**Summary**

Dretske’s aim in the paper is to defend the view that the defining characteristic of a law of nature is a relation not between particulars but between universals; i.e. not between Fs and Gs but between F-ness and G-ness.

**Text**

- Empiricists have tended to identify laws of nature with a certain class of universal truths. For instance, \((x)(Fx \supset Gx)\) or \((x)(Fx \equiv Gx)\), where \(F\) and \(G\) are purely qualitative (non-positional\(^2\)). Dretske gives Hempel’s examples (“All metals conduct electricity”, etc). We are supposed to be able to understand quantitative laws by using functors in place of the Fs and Gs. This is not Dretske’s view, but one to which he thinks empiricists are “tempted”.

- The editor of the volume in which this paper appears objects to Dretske’s “functors” description (though saying that this doesn’t affect any of the philosophical issues debated in the chapter). The concern is that predicate logic doesn’t have the resources to cope adequately with quantitative laws. While functors convert equations into functions that can act as predicates, they do so degenerately. For the ideal gas law \(PV = nRT\), there are several possible functors, and the two proposed by the editor are (a) “is identical to \(nRT/V\)” so that in our predicate expression \((x)(Fx \supset Gx)\), \(Fx\) is “\(x\) is the value of the pressure of an ideal gas” and \(Gx\) is “\(x\) is identical to \(nRT/V\)”. And, (b) “obeys the equation \(PV = nRT\)” so that in \((x)(Fx \supset Gx)\), \(Fx\) is “\(x\) is an ideal gas” and \(Gx\) is “obeys the equation \(PV = nRT\)”. Now (a) biases the gas law towards \(P\) (it is really about all the variables) and (b) effectively says that ideal gasses obey the ideal gas law, which hardly displays that law.

- Getting back to the standard view, Dretske thinks the reasons for the “temptation” are that if the content of a law was considered greater than \((x)(Fx \supset Gx)\), it would be beyond our epistemological grasp. The data we have to work on are of the form “all examined Fs have been G”. Some philosophers want to go beyond “all Fs are (as a matter of fact) always and everywhere G” to say that all F’s are necessarily G; but where could the evidence for this come from? If the Fs and Gs are modally connected, in looking for evidence we’d be in the position of someone searching for evidence for an analytic relation (eg. by checking bachelors to see if they were unmarried men). Such evidence, while it might confirm the truth of the connection doesn’t confirm its modality. So, if a law has to describe a necessary connection, how would we ever confirm this from individual observations?

- Dretske thinks that despite this epistemological problem, there’s more to a law than it being a universally true statement. Consider \((x)(Fx \supset Gx)\), with the predicate expressions satisfying all the restrictions necessary for it to be a statement of law. Now consider a predicate \(K\) that is externally co-extensive with \(F\) for all time, ie. \((x)(Fx \equiv Kx)\). Then for an universally true statement of the above form, this ought to imply \((x)(Kx \supset Gx)\). While the class of universal truths is

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1 Note “≡” is “iff” not “identical to”!

2 This terminology hails from Goodman’s *Fact, Fiction and Forecast*. A predicate is positional if it contains reference to particular individuals or places (but maybe not times!).

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closed under the operation of coextensive predicate substitution, this isn’t the case for laws, as it depends whether the coextensive equivalence is itself a law. The example Dretske gives is F as “is a diamond”, G as “has a refractive index of 2.419” and K as “is mined in kimberlite”. It is not a law that “all things mined in kimberlite have a refractive index of 2.419”.

- Dretske now introduces the concepts of opacity and transparency of predicates, those in statements of law being opaque while those in universal truths are transparent.

- These concepts come from the theory of reference within the philosophy of language. If we can substitute one co-extensive expression for another in the predicate without changing its truth value, the predicate is transparent, otherwise opaque. Hence, “… lives in water” is transparent because if we substitute “the largest mammal on earth” for “blue whales” we still have a true statement. However, the two-place predicate “… knows that … lives in water” is opaque because someone might not know that blue whales are the largest mammals on earth. Modal contexts are also opaque – blue whales are necessarily whales, but the largest mammals on earth are not necessarily whales.

