Anti-Exceptionalism about Logic

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Abstract. According to *anti-exceptionalism about logic* (AEL), logic is not as exceptional in terms of its subject matter and epistemology as has been traditionally thought. In this chapter, we focus our attention on *epistemological* AEL, the view that logics are justified on the basis of similar mechanisms of theory-choice and sources of evidence as theories in the sciences. In particular, we consider the motivations for rejecting a particularly important traditional property of logic—the *foundational* status of its laws—based upon empiricist commitments, the nature of logical facts, and logical practice, and then outline those non-foundationalist accounts of logic's epistemology that result from these motivations, including Quine's evidential holism, logical abductivism, and logical predictivism.

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1. Exceptionalism and Anti-Exceptionalism about Logic

Tradition has it that logic is exceptional. And not simply special in the sense that every recognised science is special, but rather *extraordinarily* special. While each science has its own research goals, apparatus, and procedures, logic has long been thought to be distinct from the sciences in terms of its subject matter, methodology, and epistemology. Whatever our eventual account on the nature of logic, "[l]ogic must turn out to be a *totally* different kind than any other science" (Wittgenstein, in McGuiness 1995: 30).

But, in what does this exceptionality consist? In short, by virtue of having certain essential properties which, combined, differentiate it from the recognised sciences. First, unlike the laws of other fields of enquiry, those of logic apply equally to all domains. The laws of molecular biology focus upon the composition, structure and interaction of *cellular molecules*, while number theory constrains itself to (operations on) the *integers*. Even the most fundamental laws of physics apply only to *physical* systems. In contrast, the logical laws are putatively wholly *general*, applying to all entities. Indeed, to admit that a law is only applicable to a given domain is treated as an implicit admission that the law is not deserving of the honorific *logical* after all. For in this case logic would simply become "a name for any collection of rules in accordance with which we may argue in some context" (Kneale 1956: 238). It was partially on this basis that Frege made the case for the success of his own *Begriffsschrift* over Boole's algebraic treatment of logic, in virtue of its ability to serve as a universal language for science (van Heijenoort 1967).

To the extent that logic is wholly general, it is not concerned with the particular identity of any object or property. Indeed, some have gone so far as to say that this universality is synonymous with logic *lacking* a subject matter and its laws being contentless (Wittgenstein 1961 [1921]). While the empirical sciences are concerned with the world, whether the natural or our socially constructed world, logic is about neither. Rather, it is about the *formal* structure of propositions, and not their content.[1] For this reason, logic's laws are both (metaphysically) *analytic* and *necessary*, in not being responsive to the peculiarities of events in the actual world.

[1] It is not an inevitable consequence of logic's generality that its laws are contentless. In fact, logic's *generality* is totally consistent with the view that logic's laws are about the world in just the way those of the sciences are; simply more *general* or *structural* features of the world. This was Bertrand Russell's (1919: 169) view at one time, and is shared (with some variations) by Maddy (2007), Sider (2013), and Williamson (2017). This position, sometimes known as *universalism* (Ricketts 2017), is (as we note below) a form of *metaphysical anti-exceptionalism*. Wittgenstein's view on the content of logic can very much be seen as a reaction to Russell's (cf. Potter 2009).

While logic may share some of these features with other research areas—the laws of mathematics are equally *necessary*, and those of metaphysics equally *general*—it does not share them all (at least, according to tradition). The laws of mathematics, save from perhaps set theory and category theory, are not general, and logic is not just metaphysics. For while the latter is concerned with what the general facts of this and other possible worlds are, logic is not primarily concerned with how matters are, but rather with how they *should* be. In other words, logic's laws are inherently normative; "they are the most general laws, which prescribe universally the way in which one ought to think if one is to think at all" (Frege 2013 [1893]: xv). In this respect, one may think logic has a greater similarity to ethics than science (Resnik 1985).[2]

Equally important are the putative epistemological differences between logic and the recognised sciences. While in mathematics and the sciences we often presume the validity of certain logical inferences to establish results, within logic we cannot do this without begging the question. Accordingly, justification for logic must be *non-inferential*. Further, given that no observable states of affairs directly demonstrate that a rule of inference is valid, or a law true, in virtue of the justification for logic being *non-inferential*, it must also be *a priori*.

Articulations of this exceptionalist view of logic can be traced back at least as far as Kant, where in the *Jasche Logic* (general) logic is defined as "a science a priori of the necessary laws of thought, not in regard to particular objects, however, but to all objects in general" (1992: 16). Yet subsequent expressions of the same message, that logic is somehow importantly different from the recognised sciences, are echoed by advocates of a range of subsequent traditions, from the logical positivists (Wittgenstein 1961 [1921]) to contemporary rationalists (Katz 1998).

Of course, not all philosophers of logic have shared these traditional presumptions about logic. Some, such as domain-specific pluralists, have denied the *generality* of logic (Bueno & Shalkowski 2009). Different domains of enquiry require differing logical principles. Others have denied that logic is *formal* in any interesting sense (Etchemendy 1983). Sure, its laws may be schematized, but so are those in other sciences in which mathematics plays a key role. Others still have called into question the peculiarly normative role of logical laws (Harman 1986). The laws of implication may have some consequences for how we reason, but they are far from unique in this regard. Each of these positions count as versions of what is known as *anti-exceptionalism about logic*, the view that at least some of the presumptions about the special character of logic in contrast to the sciences are mistaken, or at least wildly overblown.[3]

In particular, two connected but distinct variants of anti-exceptionalism are prominent in the literature:

First, *Metaphysical* AEL, which proposes that the laws of logic are about the world in the same way that those of the sciences are; they are simply concerned with more "general" facts (Maddy 2007; Sher 2016;

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[2] It's notable that the putative necessity and generality of set theory and metaphysics have led to very involved debates over whether set theory should be considered part of logic, and whether (and in what sense) metaphysics and logic are distinct from one another. For the former, see the ongoing debate over the criterion of logicality provided by the Tarski-Sher thesis (Sher 1991). For the latter, see the historical debate from the 14th Century onwards regarding to what extent the science (*scientia*) of logic is distinct from metaphysics, given that both are concerned with the most general subject matter (Lu Adler 2018).

[3] There is some disagreement in the literature over how exactly to characterise AEL (Martin & Hjortland 2022). According to one conception, *AEL as Continuity with the Sciences*, AEL should be understood as proposing that logic is continuous with the sciences in terms of its subject matter, epistemology, and theoretical methods (cf. Payette & Wyatt 2018). Another conception, *AEL as Tradition Rejection*, in contrast, proposes that we understand AEL in terms of its rejection of certain traditional properties of logic, such as its *formality*, *necessity*, and *analyticity*, which as a package putatively made logic exceptional as a research area. While the present authors have argued that it's more fruitful to understand AEL in the latter terms, we'll pass over the intricacies of this distinction in the following.

