

LAWS ACROSS SCIENTIFIC PERSPECTIVES

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Is the concept of law of nature consistent with historically situated scientific practices? Can we account for the historical development of the very concept across history of science? Recently, Michela Massimi (2018a) has offered a positive argument to address those questions. According to Massimi, laws have a historical and metaphysical nature, and laws perform the role of axioms in series of systems of propositions across multiple scientific perspectives. Laws have to be reassessed, goes on the view, in the light of a perspectivist stance towards scientific practice (Massimi 2018a, 2018b).

However, I argue that perspectivism has to acknowledge a distinction between particular laws, general concepts of lawhood and perspectival laws. This latter addition meets the no-law or law nihilism challenge: whether there is a unitary concept of law across multiple practices, given that the concept is subject to radical theoretical changes (Giere 2006). My own contribution is to explore to what extent perspectival laws stay the same across theoretical changes, and how perspectival laws are unceasingly explored in real actual scientific perspectives.

Keywords: perspectival laws, perspectivism, law nihilism, scientific practice, history of science

1. Introduction

1.1 Laws and the problem of scientific practice

Since the Scientific Revolution, laws have figured prominently in our way of thinking about the order of the world (e.g. the law of momentum conservation, the law of supply and demand, or the law of genetic

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inheritance). The metaphysical underpinnings of this concept hints to something that enforces regularity. The concept of law is thus a constitutive part of our common or scientific vocabularies. However, there seems to be a radical disagreement as to how laws of nature relate to actual scientific practices, especially because no concept of law is widely accepted.² One source of disagreement can be traced back to the various meanings attached to the concept of law in scientific practices from different periods of time. There is a seventeenth century concept of lawhood that has theological roots – God is a “lawgiver”, where necessity may come from and who enforces laws as divine commandments (Daston & Stolleins 2004: 3). Instead, the theological concept runs counter to the twentieth century concept of law, which is grounded in modeling practices that became secularized and are regarded as “principles that define highly abstract models” (Giere 2006: 70-72). In this respect, the very concept of law of nature seems to be essentially “malleable” – relative to scientific communities, scientific practices or centuries wherein it is used in “ambiguously” and “contradictory ways” (Patton & Ott 2018: 1; Giere 2006: 70).

Another source of disagreement can be that the very same law stands for distinct things in different perspectives. The Newtonian law of gravitation describes a real cause of the world, that ceases to be so in the Einsteinian perspective, where it is just a way of curving space-time (Massimi 2018a: 143-144). A gripping account of laws has to account for this plurality of practices in order to explain what they have in common. If not, views about laws must give up aspirations to generality and historical accuracy, and collapse into a mild form of nihilism about laws: no common concept of lawhood across perspectives. My own contribution is to explore the perspectival nature of laws – how laws are unceasingly explored in real actual scientific perspectives, what changes they are subject to, and what stays the same across theoretical changes. The whole paper rests on a distinction between three kinds of laws: a particular law (e.g the Newtonian law of gravitation), a particular

² I appeal to Massimi’s concept of perspective as a specific system of scientific practices at a given moment of time, that provide a corpus of scientific knowledge claims. I return to this point in the fourth section.

concept of lawhood (e.g. seventeenth century concept of lawhood), and perspectival law (e.g. the concept of a law as a general axiom across perspectives).³ My main claim is that although particular laws and particular concepts of lawhood change, the perspectival law remains stable across perspectives. I intend to argue for the claim by, initially, reviewing Lewis's best system approach and then by looking at recent work on perspectivism and laws done by Massimi.

1.2 Laws in best systems – Lewis' approach

One influential answer to what a law of nature is was provided by David Lewis's best system approach.⁴ The guiding thought of this approach is that a law is a regularity depicted as an axiom in an ideal system of science as a whole. This theorem has to strike a balance between strength and simplicity to qualify as a law. The strength stands for the ability of a law to convey as much information as possible. Simplicity could be taken either in a semantic (the conveyed information to be stated as precisely as possible), or in an ontic meaning (positing as few unobservable entities as possible – parsimony). The Newtonian law of gravitation, for instance, is both informative and simple. It is informative because it explains terrestrial and celestial phenomena under the same inverse-square force. For instance, it explains that a falling body on Earth as well as Jupiter's motion are governed by the same law. It manages to explain this variety of phenomena under a mathematical formalism; such that the concept of law of gravitation is a "mathematical" treatment of the concept of force. I will return to the prospects of a best system approach in sections 1.1 and 1.3.

³ I use the first two meanings in relation with the old ratbag idealist objection (in the second section), and the latter two in regard with the second version of the new objection (in the third section).

