Leibniz on the laws of nature and the best deductive system

Joshua L. Watson

Department of Philosophy, 100 N. University St., Purdue University, West Lafayette, IN 47907, United States

ABSTRACT

Many philosophers who do not analyze laws of nature as the axioms and theorems of the best deductive systems nevertheless believe that membership in those systems is evidence for being a law. This raises the question, “If the best systems analysis fails, what explains the fact that being a member of the best systems is evidence for being a law?” In this essay I answer this question on behalf of Leibniz. I argue that although Leibniz’s philosophy of laws is inconsistent with the best systems analysis, his philosophy of nature’s perfection enables him to explain why membership in the best systems is evidence for being a law of nature.

1. Introduction

Although not all philosophers analyze laws of nature as contingent generalizations appearing in the best deductive systems, many believe that the laws of nature bear a special epistemological relationship to the axioms and theorems of the best deductive systems. John Carroll, for instance, rejects the best systems analysis of laws (BSA), but nevertheless agrees that “a proposition’s being part of a true theoretical system with a best combination of simplicity and strength is epistemologically relevant to that proposition’s being a law.”1 For philosophers who reject the BSA and yet recognize the epistemic relevance such axioms and theorems have to the laws, the following question arises: if we cannot analyze laws in terms of membership in the best systems, what explains the fact that being a member of such systems is evidence for being a law of nature? I will refer to this question as the “Epistemological Question.” In what follows I will answer the Epistemological Question on behalf of Leibniz. I will argue that although Leibniz’s views are inconsistent with the BSA, Leibniz’s philosophy of nature’s perfection commits him to the view that the laws are coextensive with the axioms and theorems of the best deductive system, which enables him to answer the Epistemological Question.

Answering the Epistemological Question on behalf of Leibniz is of philosophical and historical interest. The relationship between the laws and the best deductive systems is interesting in its own right, and Leibniz’s philosophy of nature’s perfection (the portion of Leibniz’s thought most relevant to this relationship) contains philosophically interesting proposals about perfection, aesthetic delight, and theoretical simplicity.2 Addressing the Epistemological Question on Leibniz’s behalf is also historically interesting. Leibniz’s

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1 Carroll (1994, p. 49).
2 Throughout this article I will use the term “nature” to refer to the world of bodies. How bodies ultimately fit into Leibniz’s metaphysics is a controversial issue that lies beyond the scope of this paper. My focus is narrower, and primarily concerns the relationship between nature’s perfection and the laws of nature in Leibniz’s thought.
remarks about the theoretical virtues of simplicity and strength suggest that he regarded the simplest theory among the empirically adequate theories as true. He writes,

Some hypotheses can satisfy so many phenomena, and so easily, that they can be taken for certain... The conjectural method a priori proceeds by hypotheses, assuming certain causes, perhaps without proof, and showing that the things which now happen would follow from these assumptions. A hypothesis of this kind is like the key to a cryptograph, and the simpler it is, and the greater number of events that can be explained by it, the more probable it is.3

Among different systems of laws, therefore, we would expect Leibniz to prefer the one that is simpler than all rivals while remaining empirically adequate; that is exactly what we find.4 Showing how his views on the simplicity and the explanatory power of the laws of nature are grounded in his philosophy of nature’s perfection will shed light on how this preference is justified by his metaphysics.

I will develop my case as follows. In section two I will explain the tenets and motivations behind the BSA. In section three I will draw on Leibniz’s philosophy of miracles to show that his views are inconsistent with the BSA. In section four I will explain Leibniz’s general theory of perfection. In section five I will answer the Epistemological Question on Leibniz’s behalf by showing that his theory of perfection, when applied to nature, entails that the laws are coextensive with the axioms and theorems of the best systems.

2. The Best Systems Analysis of Laws

The BSA is motivated in part by the failure of the naïve regularity account and the desire to propose a better analysis while remaining in the regularity framework.5 I have borrowed the phrase “naïve regularity account” from David Armstrong, who, following George Molnar,6 construes the account as follows:

\[ p \text{ is a statement of a law of nature if and only if} \]

(i) \( p \) is universally quantified
(ii) \( p \) is [omnitemporally and omnispatially] true
(iii) \( p \) is contingent
(iv) \( p \) contains only non-local empirical predicates, apart from logical connectives and quantifiers.7

The restriction against local predicates is presumably intended to exclude from the class of law statements any statement containing names of particular individuals.8 The naïve regularity account accords well with the intuition that laws are contingent, exceptionless, and “general” in the sense of not guaranteeing the existence of any particular individual. It also gets some cases right. For instance, the naïve regularity account correctly requires that it is a law of nature that all signals travel at speeds less than or equal to 186,000 miles per second because this statement satisfies all of (i) through (iv) above.

