According to tradition, some knowledge is “absolutely independent of experience.” This knowledge is a priori, standing opposed to “empirical knowledge, which is knowledge possible only a posteriori, that is, through experience.” Traditionalists hold that understanding a statement in this privileged class can provide justification, sufficient for knowledge. One can deduce a truth in this privileged class from premises that issue solely from understanding. Canonical examples of a priori knowable truths include:

Logical Truths: ‘everything is self-identical’; ‘all dogs are dogs’; ‘either it’s raining or it’s not raining’;

Mathematical Truths: ‘7+5=12’; ‘every number has a successor’; ‘the interior angles of a triangle add to 180°’; and,

Definitional Truths: ‘all triangles have three angles’; ‘all bachelors are unmarried’.

Some of these statements require experience to understand. Perhaps, one needs spatial experience to know what a triangle is. But the knowledge that all triangles have three angles is still pur-
portedly a priori, since it can be known without empirical evidence. The experience enables one to entertain the claim, it does not justify it.

Since a priori claims are supposedly justified just by understanding them, the traditionalist says that the justification is insensitive to the particular experiences of the knower. Anyone who understands the meaning of ‘triangle’ has justification to believe that all triangles have three angles. So, on this traditional conception, a priori knowledge is a kind of epistemic necessity. Experience rules out epistemic possibilities. But a priori truths hold regardless of the information provided by experience; they hold in any epistemic possibility. They are “confirmed no matter what.” As a result, a priori truths are empirically indefeasible on this traditional conception. There is no empirical evidence that could rationally undermine one’s justification to believe in them.

Yet, the traditional conception of the a priori and many of its applications were cast into doubt by a series of challenges raised by Quine. Quine’s most compelling argument appealed to examples from the history of science to make two points: that every claim may be held true come what may and that every claim is susceptible to empirical revision. To say that a claim may be held true come what may means that for any claim \( S \), it is possible for an agent to continue to rationally endorse \( S \) regardless of the agent’s incoming experience. If every claim can be held true come what may, then every claim will be a priori on the traditional conception. On the other hand, if every claim can be rationally revised in light of empirical evidence, then there are no a priori truths, since no claim is epistemically necessary. Some have reacted to these Quinean arguments by abandoning the assumption that there are any epistemically necessary claims. They hold that the justification for any claim can be defeated by empirical evidence. This leaves space for claims that are a priori in some minimal sense. Specifically, these claims have a certain degree of pro tanto justification arising just from understanding. But, this justification can be overwhelmed by contrary evidence issuing from experience. So whether an agent is overall justified in believing the claim will depend on her particular experiential state.

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We explore a different reaction which seeks to preserve the traditional conception for some core cases of a priori knowledge. For instance, Chalmers says,

On a common traditional conception, at least some a priori justification (and some justification for believing analytic truths) is indefeasible. One reasonably might hold that some a priori justification (in logic or mathematics, say) yields not just knowledge but certainty, at least on ideal reflection.9

This position requires meeting Quine’s argument head on. It requires arguing that some claims may not be held true come what may and that some a priori justified claims cannot be revised in light of experience.

Chalmers does just that.10 He defends rational constraints on belief revision and argues that these falsify both Quinean claims. Specifically, Chalmers argues that belief revision is irrational if it violates the Bayesian principle of conditionalization: a rational agent’s credence in S after acquiring evidence E must be equal to her conditional credence in S given E prior to acquiring E. Chalmers appeals to this principle to argue (1) that not every claim may be held true come what may and (2) that some claims are unrevisable in light of empirical evidence. It would follow that Bayesianism conflicts with Quinean empiricism. This is surprising given that Bayesianism requires a kind of holism about justification resembling Quine’s.11

By carefully examining Quine’s argument, we show that Chalmers’s criticism misfires. First, we show that adopting Bayesianism actually reinforces the conclusion that a rational agent may hold true any statement come what may. We then find some auxiliary premises in Chalmers’s text meant to show that there are claims that cannot be held true come what may. We argue that these auxiliary premises do not threaten Quine’s claim when it is rightly understood.

Next, we turn to Chalmers’s specific example of a statement that is purportedly immune to empirical revision. This statement is a material conditional D ⊃ S. The antecedent D is meant to be a complete description of the world expressed in a privileged vocabulary. The consequent S is some ordinary claim such as ‘water is H₂O’ made outside of the privileged vocabulary. Chalmers thinks that since the antecedent contains all of the empirical information about a world, there is no empirical evidence that can lower one’s credence in the whole conditional. The information

11 Chalmers’s arguments are partially in the service of defending against objections to his conception of analytici-ty. Even if Chalmers’s response to Quine fails for the reasons discussed in this paper, this does not show that his account of analyticity falls to the Quinean objections.
has been “frontloaded” into the antecedent of the conditional. We sort through various notions of empirical revisability that can be reconstructed in the Bayesian framework. We then propose that the prospects for empirical revision are more promising than Chalmers suggests. Previous responses such as Ebbs (2014) implicitly concede that holding true or revisability require violations of conditionalization. On both points, we directly challenge Chalmers’s claim that Quine’s theses require violations of conditionalization.

In §1, we frame the debate by excluding some prima facie conflicts between Bayesianism and Quinean holism. Specifically, we will set aside logical truths and evidence sentences both of which are assigned the highest possible credence by Bayesians. In §2, we discuss and reject Chalmers’s argument that not every claim may be held true come what may. Indeed, we will argue that Bayesianism actually supports the opposite conclusion. In §§3-4, we develop Chalmers’s argument that certain “frontloaded” material conditionals are unrevisable. In §4, we show that the argument is compatible with a minimal conception of revisability. In §5, we go beyond this minimal conception to explore the prospects of more substantive empirical revisability.

I. LOGIC, EVIDENCE, AND THE A PRIORI

We begin with some preparatory work to fit Quine’s theses into the Bayesian framework. Quine’s usual formulations involve only two attitudes an agent may have towards a claim: endorsement and rejection. The Bayesian framework posits a great deal of additional structure in the agent’s credal states. Rather than belief and rejection, the framework posits that each agent $A$ has a credence distribution $c_A(\ldots)$, a function that assigns a number between 0 and 1 to each claim. Assignments of 0 and 1 represent, respectively, rejection and acceptance with certainty. Intermediate assignments represent intermediate attitudes.

Standard Bayesian models make assumptions about logic and about evidence that sit ill with Quine’s theses.

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Logical truths and falsehoods: In classical Bayesian epistemology, logical truths are assigned credence 1 and logical falsehoods are assigned credence 0.\textsuperscript{14}

Evidence sentences: In classical Bayesian epistemology, evidence sentences are assigned credence 1. Sentences which entail the falsehood of evidence sentences are assigned credence 0.\textsuperscript{15}

These assumptions are problematic because credence 1 and 0 correspond to acceptance and rejection with certainty in the Bayesian framework in the following sense. If a statement \( p \) has credence 1, then conditionalizing on any evidence \( E \) does not lower one’s credence in \( p \). Statements assigned credence 1 are therefore immune to revision in the Bayesian framework. Similarly, if \( p \) is assigned credence 0, then there is no evidence \( E \) such that updating with \( E \) can raise one’s credence in \( p \). In these respects, the assignment of credence 1 or credence 0 to a statement can be said to be persistent under conditionalization.\textsuperscript{16}

If Quine holds that \textit{any claim whatsoever} can be held true come what may or can be revised in light of empirical evidence, then the Bayesian treatment of logical falsehoods and logical truths is problematic. Since they are assigned credence 0, there is no way in the standard Bayesian framework to hold logical falsehoods true in the first place. Thus, they cannot be held-true-come-what-may. Similarly, there is no evidence that can lower one’s credence in a logical truth. So, logical truths cannot be revised in the standard Bayesian framework.

We spot the certainty of logical truths and the certain falsity of logical falsehoods to Quine’s opponent. This is not because we want to endorse the thesis that logical truths are unrevisable, but because it is difficult to discuss the Bayesian framework without introducing the assumption. In our view, the fact that an agent must assign the same credence to all logical truths should be seen as a \textit{limitation} of the Bayesian framework, just as the identification of the propositions expressed by logically true sentences is seen as a limitation of the possible worlds framework for propositions. That this is a limitation does not mean that the Bayesian framework is inaccurate or inappropriate for modeling belief revision.\textsuperscript{17} Nonetheless, our discussion will not push the limits

\begin{itemize}
\item \textsuperscript{14} This is because a credence function is defined as a classical probability function, which is defined so that the probability of a logical truth is 1.
\item \textsuperscript{15} This is because the rational credence in \( p \) in response to acquiring evidence \( E \) is modeled as the prior conditional credence in \( p \), given \( E \). But \( cr(E|E) = 1 \).
\item \textsuperscript{16} See related discussion in Williamson, \textit{Knowledge and Its Limits}, op. cit., §10.2–10.6.
\end{itemize}
of the Bayesian picture in this way. One reason for this is that Chalmers himself attempts to show
that there are non-logical truths that cannot be held true come what may and also that there are
non-logical claims that are unrevisable. This would be a much stronger anti-Quinean result than
could be established merely by appealing to the controversial status of logical truths in the Bayes-
ian framework. Indeed, Chalmers simply presupposes certainty in logical truths as a background
constraint on ideal reasoning. Consequently, we restrict our attention to non-logical truths: we
investigate whether any \( S \) not expressed by a logical truth may be held true come what may and
whether any statement \( S \) not expressed by a logical truth is defeasible in light of new experi-
ence.\(^{18}\)

The Bayesian treatment of evidence sentences also calls for comment. Quine thinks of evi-
dence as constituted by \textit{experiences}, particular events at the periphery of the human body. For
this reason, Quine thinks that an evidence, or observation, sentence may be revised if it conflicts
with the rest of our theory.

\[ \text{Surely an observation is evidence for the sentence that reports that very observation, and against}
\]
\[ \text{the sentence that predicated the contrary. Our legalist can stand his ground even here, pointing out}
\]
\[ \text{that in an extreme case, where beliefs that have been supported overwhelmingly from time immemo-
}\]
\[ \text{rial are suddenly challenged by a single contrary observation, the observation will be dismissed as an}
\]
\[ \text{illusion.}^{19} \]

If the observation sentences are treated as evidence, then the Bayesian framework will assign
them credence 1. They will therefore be unrevisable. This issue has been discussed extensively,
but it raises different issues from what is discussed here.\(^{20}\) For this reason, we concede that
evidence claims are assigned credence 1 and that claims that are incompatible with a claim in evi-
dence are assigned credence 0. Thus, claims in evidence and their logical entailments are treated
as unrevisable.