⁴ In what follows, I focus on Lewis' concept of law for its minimalist understanding of lawhood. I mean that laws are non-governing regularities in the world, they stand for lawlike correlation of events.

1.3 *Are particular laws and particular values relative to perspectives?*

Is simplicity a value whose content is stable across scientific perspectives? Does reference to simplicity fix what a law amounts to? This line of reasoning is known as “ratbag idealist objection” according to which “a ratbag idealist might say that” strength and simplicity are vague and relative *within* a context but not subsequently common *across* multiple scientific perspectives.⁵ (Lewis 1989: 232). The ratbag idealist aims to show that if strength and simplicity are not precise concepts, the best system approach cannot secure the concept of lawhood. The context-relativity at play could be expressed in two versions. The first version points to the fact that the content of values are relative to a context – meaning that values do not have absolute content in themselves.⁶ Their content, instead, is provided only in relation with the scientific perspective. The content of a value in a given perspective stands for two things. Firstly, for what the community of scientists generally understand by a value; secondly, for those details that scientists pay special attention to from a perspective and at a given moment in time. Whereas the function of a value refers to what role it performs in a historical perspective. Instead, the second version points to the relativity of a particular law to a perspective. Where both versions are concerned, I frame the problem in terms of particular concepts of simplicity and particular laws (e.g. Newtonian versus Einsteinian simplicity – Newtonian *versus* Einsteinian laws of gravitation). I state this objection in section 2.2.

For refuting the older ratbag objection, Lewis introduces the concept of natural property, whose discovery is related to the existence of laws and, natural properties being supposed to secure knowledge of laws. I argue in section 2.4 that Lewis’ reference to natural properties as a solution is ineffective. Lewis’ reply in terms of natural properties just postpones the ratbag idealist objection.

⁵ I consider this formulation as an older version, that I contrast with a new formulation below.

⁶ The definitions I provide for function and content are tailored to include only the concept of scientific perspective since I am not interested in exploring the concepts in their general or common meanings.

1.4 Perspectivism strikes back: relative to versus valid across

In reply, I argue that the ratbag objection is misguided since it conflates values and laws as being relative to perspectives with values and laws as valid across perspectives. The perspectivist approach preserves Lewis' central claim that laws are theorems of systems aimed at describing phenomena. Perspectivism is an epistemic and historical view about scientific claims, wherein a claim stands as being true or valid across multiple perspectives (Massimi 2016: 172-173; Crețu 2020: 6). Firstly, it is epistemic since it regards how scientific knowledge is obtained in scientific practices. Secondly, it is historical because scientific claims are possible in "historically well-defined scientific perspectives" (Massimi 2018b: 167). I provide a detailed exposition of perspectivism in sections 3.1 and 3.2.

In terms of value, perspectivism emphasizes the role of monitoring scientific claims performed by simplicity and strength across a historical series of perspectives. Simplicity and strength single out which relevant scientific claims are at stake in a given scientific perspective. This role of guidance is consequently called "standard of performance adequacy". This is what various concepts of scientific simplicity actually share. I will extend this point in section 3.2. In terms of particular laws, perspectivism is a view about multiple ways of acquiring knowledge about laws that occurred across the history of science. The best way to address the original ratbag idealist objection is to recognize that development of the same value or law as being common *across* multiple scientific perspectives.

1.5 Are the concepts of lawhood and the functions of values relative to perspectives?

My contribution to the debate is to argue in section 3.3 that perspectivism could once again face the ratbag idealist objection under at least two new versions. The first version doubts whether simplicity performs the role of monitoring the relevance of scientific claims across perspectives. The second version of the ratbag idealist concerns the so called law nihilism approach, which stresses there is no unitary concept of lawhood across the history of science (Giere 1999: 84-85). This time, I state the

new version in terms of notions of lawhood instead of particular laws in order to reinforce the older version. This multiplicity of lawhood concepts may show that the very concept of law is relative to certain perspectives.

Regarding the first version of the new objection, I argue that as long as the epistemic needs of a real scientific community stay the same, simplicity and strength will perform the same role as standards of performance adequacy (e.g. the need to generate relevant scientific knowledge). As a reply to the second version, I determine what is common to all these scientific perspectives. In fact, what is mostly stable across these theoretical changes, is how the law “continues to be a theorem in our best system” (Massimi 2018a: 155). For expressing this stability, I introduce the term *perspectival law*.⁷ A particular law (the contention of the old version) and a particular concept of lawhood (the case of the new version) can change, and history of science provides examples for these. But what did stay the same is the general concept of perspectival law understood as an axiom of our best systems in a series of scientific perspectives. I will address and refute the two new versions of the objection in sections 3.3 and 3.4.

