**Fine-tuning and Humean Laws:
Fine-tuning as argument for a non-governing account of laws rather than for God or multiverse[[1]](#footnote-2)**

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*We are the result of the actions of the laws of physics over the history of the Universe. It is these laws that power the Sun, forge the elements, build the planets, form the molecules, and drive the chemistry of life. So now we can now ask: What if? What if the laws of physics were different?
(Lewis and Barnes, 2016)*

The standard fine-tuning argument in physics begins by showing how certain parameter values are found within the exacting bounds needed for life. A toy model gives the idea. Neutrons at 939.57 MeV are just a bit more massive than protons at 938.28 MeV. As a matter of law, were the mass of the proton a couple MeV greater, it would be energetically possible for the proton to decay into a neutron together with lighter particles; in that case, isolated neutrons rather than protons would be stable. Assuming that the other laws of nature and big-bang initial conditions are unchanged, the resulting hypothetical universe is a sterile neutron-world. A more realistic account in terms of quark masses has the same upshot. And fuller accounts show that remarkably precise tuning is needed, across a wide range of physical parameters, to bring about any kind of complexity that includes life. (See Lewis and Barnes 2016 for a cutting-edge yet non-technical overview.)

The popular explanations for this fine-tuning are strikingly metaphysical. Some hold that the universe is designed by a God who selects parameter values to allow life. Others interpret the fine-tuning as a selection effect within the multiverse: much as we find ourselves on a rare habitable planet, humans live within a vast reality of “pocket” universes only a tiny fraction of which have parameter values allowing life. Neither of these options is particularly *ad hoc*. Both have sophisticated defenders. (See Lewis and Barnes 2016, Hawthorne and Issacs 2018 and Friederich 2021.) So, reasonable credence for either divine design or the multiverse would seem high given fine-tuning. However, there is an alternative empiricist position which takes fine-tuning as explicable as the precise balancing act necessary for compact, systematic representation in science. And there are reasons to prefer this alternative.

The rough idea is this. According to governing accounts like that quoted in the epigraph, the laws of physics are fundamental to the universe: they are metaphysically and perhaps temporally prior to and responsible for what goes on. Then, the fine-tuning of such principles of nature may seem to indicate selection for complexity and life, a selection *set from the universe’s beginnings.* Very much to the contrary, a best-system account (BSA) takes laws to be *compact descriptions* defined in terms of ideal physics and so *after* the fact: the BSA laws are dependent on (rather than responsible for) the totality of events making up the universe. The laws of physics are indeed designed on this view, but only by theoreticians in an attempt to get at the ideal or “best-system”. [[2]](#footnote-3) Moreover, fine-tuning is a fairly generic feature of physics systematization, I argue, and so the fine-tuning in the laws is plausibly just an artifact of human mathematical representation.

To make the case, I will muster earlier work from Juhl (2006) and Weisberg (2010, 2012). Both authors provide reasons meant to undermine the standard fine-tuning argument. Although their reasoning has not succeeded in quieting the call for design or multiverse, the least controversial aspects of their (separate) analyses are used here to make the argument that fine-tuning provides evidence *against* the fundamental governing notion laws rather than *for* metaphysically extravagant conclusions. I develop the argument in sections 1 through 4 and leave objections and limitations until the concluding section 5.

1. Non-governing accounts of scientific law go back at least to Mach and Mill in the 19th century; the leading idea then as now is that *scientific laws are principles of the system or systems best summarizing the regularities of nature*. The best-known 20th century version is still the most influential: David Lewis’s “best-system” account. The idea is Humean; no more is to be postulated than the occurrent facts, the “Humean mosaic”, a patchwork of independent happenings. Claims about the nomic – about laws, chances, dispositions, powers, etc. – provide an *interpretive overlay* useful for integration and prediction. L is a law, for example, if L is a consequence of the axiom system that best trades off simplicity for strength regarding the truths about the occurrent. The early statement of the account in Lewis (1973) is brief and preliminary including this: “Imagine that God has decided to provide mankind with a Concise Encyclopedia of Unified Science, chosen according to His standards of truthfulness and our standards of simplicity and strength.” (74) The resulting ideal description is understood as a system of *laws.* I will take this rough version as representative of the best-system account.

