KNOWING THE FUTURE

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Abstract: In this essay, I argue that one can lose knowledge simply by moving through time. An initial argument for this claim starts with the observation that there are cases in which one can assert, at an initial time t, that an event e will occur, even though one is not in a position to assert, at later time t', that e did occur, despite no relevant change in one's epistemic position between t and t'. Given the familiar idea that knowledge is the norm of assertion, a natural explanation of this observation is that one knows, prior to e's occurring, that it will occur, but one loses this knowledge as the passage of time pulls e from one's future into one's past. I then present a model of knowledge which permits knowledge of the future to be lost simply by moving through time. The model builds in the idea that we enjoy a default entitlement to assume that the future will develop in a suitably normal manner, but do not enjoy a similar entitlement with respect to the past. The final section of the essay offers a second argument for the claim that knowledge can be destroyed by the passage of time. This argument turns on the role of knowledge ascriptions and denials in the normative evaluation of practical reasoning and of inquiry. This argument also casts light on why we might use *knows* to pick out a relation that is future-biased in the way I am suggesting.

1 Introduction

What one knows changes over time. We gain knowledge, usually by gaining evidence. We also lose knowledge, usually by forgetting. But there are other, more subtle ways in which one's knowledge might change over time. For example, one might lose knowledge by gaining misleading evidence, evidence that suggests that what is in fact true is not.[1] Some epistemological views predict yet further ways that knowledge can be created or destroyed. According to *sensitive invariantism*, for example, knowledge can be gained or lost if the costs of being wrong change, or if the salient possibilities of error change.[2]

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[1] For an example of this, see Williamson (2000, 205–206). Harman (1973, 143–144) suggests that misleading evidence can undermine knowledge even when that evidence is not possessed; it need only be sufficiently available. See also Harman (1980, 164-165) and Lycan (1977).

[2] For discussions of sensitive invariantism, see Fantl and McGrath (2002, 2009), Hawthorne (2004), Stanley (2005), Kim (2017) and the references in the latter.

This essay explores the idea that *moving through time itself* might affect what one knows. More specifically, we consider cases in which it seems that an agent x knows, at an initial time t, that a certain event e *will* occur, despite the fact that x is not in a position to know, at a later time t', that e *did* occur, despite no change in the factors usually thought relevant to knowing. If these appearances are accepted, then knowledge can be destroyed when the passage of time transforms a fact about the future into a fact about the past or present. If these appearances are accepted, then knowledge of the future differs from knowledge of the past and present in ways we have failed to appreciate.

Section 2 presents an initial argument for the claim that knowledge of the future can be lost simply by moving through time. This argument relies on judgments about the assertability of certain claims together with the familiar idea that knowledge is the norm of assertion. Section 3 offers a model of knowledge which permits knowledge to be destroyed by the passage of time. Section 4 offers a further argument for the claim that one can lose knowledge simply by moving through time. This argument turns on the role knowledge plays in the characterization of two norms: a norm of *practical deliberation*, and a norm of *inquiry*. One feature of this argument is that it connects the fact that knowledge can be lost in this way to two of the central social functions of knowledge ascriptions and denials.

2 The argument from assertion

The argument from assertion concerns cases with a certain structure. To describe that structure abstractly, let us adopt some notation. Where e is an event-type and t a time, let $e(t)$ be a proposition that is true iff e obtains at t. And let (t_0, t_1, t_2) be an arbitrary triple of times such that $t_0 < t_1 \leq t_2$. Then the cases we are concerned with are ones in which a speaker x seems to be in a position to assert $e(t_1)$ at time t_0, but seems not to be in a position to assert $e(t_1)$ at t_2, despite no change in x's relevant epistemic position between t_0 and t_2. By "no change in x's relevant epistemic position," I mean that there is no change in any of the factors mentioned above: the relevant evidence, the practical stakes, the salient possibilities of error, the availability of misleading evidence, and so on.

Here is an example of the sort of case I have in mind:

Beth case

Andy is a personal chef to a wealthy entrepreneur, Beth. It's Friday, and Andy is making a new dish for Beth's dinner tonight. Based on his knowledge of the sorts of foods that Beth usually likes, Andy says to his friend Chris,

(1) Beth will like this when she eats it.

Andy finishes preparing the dish, and heads home for the night, before Beth gets back from work to eat dinner. When Beth returns, she eats the dish Andy has prepared, and thoroughly enjoys it.

The next morning (Saturday), one of Andy's friends asks Andy, *Did Beth enjoy the dish you made for her yesterday?* Andy hasn't heard from Beth or anyone else whether or not she enjoyed the dish.

I think it would seem odd here for Andy to flat-out assert that Beth liked the dish, i.e. to say,

(2) Yes, she liked it.

In order to make that claim, Andy would need to be more directly connected to the fact that Beth enjoyed the dish in question. For example, Andy would need to have been told by Beth or someone else that she did in fact enjoy the dish. Absent evidence of that sort, it would be better for Andy to hedge in some way, i.e. to say one of the following:

(3) She probably liked it.

(4) She must have liked it – it was just the sort of thing she usually likes.[3]

The case is not a one-off: once one sees the relevant structure of the case, further examples can be constructed (AUTHOR XXb). A similar case will be discussed in Section 3.

Some further stipulations will facilitate our discussion. Let's assume that Beth eats the dish at 7pm on Friday evening, and that Andy knows this throughout the case. Furthermore, let's assume that Andy never loses track of time at any point in the scenario. So on Friday afternoon, Andy is in a position to assert (1) just in case he is in a position to assert (1'):

(1') Beth will like the dish at 7pm.