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\(^{18}\) Another reason is that Quine himself sometimes expresses doubts about the revisability of logical truth: “Any
purely logical truth is thus exempted [from revision], since it adds nothing to what \( S \) would logically imply anyway;
and sundry irrelevant sentences in \( S \) will be exempted as well.” W. V. O. Quine, \textit{Pursuit of Truth: Revised Edition}


\(^{20}\) See, for instance, Jonathan Weisberg, “Commutativity or Holism? A Dilemma for Conditionalizers,” \textit{British
Journal for the Philosophy of Science}, \textit{LX}, 4 (December 2009): 793–812; and Jonathan Weisberg, “Updating, Un-
II. HOLDING TRUE

The thesis that one may retain a belief “come what may” follows from Quine’s holism about justification. Holism says that individual claims are not directly confirmed or disconfirmed by experience. Rather, experience immediately confirms or disconfirms only a whole theory.

The dogma of reductionism survives in the supposition that each statement, taken in isolation from its fellows, can admit of confirmation or infirmation at all. My countersuggestion [...] is that our statements about the external world face the tribunal of sense experience not individually but only as a corporate body.21

In seeking to disprove the claim that the Earth is flat, for instance, one might attempt to circumnavigate it by traveling along a path without turning until one arrives at a position resembling one’s starting location in exact detail. But any experiment of this sort will disconfirm the flatness of the Earth only in the context of auxiliary assumptions: that the failure to turn guarantees that one travels on the straightest path on the Earth’s surface or that there are not two exactly resembling locations on the Earth. The experiment immediately refutes—at best—the conjunction of these hypotheses together with other background hypotheses. The thesis that one may hold a claim true come what may emerges from the fact that the denial of a conjunction is logically consistent with the truth of each conjunct.22 Suppose a scientist has attempted to circumnavigate the Earth and finds herself, after a year, in a city nearly indiscernible from her origin. Reports say someone resembling her left one year ago. This scientist remains logically consistent if she retains the thesis that the Earth is flat, but comes to believe that she has arrived at a new city indiscernible from the one she left from which another traveler set out a year ago. Indeed, agents with different background beliefs find one of these claims more plausible to reject. Actual agents find it more plausible to reject the flatness of the Earth. Other agents may have reasons to expect symmetry on the Earth’s surface. They may find the experience as yet more confirmation that different areas of the world are symmetric, rather than that the Earth is not flat.

Quine’s thesis that one may hold any statement true come what may—call this belief-retention-come-what-may—is a possibility claim. It entails that for any evidence $E$ and statement $S$, it is possible for there to be an agent who holds true a statement $S$ despite having evidence $E$.23 But

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21 Quine, “Two Dogmas of Empiricism,” op. cit., p. 41.
22 This assumes, of course, that neither conjunct implies the conjunction.
23 We therefore read the claim as an existential claim: there exists a possible agent who endorses $S$ after acquiring evidence $E$. But this point has been missed. For example, Ebbs, “Conditionalization and Conceptual Change,” op. cit., p. 692, principle (1’), reformulates Chalmers’s argument against holding-true as a challenge to revisability.
belief-retention-come-what-may says more than that it is merely possible for one to endorse $S$ after confronting evidence $E$. Such a thesis would not threaten the traditional conception of the a priori. Rather Quine must show that it is possible for an agent to rationally endorse $S$ despite having evidence $E$. As Chalmers says,

> It is unremarkable that irrational subjects might hold onto any sentence or reject any sentence, and this observation has no consequences regarding analyticity or a priority. For Quine’s observations about revisability and holding-true to have any bite, rational subjects are required.\(^\text{24}\)

The discussion above, however, appealed only to the fact that it is logically consistent to maintain any individual thesis in a theory which has been disconfirmed by experience. This does not entail that it is rational to do so.

Chalmers offers an argument purporting to show that it is not possible for a rational agent to continue to endorse any claim “come what may.” Chalmers argues by identifying additional constraints on rationality so that for every statement $S$ there is some evidence $E$ such that it is not possible for a rational agent to endorse $S$ while having evidence $E$. Specifically, Chalmers argues that a Bayesian account of belief change undermines the possibility of rationally holding true any claim come what may. In Chalmers’s preferred formulation, the principle says:

\[(cs)\text{ If a subject is fully rational, and if the subject acquires total evidence specified by } E \text{ between } t_1 \text{ and } t_2, \text{ and if the content of the sentence } S \text{ does not change between } t_1 \text{ and } t_2, \text{ then } cr_2(S) = cr_1(S|E).\] \(^\text{25}\)

Here $cr_2(S)$ is the agent’s credence in $S$ at $t_2$, and $cr_1(S|E)$ is her conditional credence in $S$ given $E$ at $t_1$. The objects of credences are sentences in Chalmers’s statement of (cs), which is why he includes the possibility that $S$ changes content between $t_1$ and $t_2$. If continuing to hold true a sentence $S$ in light of evidence $E$ requires that $S$ changes meaning, then Quine’s observation has no obvious consequences for the traditional conception of the a priori.

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\(^\text{24}\) Chalmers, *Constructing the World*, op. cit., p. 213.

\(^\text{25}\) Ibid.
Chalmers argues that the principle of conditionalization undermines the view that for any claim \( S \) and evidence \( E \), it is possible for a rational agent to endorse \( S \) despite having evidence \( E \), since “Quinean holding-true come what may requires widespread violation of conditionalization, which requires irrationality or conceptual change” on the part of the agent.\(^{26}\)

Chalmers considers a subject who holds true a sentence such as ‘all bachelors are untidy’ despite the contrary evidence that there are tidy, eligible, unmarried men of a certain age. The subject accommodates this evidence by suitably adjusting her overall credences so that she comes to doubt the claim that all and only bachelors are eligible, unmarried men of that age.

Suppose that at \( t_1 \), Fred asserts ‘All bachelors are untidy’. At \( t_2 \), Fred acquires evidence indicating that there is a tidy, unmarried 25-year-old man, and responds by denying that the man is a bachelor, as bachelors must be over 30.

Let \( B \) be ‘All bachelors are untidy’, and let \( E \) be Fred’s total relevant evidence acquired between \( t_1 \) and \( t_2 \). Let \( cr_1(B) \) stand for Fred’s credence in \( B \) at \( t_1 \), and \( cr_2(B) \) stand for Fred’s credence in \( B \) at \( t_2 \). Then \( cr_1(B) \) and \( cr_2(B) \) are both high.

The crucial question is: What is \( cr_1(B|E) \), Fred’s conditional credence in \( B \) given \( E \) at \( t_1 \), before Fred acquires the evidence in question?\(^{27}\)

If Fred’s conditional credence \( cr_1(B|E) \) is low, then Fred violates the principle of conditionalization: Fred had a low conditional credence in \( B \) given \( E \), but upon acquiring evidence \( E \), he has a high credence in \( B \). This is exactly the possibility that the principle of conditionalization forecloses. It follows that either Fred is irrational or that \( B \) has changed meaning. Neither solution secures the result that a rational subject may retain a belief come what may. So the crucial question is whether Fred’s conditional credence \( cr_1(B|E) \) can be high.

We argue that there is no impediment issuing from Bayesianism to \( cr_1(B|E) \) being high. There is, therefore, no conflict between holding-true and Bayesianism. We then identify an additional constraint on rationality in Chalmers’s text which is actually operative in his argument against belief-retention-come-what-may. We argue that this constraint does not undermine belief-retention-come-what-may, if it is rightly understood as a possibility claim. Once the logical form of the Quinean thesis is properly articulated, Chalmers’s argument dissolves.

II.1. Why Conditionalization Is Compatible with Holding-True. The principle of conditionalization does not rule out the possibility that Fred’s conditional credence $cr_1(B|E)$ is high. Quine’s thesis is that an agent may continue to endorse $S$ in spite of evidence $E$ if she retracts her endorsement of some auxiliary assumption $S^*$. One reason for this is that $E$ only logically conflicts with $S$ given the presence of the auxiliary assumption $S^*$ in the theory. Given that the Bayesian framework speaks not only of endorsement and rejection but also of an agent’s credal distribution, it posits additional structure in the agent’s credal states.