Williamson 2017). As a consequence, while logic is indeed more general than the other sciences, its laws are no less descriptive and no more necessary than those of the sciences.

Second, *Epistemological* AEL, taking its lead from Quine's (1951) evidential holism, proposes that logics are justified by a similar means to scientific theories. Whereas logic's epistemology has often been thought to be exceptional, for instance, in virtue of being both *non-inferential* and *a priori*, logics are actually justified and ultimately chosen on the basis of a similar mechanism of theory-choice and sources of evidence as theories in the sciences.[4]

Rather than using this introductory chapter as an opportunity to survey these many purported exceptional properties of logic, their motivations, and detractors—something partially done elsewhere (Chen 2024; Martin & Hjortland 2022)—we focus our attention here on one of these purported properties: logic's epistemic foundational status. This particular putative property of logic is important not only because (unlike some of the other properties) it serves to singularly differentiate logic from the recognised sciences—no scientific laws are epistemically foundational in the sense those of logic are—but also because it is the rejection of this putative foundational status of logic which has directly led to the development of the various anti-exceptionalist accounts of logic's epistemology in the literature.

The rest of the chapter runs as follows. Section 2 outlines the putative foundational status of logic, the motivations for endorsing foundationalism about logic, and the epistemic pictures of logic that result from this foundationalism. Section 3 then discusses the various challenges to the foundational picture of logic's epistemology. What results from a rejection of logic's foundationalism is a form of *epistemological* anti-exceptionalism about logic. Sections 4 and 5 then move onto discussing these anti-exceptionalist epistemologies. Section 4 presents Quine's famous view that our logic should be assessed as part of our wider web of belief and Section 5 presents two contemporary non-foundationalist epistemologies of logic—logical abductivism and predictivism—both of which suggest the method by which logical principles are justified are not fundamentally different from that found in the sciences.

2. The Foundational Status of Logic

In general, to say that our beliefs in any particular domain are *epistemically foundational* means, firstly, that our justified belief in any proposition within the domain is *self-sustaining*, thereby not depending for its justification on any other belief and, secondly, that our justification for some other beliefs depends (at least partially) on our having justification for these foundational beliefs.[5] Thus, to say that (some of) our beliefs regarding logic are epistemically foundational means that our justification for these beliefs is *self-sustaining*, and that they serve to at least partially justify other beliefs we possess.

One immediate complication that arises when we speak of (justified) beliefs *regarding logic* is that talk of "logic" is ambiguous, and so talk of justification with regards to logic is derivatively ambiguous. In particular, talk of justification with regards to logic often stands, simultaneously, for our justification in *making certain inferences* deemed *logical*, such as making the inference to "I'll go to Marseille this weekend" on the basis

[4] As we shall see, while it's become the norm to think of both of these elements of epistemological AEL—that the *mechanisms of theory-choice* are the same, and the *sources of evidence* are the same—as a package, due to Quine endorsing both, this is not the case. Both end up comprising distinct and separable *aspects of* epistemological AEL.

[5] As with many distinctions in epistemology, they can be equally made in terms of *justification* and *knowledge*. Our preference here will be talking in terms of justification, in virtue of the property being non-factive. This makes it easier to speak of individuals having beliefs regarding logic with positive epistemic status without having to worry about their correctness.

of my standing commitments that "I'll either go to Herne Bay or Marseille this weekend" and "I won't ever go to Herne Bay again", and our justification for believing certain *logical laws* or *principles*, such as the disjunctive syllogism. Clearly, these two forms of "logical" justification are not equivalent. An able mathematician can justifiably infer in accordance with the disjunctive syllogism without justifiably believing the law (for that, they would usually have to take a discrete mathematics or logic course).

While the question of what justifies our *making inferences* that we deem logical, and what justifies our belief in logical laws, are both interesting questions, it is the latter which is our focus here. In distinguishing between the epistemology of logic and the recognised sciences, the distinction is not between our justification in making *logical* inferences and *scientific* inferences, but rather the means through which we come to be justified in believing logical claims (or theories) and scientific theories. Thus, when speaking of foundationalism with regards to *logic*, we are explicitly concerned with foundationalism about logical *principles* or *laws*, not specific inferences.

There are two prominent rationales for foundationalism about logical principles, both of which are related to general motivations for all forms of foundationalism.

Firstly, admitting that our justification for logical principles is foundational allows one to address *sceptical concerns* over not only the logical principles themselves, but other putative items of knowledge which evidentially depend upon logic, such as those of mathematics. If each of our beliefs requires justification, then to avoid an infinite regress some of these must have self-sustaining justification. This demand for a self-sustaining justification is particularly pressing in the case of mathematics, given the explicit requirement for a proof. Unless the resulting theorem is of conditional form, it is not enough that our logical inferences be epistemically secure; our justification of the axioms must also be self-sustaining. This view is sometimes known as *Euclidean* foundationalism (Shapiro 2009).

Why, though, think it is our beliefs in *logical* principles in particular that serve this foundational role? Even if one is inclined towards a form of foundationalism in general, or in mathematics in particular, it is unclear why it should be our justification in *logical* principles which serves this role, rather than a subset of our *non-logical* mathematical beliefs. We have two hypotheses here.

The first is that the presumed *generality* of logical principles makes these good candidates for the role, on a pragmatic basis. After all, in virtue of generality, if we can show that our justification for these principles is self-sustaining then, in virtue of their generality, they can serve as the foundational basis for most (if not all) of our further justification. It is hard enough to show that *any* of our justification is self-sustaining, so best to keep the required items to a minimum and ensure they have the biggest epistemic impact.

Second, given that the *transmission* of our justification from the self-sustaining foundations to other beliefs requires us to make logical *inferences*, in order to ensure these inferential transitions are epistemically safe we need justification for these logical inferences. Further, unless we are inclined to accept a form of reliabilism, we may conclude that the only means to ensure that these logical inferences are epistemically safe is to have prior justification for the logical principles sanctioning them.[6] Further, given that any non-self-sustaining justification for the logical principles would require logical inferences to be made, this justification for the logical principles itself must be self-sustaining.