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[3]This case was first discussed in AUTHOR (XXa).

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And Andy is in a position to assert (2) on Saturday morning just in case he is in a position to assert (2′):

  (2′) Beth liked the dish at 7pm.

I frame the discussion below in terms of (1′) and (2′), rather than their more natural counterparts, (1) and (2). This is because the explicit temporal adverbial *at 7pm* helps us to compare the propositions Andy is in a position to assert on Friday afternoon with those he is in a position to assert on Saturday morning. In addition, let us suppose, for concreteness, that Andy's utterance on Friday afternoon takes places at 4pm, and that his friend asks him whether Beth liked the dish on Saturday at 9am.

   Now, a couple of more substantive assumptions concerning the nature of propositions, and concerning the semantics of sentences (1′) and (2′). First, assume that propositions are *eternal* or *tenseless*, in the sense that they do not vary in truth value over time. Second, assume that, relative to Andy's context on Friday at 4pm, sentence (1′) expresses the proposition *that $f_4 < f_7$ and Beth likes the dish at f_7*, where f_4 is Friday at 4pm, and f_7 is Friday at 7pm. If we represent propositions by sets of possible worlds, then this is equivalent to:

   $\{w: f_4 < f_7 \text{ and Beth likes the dish at } f_7 \text{ in } w\}$

Third, assume that, relative to Andy's context on Saturday at 9am, sentence (2′) expresses the proposition *that $f_7 < s_9$ and Beth likes the dish at f_7*, where s_9 is Saturday morning at 9am. In possible worlds terms:

   $\{w: f_7 < s_9 \text{ and Beth likes the dish at } f_7 \text{ in } w\}$

We return to these assumptions below, but let us first examine where they lead.

   Given these assumptions, (1′), relative to Andy's Friday context, essentially carries two pieces of information: (i) that the utterance time (f_4) is prior to the time of Beth's eating (f_7), and (ii) that Beth like the dish at f_7. Let us call this second piece of information α, and agree to represent it as follows:

   $\alpha := \{w: \text{Beth likes the dish at } f_7 \text{ in } w\}.$

Given these assumptions, (2′) also carries two pieces of information: (i) that the context time (s_9) is after the time of Beth's eating (f_7), and (ii) that Beth likes the dish at f_7. Note that this second proposition is just α again. This means that (1′), relative to Andy's Friday context, and (2′), relative to Andy's Saturday context, are equivalent *modulo* the information they contain concerning how the respective context times relate to the time of Beth's eating.

Consider now the knowledge account of assertion, the much-discussed idea that assertions are governed by the following norm:

One must assert p at t only if one knows p at t. [4]

One violates this norm just in case one asserts a proposition p without knowing p. If one is sympathetic to the knowledge account of assertion, then the following explanation of the Beth case is very tempting. First, since Andy is in a position to assertively utter (1′) at 4pm on Friday, it must be that he knows the proposition expressed by that sentence in that context. Since α is a trivial consequence of that proposition, it would be very natural to suppose that Andy knows α on Friday afternoon—indeed, we could add to our description of the case the stipulation that Andy knows any trivial consequences of propositions that he knows. Second, since Andy is *not* in a position to assertively utter (2′) at 9am on Saturday, a very natural explanation of this fact, given the knowledge account of assertion, is that he isn't in a position to know the proposition that sentence expresses in that context. Since he *does* know that the context time is later than the time of Beth's eating—he knows that $s_9 > f_7$—it follows that it is α that he isn't in a position to know on Saturday morning.

If this explanation is correct, then it follows that while Andy knows, on Friday afternoon, the tenseless proposition Beth likes the dish at 7pm, he is not in a position to know that same proposition on Saturday morning. On natural ways of filling out the case, Andy neither gains nor loses any relevant evidence between Friday and Saturday, nor does his epistemic position seem to change in any other relevant way. We may suppose that neither the practical stakes—the costs of being wrong—nor the salient possibilities of error change for Andy between Friday and Saturday, and we may suppose that there is no change in the availability of misleading evidence. Given

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[4]For arguments in favor of this view, see Unger (1975), Gazdar (1979), Williamson (1996, 2000), Benton (2011, 2016), and Turri (2016). For criticisms of it, see Weiner (2005), Lackey (2007), and Schechter (2017). I discuss the applicability of this norm to the present case in more detail in AUTHOR (XXb).

these assumptions, it seems that Andy goes from knowing α to not being in a position to know α simply by moving through time.

This argument depends on a number of assumptions. First, it assumes *eternalism*, the claim that propositions do not change their truth values over time. Second, it makes some assumptions about the semantics of future-oriented sentences like (1'). Third, it depends on the knowledge account of assertion. One can challenge this argument by challenging one or more of these assumptions. Since I have discussed these assumptions in more detail elsewhere (AUTHOR XXb), I won't try to defend them at length here, but a few pertinent remarks are in order.

First, the assumption of eternalism is made mostly for the sake of ease, since it is easier theorize about retaining and losing knowledge if propositions don't change their truth values over time. But I suspect that most of the discussion in this essay could be reformulated in temporalist-friendly terms, once the temporalist furnishes us with an adequate account of what it is to lose or retain knowledge. Second, my assumption about what proposition sentence (1') expresses is a natural one, given the assumption of eternalism. Or rather: it is natural given the standard view that future operators like *will* simply shift the evaluation time forward, and do not express non-trivial quantification over possible worlds. For alternative views, see Kaufmann (2005) and Copley (2009); for critical discussion of the latter, see Cariani and Santorio (2018) and AUTHOR (XXb).

