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Different Views of Laws of Nature*

Farklı Doğa Yasaları Görüşleri Üzerine

ÖMER FATİH TEKİN
Kastamonu University

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Abstract: There are roughly two main understanding in philosophy of science: Epistemology of Science and Metaphysics of Science. It is examined that some concept such as Laws of Nature, Causation, Time and Space into the metaphysics of Science. In this paper, it has been studied laws of nature which is one the most important subjects in metaphysics of science. Let's think outside the box, there are three significant views about laws of nature; Regularity Theory, Necessitation Theory and Dispositional Essential views. It has been worked the views of David Lewis in regularity theory. In the section of nomic necessitation we have been scrutinised the arguments put forward by David Armstrong and finally the last section; it has been discussed Alexander Bird's views of dispositional essentialism comparing with the other two aspects.

Keywords: Laws of Nature, regularity theory, nomic necessitation, dispositional essentialism.

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✉ Ömer Fatih Tekin, *Arş. Gör.*
Kastamonu Üniversitesi Fen Edebiyat Fakültesi Felsefe Bölümü
37150, Kastamonu, TR | oftekin@kastamonu.edu.tr

Introduction

Every morning, the train passes through in front of my house exactly at 8.30 am coming from Easton and leading towards Avon-mouth. This is regularity for me, because I have seen it every morning since I came to Bristol. On the other hand, when I drop my pencil, it falls down, attracted by the Earth. We have a tendency to generalize the latter kind of instances into a natural law, but do not have any tendency to do so for the first kind of instances. Historically, the latter kinds of instances are called regularities, and the former kinds of instances are called accidents. So, the basic discussion is about establishing a relationship between accidents, regularities, and laws of nature. More precisely, the question is whether accidents or regularities, (or both, or neither of them), lead us to the laws of nature. Put it in a more philosophical manner, the question is, then, "what is it to be a law?"

The discussion on the ontological position of the laws of nature has been divided into three main parts in the general history of science: Regularity Theory, Nomic Necessitation, and Dispositional Essentialism. Regularity Theory dates back to David Hume, but its modern development is due to David Lewis (1973). The fundamental view in this account is that laws of nature do not possess any physical necessity. Every time I drop my pencil, it accelerates towards the centre of the Earth at a constant acceleration rate. The law here is Newton's law of free fall (which is a special instance of Newton's second law and the law of gravitation), and the free fall of the pencil every time I drop it is the instance of these laws. Rather than attributing any physical necessity to the relation between the law and its instance, Regularity Theorists claim that the law is the collection of all these instances, and nothing more than that. Since we do not attribute any kind of ontology to the law itself, rather than being the totality of instances, (in other words, we make the *minimal* claim about the ontological status of the law), Bird calls this view "Minimalism about Laws" (Bird, 1998, p. 27).

An alternative view of the laws of nature that has been introduced as the rival of the regularity view is Nomic Necessitation. *Nomic*, or *nomological* here roughly refers to the empirical ontology of law-hood. The assertion is that there is something more to the laws of nature than being mere collections of instances. And this surplus or exceeding part is somehow related to ontology of law-hood. Since Regularity Theorists do not attribute any ontology to the laws of nature beyond being mere collection of instances, they do not assert any *necessary* relation between these instances and laws of nature. Rather, the relation is *contingent*. As for the nomic necessity, on the other hand, there is a *necessary* physical connection between instances and laws. This theory has been historically associated with David Armstrong (especially 1983). According to Bird (2007, p. 2), this "view of Armstrong gives laws much more ontological robustness". It does so because the identity between instances of a law and the law itself in the regularity theory has been avoided by the introduction of *universals*. Our basic problem of finding an intermediate step between instances of a law and the law itself, therefore, is solved by the introduction of universals. Recall here my claim that, although regularity theory's modern development is due to Lewis, its heritage lies in the work of Hume (2000; 2007). Despite prima facie opposition of two theories, the regularity theory and the nomic necessitation theory of Armstrong are both basically Humean (although it was argued that Armstrong's position is semi-Humean, it is still Humean). Some accepted that Armstrong's manoeuvre has made a step forward within the discussion by establishing a connection between the instances of the law and the law itself. However, they argued, the theory is still Humean and we should take a one more step forward by eliminating this Humeanism totally, in order to make the necessitation about laws of nature a much more plausible position.