This leads us onto the second motivation for logical foundationalism. Foundationalism may seem like a natural response to concerns over the inevitable bootstrapping that would occur if we were to propose that some of our non-logical beliefs could be used to justify logical principles. Any epistemology of logic which

[6] This is the view of several in the epistemology of (logical) inferences literature; see Boghossian (2000).

proposes that we come to be justified in believing a logical principle *P* via other beliefs *B* will always face problems, so the foundationalist may say, for we will always need to appeal to *logical rules* to demonstrate that *B* is (in)consistent with *P*, or supports *P*. In other words, any non-foundationalist justificatory process for logical principles would require making *deductive inferences*. However, of course, any logical rules relied upon in making such inferences will either need to be sanctioned by the set of logical principles under consideration or not. If they are, then the advocate of the principle(s) is simply begging the question in relying upon the rule for the principle(s) evidential support, and so the putative justification offers no new evidence for the principle(s). Instead, if the principle(s) fail to justify the deduction, then the principle(s) undercut(s) their own possible justification. They only succeed in pulling their own justificatory ladder away from themselves. Either way, the justification of *at least some* logical principles cannot rely upon non-immediate evidence, as it would require deductive inferences to be made whose viability presumes the truth of the principles themselves.

This concern over non-foundationalist epistemologies of logic, known variously as the centrality (Wright 1986), background logic (Martin 2021b; Woods 2019b), and metalogic (Shapiro 2000) problem, is probably the main motivation for contemporary foundationalist epistemologies of logic (BonJour 1998). It has a similarity to those concerns against circular arguments which motivated foundationalist responses to the infamous Pyrrhonean sceptical challenge. However, in this case, the argument is not explicitly *premise* circular, but rather *rule*-circular, in that any non-foundationalist argument for a logic presupposes the validity of the rule of inference in reasoning to the justificatory argument's conclusion, rather than explicitly including the concluding logical principle as a premise.

Of course, neither of these concerns over non-foundationalist epistemologies of logic themselves suffice for endorsing foundationalism. After all, there are other non-inferentialist options on the table. One could embrace a version of *non-factualism about logic*, in which one is free to endorse a set of logical principles as one sees fit, akin to a form of personal ethics (Resnik 1985). Secondly, one could propose that instead of having positive epistemic justification for the principles, our belief in a certain set of these principles holds the status of being *default reasonable (but defeasible)* beliefs (Field 2000). We won't have much to say about these further options here, as it would take us beyond the scope of this chapter. However, the existence of these further possibilities shows that to support either foundationalism or non-foundationalism about logic, it does not suffice to show that the other is inadequate. One must provide significant positive evidence in favour of one's own proposal, or show that these other possible epistemologies of logic are also grossly inadequate.

Once one admits that our justification for at least a subset of the logical principles must be foundationalist, two further properties of our justification for logic likely follow:

First, that there is some identifiable conscious property associated with this foundational justification. If we are to be justified in believing these logical principles without any evidential dependence from other items of knowledge, and we are to have *conscious access* to this justification, then there must be some identifiable property of these belief states associated with their epistemic self-sustaining status, such as *self-evidence* (Shapiro 2009). This does not *require* that there is such an associated identifiable property, for it is an open possibility the foundationalist admits that while we have such self-sustaining justification, we can never actually recognise when in fact we do. However, this would be a rather unsatisfying result, given the need to answer the question of why we should endorse a set of logical principles L_1 rather than L_2.

Second, in virtue of our justification for the logical principles being non-inferentialist, it is highly likely that these principles must be justified by *a priori* sources. This is a product of two-factors. Firstly, the possibility of *inferring* evidence for particular logical laws from empirical evidence is precluded by the justification for the logical laws being self-sustaining. Secondly, while this does not rule out the possibility of *non-inferential*

perceptual evidence immediately justifying these logical principles, there are no viable observable states of affairs that directly demonstrate a rule of inference is valid, or that a principle is true. We do not directly *perceive* the validity of contrapositive, for instance. Thus, if our justification for logical principles is self-sustaining, it is also likely to be *a priori*.

This, then, is the standard foundationalism view with regards to logical principles:

> We must have unmediated *a priori* access to at least some laws of validity, that we come to appreciate through some identifiable property, such as self-evidence.

From this starting assumption that we have unmediated *a priori* access to certain logical principles, two broad accounts of logic's epistemology have arisen within the modern literature: logical *rationalism* and *semanticism*. While both agree that the justification for logical laws must be non-inferential and *a priori*, they disagree on the source of this *a priori* evidence.

According to *rationalists*, one comes to be justified in believing logical laws via a *quasi-perceptual* intellectual faculty, commonly known as *intuition* or *mental insight*, in which one simply *non-perceptually sees* that a particular logical law is true (BonJour 1998). Such intuitions are now commonly conceived of by their advocates as being phenomenologically similar to perceptual states (Chudnoff 2011), and thus able to represent states of affairs, providing us with evidence for the truth or falsity of their contents, including logical propositions:

> When you have an intuition that *A*, it *seems* to you that *A*… [understood as a] genuine kind of conscious episode. For example, when you first consider one of de Morgan's laws, often it neither seems true nor seems false; after a moment's reflection, however, something happens: it now just seems true. (Bealer 1998: 207)

In this regard, for the rationalist, logical knowledge is similar to knowledge of other necessary truths, such as conceptual and mathematical truths (BonJour 1998; Chudnoff 2011).[7]

In contrast, *semanticists* deny the need to posit a novel cognitive faculty to accommodate logical knowledge. Instead, justification for the logical laws is understood in terms of linguistic proficiency; in virtue of understanding the meaning of the constituent terms of a logical law, we automatically become justified in assenting to its truth:

> If one knows what is the function of the words 'either', 'or', and 'not', then one can see that any proposition of the form 'Either p is true or p is not true' is valid. (Ayer 1936: 79)

In other words, logical laws are *epistemically analytic* (Boghossian 1996).

Which of these particular epistemic pictures the foundationalist endorses often depends upon their further philosophical commitments, whether this be their metaphysical stance on the nature of logical facts or how viable they deem the proposed evidential sources to be. For instance, semanticists are commonly motivated by naturalism (Warren 2020: Ch. 1). By embracing analyticity, the semanticist can aim to account for the necessary truth of logic's laws in terms of linguistic conventions, rather than ways the world must be. In contrast, rationalists desire to uphold the putative objectivity of logic–which they believe the semanticist

[7] Some rationalists, such as BonJour (1998) appeal to rational intuitions to justify both logical principles themselves and specific (logical) inferences. That is, they amalgamate the epistemology of logical theorizing and of reliable (logical) inference. It isn't always clear whether this amalgamation is a conscious decision or an oversight, however it is certainly unjustified (see Martin 2025 for discussion). Again, here we are solely concerned with the role of intuition in the direct justification of logical principles.

throws away by demoting logic to the status of conventions (BonJour 1998)–by rejecting this naturalism and admitting abstract non-spatiotemporal facts, which they claim can be accessed via the special faculty of rational intuition (Katz 1998).[8]

Regardless of which of these foundationalist proposals is ultimately chosen, each sees our justification for logical principles as distinctly different from that of the sciences. Anti-exceptionalist epistemologies reject this picture, by denying that we have unmediated *apriori* access to these logical principles. In the next section we look at some of those motivations which have led to a rejection of these foundationalist proposals.