1.6 My claim: Into the perspectival scope and nature of laws

In this paper, I aim not to add robustness to Massimi’s perspectivist approach, but to reassess the scope and meaning of laws of nature in recent perspectivism. I do this by introducing the concept of perspectival law in section 3.3, a conceptual bridge between perspectival considerations regarding knowledge and regularities as mind-independent states of affairs. I think that it is crucial for perspectivism to discuss this new version since Massimi initially related the ratbag objection to Lewis’ account of laws, without providing an analysis of the interplay between perspectivism and the ratbag objection. I shed light on the threat of the ratbag idealist objection by drawing a distinction between older and

⁷ I take as a source of inspiration Massimi’s concept of perspectival truth: truth as a conceptual bridge between perspectivalism with respect to knowledge and mind-independent entities (Massimi 2018b).

newer formulations, adapting each formulation to at least two distinct versions (one about value and the other about lawhood). It is also important to take this objection into consideration since it provides a gateway into the perspectival nature of laws.

Additionally, I am the first one to relate the law nihilism approach with the ratbag objection and show, therein, that Giere's pessimistic conclusion is unproblematic for perspectivism.⁸ I achieve this through three pairs of distinctions. Firstly, I distinguish between contextualism and perspectivism in regard to values and laws in sections 2.3, 3.2. and 3.3.⁹ Secondly, I provide a distinction between the role and the content of value which are linked to the concept of perspective (3.2). Finally, I draw a completely novel distinction between particular laws, particular concepts of lawhood and the perspectival concept of law – while the former two can change, as I argue, the latter stays the same across perspectives.¹⁰ My arguments take Massimi's perspectivism more as a starting point for exploring the nature of laws rather than a settled account. In this respect, perspectivism about laws is not a finished project. My personal contribution sheds light on the dynamical nature of perspectival laws, showing how they change and how this change occurs throughout the history of science.

2. How to conceive laws of nature: Lewis' approach *versus* contextualism

In this section, I will introduce the metaphysical components of the best system approach. In section 2.1, I define what counts as lawhood, and, secondly, I will show how this concept of law is integrated in the metaphysical edifice of Humean Supervenience. I should remark that in this section the concept of law is used only in the sense of a particular

⁸ I am one of the few writers in the recent literature that take the law nihilism approach into consideration. For unknown reasons, this approach doesn't get the critical scrutiny it deserves.

⁹ Massimi does talk about the contextual relativity of values, but the possibility of contextual-relative laws is nonetheless left out.

¹⁰ This latter distinction can clarify ambiguities that may arise for Massimi's view. I thank Andrei Mărășoiu for this straightforward remark.

law and a particular concept of lawhood. My main example of particular law will be the Newtonian law of gravitation, as it figures in *Principia*. This step-by-step build-up occurs in 2.2 with the analysis of the interplay between natural properties and lawhood. In 2.3, I provide the ratbag idealist objection and I argue that it is an endorsement of a form of contextualism. In 2.4 I will shed light on Lewis' reply to the ratbag objection and show the reason for which the response fails. This will pave the way for a perspectival understanding of laws.

2.1 A statement of the best system approach

Lewis provides a weak concept of lawhood.¹¹ For a regularity to be a law, it is a necessary condition for it to be perform the role of a "theorem" (Lewis 1984: 367) in a deductive "ideal system of truths" (Lewis 1986, xi).¹² That proposition has to achieve a combination of strength and simplicity. This concept of lawhood grounds a meaningful distinction between fundamental and derivative laws. The former stands for the most general and informative truth content of a scientific system. The latter are supposed to be inferred from these fundamental theorems.

Newtonian gravitation qualifies as a law in this sense because it performs the role of a fundamental law in *Principia*. It unifies different realms of phenomena, from the motion of the planets on their orbits to the motion of the tides of the ocean, the free fall of bodies, the swing of the pendulum and so on. Thus, the law of gravitation is informative in its content. It describes an attractive force that is directly proportional to the quantity of matter and inverse to the square of the distance. It succeeds to be simple, perhaps because it doesn't contain much information about every particular that obeys the law (e.g. a specific ocean, or every inclined plane, or a random celestial body). Finally, it achieves a balance between strength and simplicity. The Newtonian law

¹¹ It is a weak approach since, at first blush, laws are only *summaries* of facts and nothing over and above.

¹² The best system approach doesn't commit one to a syntactic view of theories; it is also compatible with a semantic view (Halpin 2004: 157).

reduces these phenomena to the simple “physical seat of forces” and “true causes” of things (Newton 2004: 52, 124). This example shows how derivative laws (Kepler’s laws, or Galileo’s free fall law) could be deduced from the Newtonian fundamental law.