This additional structure actually supports the thesis of belief-retention-come-what-may, since it posits more parameters of freedom that can be revised to preserve the belief in question. That is, given an apparent conflict between a claim $S$ and some evidence $E$, an agent doesn’t actually need to revise her outright belief in any other sentence $S^*$ to resolve the conflict. Rather, she can also reassign her credences and conditional credences so that updating with $E$ fails to lower credence in $S$. To put this another way, the fact that claim $S$ conflicts with evidence $E$ for some rational agent $A$—equivalently, $cr_A(S|E)$ is low—does not entail that $S$ conflicts with $E$ for all rational agents $A^*$. For $A^*$ may simply assign different levels of credence (and conditional credence) to the totality of her background beliefs so that $cr_{A^*}(S|E)$ is high. In other words, $A$ and $A^*$ may assign different prior probabilities to $S$ and $E$. So in the case at hand, there is no contradiction in Chalmers’s character Fred assigning a high prior conditional credence to the claim that bachelors are untidy given evidence $E$.

Not only is this assignment consistent, but it is in line with a popular position among Bayesi-
ans, subjectivism, according to which there are no rational constraints on prior credences other than that logical truths be assigned credence 1 and logical falsehoods assigned credence 0. Indeed, Chalmers is cognizant of this fact: “A common strand in Bayesian thinking, radical subjectivism, denies that there are any such constraints on ultimate priors […]” 28 It follows that there is nothing inherent in the principle of conditionalization that rules out belief-retention-come-what-may.

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II.2. *Chalmers’s Additional Premise*. So if there is a problem with the thesis that one may hold any claim true come what may, it must issue from a constraint on rationality beyond the principle of conditionalization. Chalmers elsewhere suggests that there are rational constraints on prior probabilities. Chalmers therefore seeks to articulate how these constraints prohibit belief-retention-come-what-may. Chalmers asks,

> [I]s it true that a subject can hold on to any given sentence $S$ come what may, in light of any evidence, without irrationality or conceptual change? By this analysis, this claim requires that for any given sentence $S$ and any evidence $E$, $cr(S|E)$ is high (or at least is not low).

In order for it to be possible for an agent to rationally believe-come-what-may a claim $S$, it must be possible for there to be an agent with antecedently high credence in $S$ given $E$, for any evidence $E$. It is this possibility which Chalmers seeks to rule out.

Chalmers’s additional constraint on rationality—along with its importance to his argument—is only briefly stated. He considers the claim that for any sentence $S$, a rational subject can endorse it come what may. Chalmers says:

But this claim is obviously false. For rational subjects and most sentences $S$, there will be evidence sentences $E$ such that $cr(S|E)$ is low. So if these subjects conditionalize, they will not be able to hold onto $S$ come what may.

Chalmers’s core argument against belief-retention-come-what-may rests on this passage.

Unfortunately, Chalmers’s statement is unclear. To show this, we revisit what it means to say that an agent may hold true a claim come what may. Once again, that one may hold-a-claim-true-come-what-may is a possibility claim. So it must concern the possible existence of a rational agent who holds a claim true despite acquiring particular pieces of evidence. But Chalmers’s characterization suppresses any reference to an agent. We have three options for recovering the existential quantification over agents:

**HOLDING-TRUE1**: There could be a rational agent $A$ such that for any claim $S$, and for any evidence $E$ compatible with $S$, $cr_A(S|E)$ is high (or at least not low).

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29 Ibid.


HOLDING-TRUE2: For any claim $S$, there could be a rational agent $A$, such that for any evidence $E$ compatible with $S$, $cr_A(S|E)$ is high (or at least not low).

HOLDING-TRUE3: For any claim $S$, for any evidence $E$ compatible with $S$, there could be a rational agent $A$ such that $cr_A(S|E)$ is high (or at least not low).

HOLDING-TRUE1 is the strongest form of this claim. It says that some rational agent has a high credence in any claim conditional on any evidence. This is obviously absurd. Given that having high conditional credences has implications for one’s absolute credences, it requires the existence of a rational agent to endorse every claim—even claims that contradict one another—given any information. Surely, this is not what Quine had in mind!

In rejecting HOLDING-TRUE1, we are retreating from the strongest possible reading of Quine’s principle that any statement may be held true come what may. Though there are undoubtedly some formulations in Quine that are suggestive of this stronger requirement, many of the formulations in Two Dogmas require only the weaker claims HOLDING-TRUE2 and HOLDING-TRUE3. For instance, observe that Quine’s formulation of the doctrine pertains to the statement itself, not to the agents: any statement may be held true come what may. Moreover, Quine’s reason for this claim is agent neutral: rather than reject a controversial claim, “[a] recalcitrant experience can […] be accommodated by any of various alternative reëvaluations in various alternative quarters of the total system.”

Notice that Quine does not say that any recalcitrant experience can be held true by any agent. Indeed, Quine observes that we ourselves would have natural tendency to reject some claims and not others.

[…] in the cases which we are now imagining, our natural tendency to disturb the total system as little as possible would lead us to focus our revisions upon these specific statements concerning brick houses or centaurs.

So as we read Quine, he is not saying that we ourselves may hold true any claim come any evidence. Rather, he is saying that it is possible for someone to do so.

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32 Throughout we require compatibility of evidence $E$ with $S$. This is because if $E$ were to imply the negation of $S$, the conditional probability $P(S|E)$ would be bound to be 0 by the laws of probability. Only a revision of logic might free one (partly) from imposing this requirement. We have, however, set this possibility aside.

33 Quine, “Two Dogmas of Empiricism,” op. cit., p. 44.

34 Ibid.
Even more importantly, the weaker interpretations do justice to the point of the doctrine in Two Dogmas. Quine is concerned that if a statement has definite confirmation and infirmation conditions, then one will be able to extract from this a doctrine of analyticity.

As long as it is taken to be significant in general to speak of the confirmation and infirmation of a statement, it seems significant to speak also of a limiting kind of statement which is vacuously confirmed, ipso facto, come what may; and such a statement is analytic.\(^{35}\)

In order to undermine the analytic-synthetic distinction, Quine needs only to show that no statement is associated with a single set of confirmation or infirmation conditions. It suffices for this purpose that some agents may rationally take the statement as confirmed in circumstances where others do not take it to be confirmed. Importantly, Quine would not be required to show that a single agent has the option of taking the experience to confirm every statement.

Fortunately, the other interpretations of belief-retention-come-what-may are weaker, but still threaten the traditional doctrine of the a priori. HOLDING-TRUE2 says that for any claim \(S\) there could be a rational agent who holds that sentences to be true on any evidence whatsoever. This interpretation does not require any one agent to hold multiple claims true come what may. HOLDING-TRUE2 is a very plausible principle given the Bayesian framework. It would obtain if for any non-logical claim \(S\), it is possible that there is an agent who acquires a state of certainty in \(S\). Once again, this result is outright entailed by subjective Bayesianism. But it is not ruled out by various forms of objective Bayesianism either. Finally, HOLDING-TRUE3 says that for any claim and any evidence, there is a rational agent who endorses the claim conditional on the evidence. Importantly, HOLDING-TRUE3 is compatible with every rational agent rejecting every claim given some evidence or other. But the evidence that disconfirms each claim may differ for different agents.

Either of these interpretations would pose troubles for the traditional view that beliefs that cannot be defeated by empirical evidence are a priori. According to this traditional conception, every claim knowable only a posteriori will be disconfirmed by some evidence \(E\). If HOLDING-TRUE2 is true, then for every claim \(S\), there is some rational agent for whom \(S\) cannot be defeated by any evidence state \(E\). It follows that some canonically a posteriori claims will be indefeasible for some rational agents.

HOLDING-TRUE2 does conflict with some forms of Regularity, the thesis that agents should assign probability 0 to only doxastically impossible propositions. Regularity is popular with some proponents of standard Bayesianism. However, there are standard concerns about Regularity arising from the possibility of uncountably large sample spaces: a dart with a point-sized tip hitting one of a real number of possible points on a dart board. Chalmers himself is aware of these challenges to Regularity. To accommodate this possibility, Chalmers himself is open to assigning credence 0 to doxastically possible propositions. Indeed, many of his own arguments (such as those discussed in the section on revisability) require conditionalizing on maximally specific—but doxastically possible—propositions that are likely to have probably 0.

We now turn to HOLDING-TRUE3 which avoids this complication entirely. If HOLDING-TRUE3 is true, then there is no evidence $E$ that disconfirms any claim $S$ in itself (but only relative to background principles which may or may not be accepted). It follows that some canonically a posteriori claims are not—in principle—disconfirmed by any piece of evidence $E$. So HOLDING-TRUE3 is a reasonable interpretation of Quine’s thesis that there is no such thing as evidence that confirms or infirms a statement simpliciter, but only relative to a theoretical background. Lastly, it is consistent even with Regularity, so it is consistent with a wider variety of standard Bayesian views. Thus, both of these weaker theses threaten the traditional doctrine of the a priori. Moreover, these interpretations do better justice to the idea that agents with different background beliefs may accommodate the same evidence differently.