3. Challenges to the Exceptionalist Picture

There is not one outstanding motivation for rejecting foundationalist accounts of logic's epistemology. There are multiple possible critiques available, each of which can provide motivation for distinct anti-exceptionalist positions with regards to logic's epistemology. In this section we'll consider four of these possible motivations: (i) empiricism; (ii) metaphysical views on logic; (iii) the proliferation of competing logics; and (iv) the practice of logicians.

3.1 Empiricism

Empiricism poses a direct threat to foundationalist accounts of logic's epistemology in virtue of calling into question the viability of *a priori* sources of justification. Admittedly, empiricism does not in and of itself require a rejection of the foundationalist picture of logic. If the empiricist is willing to restrict their theory to only those propositions which are about "matters of fact", as Hume was, then exceptionalism about logic's epistemology can be admitted as long as it's recognised that logical principles are not in any sense about the world, but rather only about conceptual or semantic relationships.[9] This possibility for the empiricist, however, can be undercut on the basis of any one of at least three further considerations:

First, if one wishes to admit that logical claims are *about the concrete world*, while continuing to maintain one's empiricism, then one is committed to admitting that our evidence for logical principles must be equally empirical. A fine example of this motivation for an anti-exceptionalist epistemology is J.S. Mill, who took at least certain of the logical laws to be inductive generalisations of our empirical observations (Godden 2017).

Second, if one is dissatisfied with the viability of the potential sources of evidence that are supposed to provide us with justification for these "relations of ideas", such as epistemic analyticity, then one will doubt that any logical justification we possess can be accounted for by this evidential source. In which case, the empiricist is required to either admit we possess no justification for logical principles after all, or that such justification has the same *aposteriori* sources of evidence as theories in the sciences.

Third, if one goes a step further and commits oneself to *methodological naturalism* then the possibility of appealing to epistemological analyticity is precluded, as the only viable sources of evidence are those of the natural sciences. This again leaves one with the option of either admitting we possess no justification for

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[8] A third, less-common foundationalist epistemology of logic, *logical conceptualism*, claims that one comes to be justified in believing logical principles in virtue of *grasping their conceptual* content (Giaquinto 2008). Conceptualists tend to share semanticist's dissatisfaction with appeals to non-perceptual rational insight, while doubting that *linguistic* comprehension suffices for epistemic justification. This can be due to concerns over epistemic analyticity, or worries that committing oneself to epistemic analyticity means also endorsing metaphysical analyticity. See Williamson (2007) for details.

[9] Of course, in such a scenario, it is likely that the epistemology of logic will be treated as similar to that of other abstract sciences, such as mathematics.

logical principles, or that such justification has the same *aposteriori* sources of evidence as the sciences. This is ultimately the position Quine takes on the matter (see section 4.1).

Thus, while empiricism does not entail the rejection of exceptionalist accounts of logic's epistemology, it has rather often led to this consequence due to a dissatisfaction with relegating logical principles to the status of "relations of ideas", for differing reasons.

3.2 Metaphysics of Logic

A related but independent motivation for rejecting foundationalism is a particular metaphysical view about the nature of logic. If logic is to be *about the world*, just as the laws of biology or physics are, then we should not expect to have non-mediated access to these truths. Just like in any other activity when attempting to discover facts about the world, we need to test our theories in accordance with what we know about the world. This appears to be Bertrand Russell's position on the matter. In virtue of "logic [being] concerned with the real world just as truly as zoology, though with its more abstract and general features" (Russell 1919: 169), science's "*methods*… can be transferred with profit from the sphere of the special sciences to the sphere of philosophy" (1957: 98).[10]

The significant difference between this metaphysical motivation for anti-exceptionalism and previous empirical motivations is that while it precludes foundationalism, it does not preclude that the *sources* of evidence that inform our best theories of logic are *a priori*. Indeed, if one thinks that what differentiates logical facts is that they are facts about the *general* or *structural* features of the world, then one might well doubt that empirical evidence is the most appropriate source of evidence. Again, Russell (1949: 111) seemed to be of this opinion, and we find similar points made in Maddy (2007) and Sher (2016).

3.3 Proliferation of Logics

The last fifty years have seen a proliferation in the number of non-classical logics proposed to challenge the truth of classical logic. This proliferation calls into serious question the *self-evidence* of logic. After all, if some set of logical principles genuinely possessed a positive epistemic property that was detectable by us in virtue of our properly functionally cognitive abilities, we would not expect so much disagreement over these principles. To address this concern, the foundationalist requires a significant *error theory* to explain why so many seemingly capable logicians simply *do not see* or *grasp* the apparent self-evidence of these principles (Martin 2021b; Williamson 2007).

This challenge to foundationalism does not directly call into question the possibility that we do in fact have self-sustaining justification for certain logical principles. It does, however, call into question that there is some *shared detectable property* that we can use as a community to determine which of these principles are in fact self-sustaining. This raises a problem for the foundationalist, as we are then owed a plausible story of how we come to discover these justified logical principles, given that (after all) logicians do not just propose particular logics on a whim.

3.4 Logicians' Practice

This brings us to our final motivation for rejecting foundationalism. Related to the proliferation of logics is the rejection of foundationalism because it is in tension with how logicians actually go about justifying their logics. If foundationalism were true, we would expect debates over the correct logical principles which logicians engage in to betray the sources of evidence proposed by foundationalist epistemologies of logic. For example, if rationalism were correct, we would expect logicians attempting to justify their own preferred theory against competitors by appealing to their *direct intuitions over* the differentiating principles.

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[10] See also Williamson (2017), which has similarities to Russell.

However, if we look at how logicians actually go about justifying logics, they rarely (if ever) appeal to the straightforward self-evidence of a logical principle. Rather, what we actually find is logicians appealing to a range of different considerations to support their favoured logic, including the ability of the logics to facilitate important mathematical results, *explain why* the inferences mathematicians make within informal proofs are acceptable, and resolve outstanding puzzles, such as the logico-semantic paradoxes. In none of these cases is it deemed acceptable or sufficient to merely appeal to one's rational intuitions regarding a logical principle, or one's *proper semantic grasping* of the principle, to justify one's commitment to it. Rather, logicians are expected to support one's logic by demonstrating what it can *deliver*.[11] This criticism of foundationalism is found in Martin (2021b; 2025) and Williamson (2007), and is common among advocates of a *practice-based approach* towards the epistemology of logic (see entry on PRACTICE-BASED APPROACH).