Despite these strengths, the naïve regularity account faces a plethora of difficulties. One such difficulty is the problem of distinguishing accidental from law-like generalizations. Unlike law-like generalizations, accidental generalizations are not characterized by physical necessity. Consider, for instance, the proposition \( \text{All bears weigh less than } n + 1 \text{ pounds, where } n \text{ is the weight in pounds of the heaviest bear.} \) While this generalization may satisfy all of (i) through (iv) above, it is implausible that it is characterized by the physical necessity that characterizes laws. Contra the naïve regularity account, therefore, a proposition satisfying (i) through (iv) above is not sufficient for being a law of nature.9

It is now widely recognized that any adequate account of laws must distinguish accidental from law-like generalizations. One of the attractive features of the BSA is its ability to make this distinction without abandoning the regularity tradition. Supporters of the BSA maintain that being a law is simply a matter of being a contingently true generalization appearing in the best deductive systems. Frank Ramsey writes, \[ \text{[E]ven if we knew everything, we should still want to systematize our knowledge as a deductive system, and the general axioms in that system would be the fundamental laws of nature. ... Of course, the system is required to be as simple as possible.} \]

David Lewis, avoiding the counterfactual about omniscience, states that a contingent generalization is a law of nature if and only if it appears as a theorem (or axiom) in each of the true deductive systems that achieves the best combination of simplicity and strength.10

Since not all contingent, true generalizations appear in such systems, not all contingent, true generalizations are laws. Membership in the best systems, therefore, provides a way of distinguishing accidental from law-like generalizations, and also explains why membership in the best systems is epistemologically relevant to lawhood.

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4 “Thus one must suppose that, among the general rules which are not absolutely necessary, God chooses those which are the most natural, which it is easiest to explain, and which also are of the greatest service for the explanation of other things... The ways of God are the most simple and uniform: for he chooses rules that least restrict one another. They are also the most productive in proportion to the simplicity of ways and means” (G VI 241: H 257). There are two reasons to think that “rules” refer to the laws of nature. First, Leibniz is here endorsing Malebranche’s view that the laws of nature are both simple and capable of explaining many phenomena (see Strickland (2006, pp. 67–75) for an excellent discussion of this topic). Second, Leibniz associates the simplicity and productivity of these rules with the absence of superfluous miracles involved in making many exceptions to the laws of nature.
5 By the “regularity framework” I mean the tradition constituted by those who analyze laws as statements expressing regularities (regularities that perhaps have some special feature) as opposed to those who analyze laws in terms of dispositions (see Bird (2007) and Ellis (2001)) or necessitation relations between universals (see Armstrong (1983) and Tooley (1977)). Often the regularity framework is thought to stand in the Humean tradition, though clearly not all regularity accounts were proposed or defended by Hume.
6 Molnar (1969, p. 79).
8 Carroll interprets the phrase in this way. See Carroll (1990, p. 191).
9 This example is a simple variation of an example found in Armstrong (1983, p. 18).
10 The naïve regularity account also entails that all unrestricted, universally quantified, non-local generalizations of the form \( \text{All Fs are Gs} \) are laws of nature when there are no Fs that are Gs (see Carroll (1994, p. 31)).
12 Lewis (1973, p. 73). In this early formulation Lewis countenanced the possibility of having ties for best deductive system, and stipulated that in such cases only the axioms and theorems appearing in each of the best systems are laws. He subsequently revised his account, requiring that there exist a deductive system that is uniquely best. Concerning the possibilities of ties, Lewis writes, “I used to say that the laws are then the theorems common to both systems, which could leave us with next to no laws. Now I’ll admit that in this unfortunate case there would be no very good deservers of the name of laws” (Lewis (1994, p. 479)).
3. The Incompatibility of Leibniz's Views with the Best Systems Analysis

Whatever merits the BSA has, Leibniz views are inconsistent with it, as is evident from his remarks concerning miracles. Leibniz maintained that law-breaking events are possible,\(^\text{13}\) and that it is within the power of God to perform perpetual miracles:

For instance, if God were to cause a body which had been set in a circular movement, by means of a sling, to continue to move freely in a circle when it had been released from the sling, without being impelled or checked by anything at all, that would be a miracle, for according to the laws of nature it should continue along a straight line at a tangent; and if God were to decree that that should always occur, he would be performing natural miracles, since this movement is not susceptible of a similar explanation.\(^\text{14}\)

Leibniz imagines a world where God performs miracles not just occasionally but all the time. Call this world the “Perpetual Miracle World.” Leibniz thought that, despite the perpetual divine intervention, it is a law of nature in the Perpetual Miracle World that bodies in motion travel in straight paths unless they come into contact with another body. Although the bodies perpetually travel in circles in the Perpetual Miracles World, “according to the laws of nature” these bodies “should continue along a straight line at a tangent.” Call this law of nature “I”.

Could a proponent of the BSA consistently maintain that L is a law of nature in the Perpetual Miracle World? No. According to the BSA, for L to be a law in the Perpetual Miracle World, it must be a true, contingent generalization appearing in the best deductive systems. But in the Perpetual Miracle World there simply are no true, contingent generalizations stating that all bodies in motion travel in straight paths unless they come into contact with another body. So, if the BSA is correct, then L cannot be a law in the Perpetual Miracle World.

Leibniz’s account of laws more closely resembles a powers approach than a regularity approach. In the following remark, Leibniz states that it is their relationship to the powers of bodies that accounts for propositions being laws:

But let us see whether the system of occasional causes does not in fact imply a perpetual miracle. Here it is said that it does not, because God would act only through general laws according to this system. I agree, but in my opinion that does not suffice to remove the miracles. Even if God should do this continuously, they would not cease being miracles, if we take this term, not in the popular sense of a rare and wonderful thing, but in the philosophical sense of that which exceeds the powers of created beings... [A]ll that happens must also be explained through the nature which God gives to things. The laws of nature are not so arbitrary and so indifferent as many people imagine.\(^\text{15}\)

These remarks and his commitments concerning the possibility of perpetual miracles indicate that Leibniz analyzed laws in terms of the powers of bodies and not in terms of membership in the best deductive systems.