2.2 *Best system, natural properties, and the God Eye’s View system*

One further detail about lawhood is added by the fact that Lewis envisages a “neck-to-neck” competition between given scientific law systems about distinct phenomena (Lewis 1999: 233). This competition must end with the victory of the most robust system, the one that achieves to embody a “properly balanced combination of simplicity and strength” (Lewis 1973: 73). Lewis believes in the scenario of a final God’s Eye View system of lawhood as the most robust system.

The best system concept of lawhood is backed by Humean Supervenience. The world is a “mosaic of local matters of particular facts”, namely instantiations of “natural perfectly intrinsic” non-modal properties (Lewis 1986: ix). The Humean feature of the thesis stands for the absence of *de re* modality in the world. Lewis takes the distinction between natural and non-natural properties as being one of degree. Natural properties are expressed by primitive, unanalyzable, categorial, and fundamental predicates, such as those borrowed from fundamental physics (a pair of examples: mass, charge, momentum, spin). Being categorial properties, natural properties only classify (categorise) which sets the properties can be part of. Humean supervenience is “at best a contingent truth” (a weak version). To assert that so-and-so supervenes on such-and-such is to say that there can’t be any difference in respect of so-and-so without a difference in respect of such-and-such (Lewis 1984: 358) (Lewis 1984: ix). The laws of nature supervene on these “arrangement” natural properties, such that there will be “no difference” among the fundamental laws “without difference in the arrangement” of those properties (Lewis 1986: x). The candidate systems of truths are said to “supervene safely” on the natural properties (Lewis 1986: xi).

Finally, Lewis argues that lawhood and natural properties are interrelated. The discovery of natural properties entails the discovery of

laws, such that “laws will tend to be regularities involving natural properties” (Lewis 1984: 368). In the example of Newtonian gravitation, the discovery of the inverse-square relation between masses and distance involved the investigation of the natural properties at stake (e.g. mass). Mass figures prominently in the law that led to its discovery. Natural properties and lawhood go hand-in-hand because it is “a package deal” (Lewis 1984: 368). This is far from obvious if we examine the ratbag idealist objection. I will argue that this reply only postpones the real issue at stake. Natural properties are relative to the knowledge of a given perspective at a certain moment in time. This fact renders the best system approach untenable.

2.3 The old ratbag idealist objection – contextualism in values and laws

The objection states bluntly that “our thinking”, as Lewis puts it (Lewis 1999: 233), makes up our way of understanding the scientific values in historically constituted scientific perspectives.¹³ The contextualism endorsed by the ratbag idealist is a two-tier view about the content of values and the concepts of lawhood, that are true or valid “always relative to a perspective” (Giere 2006: 81).¹⁴ Accordingly, scientific observational or theoretical claim “should in general be relativized to a perspective” (Giere 2006: 82).¹⁵ In the first version of the objection, contextualism is a view about values, according to which epistemic norms possess content only relative to a certain perspective. Consequently, every perspective includes its own particular bundles of values (Kuhn 1970: 184-185).

¹³ Lewis addresses only the first version of the objection.

¹⁴ I am not advancing an argument whether idealism equates contextualism in full generality. For present concerns, the ratbag idealist objection, in Lewis’ construal, is a contextualist contention. It could be better to call it the ratbag contextualist objection, but I am sticking to Lewis’ terminology for simplicity.

¹⁵ Giere argues that his project from (Giere 2006: 13-15) is a brand of perspectivism; instead, I think it collapses into a variety of contextualism since the author argues explicitly that scientific claims are perspective-dependent, meaning that those claims cannot be true unless they are bound to a perspective. Once we take the claim outside the perspective, it ceases to be a truth for that perspective. I argue for a different approach in the third section.

Newtonian simplicity means to account for every cause in terms of forces, including gravitational pull or push. For the relativistic mechanics of the Einsteinian sort, simplicity means something radically different. In the relativistic framework, the law of gravitation ceases to be a true cause of physical interactions. It is simply a way of warping the space-time. For Einstein to commit himself to the reality of gravitation as a genuine physical cause, it would mean to posit the existence of an unnecessary feature.¹⁶

In the second version of the objection, contextualism is a view about regularities that are laws only within a certain perspective; meaning that the Newtonian law of gravitation is a law only relative to the Newtonian perspective. Newtonian lawhood is not similar with relativistic lawhood in the same manner as Newtonian simplicity is not similar with relativistic simplicity. The defender of this objection would say that Newtonian simplicity and the Newtonian law are incommensurable with relativistic simplicity and the Einsteinian law. This would amount to saying that we can't use the Newtonian concept of lawhood to grasp what lies behind relativistic lawhood.