Finally, the argument of course depends on the claim that knowledge is the norm of assertion. While this claim is influential in contemporary philosophy, it is not wholly uncontroversial. Philosophers who defend alternative accounts will draw a different lesson from cases like the Beth case. For example, some philosophers might instead conclude that one can lose justification or warrant for a belief simply by moving through time. Such philosophers are invited to consider to what extent the theory of knowledge developed in the next section could be modified to provide a theory of justification or warrant.

Moreover, it should be noted that the foregoing argument is not the only argument I shall provide for the thesis that knowledge can lost simply by moving through time: Section 4 offers a second, more theoretically-driven argument for this claim. But before we come to that argument, I first want to explore a model of knowledge motivated by the above considerations.

3   A model of knowledge

Imagine an experienced meteorologist attempting to forecast the path of a hurricane currently out at sea. She wants to know when and where it will first make landfall. She examines the output of various computer simulations, makes judgments about each model's general reliability, and considers small local effects that the models typically ignore. Eventually, she comes to a judgment: the hurricane will hit the Bahamas late Sunday night. We may suppose that she is right, and that her judgment is well-supported by her evidence. Given those stipulations, it seems to me that we can imagine the case in such a way that she counts as knowing that the hurricane will hit the Bahamas late Sunday night. For we can imagine the case as one in which she is in a position to tell her colleagues that the hurricane will hit the Bahamas late Sunday night, and as one in which she could use that proposition as a premise in her practical deliberations. Those are at least defeasible indications that she knows the proposition in question.

But now imagine her waking up on (the relevant) Monday morning. It seems to me that, prior to checking what actually happened, she could no longer be said to know that the hurricane really did hit the Bahamas the previous night. Note, for example, she is not in a position to go around telling people that she was right, that the hurricane really did hit the Bahamas late last night, just as she predicted. Nor is she in a position to update her institution's historical records with this information. Before she can do any of those things, she needs to check to see what actually happened. All this suggests that she is not in a position to know, on Monday morning prior to checking, whether the hurricane really did hit the Bahamas late Sunday night.

Again, it seems that we can imagine the case in such way that there is no relevant change in the forecaster's epistemic position between the time of prediction and Monday morning. So if we accept these judgments about what she does and does not know in this scenario, we have another illustration of our claim that one can lose knowledge simply by moving through time. But how should we think of what is going on in cases like this?

I want to start by examining how our forecaster reaches her prediction. Her prediction is based in part on her knowledge of the outputs of the computer simulations, her knowledge of each simulation's general reliability, and her knowledge concerning factors that the models typically

ignore. We may assume that all of this knowledge is knowledge of facts concerning the past and present. But her prediction isn't based solely on her knowledge of these particular facts. To see this, note that someone without her experience might know these particular facts without knowing precisely what they imply about the future. A less-experienced observer might, for example, think that these particular facts support the prediction that the hurricane will hit the Bahamas early Sunday afternoon, or the prediction that the hurricane will just miss the Bahamas. A wholly inexperienced observer might not know what to make of the totality of these data. In addition to her knowledge of these particular facts about the past and present, our forecaster seems to know something that enables her to move from these judgments about the past and present to a judgment about the future.

What is it that she knows that enables her to move from her judgments about the past and present to a judgment about the future? It is presumably a generalization of some kind, something that says that in any scenario in which things are thus-and-so at time t_0, things will be thus-and-so at later time t_1. Of course, she may not be able to articulate her knowledge of this generalization— her knowledge of it may be tacit. Even so, her knowledge of this generalization is evidenced by the fact that she reaches her prediction in a rule-governed manner, in the minimal sense that, were she in suitably similar circumstances at another time, she would reach a suitably similar judgment. If the process by which she reached her prediction were not rule-governed in this minimal sense, it is hard to see how the prediction could constitute knowledge.

Whatever the generalization our forecaster relies on in order to reach her prediction is, we can expect that it will entail a generalization more narrowly-tailored to the situation at hand. To state this narrower generalization, it will help to adopt some notation. Let t_0 be the time at which our forecaster reaches her prediction, and let Γ be a function from times to sets of propositions such that $\Gamma(t_0)$ is the set of particular propositions on which our forecaster bases her prediction. So $\Gamma(t_0)$ will consist of various facts concerning the outputs of the computer simulations, etc.. Further, assume that, for any other time t, $\Gamma(t)$ is a suitably similar set of facts, suitably similar in the sense that, all else being equal, if our forecaster knew all the facts in $\Gamma(t)$ at t, she would arrive at a similar prediction. We assume that $\Gamma(t)$ consists only of facts about times t' no later than t, i.e. facts that, from the point of view of t, all concern the past and present. Let ϕ be a function that maps a time (interval) t to the proposition that a hurricane will hit the Bahamas during t. Then the narrow

generalization in question may be stated as follows:

($\star$) For any times t, t', if the propositions in $\Gamma(t)$ are true, then, all else being equal, $\phi(t')$ is true, where $t < t'$ and $t' = f(t)$.

Here, f is a function that specifies how long after t we should expect ϕ to obtain given that Γ obtains at t, information we take to be included in ($\star$). If t_1 is a suitable interval of time on Sunday night, we may that $f(t_0) = t_1$ (recall that t_0 is the time at which our forecaster reaches her prediction).