Despite the fact that Leibniz’s account of laws is inconsistent with the BSA, Leibniz thought that the laws of nature are coextensive with the law-statements contained in the simplest empirically adequate system of laws. Although he did not use this terminology, in contemporary jargon this view would be expressed as the view that the laws of nature are coextensive with the axioms and theorems of the best deductive system. As we have seen, Leibniz thinks that the simplest of the empirically adequate physical theories is true. According to Leibniz “the simplest system is always preferred”\(^\text{16}\) and God “made choice of a manner of action which should be worthy of the supremely perfect Being, that is, which should be infinitely simple and uniform, but yet of an infinite productivity.”\(^\text{17}\)

It is plausible that Leibniz is here referring to the theoretical virtues of simplicity and strength, claiming that the laws of nature permit us to explain the greatest amount of data in the simplest fashion. This is exactly the role played by the axioms and theorems of the best deductive systems. Leibniz is therefore committed to the laws of nature being coextensive with the axioms and theorems of the best deductive system.\(^\text{18}\) I will refer to this thesis as the “Coextension Thesis.”

That Leibniz is committed to the Coextension Thesis gives us a clue about how he would address the Epistemological Question. We began by wondering why, if the laws cannot be analyzed in terms of the axioms and theorems of the best systems, membership in those systems nevertheless counts as evidence for being a law of nature. The Coextension Thesis, if true, helps address this puzzle, since its truth guarantees that being a member of the best systems reliably tracks being a law of nature. However, simply asserting the Coextension Thesis is not an adequate solution to our problem. Such a groundless assertion fails in at least two respects. First, it fails to give us reasons to think the Coextension Thesis is true. Second, it fails to explain why the laws of nature are coextensive with the axioms and theorems of the best systems.

The second problem is distinct from the first. Merely discovering that a correlation holds is not sufficient for possessing an explanation of the correlation. In what follows I will explain how Leibniz’s...
philosophy of nature's perfection both guarantees and explains the truth of the Coextension Thesis.

4. Leibniz's Harmony Theory of Perfection

Leibniz accounts for perfection in terms of harmony, that is, unity in variety.19 In 1715, Leibniz wrote that “Perfection is the harmony of things, or the state where everything is worthy of being observed, that is, the state of agreement or identity in variety.”20 Insofar as unity and variety increase in a system, harmony increases in the system:

Harmony is the perfection of thinkable things insofar as they are thinkable. Harmony is when many things are reduced to a kind of unity. For where there is no variety, there is no harmony.... In turn, where variety is without order, without proportion, without concord, there is no harmony. From this it is evident that however much greater is both the variety and the unity in variety, so much greater is the harmony.... Now from this it is clearly evident that harmony is the perfection of thinkability.21

This passage (from either 1677 or 1678) implies that the early Leibniz believed that the variety in a harmonious system is reducible to unity. This remark also shows that the early Leibniz believed that perfection, harmony, and “thinkability” are closely related.22 Leibniz still retains this intellectual component of his theory of harmony in 1715, where in a letter to Wolff he claims that harmony is the “degree of affirmative intelligibility”23 or the “degree of contemplability.”24 Leibniz’s view is not that the harmony of a system depends on whether finite minds actually carry out the reduction. On the contrary, “the perfection a thing has is greater to the extent that there is more agreement in greater variety, whether we observe it or not.”25 What is crucial is that the system be such that it, at least by its nature, admits of such reductions.26

Clarifying the intellectual component in Leibniz’s theory of harmony requires understanding the notions of variety and unity. Unity in variety consists in a ratio, according to Leibniz. “[H]armony and discord,” writes Leibniz, “... consist in the ratio of identity to diversity; for harmony is unity in multiplicity, and it is greatest in the case where it is a unity of the greatest number of things.”27

What does this involve? Diversity refers to qualitative variety characterizing the system.28 A song becomes more diverse insofar as it involves numerous kinds of instruments, changes in tempo, shifts from dissonances to resolution, etc.29 The chiming of a clock, however, is characterized by little diversity, as each chime is separated by the same interval of time and emits the same note.

Leibniz’s notion of the unity of a system is more difficult to clarify. Like diversity, unity comes in degrees.30 In his earlier texts, Leibniz formulates his theory of harmony in a highly cognitive fashion, connecting a system’s unity with the number of “intellectual acts” required to comprehend the system:

Harmony is the perfection of thinkable things insofar as they are thinkable.... Hence a more perfect manner of thinking is where one act of thinking extends to many things simultaneously, for in this way there is more reality in that thought.... Harmony results from everything in a given object taken together. Therefore the more relations (the aggregate of which is harmony) there are in a thinkable object, the more reality, or what is the same, the more perfection there is in the thought. Therefore it follows that harmony is the perfection of thinkable things, insofar as they are thinkable.31