Importantly, while the appeal to logicians' practice calls into question the viability of foundationalism, it does not preclude that the relevant sources of evidence used within the justification of logical principles are *a priori*. The fact that the evidence logicians provide one another for their preferred logics suggests that they do not have *direct access* to the truth of logical principles does not determine *which* sources of evidence (whether *apriori* or *aposteriori*) logicians do in fact appeal to. That also must be determined by looking at their practice.

While each of these concerns provide a reason to be dissatisfied with the exceptionalist foundational picture of logic's epistemology in some regard, they do not require us to reject all of the elements of this exceptionalist picture equally. In the following sections, we consider several of the epistemological pictures of logic these arguments against foundationalism have motivated.

4. The Positive Picture

4.1 Naturalistic Accounts

In the spirit of empiricist criticisms of foundationalist proposals, some early anti-exceptionalists attempted to show that logical principles can be justified *empirically*. As we do not directly observe the truth of logical principles, we are owed an account of how these principles can be *inferred* from observations. The simplest way to achieve this would be straightforwardly via induction, whereby at least some logical principles are generalizations formed by directly extrapolating from observed instances; a position sometimes attributed to John Stuart Mill (1843/1963).

Inductivism about logic would have few supporters today, given that it's unclear how the position can explain our justification for principles for which there are no obvious observable correlates, such as those containing iterations of conditionals (Martin 2025). However, there are other possible, less direct, mechanisms by which empirical evidence can justify our logical theories. Putnam (1969), for instance, famously argued that not only is the justification for logic ultimately empirical, but that classical logic should be revised in light of our best theory of fundamental physics, quantum mechanics, by giving up the law of distributivity and endorsing a quantum logic based on Hilbert spaces. Unlike the inductivist, however, Putnam does not argue *directly* for or against logical principles on the basis of empirical evidence. Like in the sciences more generally, laws are not supported by mere inductive extrapolations from the data. Instead, the argument in favour of quantum logic is that it is (putatively) a better overall match with quantum mechanics than its classical counterpart.

Putnam (2012) would later reject quantum logic as a revisionary project, but the example still stands as the paradigm of an empirically motivated revision of classical logic. In fact, the example was cited during

[11] What exactly is meant by "what it can deliver" is a topic for the following sections.

probably the most well-known discussion of the empirically-motivated justification and revision of logic, Quine's defence of *evidential holism*: "Logic is in principle no less open to revision than quantum mechanics or the theory of relativity" (1986: 100). Of course, no one now denies that our theories of logic have been revised many times throughout history. From Aristotle to Buridan, Boole to Frege, our account of what counts as a logical law has been altered. Yet, what makes Quine's view radical is that it allows for these theoretical revisions in logic to be rationally motivated by *empirical* evidence.

The starting point for Quine's own proposal was a deep dissatisfaction with foundationalist epistemologies of logic. Due to his own naturalistic tendencies, Quine did not take seriously the viability of a quasi-perceptual mental faculty like intuition. Rather, we should rely only upon those epistemic sources for which we have scientific support: "[I]t is a finding of natural science itself, however fallible, that our information about the world comes only through impacts on our sensory receptors" (1990: 19). Unlike other empiricists, however, Quine (1951) was also famously unmoved by the suggestion we could explain our justification for logical laws in terms of analyticity, given that there is no principled distinction between sentences we can become justified in believing through semantic competence alone (analytic sentences) and those we cannot (syntactic sentences). As a result, if we have justification for our logical beliefs, it must ultimately come via (scientifically acceptable) empirical data.

It is here that Quine's other philosophical commitments inform his precise account of logic's epistemology. Inspired by Duhem, Quine (1951) denied that individual hypotheses can be conclusively verified or falsified in isolation. Evidence that seemingly disconfirms a hypothesis can always be explained away by dropping auxiliary hypotheses instead. For instance, the hypothesis that *matches light when struck* is not directly falsified by a failure to ignite a given struck match on a specific occasion. Perhaps instead the red phosphorus wasn't dry, the striking didn't generate sufficient heat, or there was no oxygen in the room. Thus, when we strike the match we do not test the hypothesis *matches light when struck* in isolation, but rather a cluster of hypotheses.

Quine then goes on to make an even stronger claim: that *no* hypothesis can be meaningfully separated from the entire theory it belongs to (Quine & Ullian 1970). Or, to put matters in another way: *no* claim we endorse can be separated from our entire system of beliefs. After all, there are boundless connections between each of the beliefs we hold; what Quine & Ullian (1970) in a memorable metaphor calls the 'web of belief'. Thus, if our beliefs are to be evaluated, they must be evaluated as a whole.

Yet, within this web sit not only our beliefs about matches and the external world, but beliefs about logic and mathematics. Granted, these beliefs are not as readily rejected as a result of new observations, but only because they inhabit a more central place in the web. In principle, there is no reason why we could not ultimately conclude that our overall theory was best served by rejecting, say, the law of excluded middle or a geometric postulate. In other words, our logical and mathematical beliefs are assessed simultaneously with others beliefs in the web. Despite their central position, logical laws hold no distinguished epistemological position. For Quine, it is their centrality, and thus indispensability to the rest of the web, which explains their appearance of necessity (Carlson 2015).

4.2 Evidential and Methodological Anti-Exceptionalism

According to Quine's evidential holism, logic is assessed by both the same *mechanisms* and the same *sources of evidence* as our other theories. Given Quine's influence on the debate, this has had the effect of leading some to presume that to be an epistemological anti-exceptionalist requires one to be committed to both non-foundationalism and empiricism about logic (e.g., Boghossian & Wright 2024). Yet, this is not the case. In fact, we can identify *two distinct strands* in Quine's philosophy of logic relevant to his epistemological anti-exceptionalism (Martin & Hjortland 2022, 2024). First, Quine is an *evidential* anti-exceptionalist, because he holds that our logical theories are supported by the *same types of evidence* as theories in the sciences.

Since only observational evidence impinges on the edges of the web, the evidence for logical theories is not essentially different from the evidence of physics or chemistry. Second, Quine is a *methodological* anti-exceptionalist, by claiming that the criteria and mechanisms for theory-choice in logic are unexceptional.[12] As our logical beliefs are assessed as part of the whole, the exact same principles of theory-choice apply to logic as elsewhere.