Generalization ($\star$) is a way of encoding our forecaster's sense of how she would expect things to develop in any situation in which Γ obtains and all else is equal. It reflects what she would take to be a normal course of events, given those facts. However schematic our presentation, I take it that the idea here is fairly familiar: judgments about the future are often (though not invariably) based on two things: (i) a set J of judgments about the past and present, and (ii) judgments—perhaps tacit—about how things would normally develop given the truth of the judgments in J. We project the future based on our knowledge of the past and present, together with our knowledge of the normal flow of events over time.

Note that the generalization ($\star$) has a *ceteris paribus* clause ("all else being equal"); this will be important below. The justification for this is that the particular facts on which her judgment is based are unlikely to necessitate the outcome she predicts. We might, for example, expect that, were our forecaster to repeatedly make similar predictions in similar circumstances, a certain percentage of those predictions would be wrong.

I want to use the foregoing remarks to guide us in constructing a model of knowledge that allows knowledge of the future to be be destroyed by the passage of time. To that end, consider an arbitrary generalization G of the same form as ($\star$):

(G) For any times t, t', if the propositions in $\Delta(t)$ are true, then, all else being equal, $\psi(t')$ is true, where $t < t'$ and $t' = g(t)$.

for some Δ, ψ, and g of the appropriate types. Then we adopt the following definition:

DEFINITION: NORMALITY

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For any generalization G of the above form, let us say that a possible world w is *normal with respect to G at time t* just in case: if the propositions in $\Delta(t)$ are true at w, then $\psi(t')$ is true at w, where $t < t'$ and $t' = g(t)$.

If w fails to be normal with respect to G at t, we say that it is *abnormal* with respect to those parameters.

Let w be a world and t a time such that $\Gamma(t)$ obtains in w (recall that $\Gamma(t_0)$ is the set of particular facts that informed our forecaster's prediction). So (w, t) is a situation in which the facts about outputs of the computer simulations are as they are in our forecaster's world, as are the facts about their general reliability, etc.. Then w is normal with respect to $(\star)$ at t just in case a similar hurricane hits the Bahamas at some time $f(t)$ later than t, and abnormal otherwise. Worlds that are abnormal with respect to $(\star)$ and t are ones in which the relevant particular facts in $\Gamma(t)$ obtain, but in which something breaks the normal connection between the facts available to our forecaster and the expected landfall of the hurricane. These worlds may be diverse in their abnormality. In one such world, an atmospheric event that the models' assign a very low probability might unexpectedly occur, pushing the hurricane off its expected course. In another abnormal world, one or more of the computers might experience a hard-to-detect hardware problem, rendering a generally reliable piece of equipment unreliable in the particular case at hand. Or the error might arise not with the simulations, but with the data fed into them, perhaps as the result of an unexpected and hard-to-detect measurement error. There are many ways things could go wrong even if all the facts in $\Gamma(t)$ obtain.

One of the key components of my proposal is that an agent enjoys a default entitlement to assume that the future will unfold in a suitably normal fashion.[5] More precisely, I propose that, for an agent x at time t in world w, there is a suitable set $\mathcal{G}$ of generalizations such that x is entitled to assume that her world is normal with respect to each G at t (for all $G \in \mathcal{G}$). So, for example, we may assume that our forecaster is entitled to assume, at t_0, that her world is normal with respect to $(\star)$ at t_0. On the account proposed below, this default entitlement plays a crucial role in securing our forecaster's knowledge of $\phi(t_1)$ at t_0.

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[5]I take the notion of having a default entitlement to assume things are normal in a certain respect from Goodman and Salow (2018), though I develop it in a different (though perhaps complementary) way from those authors. The notion of normality has surfaced in a number of other places in recent epistemology; see, for example, Smith (2010, 2017), Greco (2014), Stalnaker (2015), and Beddor and Pavese (2018).

Another key component of the proposal is that one does *not* enjoy a similar default entitlement with respect to the *past* (or present). So although, *at* t_0, our forecaster is entitled to assume that her world is normal with respect to ($\star$) and t_0, she is not entitled to assume this *at* t_2, where t_2 is the relevant time on Monday morning, before our forecaster has checked to see whether her prediction was correct. That is, at t_2, she is entitled to assume that her world is normal with respect to ($\star$) and t_2, but, at t_2, she is not entitled to assume that her worlds is normal with respect to ($\star$) and t_0. This asymmetry plays a crucial role in our model of how knowledge of the future can be lost simply by moving through time. Precisely *why* there is an asymmetry between what we are entitled to assume about the future and what we are entitled to assume about the past and present is an issue I shall return to later (see Section 4).

To refine the picture, it will help to engage in a modicum of epistemological theorizing. A familiar idea from contemporary epistemology is that an agent x knows a proposition p at time t in world w only if p is true at a suitable set S of possibilities, where S may be determined as a function of the triple (w, t, x). For example, philosophers who endorse a *safety condition* on knowledge, hold that, for a given (w, t, x), S is the set of nearby possibilities in which x believes p at t (e.g. Williamson 2000, 128).[6] And on some versions of the *relevant alternatives* approach to knowledge, S is the set of relevant possibilities uneliminated by x's evidence at t in w, where relevance is determined by a number of factors, including actuality, similarity, and salience (e.g. Lewis 1996).[7] I suspect that the underlying idea of the present approach could be implemented within either of these frameworks, though the framework of relevant alternatives provides a slightly more natural fit, and so I shall develop the proposal in such terms. Readers more sympathetic to the idea that knowledge is safe belief may wish to consider how the proposal that follows might be adapted into their favored framework.

I will assume an account that has the same broad structure as that of Lewis (1996).[8] There are two central notions in such an account. First, we have the notion of a *possible world's being eliminated by an agent's evidence at a time and a world*. Given a triple (w, t, x), let $E(w, t, x)$ be the set of worlds not eliminated by x's evidence at t in w. Second, we have the notion of a *possible world's*

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[6]See also Sosa (1999).