19 Nicholas Rescher defends a harmony interpretation of Leibniz’s account of perfection, writing that Leibniz construed “metaphysical perfection in terms of orderliness and variety.” (Rescher (1981, p. 10)). Donald Rutherford, however, has argued that the harmony account is not Leibniz’s considered analysis of perfection. According to Rutherford, the harmony interpretation of Leibniz’s theory of perfection “faces a challenge from other passages in Leibniz’s own writings in which he advances a quite different view of the world’s perfection. In the essay On the Ultimate Origination of Things, he asserts that the perfection of a possible world is a direct function of the “quantity of essence” it contains” (Rutherford (1995, p. 23)). This does not convince me that the harmony account is not Leibniz’s considered analysis. All interpreters of Leibniz face the problem that Leibniz sometimes accounts for perfection in terms of harmony and sometimes accounts for it in terms of degree of essence. Rutherford would like to choose the degree of essence account as the more fundamental analysis, but it is no justification for this interpretation to point out that Leibniz sometimes accounts for perfection in terms of degree of essence. What I would like to emphasize, however, is that even if it turns out that Rutherford is correct, it will not affect the main thrust of my argument if according to Leibniz God maximizes the degree of essence if and only if he maximizes nature’s harmony. That biconditional is sufficient for my purposes, since it guarantees that in the best possible world, where degree of being is maximized, nature’s harmony is also maximized. This biconditional, furthermore, is not threatened by Rutherford’s interpretation. Moreover, it is plausible that Leibniz endorsed this biconditional. Leibniz remarks that “order, regularity, and harmony come to the same thing. You can even say that it is the degree of essence, if essence is calculated from harmonizing properties....” (GLW 172: AG 234). On the basis of passages like this, Gregory Brown concludes that Leibniz considered the two accounts logically equivalent (see Brown (1987, p. 200)). With Brown, I think it is a mistake to take the degree of essence theory as a rival to the harmony theory.

20 GLW 172: AG 233-234.

21 A VI,1359: S LT 191. In light of this remark one wonders whether Leibniz thought that the only way to increase harmony is to increase both unity and variety. There is some reason to believe that Leibniz thought that increases along just one dimension may still result in an increase in harmony. Leibniz writes, “Agreement is sought in variety, and the more easily it is observed there, the more it pleases; and in this consists the sense of perfection” (GLW 171: AG 233). That suggests that Leibniz thought that even when diversity is kept constant, increases in unity result in more harmony than would otherwise obtain.

22 “Laurence Carlin draws attention to the cognitive aspect of Leibniz’s theory of harmony, writing “whether or not a set of entities is harmonious depends on how those entities are capable of being related in thought” (Carlin (2000, p. 106)).

23 GLW 161: AG 230.

24 GLW 172: AG 234.


26 Leibniz is sensitive to the distinction between a reduction being by nature possible and the reduction being within the power of a human to accomplish. He writes, “Since everything confused is by its nature resolvable into the distinct, even though it may not always be in our power to do this, it follows that all qualities and mutations of bodies can, according to their nature, at length be reduced to certain distinct concepts” (A VI,2006-2007: L 287). Whether or not we humans are capable of accomplishing this reduction is not relevant to whether or not the system is, as a matter of fact, characterized by unity in variety. It may, however, be relevant to whether we humans are able to detect the unity amidst the system’s variety. How, one wonders, can humans detect the unity of a system if they cannot accomplish the relevant reduction? As we will see, Leibniz’s doctrine of sympathy helps explain how we might in some sense detect the unity in a system’s variety without being occurrently, distinctly aware of the unity of that system. See note 51 for a more detailed discussion.

27 A VIII,122: CP 43-45.

28 Lloyd Strickland has pointed out that “Leibniz generally reserves the term ‘variety’ for kinds of thing rather than individual things....” (Strickland (2006, p. 49). Strickland calls this the case where it is a unity of the greatest number of things...” (A VI,1359: S LT 191).

29 After stipulating variety as a necessary condition for harmony, Leibniz gestures toward a line from Horace stating, “The musician who always plays on the same string, is laughed at” (A VI,1359: S LT 191).

30 “From this it is evident that however much greater is both the variety and the unity in variety, so much greater is the harmony” (A VI,1359: S LT 191).

31 A VI,1359-1360: S LT 191-192.
According to this text, the fewer intellectual acts required to comprehend the system, the more unity and cogitability the system has. Admittedly, this text is early (from either 1677 or 1678). However, as the text cited in note 20 indicates, Leibniz continued to construe harmony in terms of unity in variety throughout the rest of his life. Furthermore, not only does the “unity in variety” formulation persist throughout his mature thought, but, as we know from the texts cited in notes 23 and 24, as late as 1715 Leibniz’s theory of harmony retains the highly intellectualist character found in the early texts. This cognitivist component is also evident in a text from 1714 where Leibniz says that even our sensory delight in harmony is reducible to intellectual delight caused by the subconscious calculations of the soul. Finally, the connection Leibniz makes in the text above between harmony and degree of reality is also evident in the later texts discussing harmony. Far from a great discontinuity between Leibniz’s earlier and later remarks concerning harmony, the later remarks bear an impressive similarity to the earlier ones. We should not be too shy, therefore, about looking to Leibniz’s earlier remarks about harmony for clarifications about his notion of “unity,” since his mature theory of harmony departs in no significant way from his earlier ideas on the matter.