It is precisely this combination of evidential and methodological anti-exceptionalism that is characteristic of Quine's brand of naturalism about logic. But the naturalist position should not be confused with epistemological anti-exceptionalism more generally. While the naturalist is committed to both strands of epistemological anti-exceptionalism, one need not be. Indeed, contemporary anti-exceptionalists tend to drop the commitment to the *sources of evidence* in logic being identical with those in the recognised sciences. This is not only because few anti-exceptionalist subscribe to the scientism underpinning Quine's philosophy of logic, but because the naturalist picture fails to account for the bulk of actual theory-choice in logic.

When it comes to revisionary arguments against classical logic, quantum logic is something of an outlier. Whereas quantum logic is motivated by empirical evidence from physics, most non-classical theories of logic have different rationales. Rather than findings from the natural sciences, the most straightforward challenges to classical laws of logic come from natural language or mathematics. Rudimentary data about our judgements over inferences within natural language has produced numerous objections to classical logic, from McGee's (1985) counterexample to *modus ponens* and Yalcin's (2012) counterexample to *modus tollens*, to the paradoxes of the material implication. In mathematics, classical logic has been challenged by both intuitionistic logic (Posy 2020) and nonclassical solutions to set-theoretic paradoxes (Priest 2006b). Further, a host of revisionary arguments stem from efforts to provide axiomatic theories of truth that can solve alethic paradoxes like the liar and Curry paradoxes, in an attempt to show that classical logic is consistent with our wider commitments over the nature of truth (see entry on NON-CLASSICAL LOGICS).

None of these examples are tied to observational evidence in the way we would expect if *evidential* anti-exceptionalism were true. Of course, the naturalist might still argue that even set-theoretic axioms are ultimately selected on the basis of observational evidence due to their indispensable role in theories within the natural sciences, but ontological naturalism about mathematics based upon indispensability arguments is highly contentious (Maddy 2007). In contrast, the non-naturalistically minded anti-exceptionalist can more straightforwardly admit these other sources of evidence from mathematics and linguistic judgments as pieces of *a priori* evidence. The result being that most current versions of methodological anti-exceptionalism, informed by contemporary logical debates, depart from the strict empiricist motivation of its Millian and Quinean predecessors.

Take, for instance, Priest's (2016) version of *methodological* anti-exceptionalism. While Priest admits that "logic is revisable in the just the same way as any other theory" (2006a: 155), it is mainly linguistic judgments which inform theories of logic:

> It is clear enough what provides the data in the case of an empirical science: observation and experiment. What plays this role in logic? The answer, I take it, is our intuitions about the validity or otherwise of vernacular inferences. (2016: 355)

It is our spontaneous attitudes towards natural language instances of syllogisms, the law of excluded middle, and *modus tollens* which primarily serve as a source of evidence to shape our logical theories, not collected empirical evidence.

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[12] Though, admittedly, he isn't clear on what these precise mechanisms are.

5. Non-Foundationalist Models of Theory-Choice

Thus, rejecting naturalism does not require the rejection of epistemological anti-exceptionalism as a whole. One can admit that logic has its own particular sources of data, but that the mechanisms by which its theories are informed and justified by these data are significantly similar to those mechanisms used to justify scientific theories.

All such forms of methodological anti-exceptionalism are inherently non-foundationalist, due to the nature of scientific inquiry. That is, they propose that unlike foundationalist proposals, we do not have *unmediated access* to the correct logical laws. Rather, to discover these laws, inferences must be made from some relevant data to inform and test theories. Among these non-foundationalist accounts, however, there is significant room for variation over both what the relevant data are, and the mechanisms by which logics are assessed against these data. While there are other available accounts in the literature of the mechanisms by which data inform logics, including *reflective equilibrium* (Peregrin & Svoboda 2017; Woods 2019a; Martin 2024), we focus here on two of the more prominent versions of non-foundationalism: *abductivism* and *predictivism*.

5.1 Abductivism

The most popular form of methodological anti-exceptionalism currently is a broad proposal known as logical *abductivism* (Priest 2016, Russell 2015, Williamson 2017). In fact, the proposal is often understood so broadly that it's unclear what its advocates share in common. Broadly construed, abductivism claims that we come to be holistically justified in believing a logic *L* in virtue of it better accommodating relevant data, and possessing more relevant theoretical virtues, than other available logics. While this broad construal captures nicely the varying models of theory-choice given by Priest (2016), in terms of a *weighted-aggregation model*, Williamson (2017), in terms of the most unifying higher-order generalisations over the set of evidence we currently possess, and Russell (2015), in terms of solutions to the logico-semantic paradoxes, it is here that consensus among abductivists ends.

First, while all agree that adequacy to *some* data is an important criterion for a successful logic, there is disagreement over what constitutes this relevant data. While for Priest (2014: 217) the relevant data for alethic logics are "those inferences that strike us as correct or incorrect", Williamson (2017: 334) also includes other "independently well-confirmed sentences, such as well-established principles of physics" as relevant data. Second, it's unclear to what extent abductivists agree over what constitute these further theoretical virtues that logics can possess. While each of Williamson (2017: 334), Priest (2014: 217) and Russell (2015: 800) mention the putative virtues of *strength*, *simplicity*, and *unifying power*, Williamson in addition mentions *elegance* and Priest *non-adhocness*.

Further, this broad construal of abductivism that allows us to group these accounts together is probably too generic to be informative, while detached from our common understanding of abductivism in the philosophy of science. After all, according to abductivism proper, our best theory should not only be a *better fit of the data* than competitors, but provide the *best explanation* of the target phenomenon. While it appears some "abductivists" will be willing to take on this commitment, and actively appeal to the ability of logics to provide an explanation of some putative phenomenon (Williamson 2017), in other cases (e.g., Priest 2016, Russell 2015) matters are less clear.