- Dretske applies this distinction by saying that “It is a law that all Fs are Gs” is opaque. It’s not that the truth value of “all Fs are Gs” changes on substitution of some coextensive K for F, for it stays the same – as does the truth value of “it is universally true that all Fs are Gs” - but the truth value of the claim to being a law changes.

- Some philosophers have argued that natural laws have the same empirical content as universal truths, and that any differences are only in their roles, use or functions – being extrinsic rather than intrinsic. Natural laws are just more closely integrated into the corpus of scientific theory, have survived more tests, etc.

- This reductionist view says that “law = universal truth + X”, where X is some extrinsic extra that induces the opacity. Favourite candidates for X are (1) High degree of confirmation; (2) Wide acceptance; (3) Explanatory potential; (4) Deductive integration; and (5) Predictive use. The opacity is induced by possible ignorance of coextensivity or other epistemic conditions.

- This is a venerable approach in the Humean empiricist tradition, motivated by ontological and epistemological commitments. While there is disagreement about what the differentia X are, there is agreement that laws are a species of universal truth.

- There is another explanation of the opacity of laws. Following Frege, the operator “it is a law that” changes the referents of “F” and “G” in the expression “all Fs are Gs”, making positions that were transparent opaque. In the context of a law, “all Fs are Gs” is not a statement about the extensions of “F” and “G” but about a relation between the universal properties F-ness and G-ness. So “it is a law that Fs are G” is to be understood as F-ness → G-ness³.

- So, “all Fs are G” is understood as a relationship between the extensions of “F” and “G”, whereas if it is a law, it expresses a relationship between F-ness and G-ness. Consequently, even though “F” and “K” may be co-extensive, there is no guarantee that there will be a relation between K-ness and G-ness just because there is one between F-ness and G-ness. This is what makes laws opaque.

³ Dretske has a footnote explaining that the symbol “→” has no special significance but is a dummy connective or relation between the universals under consideration, whose precise significance depends on the law in question and the particular relation between the universals. “=” or “yields” are possible.
Substitution of one co-extensive predicate for another does not preserve truth-value.

- This is the view that Dretske defends in the paper. He quickly points out an intrinsic difference between true law-like statements and laws themselves. The former are singular statements of fact expressing a relationship between properties or magnitudes – universal qualities and quantities; the latter are the relationships themselves. Universal truths cannot be transformed into laws by acquiring the extrinsic properties of laws, described above, for they cannot function in these ways.

- The attractiveness of the formula law = universal truth + X lies in its ontological austerity, but we must resist its seduction as it epistemologically and functionally hopeless.

- “Confirmation” & “Acceptance”\(^4\): Though the formula explains the opacity of laws, it fails because values of X above such as (1) “confirmation” and (2) “acceptance” are epistemic notions and are therefore irrelevant to understanding the nature of laws, which are laws whether or not there is anyone around to know them. Laws are discovered rather than invented. It is the expression or statement of law and whether that statement is true or false that is validly epistemological; the ontological question of the existence of laws themselves is entirely separate.

- We should never confuse statements of law with the laws themselves. Laws can be variously expressed symbolically or verbally. A law is the proposition expressed, not the vehicle of expression.

- Dretske now examines whether the notion that laws are universal truths + X is capable of explaining the fact that laws support counterfactuals. He gives two examples. The second is easier to understand than the first, and is as follows.

  - The fact that all Fs are G does not support the counterfactual “if this non-G were an F it would be a G”. The fact that all marbles in a bag are red, does not imply that if I put this blue marble in the bag it would be red. Even if all the marbles in the whole universe have been and will be red, this does not mean that I cannot manufacture a blue marble – it just means that I won’t. We are left with the counterfactuality condition of laws totally unexplained.

- The first is more difficult to understand and involves cocker spaniels. We are supposed to imagine why we might believe the claim that all dogs born at sea have been and will be cocker spaniels. Why would the possible counterfactual “if dachshunds are bred at sea, we either get cocker spaniels or no pups at all” (required of a law-like statement of the content under consideration) be accepted? Only because of some bizarre law-like circumstances that prevent non-cocker spaniels from being born at sea. We’d have to believe such a law before accepting the proposed universal truth about nautical canine births as true.

- What is the point of this? Dretske says that that we’d expect assistance from the epistemic operators if laws are to be analysable as universal truths, but that they leave the issue of counterfactuality a mystery.