[7]On Lewis's version of the relevant alternatives theory, the set of possibilities relevant for assessing whether x knows p does not vary with the choice of p; for a view on which it does vary, see Dretske (1970). For relevant discussion, see Stine (1976) and Cohen (1988).

[8]Note that while Lewis's account is contextualist, mine is not; mine is a version of sensitive invariantism.

being relevant for an agent at a time in a world; let $R(w, t, x)$ represent this set, for a given (w, t, x). An agent x is then said to know a proposition p at time t in world w just in case p is true at every world relevant for x at t in w that is not eliminated by x's evidence at t in w:

RELEVANT ALTERNATIVES

An agent x knows a proposition p at time t in world w just in case p is true at every world that is in both $E(w, t, x)$ and $R(w, t, x)$.

Two questions face any account along these lines: what is it for a possibility to be eliminated by an agent's evidence, and what does relevance amount to? Lewis (1996) offers (partial) answers to these questions, and readers sympathetic to his account are free to read it into the remarks made here.[9] I shall largely take these notions for granted, though the principal claim of my proposal is a claim about relevance and how it evolves over time. I shall also assume that w is always relevant for x at t in w (Lewis's 'rule of actuality').

Our earlier talk of a 'default entitlement to assume that the future develops in a suitably normal manner' can now be understood as the claim that every world in $R(w, t, x)$ is normal with respect to $\mathcal{G}$ at t, for some suitable set of *ceteris paribus* generalizations $\mathcal{G}$. Let us call this claim "FUTURE NORMALITY" and set it out as follows:

FUTURE NORMALITY

For any (w, t, x), there is a suitable set of generalizations $\mathcal{G}$, such that, for each $G \in \mathcal{G}$, every world in $R(w, t, x)$ is normal with respect to G at t.

Thus, in order for x to know p at t in w, x's evidence need not eliminate worlds that are abnormal with respect to any G in $\mathcal{G}$ at t, since such worlds will not be relevant for x at t in w.

Let's see how this helps with our weather forecasting case. Let's call our forecaster *Frances* (f). As before, let t_0 be the time at which Frances makes her prediction, and let t_2 be sometime on Monday morning, before Frances has checked to see whether her prediction was right.

We assume that, at t_0, Frances knows the facts in $\Gamma(t_0)$—various facts about the output of the computer simulations and so on. And we assume that the singleton consisting of ($\star$) is the suitable set of generalizations for Frances at t_0. From these assumptions, it follows that Frances knows, at t_0, that a hurricane will hit the Bahamas late Sunday night.

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[9]For some discussion of Lewis's 'rules of relevance,' see Cohen (1998), Ichikawa (2011), and Schaffer (2015).

To see this, let w be France's world, and let w' be a world compatible with what Frances knows at t_0, i.e. w' is a world in $E(w, t_0, f) \cap R(w, t_0, f)$. Since Frances knows all the facts in $\Gamma(t_0)$ at t_0 in w, it follows from RELEVANT ALTERNATIVES that $\Gamma(t_0)$ obtains in w'. By assumption, ($\star$) is a suitable generalization for Frances at t_0 in w, which, by FUTURE NORMALITY, means that every world in $R(w, t_0, f)$ is normal with respect to ($\star$) at t_0. So w' is normal with respect to ($\star$) at t_0. Since $\Gamma(t_0)$ obtains in w', it thus follows from the definition of normality that $\phi(t_1)$ is true at w'. Since w' was an arbitrary world in $E(w, t_0, f) \cap R(w, t_0, f)$, this holds for every world in that set. It follows from RELEVANT ALTERNATIVES that Frances knows $\phi(t_1)$ at t_0. So Frances knows, at t_0, that a hurricane will hit the Bahamas late Sunday night.

On this approach, worlds that are abnormal with respect to ($\star$) at t_0 are excluded from relevance by FUTURE NORMALITY, together with our assumption that ($\star$) is one of the suitable generalizations for Frances at t_0 in w. This means that, when we assess whether Frances knows $\phi(t_1)$ at t_0, we need not consider whether her evidence eliminates worlds in which an unlikely atmospheric event pushes the hurricane off course, nor whether her evidence eliminates worlds in which an unexpected measurement error occurs, etc.. Any such world in which $\Gamma(t_0)$ also obtains will be abnormal with respect to ($\star$) at t_0, and thus will not be a relevant possibility for Frances at t_0 in w. So even if her evidence does not eliminate such worlds—as it presumably does not—the existence of such abnormal worlds does not pose a threat to her knowledge. This is the sense in which Frances enjoys a default entitlement to assume that the future will unfold in a suitably normal manner.

Now consider Frances on Monday morning (time t_2). We assume that Frances still knows the facts in $\Gamma(t_0)$, since these all concern times no later than t_0. And we assume that the singleton consisting of ($\star$) is still the suitable set of generalizations for Frances at t_2. We may also assume that the relevance-affecting factors not encoded in FUTURE NORMALITY are also just as they were at time t_0. Now, these assumptions do not entail that Frances doesn't know that the hurricane hit the Bahamas late Sunday night, but they do make that result plausible.