Leibniz’s notion of comprehending a system may be clarified by attending to an example he often cited, namely music. It is initially surprising that Leibniz would cite music as a case that fits well with his harmony theory of perfection. Music is not the most obvious example of something that we delight in by intellectual comprehension. Leibniz even seems to admit this:

“We do not always observe wherein the perfection of pleasing things consists, or what kind of perfection within ourselves they serve, yet our feelings perceive it, even though our understanding does not. . . . Music is a beautiful example of this. Everything that emits a sound contains a vibration or a transverse motion such as we see in strings; thus everything that emits sounds gives off invisible impulses. When these are not confused, but proceed together in order but with a certain variation, they are pleasing.”

It is hard to see how Leibniz is doing justice to the intellectual component of his account. Far from clarifying the intellectual component of his harmony theory of perfection, these remarks appear to emphasize the affective at the expense of the cognitive. Has Leibniz betrayed his own theory by diminishing the role of the intellect in moments of aesthetic delight?

No. According to Leibniz, our ability to discern the order of a musical piece does not require that we be able to explicitly articulate that order or that we be distinctly consciously aware of that order. Our feelings may detect the order amidst the variety even if our understanding does not bring that order before our conscious awareness. What is crucial for Leibniz’s consistency is his insistence that even in these cases our understanding is still at work, even if only subconsciously:

“And further, even the pleasures of the senses reduce to intellectual pleasures known confusedly. Music charms us, even though its beauty consists only in the harmonies of numbers and in a calculation that we are not aware of, but which the soul nevertheless carries out, a calculation concerning the beats or vibrations of sounding bodies, which are encountered at certain intervals. The pleasures that sight finds in proportions are of the same nature, and those caused by the other senses amount to something similar, even though we might not be able to explain it so distinctly.”

In these cases we “commonly say, ‘There is something, I know not what, that pleases me in the matter.’” This “something,” is “at the bottom of the matter,” and “though unnoticed, really appeals to us.” Though such perceptions escape our conscious awareness, they “nevertheless have their effect and make themselves felt, at least confusedly.” Leibniz refers to this phenomenon as “sympathy,” and claims that sympathy is at the root of our aesthetic pleasure. I will therefore refer to this doctrine as Leibniz’s “doctrine of sympathy.”

Notice that in the main passage above Leibniz says that we are aware of the harmony of the musical piece “confusedly” and ends by gesturing toward the possibility of rendering this awareness “distinct” via an explanation. This suggests that comprehending musical harmony is related in some way to distinctly grasping the notion of the musical piece. Elsewhere Leibniz indicates that distinctly grasping the notion of a system involves developing a notion of the system that enables one to discriminate among the various elements of that system.

Distinct cogitability gives order to a thing and beauty to a thinker. For order is nothing other than a distinctive relation of several things; confusion is when several things are present, but there is no way of distinguishing one from another. Distinctly grasping a notion enables one not only to distinguish the various elements of the system, but also to distinguish the system from all others:

Clear knowledge, again, is either confused or distinct. It is confused when I cannot enumerate one by one marks sufficient for

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32 See the texts cited in note 36.
33 In 1715 Leibniz wrote to Wolff, “Indeed, order, regularity, and harmony come to the same thing. You can even say that it is the degree of essence, if essence is calculated from harmonizing properties.” (GLW 172: AG 234).
34 The harmony and perfection of music is closely connected with its beauty, according to Leibniz. Leibniz writes, “Thus we see that... pleasure, love, perfection... harmony, order, and beauty are all tied to each other, a truth which is rightly perceived by few” (G VII 87: L 426).
35 G VII 86-87: L 425.
36 G VI 605-606: AG 212. In a text from 1702 Leibniz uses the example of music and explicitly denies that the soul must actually distinctly detect the order amidst the musical variety in order to be moved by it. Leibniz writes, “But,” says Mr. Bayle, ‘must not the soul recognize the sequence of notes (distinctly), and so actually think of them?’ I answer, ‘No!’ it suffices that the soul has included them in its confused thoughts in the same way that it has a thousand things in its memory without thinking of them distinctly... Is it not true that we cannot always remember even what we know, and then all of a sudden come upon it by a small chance reminiscence? And what a variety of matters we carry in the soul, even when we are unable to discover them quickly.” (G IV 564-565: L 580-581).
37 G VII 86: L 425.
38 G VII 86: L 425.
40 G VII 86: L 425.
41 See Carlin (2000, pp. 115-120) for a helpful discussion of Leibniz’s theory of harmony and his remarks about distinct cogitability.
42 Here I am following Laurence Carlin’s view according to which, for Leibniz, “the essence of an ordered relationship is one where the related elements, in virtue of their mutual relationship, can be distinguished from each other” (Carlin (2000, p. 104)).
43 G VII 290: MP 146.
differentiating a thing from others, even though the thing does indeed have such marks and requisites into which its notion can be resolved. But a distinct notion is like the notion an assayer has of gold, that is, a notion connected with marks and tests sufficient to distinguish a thing from all other similar bodies.\footnote{G IV 422–423: AG 24.}