Abductivist accounts, both broadly and narrowly construed, face challenges. First, abductivism broadly construed talks of logics "accommodating" or "fitting" data, but the current proposals lack detail on *how* logics can be thought to *accommodate* or *fit* data. Logics are not concerned with quantitative data, and so we cannot make sense of talk of "fit" to some data in terms of a best-fitting curve as one would normally in science. Nor are we provided with an account of how the postulates of our logic are operationalised so as to

be testable against some detectable data, so that we can talk non-metaphorically of our logical theories "accommodating" data. Second, we lack clarity on what exactly constitute these further theoretical virtues that determine theory-choice and *why* these particular virtues are suitable to rationally inform our choice of logic. For instance, both Hjortland (2019) and Russell (2019) have questioned the claim that *strength* should play a role within logical theory-choice. So as not to be an empty appeal to further virtues, as in the sciences we need a detailed account of what these virtues are and why they are a reliable guide to the correct theory.[13]

A further issue for abductivism more narrowly construed is how we should understand the nature of logical *explanations* if logics are said to provide explanations of some target phenomenon. First, it requires the abductivist to specify what this target phenomenon is that logics provide suitable explanations of. For explanation to make sense in the context of logic, the abductivist has to reject the idea that logical theories differ substantially from scientific theories in being wholly *prescriptive* rather than *descriptive*. Abductivists must propose that our logical theories of validity aim to account for some extra-systemic phenomenon, not merely prescribe norms of inference or reasoning. As a result, abductivists tend to think of logical *theories* as theories aiming to account for some philosophically prominent phenomena such as *validity*, or related properties such as consistency and provability (Priest 2016, Payette & Wyatt 2018).[14] Yet, as Hlobil (2021) has argued, there is not just one prominent interpretation of what this "primary" purpose of logic related to validity is, and that without prior agreement on what this putative phenomenon is that logics are supposed to be explaining, it is likely that any appeals to abductive criteria will fail in coordinating theory-choice. After all, different conceptions of the putative phenomenon will likely lead to different conclusions over relevant data and what constitutes the best explanation.

Even beyond this, however, we are owed an account of *how* logics can be said to provide explanations of the relevant target phenomena. Williamson (2017, 14), for instance, warns that:

> [w]e may speak loosely of inference to the best explanation, although in the case of logical theorems we do not mean specifically causal explanation, but rather a wider process of bringing our miscellaneous information under generalizations that unify it in illuminating ways.

In short, given the nature of logical properties it is far from obvious what kind of explanation would apply. There are indeed few attempts at providing a detailed account of explanation in logic. One exception is Payette & Wyatt (2018), who develop an account of explanation following Woody's (2015) *functional perspective*, arguing that more standard views about explanation are ill-suited for logical theories. The reason, according to them, being that deductive-nomological models of explanation in logic suffer from a fundamental flaw: these models would require us to presuppose the deductive validity of certain arguments in order to establish that a logical law provides an explanation of the relevant data. In other words, we would need to presuppose the truth of certain logical laws in order to establish the viability of the explanation, thereby begging the question for the candidate logic. If this turns out to be correct, explanation in logical theorizing has a unique restriction, differentiating it from explanations in the recognised sciences. Payette

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[13] Strictly speaking, whether the abductivist has the burden of meeting this second condition–of explaining *why* the virtues are a reliable guide to the correct theory–depends on their specific philosophical project. There are two distinct projects within contemporary methodological anti-exceptionalism: (i) *normative* methodological anti-exceptionalism, which claims that logics *should* be evaluated by similar mechanisms as scientific theories, and (ii) *descriptive* methodological anti-exceptionalism, which claims that logics *actually are* evaluated by similar mechanisms to theories in the sciences. If the abductivist is only committed to the latter position, then strictly speaking there is no requirement for them to engage in meeting the burden of showing that logicians' mechanisms of choosing theories are *rational* or *truth-conducive*. See Martin & Hjortland (2025) for details on this distinction.

[14] Of course, abductivists are not committed to saying that logics must always be in the business of explaining. Logics, understood as formal systems, are used for a whole plethora of practical and theoretical purposes. The point is that there is some privileged or "canonical" role that logic serves, related to determining validity, for which logics can be said to serve an explanatory role. See the entry on LOGICAL EXPLANATION for more details.

and Wyatt's argument is not uncontentious, however. Both their negative argument against traditional models of explanation and their positive view has been criticized in Martin (2021a).

5.2 Predictivism

For abductivist models of theory-choice to work, they must be able to discriminate between rival theories that can equally accommodate the relevant data. In other words, such models need to be able to address data underdetermination. Although the further selection criteria beyond data accommodation, such as *simplicity* and *deductive strength*, are intended to serve this purpose, there are doubts over both the rationality of using these further criteria to dictate theory-choice (Russell 2019), and the extent to which these criteria actually play a role in debates within logic (Martin & Hjortland 2021). Ideally, then, we would have a model of logical theory-choice which is able to explain how logicians can differentiate between mutually exclusive logics that accommodate the present data equally well, without appealing to these further dubious theoretical virtues.

This is a project taken up in Martin & Hjortland (2021), whose *logical predictivism* is an attempt to provide a more detailed and realistic account of the mechanisms by which theories are chosen in logic. According to this model, logical theories do indeed include hypotheses that are meant to accommodate data, but these hypotheses only represent the initial step of theory-building and theory-choice in logic. Instead, logics are ultimately chosen on the basis of their predictive success and explanatory power.

To be capable of producing both predictions to be tested against suitable data, and fruitful explanations of the target phenomenon, logical theories are not conceived of as simply sets of valid rules of inference or theorems, but rather are a cluster of definitions, laws and representation rules that provide the underlying semantics and syntax of the theory, as well as specifying how the theory connects to the target phenomenon. For illustrative purposes, here is a toy example of classical propositional logic:

> *Theory A*
>
> **Definition 1:** Let $\neg\phi$ be Boolean negation.
>
> **Definition 2:** Let $\phi \rightarrow \psi$ be Boolean material implication.
>
> **Representation Rule 1:** $\ulcorner$not $\phi\urcorner = \ulcorner\neg\phi\urcorner$.
>
> **Representation Rule 2:** $\ulcorner$if ϕ then $\psi\urcorner = \ulcorner\phi \rightarrow \psi\urcorner$.
>
> **Law 1:** For every valuation, all sentences are either true or false, and not both.
>
> **Law 2:** An argument is valid iff, for every valuation *v*, if every premise is true in *v*, the conclusion is true in *v*.

According to predictivism, such theories are initially motivated by examples of arguments judged to be *acceptable*. These can take the form of informal mathematical proofs judged to be acceptable by mathematicians, or natural-language arguments judged to be acceptable by certain "reliable reasoners".[15] For instance, the logician might initially be motivated by the following informal proofs, considered acceptable by mathematicians:

Theorem 1. *Assume* $x \in \mathbb{Z}$. *If* $x^2 - 4x + 7$ *is even, then x is odd.*

[15] This of course raises the question of *who* these reliable reasoners are and how we identify them. See dos Santos (2022) and Martin & Hjortland (2022) for discussion.

