose instead of just (33) I say:

(35) Sally is hiding because she thinks Tara might be on that bus; # and indeed Tara might be.

The continuation, ‘indeed Tara might be’ is marked here. But then the second ‘might’ cannot be exocentric. I would be saying that Sally thinks that Tara’s being on the bus is compatible with her evidence and that her belief is correct. But this is true and relevant. Presumably instead the ‘might’ here has its default reading, which makes the continuation false.

Now consider what happens when future ‘might’s occur in these environments. Suppose that Alice says:

(36) Tomorrow I’ll look in my bedroom because I’ll think the keys might be on the nightstand. #And indeed that will be one of the places they might be.

Like in (35), the material following ‘indeed’ is marked. Again, we see a parallel with exocentrics.

My theory explains how (6) and (7) could be exocentric. Exocentrics arise when we interpret ‘might’ as it would normally be used in *other* contexts. Alice’s future-self is not literally a third party, but it does occupy a different context: Alice will occupy a different partial history and so her ‘might’ will mean something different

¹⁵ *Pace Egan et al. (2005)’s own presentation.*

then. This will be a meaning for exocentrics to target; and since that reading will be true, a present exocentric ‘might’ would be true now.

5.2 Monotonicity violations in the past?

My account is fully monotonic: modal bases are monotonic from any time forward. But one might wonder whether we really want monotonicity in the *past*.

Return to **Keys on Monday**. Suppose that Alice has woken up and remembers that she either knew the keys were in the living room or that they were in the kitchen. She says

- (37) a. Either the keys had to be in the kitchen or the keys had to be in the living room.
 b. But now they could be in either place.

This speech sounds true. But my proposal says that if (37-a) is true, then (37-b) should be false. For what *was* necessary remains necessary. Even worse, I predict the modal base for (37-a) is empty: since yesterday falls outside Alice’s current partial history, no proposition known then will be in the modal base. So the domain of the modal will include *all* possible worlds and each disjunct of (37-a) is false.

A revised fully monotonic account can predict these data. First, define our modal bases as follows: where \mathcal{I} is a partial history

$$B_{\mathcal{I}}(w, t) = \begin{cases} \{p: \text{there's a time } t' \text{ not later than } t \text{ s.t. } t' \in \mathcal{I} \text{ and } p \text{ is known at } t'\}, & \text{if } t \text{ is in or later than } \mathcal{I}; \\ \text{undefined,} & \text{otherwise.} \end{cases}$$

Now, when the modal base is supplied a time *before* the relevant partial history, it will be undefined.

Next tweak the account of how the modal base is supplied. Instead of just selecting the modal base corresponding to the smallest partial history the context is in, we select the smallest partial history that *also* makes the utterance defined. More formally:

(38) **(Defined Partial History)**

Where \mathcal{I}_c is the smallest partial history containing t_c and that makes the utterances in c defined, $B_c = B_{\mathcal{I}_c}$

We take the partial history starting with the most recent episode of information loss and if the utterance is defined against the corresponding modal base, we use that one. If not, we move on to the next episode of information loss and try again. And so on.

Now return to (37-a). The smallest partial history that makes Alice's utterance defined is the smallest one that includes yesterday. And yesterday she knew where the keys were. So when fed a time from yesterday, the corresponding modal base will contain either the proposition that the keys are in the kitchen or that they are in the living room. Since that is the interval we are quantifying over, (37-a) is true.

To predict (37-b) I say (37-b) is interpreted in a different context to (37-a). This is because (37-b) is uttered after (37-a) and contexts include their times. In the (37-b)'s utterance context, the partial history which stops at Alice's most recent forgetting makes (37-b) defined. But this does *not* include yesterday's forgotten information. So (37-b) is true.

This kind of temporal context-shift is not *ad hoc*, but rather independently required. Consider a discourse like this:

(39) Alice is sitting down. Now she's standing up. Now she's sitting down again.

Here 'now' does not pick out the same time throughout. Here too the natural thought is that, because each utterance takes place in its own temporally distinct context, each 'now' picks out a different time.¹⁶

The example can be explained away; but why not instead opt for a *partially* monotonic solution, where modal bases are only monotonic from the context-time onwards? After all, this would predict (37-a) and (37-b) to be true without any subtle manoeuvring.

¹⁶This assumes neither a Kaplanian semantics (Kaplan (1989)) nor an anaphoric semantics for 'now' (Hunter (2012) and Altshuler (2016)).

The trouble is I do not know how to generate this kind of monotonicity in a principled way. We could write it in by hand into our modal bases, but we should ask for more than this. My account gives a principled explanation of the full monotonicity property. And so I think adopting **Defined Partial History** is worth the cost to simplicity.

6 A New Picture

We have solved my puzzle with monotonicity and context-shifting. I now conclude by considering some bigger picture upshots for the distinction between epistemic and historical modality, noting that, on my view, the two are more similar than typically thought.¹⁷

Consider

- (40) It hasn't been decided yet who will get the job. Alex might get it and so might Billy.

The 'might' here has a *historical* (or *circumstantial*) reading, where talks about what is possible *given the relevant facts*. On this reading, the truth of (40) depends, not on what we know, but on what holds in the world more generally. These readings are generated by historical modal bases like the following:¹⁸

- (41) $B(w, t) = \{p : p \text{ is a proposition about an interval that does not extend past } t \text{ and } p \text{ is true at } w.\}$

Notice that, as stated in (41), historical modality will be monotonic. This is no accident. Among other things, Thomason (1984) and Condoravdi (2002) note this captures an important asymmetry between past and future: once something becomes settled it remains settled; but what lies in the future can remain open. For example, suppose that it rains at time t . Before t , it was historically possible that it would not rain at t . But once we get to t and it in fact does rain, it is no longer

¹⁷See for instance, Kratzer (1991) and Williamson (forthcoming). This also seems implicit in recent *expressivist* theories, such as Yalcin (2011) and Moss (2018).

¹⁸This is Khoo (2015)'s formulation.

be historically possible for it to have not rained at t . What was possible in the past becomes historically impossible from t onwards.

We now have two asymmetries in time, one epistemic and one historical. It is surprising that both kinds of modal base should have this property, especially if there is a sharp distinction here. Why would *both* core flavours of modality have an open future but a settled past?

One avenue to explore is that epistemic modality is actually a circumscribed form of historical modality. ϕ is historically possible in a world at a time t iff ϕ is compatible with the relevant facts in that world that hold up to and including t . We might say that ϕ is epistemically possible at t just in case it is compatible with the facts about the *evidence* in a given partial history up to and including t . Thus, instead of being a distinct form of modality, epistemic modality would be a subspecies of historical modality, one that limits itself to facts about particular partial histories. Spelled out, we would have

Historical: $[[\textit{might } \phi]]^{c,w,t} = 1$ iff ϕ is compatible with the facts in w about the evidence in the relevant interval up to t .

This reduces the two asymmetries to one. The monotonicity property of historical modals accounts for the difference between past and future in both the epistemic and the historical cases. The epistemic asymmetry that this paper is about would just be a special case of the more familiar asymmetry between past and future.

Clearly, much more would need to be said before **Historical** could be accepted; epistemic modals are thought to be special in a variety of ways. But it would give a satisfying explanation of *why* epistemic modals have the monotonicity properties needed to solve my puzzle; and this, I think, should make it worthy of future investigation.

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