2.4 Lewis' reply – its rise and decline

Lewis's main reaction to the former and latter versions is to highlight that appeal to natural properties refutes the idealist ratbag objection. The best God Eye View system should describe only natural properties; the system precludes the unnatural "gerrymandered disjunctive properties" (Lewis 1999: 1). We should be able, against the background of the Humean supervenience, to draw a non-arbitrary distinction between natural properties and unnatural ones. "If nature is kind" (namely, kind enough to enable us to study its natural properties), as the argument goes, we should not be concerned with what simplicity or strength are (Lewis 1999: 234-235). They are partially "a matter of psychology"

¹⁶ As I will argue in the fourth section, the Newtonian concept of simplicity is radically different. The Newtonian simplicity grounds the idea that speculation is forbidden in Newtonian natural philosophy; whereas the Einsteinian simplicity embraces speculation.

(Lewis 1999: 234). Lewis insists that this psychological aspect means that values are subjective, they could be relative to a subject, and not common to a best system. To put it the other way, Lewis bites the bullet and accepts the first version of the old objection. Values are not essentially important in settling the issue of what counts as lawhood.¹⁷ Trusting in nature's kindness "is just a reasonable hope" (Lewis 1999: 235). Values could be relative as long as natural properties are out there and secure lawhood.

Regarding the second version of the ratbag objection, Lewis' way out is to appeal to his theory of natural properties. But this, as I've suggested already, just postpones the real problem. Take mass as an example. Mass in *Principia* is the product between the volume and the density of a body. It stands for a universal invariant primary quality of matter alongside hardness, or extension; it is supposed to perform a role in the inverse-square relation in the force-law of gravitation. However, take the property of mass from the Einsteinian relativistic mechanics. This term refers to a property that changes at a velocity close to that of light. In the Newtonian perspective, it could not be a changing property. It is essentially the other way around for Einstein. To sum up, a scrupulous examination of the history of science reveals *multiple ways* of understanding a natural property (Massimi 2018a: 147). In our case, we can ask: what concept of mass figures in which law? The Newtonian mass that led to the discovery of the Newtonian law of gravitation? As I showed previously, it is far from clear whether there are unique and mind-independent natural properties out there, given that our knowledge about how those presumptive properties behave is relative to scientific perspectives.

How satisfactory is Lewis' attempt to solve the second version of the old objection? If scientific knowledge about natural properties is also *relative* to certain scientific perspectives, does it make any sense to seek an answer in the theory of natural properties? If natural properties are problematic, how we settle down lawhood? My solution is to abandon the theory of natural properties since it doesn't lead anywhere fruitful. My proposal instead is to turn our attention to the perspectivist best system approach.

¹⁷ Perspectivism gives up this latter claim.

3. Perspectivism on the nature of laws

In this section, I sketch the perspectivist best system approach. Then I show how the perspectivist approach could account for the ratbag idealist objection. The main idea would be to replace the apparent context-relativity of simplicity with a perspectival understanding of it. I will argue for this idea with special reference to the interplay between speculation and simplicity. Although, in this section, I argue that the perspectivist approach has resources to answer the idealist ratbag objection, I develop the point further, arguing that two refinements of the ratbag objection can likewise be addressed by a modified perspectivist best system approach.

3.1 *What is a scientific perspective?*

I focus on the perspectivist approach because it places more importance on the role performed by laws in scientific practice (Massimi 2018a: 146). In this section, I ask how lawhood and values are related to a *scientific perspective*. I begin by discussing what is a scientific perspective :

A scientific perspective is the actual, historically, culturally and intellectually situated, scientific practice of a given real scientific community at a given historical moment. (Massimi 2018a: 152)

The concept of scientific practice endorsed by this definition already presupposes that scientific knowledge is generated and situated from the specific point of view of a scientific community. It is knowledge from the vantage point of a material culture that has its own scientific models, measurement and data collection techniques, instruments and experimental set-ups that yield specific scientific knowledge claims (this approach can be traced back to Massimi 2016, 164).¹⁸ Scientific practice

¹⁸ At the opposite extreme stands the concept of scientific practice as an idealization or rational reconstruction of actual scientific communities (Halpin 2004: 152), that the perspectivist view sketched above runs against.

on the perspectivist view should be taken as: (i) the corpus of scientific knowledge claims provided by a scientific community at a given time; (ii) the experimental, theoretical, and technological resources available to the scientific community at the given time to *reliably* make such and such scientific claims.¹⁹ Consequently, the material culture of a scientific community provides the proper means to generate, endorse and justify what qualifies as scientific knowledge (Massimi 2016: 164).