The first thing to appreciate is that worlds that are abnormal with respect to ($\star$) at t_0 are no longer excluded from relevance for Frances at t_2 by FUTURE NORMALITY. What FUTURE NORMALITY does is entitle us to assume that *the future* will unfold in a suitably normal manner; it does not grant us a similar entitlement to assume *the past* has unfolded in a suitably normal manner. From

the point of view of time t_2, worlds that are abnormal with respect to ($\star$) at t_0 are worlds with abnormal pasts, not necessarily worlds with abnormal futures. So FUTURE NORMALITY does not exclude such worlds from relevance for Frances at t_2 in w.

And if such worlds *are* relevant for Frances at t_2 in w, then Frances may not know $\phi(t_1)$ at t_2 in w. For Frances's evidence at t_2 would not seem to eliminate every possibility that is abnormal with respect to ($\star$) and t_0. For example, consider a world w' in which $\Gamma(t_0)$ obtains, but in which a low-probability atmospheric event pushes the hurricane off-course so that it just misses the Bahamas. Intuitively, Frances's evidence on Monday morning does not eliminate all worlds like w'. So if some such world is relevant for Frances on Monday morning, she will no longer know that the hurricane hit the Bahamas late Sunday night.

The important point to appreciate is that the account allows knowledge to be lost simply by moving through time. In Frances's case, we may assume that she neither gains nor loses any relevant evidence between t_0 and t_2, that the costs to her of being wrong do not change between these two times, that the salient possibilities do not change between these two times, and that no misleading counter-evidence becomes available between t_0 and t_2. The account allows knowledge to be lost even when all of these factors are held fixed.

4   The argument from inquiry and deliberation

The principal idea behind this model is the idea that we enjoy a default entitlement to assume the future will develop in a suitably normal manner, but we do not enjoy a similar entitlement with respect to the past. Suppose this is true. Then we may ask: why is it true? The foregoing relevant alternatives theory simply provides a way of implementing this idea; it offers no explanation of it. Why do we operate with a concept of knowledge that behaves in this way?

Here is one way to frame the issue. If I am right, then we use the word *knows* to pick out a relation K_1 that is *future-biased*, in the sense that it is, in a certain sense, easier to bear K_1 to p when p concerns one's future than it is to bear K_1 to p when p concerns one's past or present. But it seems that we might have used *knows* in a closely-related, but slightly different, way: to pick out a relation K_2, where K_2 is like K_1 except that it is not future-biased in this way. So one stands in K_2 to a proposition p at time t just in case p is true in all relevant possibilities uneliminated

by one's evidence at t, but "relevance" here is not subject to our rule of FUTURE NORMALITY. K_2-relevance would be determined only by the sorts of factors that relevant alternative theorists have traditionally countenanced (see e.g. Lewis 1996). Relation K_2 is *egalitarian*.

One question we might ask then is this: are there any important roles that knowledge ascriptions and denials play that they could not play if *knows* picked out K_2 rather than K_1? Is there something that we do with knowledge ascriptions and denials that we could not do if *knows* picked out K_2 rather than K_1?[10] Of course, these questions have a trivial answer: if *knows* picked out K_2 rather than K_1, knowledge ascriptions and denials could not be used to ascribe and deny K_1-states. But do they have a non-trivial answer as well? Is there anything else we do with knowledge ascriptions and denials that we could not do if *knows* picked out K_2 rather than K_1?

Here is another way to put the matter. Suppose a linguistic reformer came along and said to me,

> "Well, you've convinced me that our words *knows* in fact picks out the future-biased relation K_1. But I regard this as a linguistic quirk—a mere oddity of how we happen use language. I thus propose that, henceforth, we agree to use *knows* to pick out K_2, a relation that is not future-biased in this way."

Aside from any inconvenience such a reform might cause us, do we have any reason to resist this reformer's proposal?

I shall approach these questions in a somewhat indirect manner, by offering a second argument for the the claim that knowledge can be lost simply by moving through time. After laying out that argument, we shall consider the extent to which the argument helps us to understand why we use *knows* to pick out a future-biased relation like K_1, rather than an egalitarian relation like K_2.

The first premise of the argument concerns a claim about when it is appropriate to employ a proposition as a premise in one's practical reasoning. Consider the following example from Hawthorne:

> Suppose someone is offered a penny for a lottery ticket and reasons as follows:

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[10]In framing the issues in this way, I am inspired by Craig (1990), who attempts to illuminate the concept of knowledge by examining "the role it plays in our lives." Craig focuses on the role of knowledge-*wh* ascriptions in identifying reliable informants with respect to some subject matter; I focus on different roles below. See also MacFarlane (2014, Ch. 12), Hannon (2015), and McGrath (2015).

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The ticket is a loser.

So if I keep the ticket I will get nothing.

But if I sell the ticket I will get a penny.

So I'd better sell the ticket. (Hawthorne 2004, 29)

Suppose the winner has been drawn, but the announcement has not been made, and the reasoner has no inside information. Then, as Hawthorne observes, there seems to be something wrong with this reasoning, and the problem seems to lie in the fact that the reasoner does not know the initial premise, *The ticket is a loser*. Hawthorne and others take examples like these to support the following norm on practical reasoning:

> DELIBERATION NORM: One must use p as a premise in one's practical reasoning at time t only if one knows p at t.