In light of these considerations, we can assess how to read Chalmers’s contention which is meant to be incompatible with belief-retention-come-what-may. Chalmers’s positive claim is this:

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37 Chalmers, *Constructing the World*, op. cit., p. 54.
38 There is a further complication which deserves mentioning. If the concept of conditional probability receives its standard ratio definition, that is, $P(B|A) := P(A \land B)/P(A)$ provided $P(A) \geq 0$, then we can—as we have done so far—infer from $P(S) = 1$ that $P(S|E) = 1$ for any evidence $E$ for which the conditional probability is defined. In other words, on the standard definition, HOLDING-TRUE2 follows from it being rationally permissible to enter into a state of certainty about $S$. The picture changes if the standard ratio definition of conditional probability is given up, for example in favor of Rényi-Popper functions or something similar. Chalmers, *Constructing the World*, op. cit., p. 54, seems to consider this possibility favorably. We could then have a situation where $P(S) = 1$ while $P(S|E)$ is low. Although the inference from certainty would no longer go through, Rényi-Popper functions nevertheless allow for states of certainty in $S$ so that $P(S|E)$ stays high for any $E$ compatible with $S$. 

CHALMERS PRINCIPLE: “For rational subjects and most sentences $S$ […], there will be evidence sentences $E$ such that $cr(S|E)$ is low.”

There are three quantifiers in Chalmers’s statement of his principle. This leads to the following interesting quantifier scope orderings.

CHALMERS PRINCIPLE1: For any possible rational subject $A$, for most claims $S$, there is evidence $E$ compatible with $S$ such that $cr_A(S|E)$ is low.

CHALMERS PRINCIPLE2: For most claims $S$, for any possible rational subject $A$, there is evidence $E$ compatible with $S$ such that $cr_A(S|E)$ is low.

CHALMERS PRINCIPLE3: For most claims $S$, there is evidence $E$ compatible with $S$ such that for any possible rational subject $A$, $cr_A(S|E)$ is low.

CHALMERS PRINCIPLE1 is the weakest, but most natural, reading of Chalmers’s statement. It says that for every agent, for most claims, there is some evidence that would disconfirm that claim.

It must be admitted that Chalmers’s principle is highly plausible on this interpretation. But this is only a reflection of the fact that CHALMERS PRINCIPLE1 is very weak. Now, CHALMERS PRINCIPLE1 does do some work, since it is incompatible with the strongest interpretation of belief-retention-come-what-may, HOLDING-TRUE1. But we have seen that this claim is implausible as an interpretation of the Quinean idea, which is better regimented by HOLDING-TRUE2 or HOLDING-TRUE3. CHALMERS PRINCIPLE1 is compatible with these two, more plausible, interpretations of Quine’s thought. For HOLDING-TRUE2 requires only that for each sentence $S$ there could be some agent or other who holds $S$ true come what may. This is compatible with the possibility that every agent would reject the majority of claims under some evidence. HOLDING-TRUE3 is even weaker, since it is compatible with the idea that every agent would reject every claim given suitable evidence, so long as the evidence is sometimes different.

CHALMERS PRINCIPLE2 is less plausible as a reading of Chalmers’s statement, since it reverses the quantifier ordering in Chalmers’s formulation. Moreover, it is a stronger assertion. It says that for most sentences $S$, every rational agent will have low credence in $S$ given some possible evi-

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40 As the reader may note, CHALMERS PRINCIPLE as quoted above does not require $E$ to be compatible with $S$. But Chalmers nowhere draws on a possible incompatibility between the two, so it does not seem uncharitable to strengthen the principle in this way. Without this strengthening, the principle would, under no interpretation, challenge the holding-true principles which contain a similar clause.
ference. This is a stronger claim than CHALMERS PRINCIPLE1 since it requires that these rational agents find the same claims refutable. CHALMERS PRINCIPLE2 requires that for most sentences $S$, all agents agree that there is some possible evidence that would disconfirm $S$. But it does not require them to agree on what evidence this is. Now CHALMERS PRINCIPLE2 is incompatible with HOLDING-TRUE2, since the former says that for each sentence $S$, there could be a rational agent who rejects $S$ regardless of the evidence. But CHALMERS PRINCIPLE2 does not conflict with HOLDING-TRUE3, which does not require that any single agent hold $S$ to be true on any evidence $E$, but only that given any evidence $E$ we can find some agent or other who holds $S$ to be true.

Finally, CHALMERS PRINCIPLE3 says that for most claims $S$, there is some evidence $E$ such that any rational agent has a low credence in $S$ given $E$. This means that—for the majority of sentences $S$—every possible rational agent agrees about which evidence refutes $S$. CHALMERS PRINCIPLE3 is a very strong claim. It is sufficient to rule out even HOLDING-TRUE3, the weakest version of belief-retention-come-what-may, since it requires that there be some evidence which disconfirms most sentences in isolation from their background theory.

Neither CHALMERS PRINCIPLE2 nor CHALMERS PRINCIPLE3 are plausible as “obvious truths” that can undermine the Quinean position. Stated so baldly, CHALMERS PRINCIPLE3 is simply the negation of the claim that the same evidence may confirm or disconfirm a given statement depending on the theoretical background. Moreover, it requires substantial agreement among all possible rational agents about what they take to justify what. One should not expect all rational agents—even those with very different experiences—to agree about justification relations. Returning to the example of circumnavigating the Earth, agents who have experienced surprising symmetries on the Earth’s surface will not take an apparent circumnavigation experience to disconfirm the thesis that the Earth is flat, since they will expect that traveling in any one direction will lead to an indiscernible area. They will, therefore, not take their travels as evidence that the Earth is spherical. Those of us whose experience does not lead us to expect symmetries will therefore be surprised if, when traveling in one direction, we arrive at a location indiscernible from our starting point. We, therefore, take our travels as evidence that the earth is spherical. Insofar as CHALMERS PRINCIPLE3 requires homogeneity in responses to evidence, it is not plausible. It is certainly not a premise that could be used in a cogent argument against belief-retention-come-what-may.
III. REVISABILITY: AIMS AND CONCEPTS

Quine believes that every claim is revisable. His arguments appeal to results in the history of science. For instance, it was once thought that the theorems of Euclidean geometry were a priori. In particular, it was thought to be a priori that parallel lines—defined as straight lines orthogonal to a common chord—would never intersect. But development in geometry showed that this claim was logically independent of the definition of parallel lines and other postulates of the system. Developments in physics went further, suggesting that this claim might have been outright false. The possibility of a non-Euclidean physics, then, raised doubts about the parallel postulate. Quine’s arguments from the history of science have been reinforced by Putnam’s examples of possible experiences that would lead us to revise seemingly a priori judgments such as ‘All cats are animals’. Putnam suggests that if one were discover that cats are robots made by Martians, then this would undermine one’s justification to believe that all cats are animals.

To a large extent, Chalmers’s response accepts these criticisms. The traditional examples of a priori truths may not be a priori. But he argues that there are still a priori truths that are indefeasible. Traditional advocates of the a priori simply focused on the wrong examples. Chalmers aims to exhibit an unnoticed class of indefeasible a priori truths. More precisely, he argues for the existence of a (non-logical) proposition \( p \) and an a priori justification \( J \), so that an agent who believes \( p \) on the basis of \( J \) cannot come to disbelieve \( p \) on the basis of empirical evidence without conceptual change or irrationality.

Chalmers argues that certain material conditionals of the form \( D \supset S \) are knowable a priori. The consequent \( S \) of one of these conditionals is a candidate theoretical truth. Chalmers often picks standard examples of a posteriori necessities such as the claim that water is \( H_2O \). The antecedent \( D \) is supposed to be a maximal specification of a possible scenario, which we can think of as something like an epistemically possible world. The specifications will be maximal or complete in that they exhaustively describe each scenario in a privileged vocabulary. Yet, the specifications will also be circumscribed in that not every truth will be in the sentence. Truths containing ordinary “natural kind” terms such as ‘water’ will not be included in the complete descrip-

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42 In a similar vein, Timothy Williamson, The Philosophy of Philosophy (Malden, MA: Blackwell Publishing, 2008), chapter 4, has recently argued that full mastery of the relevant concepts is compatible with rationally denying even the most basic instances of logical laws.
tion. $D$ will include what Chalmers calls core evidence: “(i) subjects’ introspective evidence […] and (ii) perceptual evidence about the distribution of primary and secondary qualities in the environment.”\textsuperscript{43} It may include additional information such as Chalmers’s famous $PQTI$ specification of a scenario which describes all of the facts stateable in the language of physics, phenomenal vocabulary, indexical facts, and a “that’s-all” clause. Roughly, the target sentence looks like this:

(1) If the liquid stuff found in lakes and rivers (and …) has the chemical structure $\text{H}_2\text{O}$, then water is $\text{H}_2\text{O}$.

The blanks will be filled by all of the information about the world in the primitive vocabulary.

Chalmers argues that one may initially have a high credence in such a material conditional arising from a high conditional credence of $S$ given $D$ and that this credence can never be lowered by conditionalizing on a piece of evidence $E$. The thought is that $E$ will either be incompatible with $D$, in which case it will support the material conditional $D \supset S$, or it will be compatible with $D$, in which case it is already implied by $D$ (for $D$ is complete) and thus cannot lower the conditional probability of $S$ given $D$. We analyze the argument in more detail in section IV.