Such a position has been introduced by Bird (1998, 2007). This position is called *dispositional essentialism,* which is a totally anti-Humean view. According to Bird, "the principal idea is that this essential relation [the relation between a property and other properties] can be characterised dispositionally" (Bird, 2007, p. 3). In dispositional essentialism, laws are necessary. Recall at this point that, although Armstrong provides a "view of laws that tied laws to the presence of *contingent necessitating relations among universals*" (Psillos, 2002, p. 161; italics original), laws of nature are still contingent in his account. In Bird's view, however, laws are ultimately necessary. This switch from the contingent nature of laws to the essential nature of them has been achieved by the introduction of the idea that all properties have dispositional essences, as opposed to the categorical monist view of Armstrong that all properties are categorical.

1. Regularity Theory

According to regularity theorists on laws of nature, there is no ontologically physical necessity in laws of nature. We can take this as a fundamental of this account. In regularity theory we can see only instances; it is unnecessary to add any ontological necessity to the relation between the law and its examples. For the proponents of this theory, it can be just a collection of all the instances as a law, and nothing more than that. As a consequence, in regularity theory, laws have no ontological attribution.

Regularity theory can be dated back to Hume (2000; 2007), and is supported by Mill (1947 [f.p. 1843]), Ramsey (1978 [f.p. 1928]) and Lewis (1973. 1983. 1986, 1994). In regularity theory, laws can be thought as the determinations of the world, and nothing else. This means that laws just report what is going on in the world. What I could see from instances, is just only the regularities, so we can just pick up these regular instances in this theory. Roughly speaking, laws are identified with regularities in this view. In other words, no ontological status other than being a collection of regular instances is attributed to the laws.

As mentioned in the introduction, Bird calls this view the "minimalism about laws". It can be said that regularity means a true generalisation, which is same as a true inductive conclusion. According to Bird, "one inductive conclusion we might draw is that all emeralds are green, and another is that all colitis patients suffer from anaemia. If these generalisations are true, then it is a fact that each and every emerald is green and that each and every colitis sufferer is anaemic" (Bird, 1998, p. 27).

Now, we can explain the simplest kind of minimalism; regularity theory indicates that there is a similarity between laws and regularity. We can call this view the simple regularity theory (SRT).

1.1. Simple Regularity Theory (SRT)

Regularity theory claims that the totality of regularities has the necessary and sufficient conditions of lawhood. To generalise, we can formalise laws in the following form:

$\forall x\ (Fx \rightarrow Gx)$

We can think of "F" as the property of "being made of metal", and "G" as the property of "conducts electricity". So, we read the above formula as follow: if something is a metal, then it conducts electricity. In regularity theory, the law that "all metals conduct electricity" is solely based on the totality of instances where we observe that a metal regularly conducts electricity. No further ontological status is attributed to laws, other than the totality of instances (metals conducting electricity). This position is called the "Simple Regularity Theory". On the SRT account, then, a law is just a report of a bunch of observations. In other words, we claim here that laws and regularities are the same.

The definition of formulate of simple regularity theory, then, would be as follows:

SRT: it is a law that Fs is Gs if and only if all Fx are Gx.

I have said earlier that the regularity theory of laws has its roots in the philosophy of Hume (1738, 1748). When it is said that it is a law that metals conduct electricity, Humeans, like Lewis, mean that there is regularity in nature according to which when a metal is subject to electricity, it conducts a current. Notice that there is no necessity in this regularity account of laws, since it is a logical possibility that a metal could be subject to electricity and does not conduct a current; also there is nothing in the nature of a metal that makes it the case that, necessarily, it will conduct electricity when subject to a current.

However, when we do not establish any *necessity* between particular instances and the law, (in other words, when we assert that the law is just the totality of these instances), we would not be able to differentiate between the laws of nature and accidents, since both are regularities. So, this leads us to think that there should be something more to the laws than mere regularities, if we do not want to reduce laws of nature to mere accidents. Finally, it can be seen that, even the most simple regularity theorists would intuitively accept that the fact that the train passes through in front of my house exactly at 8.30am every morning *is not* a law, whereas 'all metals conduct electricity' *is*. This fact implies one of the most common criticisms against the regularity theory of laws, that not *all* *regularities are laws*. Since accidental generalizations are not laws, being regularity is not sufficient for being a law.