Lewis’s later versions of the best-system account are specific and important but often take classical kinematics as a model for the occurrences and classical physics theories as exemplars for what a best systematization could be. There are numerous worries about how this picture might be reworked to fit contemporary science including (a) apparently dispositional fundamentals (from quantum mechanics) as well as (b) laws and principles at higher levels (e.g., thermodynamics or psychology). Indeed, even my example, ‘*proton mass is 938.28 MeV’,* though not explicitly quantum mechanical may still include a dispositional element (if mass is dispositional) and is arguably a derived, higher-order law (perhaps dependent on the relationship between proton and Higgs fields). Clearly, more development is needed before the BSA can be a plausible account of scientific representation. Contemporary Humeans have produced numerous BSA variants inspired by Lewis’s Humean project but meant to fit contemporary science. Earman (1984), Cohen and Callender (2009), and Loewer (2021) are among the influential attempts over the last five decades. I think these attempts are promising but will neither assume nor argue that a particularly plausible version of the best-system account is on offer.[[3]](#footnote-4) I will argue instead that the fine-tuning argument provides evidence for the early, open-ended Lewis (1973) formulation. Much as the Bayesian fine-tuning argument for divine design attempts to show that fine-tuning increases the probability of some designer’s existence, P(D|FT)>P(D), the argument here will be that the probability of the best-system account increases given the fine-tuning evidence: P(BSA|FT)>P(BSA). Neither attempt requires that priors or posteriors – for P(D) or P(BSA) respectively – be high.

I take probability to be epistemic, some kind of reasonable credenceor constraint on reasonable credence*,* “D” to stand for the hypothesis that the universe has a designer preferring life, “FT” for the evidence that, given the laws of physics as we know them, life exists only for a narrow range of their parameter values. Let “BSA” stand for the hypothesis that laws of physics are to be understood in terms of a best-system account (and so are non-governing), and “GL” for the hypothesis the laws of physics should be interpreted as governing (be they God-given or not, they constrain and are responsible for the universe). GL and BSA are common claims about physical law and the only two considered until section 5.

2. Weisberg (2010) develops and then criticizes a typical fine-tuning argument comparing the likelihoods for design and no-design of the universe. At issue is a designer who wants to create life and so “sets” physical parameters for laws to “yield” life (432) – thus utilizing *governing laws* as a constraint on creation and tool for the production of life.

1. P(FT|D)>P(FT|~D) (i.e., probability for fine-tuning given a designer is greater than given no designer).
2. The Likelihood Principle (for variable evidence E and hypothesis H): If P(E|H)>P(E|~H) then E supports H over ~H.
3. So, FT supports D over ~D.

Weisberg’s critique of the argument, an attempt to *undermine* (1), begins with reason to think that P(FT|D) is not particularly high.

Imagine that a designer of the traditional sort wants to create a universe containing intelligent life, and she is contemplating what sort of cosmology to use. What are her options? One option is to implement a cosmology like the actual one…. Another option is to choose laws whose conditions and parameters do not need such careful setting.... Given only that her aim is to create intelligent life, is one of these options particularly preferable? It seems not. (Weisberg 2010, 433)

So, given only benevolent design, there is little we can expect: *Weisberg’s preliminary conclusion*, then, is that left-hand side, LHS, of (1) is not very high. He concludes on further analysis that (1) is false. The further analysis is controversial. For example, Hawthorne and Isaacs (2018) argue that the RHS of (1) is “staggeringly” small because of the needed fine-tuning to ensure that the laws “produce” life – again assuming *governing* laws. They conclude that (1) is true after all.[[4]](#footnote-5)

Still, what is important here is that Hawthorne and Isaacs are sympathetic to Weisberg’s preliminary conclusion. They write that God, an agent of some kind who designs the basic features of the universe, might well proceed in many different ways.

How likely would it then be that God would pick laws like ours—complex laws that need fine-tuning to permit life––and then fine-tune them so that they permitted life? …. Admittedly, we have an imperfect grasp of what sorts of alternatively structured laws could have produced life: alternatives like simple physical laws, something based on cellular automata, or even something non-physical. Those seem like pretty reasonable ways for God to produce life, but this universe's way seems pretty reasonable too. God might be very unlikely to choose laws like ours, but the fine-tuning argument would be viable nonetheless [because of the *extremely* small value of (1)’s RHS]. (150-1)

So, even though Hawthorne and Isaacs ultimately disagree with Weisberg about premise (1), they agree with his preliminary conclusion that P(FT|D) *is not particularly high*.