To understand Chalmers’s argument, we must recast the notion of revisability in probabilistic terms. Say that a proposition $p$ is revisable in a credal state $cr$ just in case either $cr(p)$ is low already or it is high and there is a possible piece of evidence $E$ such that updating on $E$ would yield a credal state $cr_E$ such that $cr(p)$ is no longer high. We suggest that Quine’s slogan of universal revisability can be taken either in a stronger or a weaker sense. Call a proposition weakly revisable just in case it is revisable in some credal state. Call it strongly revisable just in case it is revisable in all credal states. If a proposition is weakly revisable, then it is not epistemically necessary, for there will be a rational credal state in which it is not assigned a high credence. To the extent that epistemic necessity is part of the traditional conception of the a priori, universal weak revisability would imply that nothing is a priori. Our first task will be to show that Chalmers’s argument does not undermine weak revisability. Thus, Chalmers’s argument leaves a certain kind of revisability untouched.

We then examine whether the Quinean can defend strong revisability. This requires rejecting some of the premises in Chalmers’s argument. We argue that a Quinean with Bayesian inclinations has good reasons to reject the restriction on evidence Chalmers imposes. We then show that this restriction undermines the two most prominent Bayesian arguments that conditionalization is

\textsuperscript{43} Chalmers, \textit{Constructing the World}, op. cit., p. 130.
the only rational update rule lose their force. With a restriction on evidence in place, neither the convergence of opinion theorems nor the dynamic Dutch book arguments can be applied to the relevant cases. But if those fail, there is room to consider alternative update procedures which would make the sample conditionals again revisable. In sum, the restriction on evidence does not play well with exclusiveness about conditionalization. By rejecting either, the Quinean can regain revisability.

The structure of our discussion closely follows these argumentative steps. We start with an analysis of Chalmers’s argument. We then discuss weak revisability and strong revisability in turn.

IV. CHALMERS’S ARGUMENT

Chalmers argues that certain complex conditionals are unrevisable.44 In this section, we examine the argument, which divide into two parts, A and B.

[A] [...] $D$ is a lengthy specification of an arbitrary scenario, and where $S$ is a sentence such as ‘Water is H$_2$O’ such that $cr(S|D)$ is high. Assuming a fully rational subject, it follows that $cr(D \supset S|D)$ is high, so that $cr(D \supset S)$ is also high. We can stipulate that $D$ includes or entails a full specification of evidence that obtains in the scenario, so that $D$ entails $E$ for any evidence sentence $E$ that obtains in the scenario and that $D$ entails $\neg E$ otherwise (setting vagueness aside). [B] A quick two-case argument then suggests that no evidence $E$ could lead us to rationally reject $D \supset S$. First case: if $E$ does not obtain in the scenario, then $D$ entails $\neg E$. In this case, $cr(\neg D|E) = 1$, so $cr(D \supset S|E) = 1$. Second case: if $E$ obtains in the scenario, then $D$ entails $E$. Now $cr(D \supset S|E)$ must lie between $cr(D \supset S|E \& \neg D)$ and $cr(D \supset S|E \& D)$. But the former is 1 and the latter is just $cr(D \supset S|D)$, which we have seen is high. So $cr(D \supset S|E)$ is high. Putting the two cases together, $cr(D \supset S|E)$ is high for all $E$.45

The argument contains a piece of purely probabilistic reasoning, but also some philosophical assumptions, not all of which are made explicit.46

The probabilistic component of the argument concerns the probability of a material conditional in the light of evidence that is already decided by its antecedent. For any sentence $A$, we may consider the set $E(A) := \{B: A \equiv B \text{ or } A \equiv \neg B\}$ consisting of each sentence $B$ decided by $A$,

44 Chalmers, Constructing the World, op. cit., chapter 5.
45 Chalmers, Constructing the World, op. cit., p. 216.
46 Interestingly, Timothy Williamson, “How Deep is the Distinction between A Priori and A Posteriori Knowledge?,” in Albert Casullo and Joshua C. Thurow, eds., The A Priori in Philosophy (Oxford: Oxford University Press, 2013), pp. 291–312, develops an argument with a very similar structure intended to show that Bayesian epistemology is not a perfect model of epistemological holism.
where $A$ logically decides $B$ just in case $A$ entails either $B$ or its negation. Focussing on sentence $D$ from Chalmers’s argument, $\mathcal{E}(D)$ is the set of sentences decided by a maximal specific description of a possible world phrased in the basic vocabulary. Working with $\mathcal{E}(A)$ allows us to extract the piece of probability theory behind Chalmers’s argument:

**Probabilistic Fact**: Let $\text{cr}(S|D) = x$. Then $\text{cr}(D \supset S) \geq x$ and for all $E \in \mathcal{E}(D)$:

$$\text{cr}(D \supset S|E) \geq x.$$ 

Here $S$ and $D$ can be any sentences whatsoever and $x$ any value in $[0,1]$. What this says is simply that for sentences $E$ decided by $D$, conditionalizing on $E$ does not lower the probability of the material conditional $D \supset S$.

The first part of this result ($\text{cr}(D \supset S) \geq x$) issues from the familiar fact that the probability of a material conditional is never less than the corresponding conditional probability. The central bits of the proof of the probabilistic fact are contained in part B of the quote above. In rough outline, conditionalizing on a piece of possible evidence $E$ decided by $D$ can only raise the probability of the material conditional. If $E$ is incompatible with $D$, it makes the conditional’s antecedent true. And if it is implied by $D$, it does not affect the conditional probability of $S$ given $D$, which was assumed to be high.

We have labelled this piece of probability theory a “fact” and not a “premise,” for it is a central part of the Bayesian framework to assume that fully rational agents satisfy the standard axioms of probability theory. We’ve already noted that the Bayesian framework has its limitations, some of which are plainly in tension with basic Quinean tenets. This applies, for instance, to the status assigned to logical laws, which always receive probability 1. It should be observed that if this assumption is relaxed, then the “probabilistic fact” might fail, too, for it heavily relies on probabilistic consequences of certain entailment relations. But in the remainder of our discussion, we will set this way of responding to Chalmers’s argument aside.

The probabilistic fact alone does not establish the unrevisability of the target sentence $D \supset S$. An assumption Chalmers himself mentions (part A of the quotation above) is that $D$ must be strong enough to decide all possible evidence sentences $E$. Indirectly, this imposes a restriction on what can count as evidence. For recall that the sentence $D \supset S$ is not supposed to be a logical truth, which would be trivially unrevisable in a Bayesian framework. But this means that $D$ should not decide $S$, for otherwise $D \supset S$ would either be a logical truth (if $D$ implies $S$) or else be such that the conditional probability of $S$ given $D$ would always be zero, in which case
Chalmers’s argument could not get off the ground. Hence, if \( D \) is supposed to decide all evidence sentences but should not decide \( S \), the latter sentence cannot constitute a piece of possible evidence. So, for the argument to work, not everything can be evidence:

**Premise 1 – Limited Evidence:** Maximally consistent sets of possible evidence do not logically decide every proposition. In particular, they do not decide sentences like \( S \).

Chalmers also assumes that the conditional probability of \( S \) given \( D \) can be high. This is a necessary assumption, for the probabilistic fact itself does not imply this. Moreover, the conditional probability should not only be high in virtue of some evidence, it should already be high in a rational initial credal state, for we are looking for an unrevisable truth which is a priori. Thus, a background assumption is this:

**Premise 2 – Weak Conditional Aprioricity:** There is an initial credal state \( cr \) where \( cr(S|D) \) is high.

It is labelled “weak,” for it merely requires there to be a credal state with the desired property. It does not say that all credal states have this property.

Finally, the probabilistic fact tells us only that conditional on any piece of evidence, the credence in \( D \supset S \) will be high. In order to infer from this that we cannot rationally update so that this credence gets low, we have to assume that the only rational update rule is conditionalization:

**Premise 3 – Exclusiveness:** Conditionalization is the only rational update rule.

With the three premises in place, we can now reconstruct Chalmers’s argument. By the restriction on evidence, we can choose a \( D \) which decides all possible evidence without deciding \( S \). Given the second premise, there is an initial credal state in which the conditional credence \( cr(S|D) \) is high. The probabilistic fact entails that the credence in \( D \supset S \) is high and cannot be lowered by conditionalizing on any statement decided by \( D \). Finally, exclusiveness rules out any other way of rationally lowering our credence in the target conditional. Thus, we would find:

**Unrevisability:** For some \( S \) and \( D \), there is an initial credal state \( cr \) such that \( cr(D \supset S) \) is high in virtue of \( cr(S|D) \) being high and no such credal state can be rationally updated by evidence \( E \) to result in a credal state \( cr_E \) in which \( cr_E(D \supset S) \) is not high.

The argument poses a clear threat to the popular Quinean claim that every statement is revisable. We now investigate two avenues of resistance.
V. WEAK REVISABILITY

Chalmers’s argument, if sound, establishes that there is an initial credal state in which the probability of the conditional $D \supset S$ is high and cannot be lowered by updating on any piece of evidence. In this section, we explain that the argument leaves open the possibility that the conditional is revisable in some credal states, which is to say that it is compatible with the weak revisability of the target conditional.

Premise 2, Weak Conditional Aprioricity, says that there is an initial credal state in which the conditional probability of $S$ given $D$ is high. Given that $D$ does not logically imply $S$, there is nothing probabilistically incoherent about the conditional probability of $S$ given $D$ being low in some other rational epistemic states. That the conditional probability should be low for some epistemic subjects is independently plausible, particularly if one adopts a broadly Quinean outlook. Someone who doubts that water is $H_2O$ in this world will typically not adopt this attitude because she has doubts about the distribution of seas, lakes, and rivers on the one hand and the location of $H_2O$ molecules on the other. The reason to doubt that water is $H_2O$ will rather pertain to her general background beliefs, as suggested by Quinean holism about justification. For instance, she may think that ‘water’ expresses a vague concept and ‘$H_2O$’ a precise one, perhaps because she thinks that the former concept is defined only in terms of family resemblance whereas the latter has a clear-cut chemical definition. Or, she may think that water is essentially an impure substance, whereas $H_2O$ is a pure one. These considerations may lead her to doubt that water is $H_2O$. They may ultimately be wrong, but they do not seem to be irrational.