There are also second-order claims, of a methodological and epistemological sort, that underlie the (first-order) scientific knowledge claims (Massimi 2018a: 152). Is speculation a methodological route to pursue so as to generate scientific knowledge? Shall a scientific community posit unobservable entities? Should speculative knowledge about unobservables be considered genuine knowledge? Such conceptual concerns are addressed by the second-order claims, problems that commit the community to certain epistemological and methodological views about how (first-order) genuine knowledge should be obtained. This concept of perspective as first- and second-order claims provides an answer to the first question concerning Lewis's reply. The perspectivist approach succeeds to be historically compatible with scientific practices. It aims to account for the historical evolution that lawhood was subject to. This is the case also regarding simplicity, as I argue below.

3.2 *The standards of performance adequacy*

The concept of justification is here ineliminably *perspectival*: the justification that the material culture affords is situated in a certain vantage point. This leads to the conclusion that if justification is perspectival, a justified claim for a Newtonian such as the law of gravitation from *Principia* is no longer justifiable for an Einsteinian. The perspectival nature of justification is cashed out in terms of *standards of performance*. These standards monitor whether a knowledge claim

¹⁹ As (ii) explicitly shows, Massimi's concept of scientific perspective is backed up by a reliabilist epistemological framework. For present concerns, I shall not deliver an explicit defense of reliabilism.

satisfies the epistemic needs of a community (e.g. the need to generate genuine knowledge). For a specific knowledge claim to be counted as true it has to satisfy the standards of performance of a given perspective (Massimi 2016: 14). Consequently, the standards of performance define primarily the truth-conditions of claims within each perspective. For instance, a Newtonian knowledge claim is true if it provides a non-speculative explanation about the cause of gravitation. Such an agnostic claim qualifies as a proper and true claim since it satisfies the standards of performance of the Newtonian perspective. Those standards measure the performance of the relevant scientific knowledge claims:

These standards are used to monitor how well those scientific knowledge claims serve the epistemic needs of the original community. (Massimi 2018a: 153).

The standards of performance, as the Newtonian law of gravitation shows, may change throughout history because those standards are “subject to interpretative shifts” across scientific perspectives (Massimi 2018a: 154). This further claim provides an answer to the second question from the third section: whether simplicity has a clear meaning across scientific perspectives. Despite all these changes, truth-conditions defined by standards of performance should be assessable from the point of view of other (future) perspectives (Massimi 2016: 14). We can say that the truth-conditions of Newtonian knowledge claims should also be evaluated based on Einsteinian standards. Here is where standards of performance show that even if the relevant values are subject to interpretative shifts, they still perform the same function in all scientific perspectives. From our own perspective, we can assess what role simplicity plays in both Newtonian and Einsteinian perspectives and stress the continuity among them.

3.3 The perspectivist best system approach

We can now have a proper definition of the perspectivist best system:

Given a scientific perspective and given a set of standards of performance adequacy, laws of nature are those axioms or theorems of the perspectival best systems. (Massimi 2018a: 154)

Across the history of science there are many better systems that can be identified across scientific perspectives.²⁰ Every system reinterprets the standards of simplicity, strength, and their proper balance in its own way (Massimi 2018a: 154). This approach gives up on Lewis' assumption of an idealized and final God Eye's View best system. Instead, there are multiple intellectually and historically situated perspectives throughout history.

Speculation, the metaphysical commitment to the existence of a given phenomenon without being properly justified in believing that particular belief (Achinstein 2018: 1-2), could be considered a second-order methodological claim regarding at least some first-order scientific knowledge claims of both the Newtonian and relativistic scientific perspectives. Indirectly, speculation may also indicate a method for generating first-order knowledge, as a second-order claim that – imposes requirements first-order claims must obey. In our example, first-order Newtonian knowledge claims have to satisfy the second-order methodological norm of being non-speculative. As a corresponding outcome, a Newtonian first-order claim is a candidate for being true only if it follows the non-speculative requirement.²¹

The interplay between speculation and simplicity in both Newtonian and relativistic scientific perspectives is revealing for our purposes. It shows what simplicity means in both scientific perspectives; and *why* they are at odds. Newton exiles speculation from the body of scientific claims of the *Principia's* perspective under the formulation of the *Regulae Philosophandi* (Newton 2004: 89, 92). Newton explicitly states: “hypotheses non fingo” (“I feign no hypothesis”), meaning that speculations do not properly extend the boundaries of scientific knowledge.²² For instance,

²⁰ I shall not be pressing the question whether there are one-to-one relations between best systems and scientific perspectives.