Finally, what I take from this discussion is a *generalization* of Weisberg’s preliminary conclusion: the probability of fine-tuning given that laws are governing – *designed or not* – is not particularly high. *First*, if there is a designer who utilizes governing laws, then the design *could* be for a complex physical world like ours with laws needing fine-tuning for life. If the designer is more than a demigod, then such laws *might* end up fine-tuned for life. But unless the designer is omnipotent, difficult-to-tune laws may seem an unlikely choice for producing life.[[5]](#footnote-6) Perhaps more likely (following the lead of Hawthorne and Isaacs) are principles specifying fundamental and unanalyzable intelligence (Maxwell’s demon? angels?) or the simple principles required by cellular automata. On the other hand, one can coherently imagine a designer who prefers simple principles and no life at all. Of course, one may feel uneasy imputing possible motive and action to a hypothetical deity. I only conclude that there is *no* strong reason to believe that a designer would choose laws needing fine-tuning to produce life.

*Second*, supposing that there is *no* designer to set a universe in motion, then insofar as a governing law needs tuning for life, there is no tuner and so no reason to think the law’s parameters will be precisely set for life. With or without design, then, the following claim for rational credence about fine-tuning of physics laws would seem supported.

1. P(FT|GL) is *not* particularly high.

The next part of my argument is meant to show that P(FT|BSA) is quite high and so that P(BSA|FT) is greater than P(BSA) and that FT supports BSA more strongly than GL.

3. Juhl’s (2006) provides a very different perspective on fine-tuning emphasizing physical *theorizing* after the facts are in rather than any fine-tuning at creation. Mathematical representation found in physical science, he argues, is *unsurprisingly* fine-tuned.

Given a mathematical representation of a complicated data set, any complicated subset of the data will constrain the components of the overall representation. The more complicated or ‘ramified’ the subset, the greater the constraints on the overall representation. (273)

Life is “causally ramified”, in Juhl’s terminology, i.e., dependent on a “large and diverse collection” of other causally interrelated facts. Representation for such systems, Juhl writes, often involves coupled differential equations fine-tuned to fit the observed complexity. Ecological modelling of interspecific competition provides a well-known example illustrating Juhl’s point. The dynamical equations of the models link population size numbers to each other and to the rest of the environment (depending, for example, on capture-efficiency and competition parameters). Tweaking a model’s parameters produces population equilibrium, oscillations, or extinction. Typically, anything close to stable equilibrium requires precise tuning to represent the negative feedback mechanisms which keep the species from suffering extinction or wild swings in numbers. (Details are found in most any ecology textbook with calculus treatment, see also Keshet (2005).) This example is merely an analogue to the fine-tuning argument in physics but exemplifies the reasoning leading to Juhl’s *preliminary conclusion* about mathematical representation:

[S]ensitive dependence of the existence of life as we know it to values of parameters in our actual laws, is not enough to show something surprising. Such sensitivity is precisely what should be expected, given our variety of moderate complexity and the degree of causal ramification of life as we know it… (273)

He concludes:

Before rushing to exotic explanations involving super-Beings or super-universes, we should make sure that we have encountered a phenomenon genuinely requiring such extravagant posits. (273)

Juhl’s more contentious conclusion is this last, that fine-tuning is not obviously of metaphysical importance. To substantiate it, I will rely on the less controversial preliminary conclusion here: *mathematical representation for a complex system typically requires fine-tuning* (as in coupled dynamical equations with parameters tweaked to fit the facts).

There are other ways to justify Juhl’s preliminary conclusion. Physics modelling is frequently fine-tuned even when the model turns out to be *fictional*. Numerous now *rejected* cosmological accounts are fine-tuned: Cosmological models of flatness and smoothness in the very early universe, once paradigm cases of fine-tuning, are now usually rejected given the success of inflationary theory.  Also, some of the first inflationary models of the universe, models now rejected, require fine-tuning for life (Lewis and Barnes 2016). But of course, the fine-tuning of the rejected models is accomplished by theorists not a deity. Even Conway’s Game of Life has “laws” that need tuning to give the resulting “worlds” a sense of life. (There are many online apps that allow one to alter the Game’s parameters and prove this to oneself.) Again, the point is that fine-tuning by theorists is commonplace in representation. See also Hossenfelder (2021) who makes a similar point under the heading “no fine-tuning, no theory”. The bottom line, using Juhl’s language, is that *fine-tuning is to be expected* for scientific representation. Thus, RHS of (1), P(FT|~D), is high because P(FT) is high even without a deity and we *may* have another reason to question (1) and the standard fine-tuning argument.