Now, starting out with a low conditional credence does not mean that one starts out with a low credence in the material conditional $D \supset S$. Although a high conditional probability is sufficient for a high probability of the conditional, it is not necessary. Hence, a low conditional probability is compatible with a high probability of the conditional. In our case, a predicament of this kind is particularly plausible. The reason is that $D$ is a very strong proposition which is true only at one world or a small number of qualitatively indiscernible worlds. Given this modal profile, it is initially quite unlikely that $D$ will turn out to be true. But if $D$ is unlikely, it is likely that the conditional has a false antecedent, which would make it true. So, initially, the conditional would be probably true.

However, given that the conditional probability is low, the conditional is revisable. Updating on $D$ will result in a low credence in $S$. But under these conditions the probability of the material conditional just is the probability of its consequent $S$ (if $P(D) = 1$, $P(D \supset S) = P(S)$) and so the
conditional will have been revised: its credence has gone from high to low. This shows that the target sentences Chalmers considers are still revisable in the weak sense of there being some credal states in which they are revised. If this is so, there are no necessary connections—even assuming fully rational agents—between the grasp of certain concepts and the acceptance of certain propositions. For all the argument shows, no proposition would be epistemically necessary. This already goes a certain way towards the Quinean rejection of immunity from revision.

That Chalmers’s argument is compatible with a form of revisability can be traced back to the fact that it only assumes the weak aprioricity of the relevant conditional probability. If this premise were strengthened to strong aprioricity, that is, if it were assumed that the conditional probability must be high in all rational credal states, then a strong form of unrevisability would follow. The material conditional \( D \supset S \) would then have to be assigned a high credence in all rational credal states.

To guard against the worry that this stronger premise might hold, we should take a look at how Chalmers justifies the second premise in order to be sure that the line of argument he uses does not warrant a stronger conclusion. He does not give an explicit justification of the second premise in the chapter on Quine or in the accompanying paper, but he develops an elaborate set of arguments in other parts of the book (see particularly chapter 4.3) to show that conditionals of the type \( D \supset S \) can be known a priori. These are the so-called *frontloading arguments*. The idea behind the frontloading arguments can be seen as an epistemic variant of conditional proof. If taking a sentence \( D \) as a premise allows one to prove \( S \), this can be turned into a proof of the conditional \( D \supset S \) which no longer depends on the premise \( D \). Similarly, if we are justified in believing \( S \) after having acquired the body of evidence \( D \), we are justified in believing \( S \) conditional on \( D \), where this justification does no longer depend on \( D \). Now, if \( D \) was our total body of empirical evidence, then our justification of \( S \) given \( D \) is independent of experience, hence a priori. Although engaging with the frontloading arguments is beyond the scope of this paper,\(^{47}\) it suffices for our purposes to note that these arguments would only show that it is possible to obtain a priori justification for a conditional of the form \( D \supset S \) on the assumption that it is possible to be justified in believing \( S \) based on evidence \( D \). In credal terms, they would show only that assigning a high initial conditional credence to \( S \) given \( D \) is possible, not that it is necessary. As a matter of

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fact, if we start with a subject who rationally denies $S$ despite possessing evidence $D$, which we have argued is possible, the machinery of the argument can be employed to show that it is rationally permissible to assign a low conditional probability to $S$ given $D$. A Quinean might want to take issue with the frontloading arguments for independent reasons, but they do not pose an immediate threat to the claim that weak revisability is compatible with Chalmers’s argument.

VI. STRONG REVISABILITY

We have seen so far that a high credence in $D \supset S$ is not rationally mandatory. Agents with a different set of background beliefs may come to assign a low probability to this conditional, for they do not take $D$ to justify $S$. This is an instance of holism about justification: any particular evidential relation may be defeated by having an undermining background belief. The question we would now like to address is whether this thought generalizes even further. Can the Quinean go beyond weak revisability?

Strong revisability requires that the target conditional $D \supset S$ be revisable even in credal states which assign a high conditional credence to $S$ given $D$. Let us briefly recap where we stand in the dialectic.

- We grant that it is possible for a rational agent to have a high prior credence in $S$ given $D$ and that, as a consequence, the rational agent may have a high prior credence in $D \supset S$.
- We grant the probabilistic fact that updating by conditionalizing on a statement decided by $D$ will not lower one’s credence in $D \supset S$.
- Therefore, if $cr(D \supset S)$ can only be lowered, then one must either:
  - (a) rationally update on a statement not decided by $D$, or
  - (b) apply some update rule other than conditionalization.

On our preferred view, it is possible to update by conditionalization on a statement outside of the privileged vocabulary used in stating $D$. This means that we deny Chalmers’s restriction on what counts as possible evidence. We believe that it is possible—in the sense relevant to a claim being revisable—to update on a statement outside of what Chalmers calls core evidence or whatever statements comprise the restricted class of evidence statements.

We briefly sketch a Quinean position that does not presuppose any restriction on evidence. This Quinean position, therefore, is not susceptible to Chalmers’s argument. We then show that restrictions on evidence and exclusiveness about conditionalization do not play well together. In particular, the standard arguments for exclusiveness about conditionalization presuppose a broad
conception of evidence. This dependence poses a kind of dilemma. If Chalmers insists that evidence is limited in principle, then he cannot deploy the standard arguments for the Bayesian assumption that conditionalization is the only rational update rule. So one of the crucial premises will be unsupported. Either view will provide a route for the Quinean to escape Chalmers’s arguments.

VI.1. Broad Evidence. We reject Chalmers’s restriction on possible evidence. This position may at first seem problematic and may perhaps even appear in tension with the position which we wish to defend. Namely, Quine himself is an empiricist. He believes that our evidence is limited to a privileged class of observation sentences. Though his characterization evolves throughout his career, the central features are that observation sentences are more responsive to immediate environmental promptings and that the community will tend to issue the same judgments given similar promptings.48 These statements comprise the “periphery” of our theory in that they are the ultimate evidence for all of our knowledge.49 Do these commitments conflict with our claim that it is possible—in the relevant sense—to acquire a non-observation sentence as evidence?

The tension is merely apparent. Quine’s observation sentences are meant to include the statements that have been and will be the total evidence for our scientific theory. That is, Quine’s empiricist theorizes, among other things, about the evidence for her own theory. She conjectures, on the basis of her current evidence, that her evidence will be limited to certain kinds of sensory inputs and expressed by the narrow range observation sentences. Put in probabilistic terms, Quine’s empiricist assigns a very low credence to the claim that she will have evidence outside of the privileged class. But the important point is that “[i]t was science itself […] that demonstrated the limitedness of the evidence for science.”50 That is, the restriction on evidence is not an a priori restriction on what evidence is possible, but only a restriction on the kinds of evidence we, in our current state, will acquire. This implies that even though one’s credence that one’s evidence will be limited is fairly certain, it is still revisable. As Quine says:

Even telepathy and clairvoyance are scientific options, however moribund. It would take some extraordinary evidence to enliven them, but, if that were to happen, then empiricism itself—the crowning norm, we saw, of naturalized epistemology—would go by the board. For remember that that

48 These definitions all tend to expand on the characterization of a sentence being “germane” to experience discussed in Quine, “Two Dogmas of Empiricism,” op. cit., pp. 43–44. See the accounts in W. V. O. Quine, Word and Object (Cambridge, MA: MIT Press, 1960), §10; and in Quine, Pursuit of Truth, op. cit., pp. 2-3.
49 For instance, Quine, Pursuit of Truth, op. cit., says: “The observation sentence is the means of verbalizing the prediction that checks a theory” (p. 4) and “Observation sentences are thus the vehicle of scientific evidence” (p. 5).
norm, and naturalized epistemology itself, are integral to science, and science is malleable and corrigible. [...] The collapse of empiricism would admit extra input by telepathy or revelation, but the test of the resulting science would still be predicted sensation.\footnote{Quine, \textit{Pursuit of Truth}, \textit{op. cit.}, pp. 20–21.}

In the example, Quine mentions telepathy and clairvoyance as options for departing from his view of observation sentences. But more serious view are also available. For instance, Siegel\footnote{Susanna Siegel, \textit{The Contents of Visual Experience} (New York, NY: Oxford University Press, 2012).} offers an account according to which perception provides a very rich content and Maddy\footnote{Penelope Maddy, \textit{Realism in Mathematics} (Oxford: Clarendon Press, 1992).}—developing a broadly Quinean position—even suggests that we may have direct observational evidence for mathematical entities. Williamson’s view that evidence includes all knowledge also deserves mention.\footnote{Williamson, \textit{Knowledge and Its Limits}, \textit{op. cit.}.} The point isn’t that these views of the range of evidence are true. Rather, it’s that the evidence against them leaves room for revision even of our range of evidence sentences. Given that Quine’s empiricist believes the constraints on evidence are themselves revisable, she cannot endorse these constraints with credence 1. Otherwise, there would be no straightforward way to update through simple conditionalization.\footnote{That is, without allowing us to update on statements with 0 credence.} Thus, it is in principle possible that we acquire evidence outside of the privileged class.