By means of a clear notion of a plant, one should “be able to pick it out from others which are close to it...”\footnote{G V 236: NE 254; I am again following Laurence Carlin in emphasizing the role definitions and distinct concepts play in Leibniz’s theory of harmony. Carlin writes of those entities constitutive of harmonious systems, “In this case, the relevant entities to be distinguished are component concepts, and they may be distinguished by means of concept resolution (decomposition) or by providing a definition” (Carlin (2000, p. 118)).} Rendering our grasp of a concept distinct involves “yielding an analysis or a definition” of the notion in question.\footnote{G V 237: NE 256.} The sort of comprehension relevant to distinctly grasping the unity of a system, therefore, is closely related to conceptual analysis. As such, comprehension will be aided by the method of counterexample. Returning to the example of a notion of a plant will illustrate the point. If someone brings “from the Indies a plant which exactly fits everything we have put into our description and which nevertheless can be seen to belong to a different species,” our grasp of the notion is confused, and so must be subjected to further analysis. If the analysis is ever carried out until the notion has been reduced to its conceptual primitives, then the concept is known adequately. Concepts that are known adequately, furthermore, are also known distinctly.\footnote{47 “When everything that enters into a distinct notion is, again, distinctly known, or when analysis has been carried to completion, then knowledge is adequate (I don’t know whether humans can provide a perfect example of this, although the knowledge of number certainly approaches it)” (G IV 423: AG 24).}

Thus far we have seen that the notion of a system’s unity is inversely related to the number of intellectual acts required to fully comprehend the system. Comprehending a system involves distinctly grasping the concept of the system. Full comprehension, moreover, involves analyzing the concept of the system into its conceptual primitives, or, in Leibniz’s terminology, adequately grasping the notion of the system. Notice that nothing said thus far commits Leibniz to saying that humans can adequately grasp such notions. Leibniz can consistently say of a system both that (a) its unity is determined by the number of intellectual acts required to adequately comprehend its notion, and (b) no human is able to adequately grasp its notion. This is no more inconsistent than saying of some complete concept both that it is determined by all that is required to adequately grasp an individual substance and that no human is able to fully comprehend a substance’s complete notion.\footnote{Leibniz endorses both of these claims. With respect to the former, Leibniz writes, “We have said that the notion of an individual substance includes once and for all everything that can ever happen to it and, that, by considering this notion, one can see there everything that can truly be said of it...” (G IV 436: AG 44). Concerning the latter, Leibniz writes, “For the concept of myself in particular and of every other individual substance is infinitely more extensive and more difficult of comprehension than a specific concept like that of the sphere... It is not enough for understanding the nature of myself, that I feel myself to be a thinking substance, one would have to form a distinct idea of what distinguishes me from all other possible minds; but of that I have only a confused experience” (Fl 52–53: LA 52–53).}

Furthermore, Leibniz’s claim that humans are sensitive, even in a cognitive sense, to the unity of a system does not commit him to saying that we can adequately grasp the concept of the system. Leibniz avoids this implication with his doctrine of sympathy, according to which we may have confused knowledge and subconscious awareness of the order amidst a system’s variety, an awareness that nevertheless causally contributes to the pleasure we take in harmonies.

At this point the question arises, “In virtue of what does the adequate grasp of the notion of one system involve more intellectual acts than the adequate grasp of the notion of another?” Leibniz seems to have answered this question in terms of primitive concepts. After commenting on the perfections of the mind in his Ars Magna of Thinking, Leibniz considers the ways in which mental perfection can be enhanced. Leibniz writes, “The remedies prescribed for the mind consist of certain modes of thinking, by which other thoughts are made easier. It is the greatest remedy for the mind if a few thoughts can be found from which infinite others arise in order, just as from the assumption of a few numbers, from one to ten, all the other numbers can be derived in order.”\footnote{50 “Although the things which are conceived are infinite, yet it is possible that those conceived through themselves are few; for infinite things can be compounded out of the smallest possible number of assumptions, that is, it operates in the simplest way” (C 430: MP 2). Although the term “primitive concept” does not appear in this passage, the reference to “those conceived through themselves” is a reference to primitive concepts. We know this based on the terminology appearing in the surrounding context, especially from Leibniz’s regress argument for conceptual primitives, which he says are conceived through themselves. Notice also that Leibniz here associates simplicity with paucity of primitive concepts, a combination of a few. Indeed, this is not only possible, but even credible or probable; for nature usually does as many things as possible with the smallest possible number of elementary acts.” (C 513: MP 7). Here I think Leibniz’s doctrine of sympathy is especially helpful. Notice that in this text Leibniz does not deny that we have primitive concepts, but only doubts that we have them in such a way that we are distinctly aware of them. As we have seen, however, my interpretation does not commit Leibniz to the view that humans can distinctly grasp primitive concepts or successfully analyze a notion into its conceptual primitives. This is required neither by my interpretation of Leibniz’s theory of the unity of a system nor by my interpretation of his account of our awareness of the unity of a system, which according to his doctrine of sympathy is frequently confused and subconscious. According to my interpretation, it is, for Leibniz, possible that despite failing to distinctly grasp the primitive concepts constitutive of a system’s notion, the soul nevertheless has a confused and subconscious awareness of these primitive notions, an awareness that is part of the explanation of our pleasure in harmonies whose order we may not distinctly grasp. Indeed, returning to the problematic text we see that in the very next remark, Leibniz says, “But we can have no derivative concepts except by the aid of a primitive concept...” This suggests that even when writing the problematic text Leibniz thought that the fact that we have derivative notions is reason to think that we are at least in some sense, in contact with primitive notions (I am thankful to an anonymous referee for bringing this text to my attention).}

The remedies prescribed for the mind consist of certain modes of thinking, by which other thoughts are made easier. It is the greatest remedy for the mind if a few thoughts can be found from which infinite others arise in order, just as from the assumption of a few numbers, from one to ten, all the other numbers can be derived in order.\footnote{51 In summary, the harmony of a system consists in its unity in variety. The more unity and variety a system has, the more harmonious it is. The variety of a system is determined by the degree of qualitative diversity in the system. The unity of a system is determined by the number of intellectual acts required to fully comprehend the system’s notion. Leibniz considers the ways in which mental per-}
comprehend the system. Full comprehension requires adequately grasping the notion of the system. The number of intellectual acts required to fully comprehend the system is determined by the number of primitive concepts constitutive of the system’s notion.