The second common argument that has been used to single out the weakness of regularity theory of laws is the idea that *not all laws are regularities*. In other words, being regularity is not *necessary* for being a law. For example, we cannot see ideal conditions laws into the world. Newton's second law of motion asserts that acceleration is produced when a force acts on a mass: the greater the mass, the greater the amount of force needed. The formulation is as follow:

$F = ma$.

In other words, it is asserted that if the total force acting on an object with a mass "m" is zero, then this object would not accelerate. However, this is just an idealized condition that we cannot find any instance of, since we cannot observe an object with a zero total force acting on it. So, we talk about a law (Newton's second law of motion), but we do not have any instance of it in the real world. In other words, we have the law without any regularity. Similarly, the ideal gas law can be formalised as follows: PV = nRT, where "P" is the pressure, "V" is the volume, "n" is the number of moles, "R" is a constant number, and "T" is the temperature. We can say, for instance, that if we keep pressure (P) and the number of moles (n) unchanged, the volume (V) would be increased or decreased in proportion to the temperature (T). Again, however, there are no such idealized instances in nature where P (and n) is kept unchanged.

Although we claim here that we are talking about a *law* where we haven't observed an *instance* of it, this ideal gas law gives us information about instances that have not yet been observed. In other words, it seems that such a law would allow us to infer what *would* be the case *if* certain conditions were met. This is the point where Lewis's counterfactual theory gets into the discussion as a solution to the problems of the simple form of the regularity theory of laws.

1.2. Counterfactuals

Recall our basic question: "what is the difference between accidental generalization and a law?" We have seen that the simple regularity theory fails to provide any difference. At this point, counterfactuals seems to have potentiality to help us, in the sense that they might be used as a tool to differentiate between when a statement is a law and when it is just an accidental regularity.

A counterfactual has the following form: if it were that A, then it would be that C.

In order to see how the introduction of the concept of counterfactual helps us to differentiate between genuine laws and accidental generalizations, let us start with some examples follows;

Here is the first statement: if the rails of train going from Easton to Avon-mouth had been heated, it would have expanded. However, in the UK, weather generally cannot be very hot in summers. In real condition, the rails are not expand. Therefore, there will be no changes in the properties of rails when unless are not heated. This is related to what would have happened in non-actual worlds.

Here is the second statement: if I had studied hard, I would have passed the exam. In actual world, I will pass exams when studying hard. It can sometimes be coincidence between possible world and actual world. On the basis of this generalization, we cannot find anything. This statement does not based on any laws; this is just an accidental generalization.

In the first example, we can see it is true, since there is a law based on the statement that metals expand when heated. On the other hand, second example seems to be just an accidental generalization.

Here, the counterfactual statement that "Had the rails of train going from Easton to Avon-mount been heated, it would have expanded" does not refer to an instance that we have observed. In other words the statement is not about what actually happened. Rather, it is a statement about what would have happened in a possible world where the rails of train is heated (recall that the rails *are* not heated in the actual world). The basic idea here is that laws support counterfactuals, while accidents do not. So, at a first glance, a counterfactual theory of laws seems to be more plausible and strong enough to show that we should abandon the minimalist theory. By the introduction of the information about what would have happened in some possible worlds, counterfactual theory seems to provide much more information than the regularity view, where the laws are conceived solely as instances of what actually happens.

However, as Bird rightly points out, "laws support counterfactuals only because counterfactuals implicitly refer to laws. Counterfactuals therefore have nothing to tell us about the analysis of laws" (Bird, 1998, p. 34). Moreover, when we say all Fs are Gs, we say something about Fs and Gs here in our *actual* world. It does not have anything to do with the possible worlds where there are different Fs. This is the reason why counterfactuals do not provide an analysis of laws in Bird's terms.

So, these difficulties show that no modification of regularity theory provides a genuine understanding of laws of nature. Therefore, in the next section I will discuss the position of David Armstrong, where laws are described as contingent, but are given a much stronger character by the introduction of nomic necessitation.

2. The Nomic Necessitation Theory

So far, we have seen that we need more than mere contingent regularities for something to be a law. We have also seen that, although the counterfactual analysis of Lewis provides prima facie advantages over simple regularity theory, they have their own problems and cannot establish a satisfactory link between laws and their instances.

The necessitation theory, which was developed by Armstrong (1983), Dretske (1977) and Tooley (1987), is against the regularity theory of laws of nature. This is because in regularity theory laws are not physically necessary, whereas in necessitation theory, the connection between an instance of a law and the law itself is established by necessitation. The necessitation theory, therefore, puts forward that laws are something more than the just collections of instances.