Our position relies on the claim that the range of potential evidence is broader than the range of \textit{likely} evidence and that Quine’s empiricism consists in the fact that he thinks that all of our likely—though not all possible—evidence is sensory. But in what sense is it \textit{possible} that one acquires evidence outside of the privileged class? In what sense is it possible that one accesses the broader range of evidential claims through telepathy, say, or the kinds of evidence described by Maddy, Siegel, or Williamson? A natural first response is that it is metaphysically possible. It is metaphysically possible that we acquire different perceptual faculties. But, of course, it might turn out that the range of metaphysical possibility is surreptitiously restricted so that human beings like us simply cannot acquire such perceptual faculties. If this is the case, then we follow Chalmers in making certain idealizing assumptions so that the range of evidence is not held “hostage” to these facts about metaphysical possibility.\footnote{Chalmers, \textit{Constructing the World}, \textit{op. cit.}, §2.7. The quote is from p. 64.} It may well be that it is metaphysically impossible for a rational agent to update on (or even entertain) all of the evidence sentences decided by $D$. But for Chalmers, this would not threaten his claims that the conditionals $D \supset S$ are know-
able a priori. A similar move should be available to the Quinean, if it turns out to be *metaphysically* impossible to update on certain claims outside of the privileged class.

At this point, it is important to reiterate and clarify a concession we made in section I. In order to fit Quine’s position into the Bayesian framework, we conceded that when an agent acquires evidence $S$, then the agent’s credence in $S$ is set to 1. So—following standard Bayesianism—the effect of a subject $A$ acquiring the evidence that there is a triangle before her is that $A$’s credence that there is a triangle before her is 1 and its negation is set to 0. Since credence 1 and credence 0 are persistent in Bayesian frameworks, one cannot hold true that it is not the case that there is a triangle if one has already updated on the claim that there is a triangle. Similarly, one cannot revise the claim that there is a triangle if it has already been acquired as evidence. As a result, some care was required in formulating Quine’s doctrines of holding-true and of revisability to fit them into the Bayesian framework. The doctrine of holding-true was formulated so that any statement $S$ can be held true upon acquiring evidence *consistent with* $S$.\textsuperscript{57} Similarly, the doctrine of revisability requires any sentence $S$ may be revised, so long as we have not updated on claims logically entailing $S$.

Since we hold that a broader range of claims are *potential* evidence, this means that—for a broader range of claims—if an agent *actually acquires* the evidence entailing $\neg S$, then $S$ cannot be held true in this very epistemic state. Similarly, if an agent acquires evidence entailing $S$, then $S$ cannot be revised. Although we recognize that excepting evidence statements in this way makes the representation of Quine’s doctrine in the Bayesian framework less than perfect, we do not think the expansion of the range of *possible* evidence raises any new complications. The conception of evidence we have sketched in this section merely requires that for a broader range of (contingent) sentences $S$, there is a possible world in which it is (or can rationally be treated as) evidence. This does not mean that the sentence $S$ (or its negation) actually is evidence. Indeed, in our own view, it is *unlikely* that one will acquire such evidence.

\textsuperscript{57} Recall that HOLDING-TRUE\textsuperscript{3} says that for any claim $S$ and any evidence $E$ compatible with $S$, there could be a rational agent $A$, $cr_A(S|E)$ is high.
VI.2. Narrow Evidence. We believe that the Quinean should defend a broad conception of evidence. A more conservative move would be to stick to a narrow description of evidence, but allow for non-inferential learning. The Quinean could argue that belief change doesn’t always have to go by way of acquiring new evidence. Sometimes a claim can be learned without it being a new piece of evidence. Suppose that a subject starts her epistemic life with a high conditional credence in $S$ given $D$. Thus, her credence in the material conditional $D \supset S$ will be high and the only way it could be lowered would be for her to change the corresponding conditional credence. What might trigger such a change? As we observed earlier, a high conditional credence could be defeated by developing certain background beliefs which undermine the evidential import $D$ is taken to have on $S$. Again, this is in line with Quine’s idea of evidential holism according to which evidential relations either already depend on certain background beliefs or can be undermined by adopting further background beliefs. In the case at hand, our subject may come to realize that her theory of mass term identities would fit much better with her other views if she gave up that identity. As in our previous discussion, she may come to think that ‘water’ expresses a concept based on family resemblance, while ‘H$_2$O’ does not.\footnote{See, for instance, the possibilities sketched in Laura Schroeter, “Against A Priori Reductions,” *Philosophical Quarterly*, lvi, 225 (October 2006): 562–86; Laura Schroeter, “Epistemic Two-Dimensionalism and Empirical Presuppositions,” *Australasian Journal of Philosophy*, xc1, 2 (2013): 391–94; Schroeter, “Scrutability and Epistemic Updating,” *op. cit.*} She would produce an argument mostly based on thought, possibly combined with general lessons she has drawn from experience. One way to analyze such a scenario would be to say that our subject has learned that water is not H$_2$O. In doing so, she should conditionalize on the information she has learned and this overrides the high conditional probability that water is H$_2$O given $D$. The learning episode might consist in claims like ‘Water is an impure substance’ or ‘The concept of water has application conditions defined in terms of family resemblance’ and general theories backing up such claims. It may also include considerations about theoretical virtues relevant for best system type considerations. If the subject updates on such sentences by conditionalization, her conditional credence in $S$ given $D$ might go down, for $D$ will then no longer appear to be evidence for $S$.

The possibility of this sort of move depends on whether there can be learning episodes that are not grounded in evidence. Notice that one peculiar feature about the learning episodes is that they work by conditionalizing on what has been learned. So, the possibility of non-evidential learning does not conflict with exclusiveness or pose a problem for the view that conditionalization is the only rational response to learned information. Nonetheless, one might be uncomfortable allowing
for this sort of non-evidential learning. Indeed, one might suggest that the Bayesian should analyze any case of rational updating by conditionalization in terms of evidence on which one conditionalizes. This sort of account would rule out by non-evidential learning almost by definition.

If one imposes a restriction on evidence and identifies evidential learning with learning *tout court*, then the proponent of revisability is left with only one option. She must challenge exclusiveness, the claim that conditionalization is the only rational update rule. One might object to this move by citing the standard arguments for Bayesianism. For instance, Chalmers objects that it would require “[…] at least a revision of orthodox Bayesianism.”

We find at least two standard arguments for (orthodox) Bayesianism compelling.

*Convergence Arguments:* There is no need to appeal to an update rule other than conditionalization, since distinct credal states (satisfying certain minimal constraints) will converge if they repeatedly conditionalize on evidence.

*Dutch Book Arguments:* Violating conditionalization leads subjects to evaluate bets as favorable even though they guarantee a loss.

But we suggest that these arguments do not work in the present dialectical context. In particular, in the context of a restriction on what can be learned, these arguments lose their force. That is, these arguments exhibit an interesting dependence of this fact on a broad conception of evidence or on the possibility of non-evidential learning of broad truths.

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59 Chalmers, *Constructing the World, op. cit.*, p. 223. In addition, Chalmers points (a) to logical (and perhaps mathematical) beliefs which are bound to be assigned probability 1 by any probability function and (b) to the possibility that one might be able to redefine analyticity in terms of those sentences which cannot be revised by conditionalization without conceptual change (*ibid.*, pp. 222–23). Regarding (a), note that we granted that the status of logical truths in Bayesianism might not sit well with Quinean tenets (and is independently controversial). Regarding (b), our concern here is not to argue against the possibility of defining analyticity in epistemic terms somehow or other, but rather with the epistemological question whether any sentence can be rationally revised without conceptual change.
VI.2.a. Merger of Opinion Results. Convergence of opinion theorems show, within limits, that if two subjects start their epistemic lives with two not radically different initial probability distributions, their credences in a given hypothesis will converge over the long run through continuous updates by conditionalization. A possible difference in prior probabilities gets “washed out” in the course of learning more and more shared facts. Although the epistemological impact of these theorems is controversial, they are very suggestive. In particular, in the light of such convergence theorems, a revision of prior probabilities does not seem necessary, for the same effect can be achieved through continuous updates by conditionalization.

One of the strongest and most influential merger of opinion theorem is the one due to Gaifman and Snir. To get a feel for the theorem, two concepts are worth explicating. To begin with, two probability functions $P_1$ and $P_2$ are said to be equally dogmatic iff they assign 1 and 0 to the same sentences. It is clear that being equally dogmatic is a necessary condition for any convergence of opinions result. This is because 1’s and 0’s cannot be undone by conditionalization and so if two agents start out giving the same hypothesis opposite probabilities of 1 and 0, their opinions will never converge if they update only by conditionalization. A second crucial notion is that of a separating set of sentences. The idea behind separation is that an increasing sequence of evidence might be informative enough to distinguish between any pair of worlds $w_1$ and $w_2$. It is similarly clear that something like separation is necessary for convergence of opinion: if two agents are given only a limited amount of evidence over the course of their epistemic lives, they could still disagree about matters which remain uninformed by the evidence. With these two notions in place, the theorem by Gaifman and Snir says: If $P_1$ and $P_2$ are two equally dogmatic probability functions which are subsequently conditionalized on a separating sequence of evidence, then differences in probability assignment converge to 0 for almost all sentences. (‘Almost all’ here means except for a set of worlds which has probability 0 by the lights of $P_1$ and $P_2$.)