²¹ For a Newtonian, a speculative claim is not a candidate for being a scientific claim. Being a non-speculative claim is only a necessary condition, but an insufficient one (e.g. a Newtonian claim can be non-speculative without being a proper claim — according to Newtonian standards of performance).

²² Hypotheses are, for Newton, ungrounded speculations.

the non-resisting *aether fluidum* model in *Query 28* and *Query 31* from the *Opticks* is not meant to be a proper scientific claim since it doesn't satisfy the second-order non-speculative methodology (Newton 2004: 86, 129). The *fluidum* is described as a subtle matter that pervades all the bodies in the world. It doesn't oppose any resistance to moving bodies. The *fluidum* model attempts to explain the cause of gravitation under the form of micro- and macro-repelling and attractive particles, but it cannot be a proper scientific claim.²³ It is *merely* a hypothesis. To assert the existence of the *aether fluidum* is a complicated move from the second-order methodological point of view. It violates Newtonian simplicity and fails to be a proper knowledge claim.

Einstein, on the contrary, advises scientists to speculate as much as possible, believing that speculation could be beneficial for scientific practices. One could envisage the latter example as giving us a glimpse of what relativistic simplicity stands for. To achieve simplicity in the relativistic perspective means to incorporate scientific claims obtained by speculation. It is the negation of the Newtonian methodological rule of thumb; imagine hypotheses, one might say from an Einsteinian perspective, perhaps because it could benefit the generation of knowledge.

3.4 *Perspectivism and the old ratbag objection*

I'll now argue that perspectivism can refute the first version of the old objection. The example above shows how radically different the Einsteinian and Newtonian perspectives can actually be – each of them with their unique concepts of simplicity. The ratbag idealist objection misses the point because perspectivism describes how standards of performance monitor knowledge claims across perspectives. The way to make perspectives commensurable one with another is to assert that standards of performance adequacy play the same role in each and every perspective. We can assess what standards of performance are and what function they perform only if we take a perspective as the

²³ It is almost unproblematic to say that Newton was in this respect agnostic and didn't need a causal explanation of gravitation – he could get by in theorizing without it.

standpoint from which we evaluate the continuity. Consider taking the Einsteinian perspective as the vantage point from which we assess the continuity between it and Newtonian perspective. From this point of view, both non-speculative and speculative simplicities perform the same role in their respective scientific perspectives. This assessment is made possible by taking a perspective as the view from which we evaluate the role of the standards. Instead, an evaluation of this continuity is impossible if we adopt a perspective from nowhere or everywhere. Note that my argument does not lead to a form of presentist *hubris* from where we take, say, the Einsteinian perspective to be the God Eye's perspective. Instead, the perspective we adopt will be plausibly someday superseded by another scientific perspective – the Einsteinian point of view is one perspective among many. To sum up, my reply to the first version relies primarily on the role performed by values, and not on the content of the values at stake.

We can switch to the second version. The perspectivist defender could explain why the laws of gravitation apparently seem to be, relative to the Newtonian and relativistic perspectives. The Newtonian and Einsteinian gravitation laws perform the role of theorems of their respective best system, albeit both perspectives have essentially distinct scientific claims, both first – and second-order, or different standards of performance adequacy. We can describe this example by highlighting that the perspectivist accounts for what is unique and what is common to every perspective. I call the role of a law as a theorem across multiple perspectives as *perspectival law*. For instance, the law of universal gravitation is still a law, even if the law as such is interpreted in different fashions in distinct perspectives. Perspectivism entails unproblematically that particular laws might mean different things according to different perspectives – gravitation as a true cause versus gravitation as curving space-time. The law of gravitation still performs the role of a theorem in all these series of scientific perspectives. As long as we can trace back the law of gravitation across perspectives, we can optimistically claim that this law is not relative to one or another perspective; in fact, it is valid as a law across perspectives.

From a metaphysical point of view, perspectivism depicts perspectival laws as perspective-independent states of affairs. What scientific perspectives

do, in turn, is to theorize about the nature of these laws or properties; the knowledge endorsed by the perspectives change without interfering with the existence of those states of affairs. Knowledge in regard to laws includes both information about particular laws and about particular concepts of lawhood.

3.5 *Perspectivism versus contextualism: the new ratbag idealist objection*

The perspectivist best system approach still confronts the ratbag idealist objection in at least two forms. The first version of the new objection points out that, not only the content of scientific values are subject to transformation, but this happens also with the role of values.²⁴ Consider the previous example again. The role of simplicity can change from the Newtonian to the Einsteinian perspective; simplicity cannot perform the role of monitoring the performance of values in *both* perspectives. If there exists, in principle, this possibility, how effective is the reference to its role? This new version is question-begging. Simplicity figures in our standards of performance, and thus succeeds in performing this role, as long as scientists are aiming at generating scientific knowledge within various perspectives. This amounts to saying that as long as scientific practice has the same epistemic goals (revolving mainly around the generation of knowledge) in both Einsteinian and Newtonian, there is no worry about sameness of role.²⁵ The standards of performance adequacy tend to be the same across theory-change (Massimi 2018a: 153). Simplicity, whether Newtonian or Einsteinian, monitors the relevance of the scientific knowledge claims at stake.