Here is the formulation of nomic necessitation: it is a law that *Fs* are *Gs* if and only if *F*ness necessitates *G*ness. Fness and Gness here are universals; hence the necessitation is introduced as the connection between universals. To be more precise, a law can be identified as *relation of necessitation* between two *universals*. Or, a law is a particular *property* that holds of two *general properties* that hold of an *individual* (i.e., a law is a particular *relation)*. This particular relation is called *necessitation*.

Therefore, the difference between genuine laws and accidental generalizations has been highlighted by the introduction of universals. Let's remember our famous law, "all metals conduct electricity". Nomic necessitation claims that this law is not the sole expression of the regular succession of two instances (or two event-types). Rather, it says something more than that all metals conduct electricity, in the sense that it explains a relation between two *universals* or properties: the property of being a metal ('metal-hood') is always co-instantiated with the property of being conductive (conductivity), since there is a necessitation relation between these two properties (metal-hood and conductivity) that guaranties the co-instantiation.

The necessitating relation N (F, G) between the universal (or property) of Fness and the universal of Gness seems to provide a solid basis to differentiate between genuine laws and accidental generalizations. However, in order to understand the nature of this "N" relation, it is essential to recognize the difference between first order and second order relations. We can describe a first order universal as a predicate of or relation among specific things although a second order universal as a predicate or relation among first order universals. So if we return to our example that "all metals conduct electricity", *being metal* and *conducting electricity* are first order property of particular things, such as iron. And the second order relation among first order properties of this particular iron, or the relation among *being metal* and *conducting electricity,* is the necessitation involved within the laws.

There are several advantages of this account. Firstly, the introduction of necessitation definitely provides a strategy to differentiate accidental regularities and genuine laws. Although, regularity does not have to be an instantiation of law, all instantiations of laws are regularities. (Instantiations of laws are formed of only those regularities that are characterized by the necessitation relation). Secondly, the nature of scientific explanation: a considerable number of scientists believe that the main duty of science is to provide *explanation* for observed phenomena. By the introduction of necessitation, an explanation for law-like regularities is provided. The intuition is that the presences of those regularities that are instantiations of laws are explained by necessitation relation: why is my pencil subject to free fall near the Earth with certain acceleration when I drop it? Because my pencil has the first order properties of *having mass* and *being attracted in a gravitational field;* and because there is a second order relation among these first order properties, namely the necessitation involved in the law that massive objects are attracted in a gravitational field. So this additional second order property explains this regularity. Thirdly, there is an induction on the basis of this account. In this account, nomic necessitation theorists claim that there is no chance of being provided with a satisfactory understanding of induction by the SRT view. The idea is that the necessitation relation supplies the metaphysical "connectivity" which enables us of causal inductive inferences. It cannot be justified by such causal inductive inference, unless there is allowance for some form of connectivity.

On the other hand, on this account there are several problems, the first being concern about the vague nature of this necessitation relation: what is it? Any definition seems to have a disadvantageous position in terms of distinguishing it from SRT account. The objection is that we do not have experience of the universals. Although Armstrong's position differs from that of the Platonists in the sense that he does not argue for the existence of universals outside space-time (greenness does not exist independently if there are no green particulars), the nature of necessitation as a universal is still problematic for some. A regularity theorist, for instance could basically argue that nomic necessitation theorist will be able to saying nothing at all due to the fact that the argument of 'Fness necessitates Gness' is the same as the argument of 'there is a law that Fs are Gs'.

The second concern is about the epistemological status of this necessitation relation: how do we know it? Necessitation is in principle an unobservable property, since it is a universal. At this point, consider two worlds W_1 and W_2, which are empirically equal, meaning that both worlds agree on all observable regularities. Nomic necessitation theorists seem to be forced to claim at this point that these two worlds with common observable regularities might have different laws of nature. Now, the question for the nomic necessitation theorists is this: if the laws of nature are different in these two worlds, how could we come to know this difference, given that all observable regularities are same? If our only access to laws is through *empirical observations* of regularities in nature, then how could we establish the epistemic basis that allows us to draw the conclusion that W_1 and W_2 are different? Although the nomic necessitation account has been introduced to solve the problems of earlier account (SRT), this theory seems to have better plausibility in the face of this epistemological problem (how do we know the necessity between universals and instances). In SRT theory, on the other hand, since the laws are basically identified with regularities, if W_1 and W_2 have the same observable regularities, then *they are the same*.