5. The Laws of Nature in the Best Possible World

In light of Leibniz’s theory of perfection, we would expect Leibniz to connect the perfection of nature with its harmony. Leibniz does not disappoint in this respect.\(^{52}\) But what would it mean for the physical world to be harmonious? One needn’t ruminate long to identify a promising proposal. Recall that in order for nature to be characterized by unity in variety, there must exist some notion the primitive conceptual constituents of which are sufficient for comprehending nature’s qualitative variety. According to Leibniz, nature is comprehensible in no other way than by understanding its laws.\(^ {53}\) Adequately grasping the notion of nature, therefore, requires comprehending nature’s laws.\(^ {54}\)

We have seen that Leibniz regards nature’s harmony as conceptually related to its comprehensibility by means of laws. When we apply Leibniz’s harmony theory of perfection to nature, we see that nature increases in perfection insofar as more of its diversity is comprehensible by means of fewer primitive concepts. Since nature is comprehensible only by means of laws of nature, it follows that nature increases in perfection insofar as more of its diversity is comprehensible by means of laws involving fewer primitive concepts. This will lead Leibniz to view the simplicity of laws as a perfection-enhancing feature of a world.\(^ {55}\) The simplicity of a hypothesis is determined by the number of primitive concepts required to comprehend the hypothesis:

Yet it must be admitted that a hypothesis becomes the more probable as it is simpler to understand and wider in force and power, that is, the greater the number of phenomena that can be explained by it, and the fewer the further assumptions.\(^ {56}\)

It is likely that Leibniz associated “assumptions” with primitive concepts.\(^ {57}\) Other things held equal, therefore, nature’s perfection is enhanced insofar as it has simpler laws.

When set against the backdrop of Leibniz’s theism, these axiological facts about possible worlds become relevant for the way we can expect nature to be. God will more strongly incline toward those possible worlds in which nature is both rich in diversity and simple in laws than those worlds in which this is not the case, since God inclines towards a world in proportion to its perfection.\(^ {58}\) According to Leibniz, since there is a uniquely best world, God will actualize that world. Furthermore, Leibniz regarded nature as being maximally perfect in the best possible world, as is evident from his remarks about methods of scientific discovery. According to Leibniz, the most perfect method for discovering truths about the corporeal world “involves the discovery of the interior constitution of bodies a priori from a contemplation of God, the author of things.”\(^ {59}\) Properly employing this method enables us to discover from a priori reflection on God's perfection “the principles of sensible things.”\(^ {60}\) Although Leibniz admits that adeptly executing this method is difficult, he thinks it is possible, since “our mind is endowed with the concept of perfection, and we know that God works in the most perfect way.”\(^ {61}\) According to Leibniz, therefore, we can discover truths about nature a priori by reflecting on what is involved in nature being maximally perfect precisely because God’s perfection guarantees that nature is maximally perfect.\(^ {52}\)

It is unclear why Leibniz was confident that in the best possible world nature is maximally harmonious. As Leibniz recognized, from the fact that the whole of reality is as harmonious as possible it does not in general follow that the parts are also as harmonious as possible.\(^ {63}\) For the sake of expositing Leibniz’s view in its entirety, I will grant him the claim that in the best possible world nature is maximally harmonious, and trace the path Leibniz takes from the perfection of nature to the Coextension Thesis.

That nature is as harmonious as possible is relevant not only to God’s choice among worlds but to our choices among competing scientific theories. Consider two empirically equivalent and accurately rival theories T and T*.\(^ {64}\) Suppose that both T and T* are epistemically and metaphysically possible. Suppose that the laws in T can be fully comprehended by means of fewer primitive concepts than the laws in T*. Finally, suppose that Leibniz’s harmony theory of perfection is necessarily true. We may now reason as follows: in the best possible world, nature is as perfect as it could be. Given the harmony theory of perfection, it follows that the best possible world is as harmonious as it could be. Since the actual world is the best possible world, we may infer that there is no way nature could be according to which it has more harmony than it does. If T* is true of nature, however, then there is a way nature could be according to which it has more harmony than it in fact does, since T both could

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52 “God in creating the world was at pains to give it the greatest harmony amongst things…” (G VI 406: H 411); “[B]ut they [laws of nature] are dependent upon the fitness of things as I have already pointed out above, or upon that which I call the ‘principle of the best’. Moreover one recognizes therein, as in every other thing, the marks of the first substance, whose productions bear the stamp of a supreme wisdom and make the most perfect of harmonies” (G VI 44: H 68).