One violates this norm if one uses p as premise in one's practical reasoning despite not knowing it, as in the case of Hawthorne's bad reasoner. If this is right, then it suggests that we sometimes criticize an agent for employing a proposition p as a premise in her practical reasoning on the ground that she does not know p. So one role knowledge denials play—one function they serve—is to justify such negative evaluations.[11]

The second premise is a claim about when it is appropriate to *inquire* into a question. To a first approximation, to inquire into whether ϕ is to attempt to find out whether ϕ. Suppose you want to know how many counties there are in Ireland. To find out, you undertake an inquiry: you walk to your computer and consult Wikipedia. You learn that there are 32 counties in Ireland. Now, does it make sense for you to keep inquiring into this question? For example, would it make sense for you to contact an expert on Irish political geography and ask her how many counties there are in Ireland? It seems not. Why waste your energy inquiring into a question to which you already know the answer? (On the other hand, if you do think it is reasonable for you to continue inquiring in this case, then it seems that there is pressure on you to deny that you really do know how many counties there are in Ireland.) There is more to say about this, but such considerations provide some *prima facie* motivation for adopting the following norm on inquiry:

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[11]Norms of this sort are advocated in Hawthorne (2004, 29, 84), Stanley (2005, 9), and Williamson (2005, 230–231); see also Williamson (2000, 47). For critical discussion, see Brown (2008), Baumann (2012), and Smithies (2012).

INQUIRY NORM: One must inquire into whether ϕ at t only if one is not in a position to know whether ϕ at t.[12]

One violates this norm if one both inquires into whether ϕ while at the same time being in a position to know whether ϕ. Inquiring into whether ϕ, one might think, is just attempting to find out whether ϕ. But if one is already in a position to know whether ϕ, surely it doesn't make sense to try to find out whether ϕ. This then suggests a role knowledge ascriptions might play: we might use a knowledge ascription to justify a negative evaluation of an inquirer: "Why do you keep checking? You know that the flight arrives at 5pm. Stop wasting your time."[13]

These two claims—DELIBERATION NORM and INQUIRY NORM—are the first two premises of our argument. The final premise is that a certain practice is a reasonable one for certain agents to have under certain circumstances. In what follows, I shall describe this practice by describing a certain agent in a certain environment, and then invite you to agree that the practice is a reasonable one for the agent to have.

Let us say that one *treats a question as settled* just in case one no longer inquires into that question and one is disposed to use a particular answer to that question as a premise in one's practical reasoning. Let us say that one *re-opens a question* at a time t_1 just in case one treated the question as settled at some time $t_0 < t_1$, and one no longer treats it as settled at t_1. The practice I have in mind can then be described as follows: in certain situations, one treats a question as settled at an initial time, and one then re-opens that question at a later time, even though one's relevant epistemic position does not change between the two times. In particular, the practice I have in mind involves sometimes treating a question about the future as settled *when it is a question about the future*, and then re-opening that question at a later time, *once that question becomes a question about the past*, and doing this even though one's relevant epistemic position has not changed.

Let me describe, somewhat schematically, a creature C who engages in a practice of this sort, and who seems to have good reason to engage in a practice of this sort. Like many other creatures, C lives in an environment that is in some ways hospitable, in some ways hostile. C's survival depends on her finding food and avoiding predators. Food is available to C at different locations

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[12]One is in a position to know whether ϕ, just in case one is either in a position to know that ϕ or one is in a position to know that $\neg\phi$.

[13]For related discussion, see Clarke (1984), Craig (1990, 11) Cohen (1999), Fantl and McGrath (2009, 60), Whitcomb (2010), and Friedman (2019).

in her environment at different times. C's predators are of many kinds, and these predators can also be found at different locations at different times. C's prospects for survival depend in part on her ability to keep track of the times at which food is available at various locations, to keep track of the times at which predators can be found at various locations, and to collate these two kinds of information. Let us suppose that this task is fairly complex: there are many food sources to keep track of, and many predators to take account of.

Now imagine that C is trying to reach a decision about where to look for food on a particular occasion t_0. She needs to consider where food is likely to be found, and where predators are not likely to be found. In the course of this deliberation, it may make sense for C to treat a particular question

whether there will be a predator of kind K in location L at time t_1

as settled in the affirmative (where $t_1 > t_0$). We may suppose that her past evidence supports this hypothesis fairly strongly, and that a predator of kind K will almost certainly be prowling around L at t_1 unless something abnormal or unlikely happens prior to t_1. Furthermore, we may suppose that, for various reasons, it will complicate C's reasoning about what to do if she leaves this possibility open (even leaving it open and assigning it a low probability may complicate her deliberative task). There are many predators and many locations to keep track of, and given C's cognitive limitations, she cannot quickly and efficiently come to a decision about where to seek food if she does not treat some such questions as settled one way or the other. So, at t_0, C uses the hypothesis that there is a predator of kind K in location L at time t_1 as a premise in her practical reasoning.

Now suppose C eventually reaches a decision about what to do: she decides to look in location L' for food ($L' \neq L$). Things go well for her: she finds food in L' and does not encounter any predators. Furthermore, she was right that a predator of kind K was in location L at time t_1, and so she was wise to avoid that area. Now, even though she has achieved her goal, it may make sense for C to re-open the question, at time $t_2 > t_1$, of whether there was indeed a predator of kind K in location L at time t_1. It may make sense for her to re-open this question even if she hasn't gained or lost any relevant evidence, even if the practical stakes haven't changed, even if the salient possibilities of error haven't changed. For she might hope to obtain stronger evidence

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as to whether there was indeed such a predator at that location at that time. Perhaps she could go to location L and check for signs that the predator had been about (e.g. footprints, scat). Or if she and her conspecifics have a common language, she might ask around as to whether anyone saw such a predator in location L at t_1. Undertaking such an inquiry would presumably put her in a stronger epistemic position with respect to the question of whether there was a predator of kind K in location L at t_1.