Moreover, in nomic necessitation theory, there are several problems such as identification and inference problems can be faced. Actually, the problem is obvious; in nomic necessitation theory, there is a necessitating relation between properties and universals N (F, G), we have no idea what relation is, since there is no explanation. In addition, nothing to say that how the collection of regularity All Fs are Gs establishes. According to Psillos,

> Armstrong insists that N (F, G) entails the corresponding (Humean) regularity. All Fs are Gs; but it is not clear at all how this entailment goes if the regularity All Fs are Gs is contained in N (F, G) as the sentence P is contained in the sentence P & Q, then the entailment is obvious. But then there seems to be a mysterious extra Q in N (F, G) over the P (= All Fs are Gs). And we in the dark as to what this might be, and how it ensures that the regularity obtains. (Psillos, 2002, pp. 164-165).

The problems that are identification and inference problems are established by van Fraassen (1989, p. 38-39) that should be faced and solved by any sufficient theory of laws. There is a duty for any account of laws that explains how to assign laws, and in particular what difference laws from accidental generalisation. Identification problem can be solved by this way; for van Fraassen, reductionist account of laws can solve the inference problem because laws are regularities, but it can fail to sufficiently cope with the identification problem because it is not the issue that the differentiation between laws and accidental generalisation. However, van Fraassen argues that there is no better way in the non-reductive view of laws. It means that it can solve the problem of identification because laws can be identified with necessitation relations among universals

–we can obviously see that it is different laws from accidental generalization, but it can fail to solve inference problem because, "even if the so-called necessitating relation among universals is cogent, there is no valid inference from a necessitating relation among universals to the corresponding regularity" (Psillos, 2002, p. 165). The last objection is related to Tooley's view. Tooley claims that "the fact that universals stand in certain relationships may logically necessitate some corresponding generalisation about particulars, and that when this is case, the generalisation in question expresses a law" (Tooley, 1977, p. 622). As we have seen earlier, there is a nomic relation between Fness and Gness, and the corresponding general statement 'All Fs are Gs' are deduced from it.

Let's see Armstrong's position about the nomic necessitation. Armstrong tries to explain the necessitation relation N (F, G) and solve the inference problem. His argument is that

> The relation N (F, G) is itself a universal, which is instantiated in the positive instances of laws. Take, for instance, laws such as All ravens are black, All metals expand when heated, All planets move in ellipses and the like. On Armstrong's view they all have forms of the same type: N (F, G), N (P, Q), N (R, S), and so on. They all fall under the type N (Φ, Ψ) where Φ and Ψ are second-order variables ranging over first-order universals. So the relation of necessitation N (Φ, Ψ) is a second-order relation (universal) whose relata are first-order properties (i.e. first-order universals). (Psillos, 2002, p. 166).

For Armstrong universals mean that it can be repeatable and recurring speciality of nature. For example, it can be said that there are two bananas on the table and they are both yellow, it should be meant, at least for Armstrong, the instantiations of the two particulars (the bananas) have the very same property (yellowness). Yellowness is a repeatable component of things that is to say that different particulars have the instantiations of the very same yellowness.

In Armstrong's position, firstly properties are first-order universals, and secondly, there is a hierarchy of higher-order universals. This is basis on the Armstrong's view. Armstrong argues that it needs to be suggested higher-order properties, relations of first-order properties and relations. According to Armstrong, laws of nature are higher-order properties, since the main reason is that the relation of necessitation is necessary to be accounted for it. This explanation is a repeatable and recurring speciality of nature, so it is a universal because it provides the main criteria for being a universal. As we have seen before, the relation of necessitation N (Φ, Ψ) is a recurring component of all laws. Armstrong, therefore, considers, it is a second-order universal. According to Psillos, "Admitting that N (Φ, Ψ) is a universal, argues Armstrong, can lead us to see how a specific necessitating relation N (F, G) is such that is guarantees that the corresponding regularity All Fs are Gs obtains" (Psillos, 2002, p. 167). So it can be though that the inference problem can be solved like this.

Alexander Bird (2007) has shown the weakness of the necessitation account of Armstrong by highlighting the contingent characteristic of laws in this nomic necessitation account. He calls Armstrong's position semi-Humean, since the contingent nature of necessitation in his account does not provide a complete break with Humeanism. Unless the necessitation relation in Armstrong's account is provided on a metaphysical basis, (in other words, unless the contingent nature of the necessitation in his account is replaced by a metaphysical understanding of necessity), his arguments would not be able to provide a better position than the regularity theory. The emphasis, therefore, is on the metaphysical nature of necessity (Bird, 2007, p. 2-3).