However, Juhl’s ultimate conclusion, that fine-tuning may be of little metaphysical importance, may be harder to substantiate. Even if fine-tuning is not surprising from the current point of view (thinking in terms of mathematical representation for a complex system), one may still worry that the physical parameters were precisely right *from the beginning*, as though set to bring about complexity and life. Friederich (2021) makes the point this way.

The sense in which fine-tuning for life fails to be surprising according to Juhl differs from the sense in which it is surprising according to [other] authors … while the latter hold that life-friendly conditions are rationally unexpected from an epistemic point of view which sets aside our knowledge that life exists, Juhl holds that—given our knowledge that life exists and is causally ramified—it is unsurprising that life depends sensitively, for its existence, on the constants and boundary conditions.

My concern is this: if we bracket our old evidence that the universe is inhabited, the fine-tuning problem would seem to return. While fine-tuning is new and surprising evidence to many of us (at some point in our lives), it is apparently not new evidence to an ideal Bayesian (who could presuppose Juhl’s preliminary conclusion and conclude at once that the laws of the existing complex universe are likely fine-tuned). Still, the ideal Bayesian might wonder how physical parameters came to be fine-tuned. Inspired by Monton (2006), one may imagine an observer \* somehow outside of the universe, perhaps a demigod observing the universe as it begins, aware of the form of the laws governing its evolution but learning about the constants. For \*, the fact that the laws and parameter values are so life-friendly seems contrived: P\*(FT|D)>P\*(FT). That is, reasonable credence for \* would seem high for divine design of the conditions and laws meant to *generate* life.[[6]](#footnote-7) Moreover, we non-ideal Bayesians may need the thought experiment to learn from \*’s reasoning, take the fine-tuning as evidence for design, and so adjust our degree of belief much as Hawthorne and Isaacs suggest. Still, all this assumes that the laws are *governing*, i.e., prior to and responsible for the events of the universe, and so are constraints God could impose on the universe’s development to *bring about* her design. It is time to question that assumption and return to the BSA.

4. The fine-tuning problem for the governing law claim, GL, stems from its treatment of laws as fundamental aspects of the universe discovered by the work of physics. Then the fine-tuning required by physics amounts to a fine-tuning built into nature. In contrast, according to the BSA, laws are simply a matter of (idealized) mathematical/scientific representation. This fine-tuning is theoretician’s tuning to fit the facts rather than something fundamental baked into the universe from its beginnings.

From \*’s perspective, seeing the birth of the universe from outside, the fine-tuning of a systematic description is a consequence of the complexity to be described and so no more surprising than that complexity. So, I conclude:

1. P(FT|BSA) is high (high for us and high for \* given complexity).

 However, Waller (2020) discusses two potential lacunae to the type of argument presented here. I will address one in this section and the other in section 5. Waller begins by characterizing an older version of my current argument (Halpin manuscript; see also Halpin 2003).

[The BSA] “provides no means for a god to control the universe by first designing laws”…. Because the laws are descriptive rather than prescriptive, there is no need *to look beyond the universe* for an explanation of why they are the way they are. The laws themselves are not “designed” to produce certain outcomes and so “the *appearance of design in the fine-tuning is merely an artifact of human systematizing*”…. We see laws in nature because when we develop the theories, we organize our observations…. (148)

But, continues Waller, careful not to beg the question,

[This] does not succeed in explaining away the problem. Even if [this] account of natural laws as descriptions is correct, the problem of fine-tuning can still be raised in a different way.… Even if we consider the laws of nature to be descriptions of phenomena with no explanatory power at all, we still have a fine-tuning problem. The problem is how to explain the underlying phenomenon, not the laws. (148-9)

For the present context, one may put Waller’s point this way. Even given that *theoretical principles* for a complex system are fine-tuned as a matter of course, there is a separate and more important question about the fine-tuning of the *underlying phenomena*. The phenomena, on Waller’s counterargument, are fine-tuned independently of, and prior to, whatever our theories say about them. The Neutron-Proton toy model can be used to illustrate Waller’s idea.