- Laws become established before an exhaustive, or even percentage-wise substantial, enumeration of their instances of application; hence their predictive power.

- In contrast, Dretske asks how this is possible for universal truths. He asks us to consider the restricted and finite case that a normal coin will land heads 10 times

\(^4\) Dretske disposes of the 5 candidate X’s: “Confimation” and “Acceptance” here, “Deduction” shortly and finally “Explanation” and “Prediction”.

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in a row. Because of the independence of trials, even after a successful 9 heads in a row, the probability of 10 heads in a row is still no more than 50%. So, we have hardly been accumulating evidence during the trials, as the evidence is either too low (≤ 50%) or too high (100%) to make a prediction.

- While the probability of 10 heads has indeed risen from the 1\textsuperscript{st} to the 9\textsuperscript{th} head from 0.002 to 0.5, the probability of the 10\textsuperscript{th} head remained at 0.5 despite the extensive sampling.
- We could take the first 9 trials as evidence for the 10\textsuperscript{th} if we took them as evidence for the coin being biased. However, this is a difference hypothesis, and affects the probability of heads on each trial. We have confirmed the original hypothesis (x)(Cx \supset Hx) via a new hypothesis involving a genuine law relating the physical make-up of the coin to the expected frequency of heads.
- It is this sort of illusion that leads some philosophers to conclude that general truths can be confirmed from their instances without recourse to supplementary law-like assumptions. Dretske rejects the idea that confirmation is a matter of raising the probability of a hypothesis\textsuperscript{5}. On that approach, any hypothesis of finite scope can be confirmed by examining its instances and finding them favourable. This applies to the “coin” case as well as to the case of confirming that everyone in the ballroom will be over 30 because you and your wife are. Dretske points out that it is not the raising of the probability of the hypothesis being true that is important, but the raising of the probability that unexamined cases will resemble the examined ones in the relevant respects. This is what is required for prediction and is what was lacking in these examples.
- To address this problem, and others of unlimited scope, the reductionist tends to smuggle in what he’s trying to do without, supplementary laws that aren’t simply universal truths. These illicit laws explain the regularities in the examined cases so as to make predictions about the unexamined ones. In the examples, the supposition that the coin is biased explains both the unlikely run of nine heads while predicting the likelihood of a 10\textsuperscript{th} head; similarly, the supposition that the ball is for our graduation year explains both our presence and predicts the likely ages of other guests.
- Take the case of examining with replacement balls from an urn. The reason, were we to make 24 selections and find a red ball each time, that we’d form the hypothesis that all (or most) balls are red is that, if there were a substantial number of non-red marbles, we expect, in all probability, our random sample of 24 to produce one. If we were simply presented with a carefully selected set of 24 red balls from the urn, this would have no bearing on the redness of the others. The hypothesis that all balls in the urn are red is no longer the best explanation of the data.
- “Deduction” : Dretske has noted that the notion of explanation has crept into the way of qualifying universal generalisations to make them laws. He now examines Braithwaite’s view that it is deductive integration that is the X in “law = universal truth + X”. According to Braithwaite, what makes universally true statements of the form (x)(Fx \supset Gx) laws is their being deducible from a higher-level hypothesis, H, in an established scientific system, and this explains the opacity (ie. not being able to substitute a co-extensive K for F) and counterfactual force of laws.

\textsuperscript{5} This is very important as it is contrary to Hempel’s (and Dorothy Edgington’s) approach.
Dretske’s objection (recognised by Braithwaite) is that this only postpones the problem. \((\forall x)(Fx \supset Gx)\) implies \((\forall x)(Fx \& Hx \supset Gx)\), but this does not make the latter a law. What is required is that the higher-level hypothesis itself be law-like. Because the higher-level hypotheses are not law-like on Braithwaite’s terms, he uses explanatory power to make progress. The higher level hypotheses are laws because they explain the lower level hypotheses, but the lower level hypotheses are laws because they are deducible from laws. While this seems circular, it at least recognises the greater importance of explanation over Hempelian deduction.

Those universal generalisations that can be confirmed are those that explain their instances, because that is what we need to raise the probability of unexamined cases being like the examined. So, \(E\) confirms \(H\) if \(H\) explains \(E\).