3. Dispositional Essentialism

So far, we have seen that there are two main approaches to the nature of laws of nature. One of them is the regularity conception of laws (and counterfactuals against the SRT), and the other, the view of nomic necessitation. However, as we will see, there is another account for the laws of nature, called dispositional essentialism, which rejects the previous accounts. Dispositional essentialism differs from the previous two understandings of the laws of nature in two fundamental ways. First, laws are thought to be *contingent* on the two previous accounts, whereas *metaphysical necessity* has been introduced by the dispositional account. Second, while properties are thought to be *categorical* in the two previous accounts of laws, in the dispositional account, they have essential nomic or causal powers. In other words, properties in dispositional essentialism are thought to be something nomic, whereas in earlier accounts they have been introduced as having non-nomic (this is what categorical means in that regard) nature.

After the explanation and comparison of the preceding competing views, we can start to examine the dispositional essentialist view of laws of nature. In dispositional essentialism, as a kind of dispositional realism, unlike the previous views of laws of nature, it can be said that the nature of the fundamental natural properties is at the centre of this view. It is a metaphysical stance that, according to Ellis and Lierse,

> It is realist about the dispositional properties of the fundamental particles and fields and essentialist for two reasons: first, because it holds that these properties are amongst the essential properties of these particles and fields; and second, because it holds that it is essential to the natural processes in which these particles and fields may be involved, that they should be displays of these dispositional properties (Ellis and Lierse, 1994, p. 39).

In dispositional essentialism, perhaps not all fundamental natural properties can be seen to be held as dispositional. According to Bird's definition, however, dispositional essentialism is the claim that "at least some sparse, fundamental natural properties (and relations) have dispositional essences" (Bird, 2007, p. 45).

A disposition is characterised by its stimulus and response or manifestation. For example, we can use the popular example that objects have the property of being soluble: there is the process of dissolving as the manifestation; and there is the object being put into water as the stimulus. "At a more fundamental level inertial mass can be characterised as the disposition to respond to the stimulus of a force by accelerating in inverse proportion to that mass" (Bird, 2005, p. 354). In this context, it can be thought that there is a counterfactual relation between stimulus and manifestation. Thus, if a soluble object were put into water, then it would dissolve; "if an inertial mass were subjected to a force, then it would accelerate in proportion to that force" (Bird, 2005, p. 354).

To put it another way, the structure of dispositions is established by helping the propositions of conditional form. For instance, glasses always break when they are dropped; this means that glasses are fragile, which is to say that a glass will break, if the glass is subjected to being dropped.

"Similarly, to say that this piece of rubber was elastic is to assert a proposition with content close to: had this piece of rubber been moderately stressed, it would have deformed in a non-permanent fashion" (Bird, 2004, p.1).

Dispositional Essentialism can be divided into two separate parts: dispositional monism and the mixed view (some properties are categorical and others are dispositional). There are many philosophers who defend this view taking a stronger positon such as Popper 1959; Harré 1970; Harré and Madden 1975; Shoemaker 1980; Mumford 2004; Bird 2005, 2007; Chakravartty 2007; Whittle 2008. Dispositional monism or causal theory of properties or simply named dispositionalism asserts that the fundamental properties have dispositional essences, whereas the mixed view claims that some properties have dispositional essences and some do not. According to Bird, "dispositional essentialism is the claim that at least some fundamental natural properties have dispositional essences" (Bird, 2007, p. 45). Therefore we hold dispositional monism instead of the mixed view because it has metaphysical necessity and essential nomic or causal powers.

In dispositional essentialism, it can be thought that the essence of a property P is characterised by nomic and causal powers essentially. The nomic power of P is a sentence that symbolises the totality of the real meaning of the theory. The causal power of P, on the other hand, is its causes and effects potentially. Thus, properties are implied the following identity condition by dispositionalism: properties P and Q can be the same as each other if and only if they play the same nomic and causal powers. It is important because a property P which has the nomic and causal powers identifies how its instances are disposed to act or react under various circumstances. Therefore, on dispositionalism, any property (that is P) gives its instances with the same disposition[1].

Let's start introducing the conditional analysis of disposition. It is the central form of the dispositional essentialist view of laws of nature.