1. If the proton mass were just a little greater, then proton decay would leave a universe with nothing more complex than neutrons.

I take (6) to be correct but for the BSA it is not a matter of theory-independent, underlying nature (an underlying nature some see as in need of tuning by God during creation). Rather, for a pair of reasons, the BSA proponent should see the counterfactual (6) as theoretical, an application of best-systematization, and not an indication of some fundamental fine-tuning in nature.

 First, the BSA proponent is committed to the occurrent facts and to their best-systematization. At least for purpose of our toy model, these presumably include facts about particle position and motion and principles that systematize these facts. Facts about particle *masses* on the other hand are plausibly (i) a matter of law, (ii) dispositional so not occurrent, and (iii) dependent on theory for scaling and measure properties to back up the claim that mass differences are “small”. (David Lewis’s mature best-system account takes particle masses as natural properties and he may well have thought that there are natural measures here. But most contemporary best-system accounts eschew the metaphysics of natural properties in favor of practicality of predication. I follow the practical inclination.) So, given the BSA, (i) – (iii) indicate that the antecedent of (6) is *not* a matter of theory-independent phenomena. Second, *but most important*, because (6) is a counterfactual it is particularly theoretical. The needed principle to support (6) is something like “spontaneous decay of object 1 with mass m1 to object 2 with mass m2 is energetically possible only if m1>m2”. Only from this presumption, a matter of law and not just the occurrent facts, does one infer that an increase in proton mass would lead to spontaneous decay. My conclusion, then, is that (6) is nomologically loaded and represents only fine-tuning within theory.

Summing up, Waller’s counterargument does *not* provide reason (to a BSA proponent) for a distinct fine-tuning of the phenomena in and of themselves. The phenomena, according to the BSA, are the occurrences, *viz*., fundamentally independent happenings or existences. A best-system provides a theoretical or interpretive overlay to these. And (6) together with any fine-tuning is part of that overlay.

5. In closing, I want to give an overview of the claims I have defended above but in the context of the argument’s limitations.

If one does *not* take the laws as governing (in the fundamental sense described at the outset), then there is little problem to be found in the fine-tuning. Fine-tuning can be understood as an essential part of the standard representation needed for *descriptive summary* or *systematization*. Moreover, instead of a good argument for metaphysically extravagant claims, the fine-tuning argument may best be understood as an argument favoring the BSA. I have argued for the following two inequalities.

P(FT|BSA) > P(FT) and P(FT|BSA) > P(FT|GL).

(P(FT|BSA) is very high per the preliminary Juhl conclusion and P(FT|GL) is middling given the generalized version of Weisberg’s preliminary conclusion of section 2. These claims were codified in (5) and (4).) But, again, this is only evidence for the BSA in the limited sense that provides a likelihood argument to adjust P(BSA) upward. Moreover, I have only been considering the BSA as opposed to GL, but other non-realist accounts of scientific law/systematization may share this virtue.

There are several other limitations to the argument. First, I have utilized the less controversial preliminary conclusions from Weisberg and Juhl. But the Weisberg point (about how there are many possible ways for a designer to produce life) will have little rational force for someone with extremely high priors for a God who would runs the universe using laws like those one finds in physics. Perhaps God is supposed to be something of an ideal physicist who utilizes quantum mechanics to produce the universe as a vacuum fluctuation? With such a prior, one would have a *high* P(FT|GL). Second, Juhl’s preliminary conclusion, and my application of it, rest on a somewhat hand-waving understanding of complexity, regularities of nature, and the means to systematize these. Complex systems science is in its early days. Third, the thesis GL is only about fundamental governing laws and so my argument against GL is not an argument against other sorts of governance. Nothing in that argument militates against a designer who prefers to directly produce the Humean mosaic frame-by-frame, so to speak, and without resorting to governing laws as an intermediary tool. The only laws for such a creation are best-system laws.

Fourth, and perhaps most important, one may argue that the probability assessments I recommend, especially that P(FT|BSA) is high, depend on old evidence: that the world is the sort of complex but non-chaotic place allowing scientific systematization. Indeed, Waller may mean to do just that.