Dretske thinks this fails, because the bare fact that every \(F\) is \(G\) doesn’t explain why any \(F\) is \(G\). The fact that all men are mortal does not even suggest why you and I are mortal.

Dretske summarises the features of law that cause problems for the view that “law = universal truth + X”:-

a) Opacity  
b) Independence of epistemic considerations  
c) Confirmation by instances, predicative power  
d) Explanation  
e) Counterfactual support – “what ifs”  
f) What must, rather than what will, happen

(a) to (f) are manifestations of “ontological ascent”, i.e. a shift from individual objects and events to the qualities and quantities exemplified by them. Laws avoid particular things, magnitudes etc. and relate the qualities to one another.

Since laws are not about extensions but intensions, the opacity of extensional substitution is only to be expected. In the form of law favoured by Dretske, the relation “\(\to\)” in \(F\)-ness \(\to\) \(G\)-ness is a transparent extensional relation between properties; we can substitute any term referring to the same quantity or quality as “\(F\)-ness” for “\(F\)-ness” without affecting either truth-value or law-likeness. Laws are extensional relations between intensions and not intentional relations between extensions.

This enables us to understand the modal character of laws exemplified in (e) – support of counterfactuality – and especially (f) – necessity. It’s important to note that the modality is not in the necessity of the relation between \(Fs\) and \(Gs\), but, because \(F\)-ness is linked to \(G\)-ness; this \(F\) must be \(G\).

Dretske contrasts the valid and invalid arguments below:-

<table>
<thead>
<tr>
<th>1. Valid</th>
<th>2. Invalid</th>
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</thead>
<tbody>
<tr>
<td>(F)-ness (\to) (G)-ness</td>
<td>(\exists x(Fx \supset Gx))</td>
</tr>
<tr>
<td>This is (F)</td>
<td>This is (F)</td>
</tr>
<tr>
<td>This must be (G)</td>
<td>This must be (G)</td>
</tr>
</tbody>
</table>

The reason why (2) is invalid is, according to Dretske, that a modality that belongs to the relationship between the premises has been absorbed into the conclusion.

Dretske says he has no proof that (1) is a valid argument, but uses a legal analogy based on the US constitution. The constitution is contingent but given that it is as it is, the three branches of the legislature must interact as they do. While there is no necessity that the offices must interact as the constitution says they must, given
the constitution, the *individuals* occupying the various offices of State must act in accord with it.

- In the above example, “must” is legal in character, but Dretske thinks the analogy a good one, with natural laws being relationships between the “offices” that objects occupy, with objects constrained by the rules of the office. The modality at level n is generated by the relationships between entities at level n + 1.

- This analogy shows that it is wrong to think of laws as expressing relationships between the extensions of their terms, just as it is wrong to think of judicial laws as being directed at particular individuals. We must not think of laws as only applying to actual (past, present or future) individuals who occupy the relevant office. We can say what their obligations would have been had they counterfactually occupied the office. That is why (x)(Px ⊃ Cx), where P = “is President” and C = “must consult congress”, and where {x} are actual (past, present or future) presidents, doesn’t support counterfactuals.

- Because physical laws are relations between properties and magnitudes, rather than between particular things, we can see why they support counterfactuals. Because the law in question tells us how quality F is related to quality G, we therefore know that were an object O that possesses neither F-ness nor G-ness to acquire property F, it would therefore acquire property G. Because the laws make no reference to the extensions of the properties, we can hypothetically alter these extensions with “what ifs” – to see what would be the case in other possible worlds where the laws hold good. In contrast, (x)(Fx ⊃ Gx) makes claims about the actual Fs and Gs in *this* world and says nothing about other possible worlds.

- **Explanation & Confirmation**

- Laws are confirmed because they are more than generalisations of the data. If a statement of law doesn’t go beyond what can be completely verified, it cannot either be confirmed or be used to predict anything. It cannot be confirmed because it cannot explain, and it cannot explain because there is insufficient distance between the hoped-for explanans and the explanandum – this distance can only be achieved by ontological ascent.

- Finally, Dretske defends himself against the charge of Platonism. He has not argued that there *are* universal properties – only that *if* we want laws of nature, we can’t do without them.

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6 We really wanted “Explanation” and “Prediction”, so maybe Dretske’s argument isn’t quite structured as I’d thought.