Why would she bother with this inquiry? After all, time t_1 now lies in her past, so the question of whether there was a predator of kind K in location L at t_1 is no longer of direct relevance to her future decision-making. That's true, but it may be of *indirect* relevance to her future decision-making. For if the further evidence confirms the hypothesis that there was such a predator in that location at that time, she may gain confidence in the generalizations she used, at t_0, to come to that conclusion. If the further evidence disconfirms that hypothesis, she may put less stock by those generalizations, or she may be able refine them by taking into account the circumstances that kept such predators away on this occasion. Either way, further inquiry into the matter is likely to result in her getting a more accurate picture of the relevant predators' habits, and this may promote C's long-term prospects for survival. So it may make sense for C to re-open this question, a question that she previously regarded as settled.

More generally, we can suppose that having a general practice that involves sometimes treating a question about the future as settled, and then re-opening that question at a later time is a good one for creatures like C to have, a practice that is reasonable for them to have given their goals, their cognitive limitations, and their environment. Having such a practice may promote the long-term survival of such creatures. If so, then it is short step to the claim that the practice is one that is *legitimate*, in the relevant sense, for creatures like C to have.

These observations, together with our norms of deliberation and inquiry, suggest an argument for our claim that knowledge of the future may be lost simply by moving through time. To see this, let "$k(t_1)$" be an ambiguous sign that may stand either for the tenseless sentence *there is a predator of kind K at location L at time t_1* or for the proposition that sentence expresses. Then we seem to have the following:

(i) C used $k(t_1)$ as a premise in her practical reasoning at t_0, and it was permissible for her to do

so.

(ii) *C* inquired into whether $k(t_1)$ at t_2, and it was permissible for *C* her to do so.

Assuming that (i) implies that *C* did not violate the DELIBERATION NORM at t_0, then (i) together with that norm implies that *C* knows $k(t_1)$ at t_0. Assuming that (ii) implies that *C* did not violate the INQUIRY NORM at t_2, then (ii) together with that norm implies that *C* is not in a position to know whether $k(t_1)$ at t_2, and so is not in a position to know $k(t_1)$ at t_2. But if, as we may suppose, *C*'s epistemic position has not changed between t_0 and t_2, it follows that *C* has lost knowledge of $k(t_1)$ simply by moving through time. Thus, we have a second argument for the claim that the mere passage of time can destroy knowledge of the future.

I mentioned at the outset of this section that these considerations could help us see that there are important roles that knowledge ascriptions and denials play that they could not play if the word *knows* picked out an egalitarian relation like K_2, rather than a future-biased relation like K_1. To see this, suppose we take it as fixed that it is sometimes permissible to treat a question as settled at one time, and then re-open at a later time, despite no relevant change in one's epistemic position. In particular, let us take it as fixed that it was permissible for *C* to employ $k(t_1)$ as a premise in her practical reasoning at t_0, and also permissible for *C* to inquire into whether $k(t_1)$ at t_2. In that case, if *knows* picked out an egalitarian relation like K_2, knowledge ascriptions and denials could not play both of the two roles considered above.

Suppose, for example, that *knows* picked out K_2, and that knowledge denials could still be used to negatively evaluate instances of practical reasoning. That is, suppose *knows* picked out K_2 and DELIBERATION NORM was true. Then since it was permissible for *C* to employ $k(t_1)$ as a premise in her practical reasoning at t_0, it follows from DELIBERATION NORM that she knows $k(t_1)$ at t_0. But since K_2 is an egalitarian relation, and since *C*'s epistemic position does not change between t_0 and t_2, it follows that she must still know $k(t_1)$ at t_2. But since, by assumption, it is permissible for her to inquire into whether $k(t_1)$ at t_2, it follows that INQUIRY NORM is false, for it would be permissible for *C* to inquire into whether $k(t_1)$ despite the fact that she knows whether $k(t_1)$.

A parallel argument shows that if *knows* picked out K_2, and INQUIRY NORM was still true, then DELIBERATION NORM would not be true. Thus, in order for knowledge ascriptions and denials to

play these two roles in the evaluation of practical reasoning and of inquiry, *knows* must pick out a future-biased relation like K_1 rather than an egalitarian relation like K_2.

It is tempting to think that these observations explain why it is that *knows* picks out a future-biased relation like K_1 rather than K_2. While I'm not sure that this is the wrong conclusion to draw, we should be cautious. The fact that *knows* picks out a future-biased relation enables it to serve these two functions, but that doesn't necessarily show that this is why *knows* picks out such a relation. Something x can serve a certain function F in virtue of having a certain feature G even if x's having G isn't explained by the fact x serves function F (given its size and weight, this arrowhead makes an excellent paperweight) (cf. MacFarlane 2014, 317). That said, I suspect that sometimes such inferences are reasonable ones to make, and it may be a reasonable one to make in the present instance. But more would need to be said about the nature of such inferences—and about the nature of functional explanations—than can be said in the present essay.[14]

Note, though, that the present considerations do furnish us with a reply to the linguistic reformer considered at the outset of this section, the philosopher who would urge us reform our usage so that *knows* came to pick out an egalitarian relation like K_2. For suppose that we want—and are reasonable to want—knowledge ascriptions and denials to play these roles in the assessment of practical reasoning and of inquiry. Then we have a reason to want *knows* to continue to pick out a future-biased relation like K_1 rather than an egalitarian relation like K_2. For if the reformer succeeded, knowledge ascriptions and denials would not be able to play the roles we have been discussing. The fact that *knows* picks out a future-biased relation is not a mere linguistic quirk; this feature of *knows* appears to be intimately related to the two of the central social functions of knowledge ascriptions and denials.

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[14]See Pettit (1996) for relevant discussion.

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