A conditional analysis of a disposition might be formulated as follow:

[1] http://plato.stanford.edu/entries/dispositions/#CatDisLawNat

(CA) $D_{(S, M)}\, x \leftrightarrow Sx \mathrel{\square\!\!\rightarrow} Mx$.[2]

It can be deduced from (CA) that (Dx & Sx) → Mx is always true. There is a universal truth, ∀x ((Dx & Sx) → Mx) when we take 'x' as a general variable. So it can be seen that the universal truth follows (CA). In dispositional account of laws, we can say that, all laws can be identified by this.

(CA) is metaphysically necessary because it characterises the nature of the property D and is analysis of the dispositional concept 'D', since the dispositional nature of properties is held as essential by the dispositionalist. As a result of this, it can be seen that the dispositional law statement ∀x ((Dx & Sx) → Mx) can be seen as necessary.

So, we can understand that the dispositional law contains both dispositional essentialism and (CA).

This account of laws of nature suffers from the objection that CA is false. In order to understand what this objection actually amounts to, let's first see what finks and antidotes are. "A finkish disposition is one which is caused to cease to exist by its own stimulus" (Bird, 2005, p.358). So a finkish disposition is ceased and changed by its own stimulus. In the case on an *antidote*, on the other hand, the disposition itself is left unchanged but it "alters the environmental conditions that are required to permit the disposition to yield its characteristic manifestation" (Bird, 2005, p. 359).

Let's examine finkishness in more detail. There are some dispositions such as fragility, solubility, flammability, and so on. A finkish disposition is one of the counterexamples to conditional analysis. Consider an object that has the disposition of fragility. When we involve it in a chemical reaction, the fragile disposition can change positively or negatively. An object, for instance, when we make it cool suddenly, may become fragile and the fragility of disposition may be lost by being heated. So for example, x is fragile, for each object x, if x is dropped, x would break. When we heat the object quickly enough, the objects loses its fragility. Imagine a mechanism that is able to heat or cool an object very quickly

2 Here, '$D_{(S, M)}$ x' stands for the statement that 'x is disposed to yield M in response to stimulus S', and '□→' formulated the subjunctive/counterfactual conditional, so that 'Sx □→ Mx' abbreviates 'if x were S it would be M'.

when it is dropped or struck. When the object loses its fragility quickly enough, the dropping will not cause it to break. Although it was dropped, it did not break; however, at the time of dropping, the object was fragile. So we have a counterexample to conditional analysis. Bird says,

"The object **a** has the disposition D, i.e., D**a** (**a** is disposed to break when struck). We also have S**a** (**a** was struck), but we also have $\neg M$**a** (**a** did not break); hence we have $\neg$ (S**a** $\rightarrow$ M**a**)" (Bird, 2005, p. 358).

In addition, the reverse of this finkishness may be displayed. Consider an object that is not disposed to be fragile. If it is cooled fast enough, then the act of dropping makes it fragile. So if it is dropped, it would break. However, at the time of dropping the object is not fragile i.e. $\neg D$**a**. Hence, (S**a** $\rightarrow$ M**a**).

After the explanation of finkishness, now we can introduce further counterexamples to conditional analysis, which we describe as antidote. 'Antidote' can be used to described environmental interference with provisional causal events that are counted from a disposition's stimulus s to manifestation m. It is obvious in Bird's example:

> a poison requires not only its own chemical or biological constitution to cause illness; it also requires the participation of the victim's body. On ingesting a poison that would normally cause illness, a person may take an antidote that interferes with the metabolic pathways the poison would otherwise have exploited, preventing the poison from doing harm. (B2005, p. 358).

This situation is different from the fink situation. Because the characteristic properties of the poison were not changed, unlike in finkishness (i.e. something fragile was made non-fragile), and the constitution of the poison is still robust. Therefore, an antidote to a disposition is that the poison is still disposed to cause illness when ingested.

Conclusion

The discussion of the ontological position of the laws of nature has been divided into three main views: Regularity Theory, Nomic Necessitation, and Dispositional Essentialism. The fundamental view in Regularity Theory is that laws of nature do not possess any physical necessity. Roughly, regularity means here a true generalisation, which is the same as a true inductive conclusion. Regularity theory claims that the totality of regularities has the necessary and sufficient conditions of law-hood. In this account, the law that all metals conduct electricity is solely based on the totally of instances where we observe that a metal regularly conducts electricity. No further ontological status is attributed to laws, other than the totality of instances (metals conducting electricity).