[T]he problem of fine-tuning can still be raised in a different way. The question then becomes, “why does the universe behave in a way that allows it to be described in a law-like way?” (Waller, 149)

So, bracket any presupposition that the universe is complex and again, from \*’s perspective outside the universe, the probability for fine-tuning given the BSA may no longer seems so high (because the fine-tuning is expected only when mathematical systematization is possible). Then (5), my claim that P(FT|BSA) is high, is called into question. Moreover, one might try to back Waller’s suggestive question with combinatorial reasoning, given the way we construct possibilities, and then argue that “most” possible universes neither exhibit regularity nor allow compact description.[[7]](#footnote-8) However, there is reason for the Humean to be skeptical. Such constructed possible universes, the descriptions we give them, and the measure over them (to make sense of claims about “most”) depend on representation schemes meant for use *within* our universe. Again these schemes are theoretical or interpretive overlays to what the BSA proponent takes to be the fundamental facts. One might still ask about a universe one is inclined *to imagine* randomly constructed. Indeed, one should not expect it to be neatly systematized given concepts honed to work in the actual one. But any logically possible world can be compactly described by *some* language even if we take that language to be hopelessly gerrymandered from our perspective. So, it is unclear just what to think about such imaginings. I conclude, but more tentatively here, that *epistemic* probabilities conditioned on the BSA should not be moved by this second Waller concern.

I think, then, that my argument is limited but shows enough. The Humean BSA has neither the fine-tuning problem that troubles governing accounts of laws nor the apparent metaphysical commitments that seem extravagant to an empiricist. There is no need for an otherworldly designer for BSA laws. Also, if there is need for a multiverse, that is an independent matter about what our best science requires; the multiverse is *not* needed to explain the fine-tuning required for life. Indeed, the fine-tuning is exactly what the BSA proponent should expect given complexity and so the fine-tuning evidence supports such a non-governing account. In sum, there are important advantages to the BSA and to an interpretation of fine-tuning as more about representation than metaphysics.

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1. Many thanks to Sharon Berry, Chris Dorst, David Garfinkle, Peter Gerdes, Bradley Monton, Alberto Rojo and several anonymous referees for extremely helpful comments on earlier drafts of this paper. [↑](#footnote-ref-2)
2. It is best to contrast this BSA understanding of laws and fine-tuning with a more common presentation depending on *fundamental governing laws* in presentations of the fine-tuning argument. There laws are often likened to some kind of machine producing our universe via (a) dials (representing fundamental quantities) which (b) have been set one way but might have been differently set to give different constants and so (c) produce different (possible) universes all statistically dependent on some natural measure for the dials/constants. Instead, on the BSA, the totality of occurrent fact making up the universe is taken as fundamental, not produced or explained by something somehow prior. [↑](#footnote-ref-3)
3. I do have a preference and argue for it in Halpin (2003). [↑](#footnote-ref-4)
4. See White (2011) for the initial response to Weisberg’s larger argument. Dorst and Dorst (manuscript) is a very helpful overview which I condense as follows for the current context. The Weisberg (2010, 2012) idea in a nutshell is that God prefers life and so picks any one universe as though out of a hat *of* *life-allowing ones* (indifferent to its fine-tuning status). However, Hawthorne and Isaacs (2018) presuppose governing laws and think of God’s process very differently: as first picking a tool – governing laws – to shape the development of the universe, second calibrating the tool by selecting life-permitting parameter values. The second step requires narrow tolerance, the fine-tuning. In the final sections of this essay, I attempt to remove the temptation to think about the matter in this latter way. [↑](#footnote-ref-5)
5. And even then, there is no guarantee that a God choosing governing laws would choose laws like those in physics or that physicists would be able to discern God’s laws: underdetermination and incommensurability concerns arise regarding the choice of concepts and principles a God might choose *vis a vis* those physics chooses. [↑](#footnote-ref-6)
6. It is worth adding that Monton addresses other ways to construct the observer \*. One of these anticipates the Weisberg (2010) argument and so does not support the fine-tuning argument for design. This is important for consistency with (4). [↑](#footnote-ref-7)
7. See Filomeno (2021) for a recent and detailed presentation of this way to make the argument. [↑](#footnote-ref-8)