The second version of the new ratbag objection alleges that there is no unitary or unique concept of law across the history of science. A precise example of this version is Giere's law nihilism approach (Giere 2006: 70). The seventeenth century concept of law involves an entire

²⁴ I thank Ovidiu Babeş for raising this specific problem.

²⁵ I take inspiration from Massimi's answer to the following question: why do only simplicity and strength (and not other scientific values instead) matter in scientific practice? (Massimi 2018a)

theological framework, revolving around God as the governor of the World and as the source of lawhood. Within this framework, God governs the world through the laws of nature. Otherwise, passive bodies behave according to the sole will of God. Laws are ultimately rules or principles self-imposed by God as an hierarchical authority (Daston & Stolleis 2008: 7). The concept was imported from Christian theology and reached prominence in Descartes' writings on physics (Giere 2006: 70). The contemporary concept of law refers instead to abstract and highly theoretical principles that are used to build representational models of physical systems (Giere 2006: 60-62, 70-71). This latter acquired concept refers to symmetry, invariance and conservation principles. The concept has little to nothing in common with seventeenth century theology or metaphysics. The contemporary concept of law is purely secular, is borrowed from mathematics and contains no reference to top-down hierarchies, physical causation or any theory of matter. It has more to do with how a physical system and its features could be represented by modeling practices. Both philosophical pictures stand for distinct approaches to lawhood and seem to be at odds. This example is supposed to show the lack of unity of the concept of law across the history of science. Every perspective has its own concept of lawhood or, in contextualist terminology, every concept of law is relative to a perspective. So, perspectives have nothing in common regarding the concept of law.

I dispute, in reply to the second version of the objection, that Giere's example is not problematic after all. Granted that every perspective has a specific attendant concept of lawhood, it is definitely not a problem for perspectivism. I propose a solution to the second version by using again the concept of *perspectival law*. Scientific knowledge about how particular laws behave could change. The example regarding Newtonian and relativistic understandings of gravitation is a good test case. Concepts of lawhood that are paradigmatic for certain centuries from the history of science could change – and they do. Giere's own example amply shows this, since our contemporary knowledge about lawhood does not resemble the seventeenth century scientific perspective. But even if the concept of lawhood has radically changed from a profoundly religious to a secular and formalized concept, it is no bother for perspectivism. Instead, the

role of a law as an axiom of a system in a series of perspectives is not subject to any theoretical change.

What about the concept of perspectival law as an axiom in a series of perspectives? Is not the concept of axiom also supposed to change? Perhaps the concept of axiom changes over and over again, like our particular laws or particular concepts of lawhood.²⁶ I emphasize that, if the concept of axiom changes, that is unproblematic. Newton, for instance, did not have a highly formal concept of axiom, as twentieth century formalism was able to provide in the light of progress in the foundations of mathematics. Perhaps Newton would take the concept of axiom as a meaning the role of fundamental “rule” or “proposition” in his *Principia* (Steinle 2012: 228). But what both seventeenth century and twentieth century, or what both Newton and Einstein, certainly share is the belief in the role of law as something fundamental (call it proposition, rule, axiom or truth) in a system. That is the concept of a perspectival law.²⁷

Conclusion

I have outlined the prospects of how a perspectivist best system may deal with the ratbag objection. I argued that Lewis’ original reply is ineffective and has to be improved with perspectivist means. In particular, I tried to contribute to the debate in two ways. Firstly, I tried to extend Massimi’s example. Secondly, I attempted to see whether perspectivism successfully deals with two refined versions of the ratbag idealist objection. As a global diagnosis of the perspectivist approach, I optimistically believe it is well-equipped to deal with historical, theoretical and metaphysical difficulties. In sum, perspectivism does not provide only a particular account of lawhood, but a more general philosophical framework about historically situated scientific practices.

²⁶ I thank both Ovidiu Babeş and Andrei Mărăşoiu for raising this pressing question.

²⁷ Again, my answer rests on a distinction between role and (propositional) content of a law. The latter might be what a particular law refers to in a given perspective (the example with the divergent understandings of gravitation) – or the different concepts of lawhood (seventeenth century or twentieth century).

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