Notice that there is no necessity in this regularity account of laws since it is a logical possibility that a metal could be subject to electricity and not conduct it, and also there is nothing in the nature of a metal that makes it the case that, necessarily, it will conduct electricity when it is subject to a current. However, when we do not establish any *necessity* between particular instances and the law, in other words, when we assert that the law is just a totality of these instances, then we would not be able to differentiate the laws of nature and accidents, since both are regularities. So, it leads us to think that there should be something more to the laws then mere regularities, if we do not want to reduce laws of nature to mere accidents. This fact implies one of the most common criticisms against the regularity theory of laws, that not *all regularities are laws*. Since accidental generalizations are not laws, being regularity is not sufficient for being a law. The second common argument that has been used to single out the weakness of regularity theory of laws is the idea that *not all laws are regularities*. In other words, being regularity is not *necessary* for being a law. For instance, there are no-instance, or ideal conditions laws. Although we are talking about a *law* where we have not observed an *instance* of it, it still allows us to infer what *would* be the case *if* certain conditions were met. This is the point at which Lewis's counterfactual theory gets into the discussion as a solution to the problems of the simple form of the regularity theory of laws.

The nomic necessitation theory is against the regularity theory of laws of nature. This is because, laws are just regularities, there is no physical necessary in regularity theory. On the other hand, in necessitation theory, both the instance of law and law itself is established by the connection of necessitation. The necessitation theory, therefore, bring forward that laws are something more than a collection of regularities.

In this account, thanks to the introduction of universals, the difference between genuine laws and accidental generalizations has been foregrounded. Recall at this point that our famous law, all metals conduct electricity. According to nomic necessitation theorists, this law cannot be a sole expression of the regular progression of two instances (or two event-types). Rather, for the nomic necessitation theorists, the law says something more than that all metals conduct electricity, in the sense that it describes a relation between two universals or properties: the property of being a metal (metal-hood) is always co-instantiated with the property of being conductive (conductivity), because the necessary relation between these two properties (metal-hood and conductivity) guarantees the co-instantiation.

Armstrong's position for the universals is not the same as the Platonists in the sense that Armstrong do not want to claim that the existence of universals are outside space-time (there is no existence of redness independently when red particulars do not have). However, there are still some problems for the nature of necessitation as a universal according to some philosophers. A regularity theorist, for instance, could essentially argue that nomic necessitation theorists will really be saying nothing at all due to the fact that there is no difference between the argument of 'Fness necessitates Gness' and 'there is a law that Fs are Gs'.

The third view is dispositional essentialism. The view differs from the two previous understanding of the laws of nature in two fundamental ways. First, laws are thought to be *contingent* on the two previous accounts, whereas *metaphysical necessity* has been introduced by the dispositional account. Second, while properties are thought to be *categorical* in the two previous accounts of laws, in the dispositional account, they have essential nomic or causal powers.

In dispositional essentialism, the essences of properties are established by nomic and causal powers essentially. The causal power is related to its causes and effects potentially and the nomic power is related to the real meaning of the theory. Properties are implied by dispositionalism such that P and Q could be identical each other when they have the same powers (causal and nomic). So, properties empower their instances with the same disposition.

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Öz: Bilim felsefesi çalışmalarında kabaca iki anlayış mevcuttur; Bilimin epistemolojisi ve Bilim metafiziği. Bilim metafiziği alanında doğa yasaları, nedensellik, zaman, uzam gibi kavramlar incelenmektedir. Bu çalışmada bilim metafiziği içindeki önemli konulardan biri olan doğa yasaları incelenmiştir. Büyük çerçeveden bakarsak doğa yasaları konusunda üç önemli bakış açısı vardır; Düzenlilik Teorisi (Regularity Theory), Gereklilik (Nomic Necessitation) ve Fıtratsal Özcülük (Dispositional Essentialism). Düzenlilik teorisinde David Lewis'in görüşleri incelenmiş, Gereklilik bölümünde David Armstrong'un ileri sürdüğü iddialar irdelenmiş ve son olarak fıtratsal özcülük kısmında ise Alexander Bird'ün ifadeleri diğer iki görüş ile karşılaştırılarak tartışılmıştır.

Anahtar Kelimeler: Doğa yasaları, düzenlilik teorisi, gereklilik teorisi, fıtratsal özcülük.