53 “[U]nless physical things can be explained by mechanical laws, God cannot, even if he chooses, reveal and explain nature to us” (G I 197: L 189); “That physics, which teaches that nothing is moved naturally except through contact and motion, and so teaches that, in physics, everything happens mechanically, that is, intelligibly, this physics seems excessively clear and easy” (G VII 337: AG 312; my emphasis).

54 Rescher has drawn attention to the relationship between the perfection of nature and its comprehensibility by means of a deductive system containing laws as axioms and theorems. He writes, “As we have seen, the idea of system operative in Leibniz’s thought involves the interweaving of two inseparable threads: diversity (variety, richness of content) on the one hand and economy (simplicity, unity, elegance) on the other. It is clear that these two aspects of system are exactly the same as those of perfection…” (Rescher (1981, pp. 37–38)).

55 “But God has chosen the most perfect world, that is, the one which is at the same time the simplest in hypotheses and the richest in phenomena…” (G IV 431: AG 39).

56 G I 195-196: L 188.

57 See the passage referenced in note 50, where Leibniz connects assumptions with primitive concepts, and also suggests that simplicity is connected with paucity of primitive concepts.

58 “all possible things, or things expressing an essence or possible reality, tend toward existence with equal right in proportion to the quantity of essence or reality, or to the degree of perfection which they involve; for perfection is nothing but quantity of essence” (G VII 303: L 487).


61 A VI.v.1999: L 283.

62 It is also suggestive that Leibniz, commenting on the series of efficient and final causes, claimed that “God has no less the quality of the best monarch than that of the greatest architect” (G VI 264: H 279).

63 “Even if the entire harmony is pleasing, nevertheless the dissonant aspects of it in themselves are not pleasing, in spite of the fact that they are combined according to the rules of art. But the unpleasantness that exists in these things considered in themselves is dispelled by the departure or, rather, actually by the increase from that source of the pleasantness of the whole. Hence, because of this compensation, the dissonant in this mixture is made indifferent from what was displeasing, the permitted from what was rejected. Only the whole is pleasing, only the whole is harmonious, only the configuration, as it were, of the whole is a harmony” (A VI.i.132: CP 63).

64 By stipulating that both theories are empirically accurate I do not mean to stipulate that they are both true, but rather that both are such that they are always correct in their observable consequences.
have been true of nature and attributes more harmony to nature than $T_*$. Therefore, $T_*$ is false.

The perfection of nature, therefore, provides rational grounds for preferring simpler empirically adequate theories to those that are more complicated. Since $T$ and $T_*$ are arbitrarily chosen, the result generalizes that any empirically adequate theory that is not as simple as it can be is false. This chain of reasoning does not, however, entail that $T$ is true, since there may be some third rival theory $T_{**}$ that is on a par with $T$ and $T_*$ in terms of empirical fit but which has even fewer and simpler laws than both $T$ and $T_*$. Leibniz now has everything he needs to show that the laws of nature in the actual world are coextensive with the axioms and theorems in the best system. Physical theories consist of propositions expressing laws. To show that the laws of nature are coextensive with the axioms and theorems in the best system, we need only to show that the best system must be true of nature, given the Leibnizian framework. We can show this as follows. Among empirically adequate theories, some will be simpler than others, where simplicity is construed as paucity of constitutive primitive concepts. The simplest theory among the empirically adequate theories will be the best deductive system. Given Leibniz’s theory of harmony, the best deductive system will be the system that attributes the most harmony to nature. Given Leibniz’s harmony theory of perfection, it follows that the best deductive system will also attribute the most perfection to nature. According to the argument outlined above, all the systems that are not the best deductive system are false, since they attribute less perfection to nature than nature could have. But some theory of nature or other must be true. Because nature is maximally harmonious in the best possible world, the Coextension Thesis must be true in the best possible world.

With the truth of the Coextension Thesis guaranteed and explained, Leibniz is in the position to answer the Epistemological Question. The reason why being a member of the best systems counts as evidence for being a law of nature is because an extensional equivalence between these axioms and the laws is required by nature’s perfection in the best possible world.

6. Conclusion

Although Leibniz never endorsed the BSA, he was committed to the laws of nature being coextensive with the axioms and theorems of the best system. Leibniz’s commitments concerning nature’s perfection strongly motivated him to adopt this view. By clarifying Leibniz’s harmony theory of perfection and applying that general theory to nature itself, I have shown that without compromising his causal powers account of laws, Leibniz is able to explain why membership in the best systems is evidence for being a law. What is crucial to getting the explanation right, according to Leibniz, is a proper axiology.

References

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Secondary Sources


65 What within the Leibnizian framework excludes the possibility of ties for best deductive system? Such ties are excluded by the principle of sufficient reason. If there were at least two rival theories $T$ and $T_*$ that tied for best deductive system, then God would have no reason to actualize a world in which $T$ is true rather than $T_*$, or vice versa. This is because systems tying for best deductive system also tie with respect to harmony and are therefore on a par with respect to perfection. Were God to actualize one instead of the other, there would be a fact for which there is no contrastive explanation. But this possibility is forbidden by the principle of sufficient reason. Therefore, the Leibnizian framework forbids ties for best deductive system. See section five of Leibniz’s third paper in his correspondence with Samuel Clarke to see Leibniz employing this sort of argument strategy (G VII 363–364: ALC 26: AG 325).