The crucial point with respect to Chalmers’s argument is that the theorem applies only if the accumulated evidence ultimately separates all worlds. If there is a restriction on what counts as evidence, the theorem no longer establishes convergence of opinions for more theoretical hypotheses. In their discussion of the theorem, Gaifman and Snir assumed that the language only con-

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tains empirical predicates and thus the set of truth-functional compounds of atomic sentences could be assumed to be separating. But when the language contains in addition expressions for more theoretical concepts, this may no longer hold. Either one has to grant that they may enter as evidence or the convergence of opinion theorems only establish a washing-out of priors over a more narrow range of “empirical hypotheses.”\textsuperscript{61}

As a matter of fact, there will be no convergence of opinions regarding the sentences $D$ and $S$ which are relevant for our discussion. To see this, suppose a subject $s_1$ starts out with a high conditional probability in $S$ given $D$, whereas a subject $s_2$ begins her epistemic life with a low conditional probability. Their credence functions can then still be assumed to be equally dogmatic. Suppose further that they gradually acquire more and more evidence implied by $D$ until they ultimately have learned $D$. Then $s_1$’s credence in $S$ (and in the material conditional $D \supset S$) will converge to a high value because it will equal the prior conditional probability in $S$ given $D$, which we assumed to be high. On the other hand, $s_2$’s credence will converge to a low one, by the same argument. Since Chalmers’s restriction on evidence prohibits further sentences not decided by $D$ as possible updates, the credences of the two subjects in the material conditional $D \supset S$ will never converge.

Thus, one of the prime reasons that standard Bayesian epistemology proceeds without changes in initial probabilities cannot be invoked for the type of examples Chalmers has in mind. Consequently, if the restriction on evidence is adopted, one gains reason to allow revisions of prior probabilities concerning such examples. The package of the two assumptions—a narrow conception of evidence and exclusiveness about conditionalization—is far less plausible than it may have initially appeared to be.

\textsuperscript{61} Cf. Earman, \textit{Bayes or Bust?}, \textit{op. cit.}, pp. 150–52.
VI.2.b. Dynamic Dutch Books. The Quinean faces a second class of arguments if she accepts a narrow conception of evidence but still aims at strong revisability: the dynamic Dutch book arguments. Where the convergence of opinion theorems can be interpreted as showing that a revision of priors is unnecessary, the dynamic Dutch book arguments are usually seen as indicating that failures of conditionalization manifest a certain kind of pragmatic inconsistency. In rough outline, the dynamic Dutch book theorem says: if an agent \( a \) at \( t_1 \) is prepared to update her credences for some proposition \( A \) and some possible evidence \( E \) in a way which would violate conditionalization, for instance by setting \( c_{t_2}(A) < c_{t_1}(A|E) \) if she learns \( E \) in the interval from \( t_1 \) to \( t_2 \), then she is forced to accept a number of bets at \( t_1 \) and possibly another bet at \( t_2 \) which will jointly ensure a net loss for her no matter how the world turns out to be.\(^{62}\) In other words, our agent will be exploitable by a clever bookie who knows about her deviant update behavior. Chalmers takes the dynamic Dutch book arguments to preclude the possibility that a Quinean may allow for alternative ways of updating credences.\(^{63}\)

Debates continue about the epistemological impact of the original Dutch book arguments and their dynamic extensions.\(^{64}\) There are various reasons for being skeptical about a direct link between rationality, potential betting behavior and the exploitability by a clever bookie. On the other hand, many participants in the debate seem to believe that for some way of settling the intricate philosophical issues in the background of the Dutch book arguments, there is an important lesson to be learned from these arguments. As a proper evaluation of all the relevant issues is beyond the scope of this paper, we shall restrict our attention to those which are in direct contact with the potential unrevisability of Chalmers’s target conditionals.

Crucially, the bets which would have to be made in order to Dutch book an agent changing her credence in \( D \supset S \) by changing her conditional probability in \( S \) given \( D \) would have a very peculiar feature. The set of bets made against the targeted agent will include a bet on \( D \supset S \) (and bets on propositions in which \( D \supset S \) features as a constituent). By assuming a narrow conception of evidence, \( S \) was chosen in such way that it is not decided by \( D \), which in turn decides all possible evidence. If \( D \) turns out to be false, then a bet on \( D \supset S \) can easily be settled. But suppose \( D \) is true. First of all, given that \( D \) comprises all possible evidence, its truth can probably only be rec-

\(^{62}\) The theorem is due to Lewis, first reported in Paul Teller, “Conditionalization and Observation,” Synthese, XXVI, 2 (December 1973): 218–58.

\(^{63}\) Chalmers, Constructing the World, op. cit., p. 166.

ognized at the very last moment of time (if such exists). Secondly, in order to decide whether \( D \supset S \) is true, one would have to decide \( S \). But given that \( D \) does not imply \( S \) while still implying all the available evidence, \( S \) will not be decided by the evidence. So, in a sense, the truth or falsity of \( S \) cannot be conclusively settled. As a consequence, a bet on \( D \supset S \) cannot be settled if \( D \) happens to be true. In such a case, the agent and the bookie may reasonably disagree about who won the relevant bet or, what is more likely, they may both remain somewhat uncertain about whether \( S \) is true or not by assigning a credence strictly between 0 and 1 to \( S \) conditional on the available evidence. If the agent and bookie have an antecedent agreement for “settling up” on bets that have not been resolved, then, of course, the bookie still may be able to make money off of the agent. For instance, if the agent and bookie agree that the truth of \( S \) will be resolved for the purposes of the bet by whether the agent has high anterior or posterior credence in \( S \) given \( D \), then perhaps the bookie can lead the agent to irrational bets. But different settling up mechanisms will lead to different bets being rational. As a result, on either such a scheme, the rationality of betting on \( S \) given \( D \) seems to detach from the likelihood that \( S \) is true on the assumption that \( D \). In sum, owing to its highly theoretical nature, we are dealing with a sentence bets on which do not have fully determinate conditions under which they would count as being settled. As a consequence, it seems that the pragmatic versions of the Dutch book arguments are inapplicable.\(^{65}\)

But is there any theoretical explanation for why a rational agent might change her priors? One possibility is that revision of priors may bring the agent closer to the truth. That is, it may be that changing from a low to a high credence in \( S \) given \( D \) leads to more true and fewer false beliefs. On this view, while it may be rational to begin inquiry with a high conditional credence, one will be missing out on some truths (namely, \( S \)) if one does not revise this conditional probability at some point during inquiry. This revision might be motivated by theoretical considerations of the sort considered above such as simplicity, parsimony, and so forth.\(^{66}\) More importantly, we know from the failure of the convergence of opinions theorem for the cases Chalmers is interested in that it may be the only way of getting closer to the truth. If we did not already start out with as-

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\(^{65}\) A further problem is worth mentioning. It has been observed by Bas C. van Fraassen (in Laws and Symmetry (Oxford: Oxford University Press, 1989), chapters 7 and 13, particularly p. 174) that a dynamic Dutch book can only be made against an agent if she uses an alternative update rule recommending a different response to the evidence than conditionalization would have it (if no such rule is known to the bookie, she would not know whether to buy or sell the relevant bets). But the envisaged changes of priors do not constitute alternative ways of responding to evidence, for they are concerned with non-evidential learning.

\(^{66}\) Similarly, Igor Douven (in “Inference to the Best Explanation, Dutch Books, and Inaccuracy Minimisation,” The Philosophical Quarterly, LIXIII, 252 (July 2013): 428–44) argues that non-vulnerability to dynamic Dutch books might just be one out of many legitimate and occasionally competing goals. According to Douven, non-vulnerability to a Dutch book can be outweighed by faster convergence to the true hypothesis, for example.
signing the true hypothesis a high probability conditional on the body of evidence narrowly construed, we cannot arrive at a high credence for the true hypothesis by changing our beliefs only through conditionalization. Someone who begins with low credence in \( S \) given \( D \) will not be in a position to find out that \( S \) is true unless she revises her priors. How can a kind of belief change be irrational if it is the only way of getting closer to the truth?

VII. CONCLUSION

According to Quine, every claim can be held true come what may and every claim can be revised. Chalmers alleges that these two hypotheses are incompatible with a Bayesian theory of rational belief change. More specifically, he holds that both theses result in widespread violations of conditionalization. Chalmers’s criticism of the thesis that any claim may be held true requires the Quinean to be more explicit about the logical structure of her own position. Specifically, the key issue is that a possibility claim quantifying separately over possible agents, evidence and a target proposition. Changing the order of quantifiers leads to different versions of holding-true thesis. The only one which conflicts with Bayesianism is too obviously implausible to capturing what Quine had in mind. The remaining two claims, however, are consistent with Bayesianism and still pose a threat to epistemically demanding conceptions of analyticity or the a priori.

Universal revisability is also a mere possibility claim. This allows one to see that Chalmers’s counterargument is compatible with a weak version of revisability: to any claim there is a rational epistemic state in which it can be revised. Moreover, it exposes a connection with Quine’s thoughts about evidence. Perhaps surprisingly, Quine has a broad conception of evidence according to which everything can possibly be evidence, even though contemporary science suggests that the range of evidence in this world is more narrowly circumscribed. Finally, if one nevertheless countenances a narrow conception of evidence, it turns out that the standard arguments for the exclusiveness of conditionalization no longer stand. In either case, Quinean epistemology escapes unscathed.