Proof. We prove our result indirectly. Suppose x is even, and let $x = 2k$ for some $k \in \mathbb{Z}$, so $x^2 - 4x + 7 = (2k)^2 - 4(2k) + 7$. Then, $(2k)^2 - 4(2k) + 7 = 4k^2 - 8k + 7 = 2(2k^2 - 4k + 3) - 1$, and so $x^2 - 4x + 7$ is odd. Thus, assuming x is even, $x^2 - 4x + 7$ is odd. QED.

Theorem 2. *For all $n \in \mathbb{Z}$. If $3n + 2$ is odd, then n is odd.*

Proof. We prove our result indirectly. Suppose n is even, and so $n = 2k$ for some $k \in \mathbb{Z}$. Consequently, $3n + 2 = 3(2k) + 2 = 6k + 2 = 2(3k + 1)$. But, then $3n + 2$ is even, as $2(3k + 1) = 2j$ for some $j \in \mathbb{Z}$, where $j = 3k + 1$. So, if n is even, then $3n + 2$ is even. QED.

Having assumed that mathematicians' judgements are a reliable (though fallible) guide as to which putative informal proofs are valid and which invalid, the logician is then concerned to provide an explanation of *why* these proofs are valid. To do so, she first forms a general hypothesis that inferences found across multiple proofs may be valid for the same reasons, namely because they *share some underlying form*. This is the starting point (or, working assumption) for the whole enterprise of *formal* logic. Secondly, she then proposes a concrete hypothesis about the validity of the argument form which she believes the two proofs above exemplify:

Hypothesis 1

All arguments of the form

If not ψ then not φ
If φ then ψ

are valid.

This hypothesis itself, however, does *not* constitute an explanation of *why* the proofs are valid. All it offers is a generalisation, albeit one that can be falsified. After all, similarly, the generalization "All swans are white" does not explain *why* swans are white; for that we need a genetic or evolutionary model. In order to *explain* why arguments of this form are valid (if they do in fact turn out to be valid, that is), she must propose a theory such as *Theory A* above, which provides a set of rules determining both the characteristic properties of the component parts of the argument as well as the consequence relation. It is these postulates within the theory that allow us to not only differentiate the argument form from those which are invalid, but specify *why* this form is valid in virtue of its structure, the properties of its constituent parts (which we call the *logical constants*), and the nature of logical consequence as truth-preservation.

For example, in this given case, the postulates in *Theory A* provide a possible explanation of why Hypothesis 1 is true, and thus why instances of contraposition are valid, by: (i) showing how the underlying form of these arguments ensures that whenever the premises are true so is the conclusion, through a combination the theory's definitions, representation rules, and Law 1, and then subsequently (ii) using these results to show how the arguments of this form are valid, in virtue of Law 2.

Now, importantly, while *Theory A* offers one possible explanation of the truth of Hypothesis 1, it is not the *only* theory that does so. There are infinitely many other theories that could. So far, all we have done is "fit" the theory to the data. Thus, *Theory A's* advocates need to find further reasons to prefer the theory over competitors. One of the main routes through which they do so is by making successful predictions about the validity of further forms of argument on the basis of the theory's postulates.

The possibility of further supporting our logician's theory on the basis of such successful predictions is facilitated by two facts. Firstly, the postulates within her theory which putatively explain why the

generalisation within Hypothesis 1 is true also ensure that other arguments are valid. In principle then, the theory can be tested against whether these further arguments are indeed valid. Secondly, given that in motivating her theory the logician assumes that mathematicians' judgements over the (un)acceptability of putative proofs are a reliable guide to their (in)validity, she can subsequently use the judgements of mathematicians to test these predictions resulting from her theory. In particular, if her theory's predictions are correct, she ought to be able to find instances of these forms of argument within informal proofs.

Testing a theory has three stages. Firstly, one draws out the consequences of the theory's postulates. In the case of *Theory A*, this would include consequences such as:

Consequence 1

All arguments of the form

$$\varphi$$
$$\underline{\varphi \rightarrow \psi}$$
$$\psi$$

are valid.

Consequence 2

All arguments of the form

$$\varphi \rightarrow \psi$$
$$\underline{\varphi \rightarrow \neg\psi}$$
$$\neg\varphi$$

are valid.

Consequence 3

Not all arguments of the form

$$\varphi$$
$$\underline{\psi \rightarrow \varphi}$$
$$\psi$$

are valid.

Notice, these consequences are expressed within the *object-language* of the theory. Secondly, therefore, in order to be tested, the consequences are then *operationalised* into testable concrete predictions. Namely, whether mathematicians find steps within informal proofs of the pertinent form acceptable or not. This requires using the theory's representation rules, just as a scientific model requires representation rules for the model to be tested against its external target system. For instance, Consequence 1 would be operationalised as:

Prediction 1

Steps within informal proofs of the form

$$\varphi$$
$$\underline{\text{If } \varphi \text{ then } \psi}$$
$$\psi$$

are found acceptable by mathematicians.

While Consequence 3 would be operationalised as:

Prediction 2

Steps within informal proofs of the form

φ
If ψ then φ
ψ

are *not* found acceptable by mathematicians.

The final stage of the process is then to test these predictions against further informal proofs, not yet used to motivate the theory. Thus, the logician must at this point be engaged in considering various informal proofs, looking for instances of the forms of arguments contained within her predictions. Further, given that some of her predictions cover what mathematicians do *not* find acceptable, she must also look at instances of "pseudo-proofs", where mathematicians judge inferential mistakes to have been made. Good examples of these will often be found in introductory textbooks. Ultimately, if the logician finds that mathematicians' judgements fit her theory's predictions, then the theory is further supported. Inversely, if the judgements consistently contradict its predictions, the theory faces problems. The extent to which the theory is evidenced is dependent upon its success *relative to competitors*—namely, whether the theory is more predictively successful than alternative available theories.

Predictivism offers a framework for understanding the significance of new counterexamples as failed predictions, providing an explanation of how logicians are able to differentiate between rival logics that equally accommodated the initial data, with the benefit of being able to so without having to appeal to dubious theoretical virtues such as deductive power and simplicity.

6. Conclusion

Anti-exceptionalism about logic challenges many of the traditional assumptions about logic, and in so doing draws logic closer to the recognised sciences in terms of its epistemology and subject matter than conventionally thought. In this introductory chapter on the topic, we have focused on those variants of anti-exceptionalism concerned with logic's *epistemology*, that attempt to show the mechanisms by which logics are supported are not that different to theories in the sciences. In so doing, they reject the traditional view that at least some logical laws must be epistemically foundational. However, it is not enough to have reason to reject logic's foundational status, one must also provide an adequate non-foundationalist replacement for these traditional foundationalist epistemologies of logic. We suspect it is this project that will dominate much of the work on anti-exceptionalism in the foreseeable future.

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