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The Scientificity of the Social Sciences: A Reflection on the Deductive Nomological Model of Explanation

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Abstract

The possibility of having a science of human life brings into question whether the methods use in the sciences can be successfully applied in the prediction of human behaviour. This further questions the demarcation between science and the social sciences. This paper, however, argues that the use of DN model of explanation both in the social and natural sciences portends a boundary deconstruction of the two fields of enquiry. While engaging critical analysis method of enquiry, this paper dissects the DN model of explanation and argues that the social sciences are sciences and as such we can have scientific laws to predict, explain and control human behaviour.

Key words: Natural sciences; Social sciences; Deductive nomologica model; Explanation; Prediction and control

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INTRODUCTION

Convinced that the three cardinal aims of science are prediction, control, and explanation and that the greatest of these is explanation, this paper examines the deductive nomological model of science which enjoys a position of near-orthodoxy, although according to Alan Ryan it "has to fight for this position under a sniping fire from more or less critical alternatives." (Ryan, 1970, p. 46) Roughly put this view of explanation require the adducing of general laws, with the status of empirical hypotheses about the natural order, from which in conjunction with statements of initial conditions, we can deductively infer statements about empirical consequences. The element of this account have a long history; but since the early nineteenth century it has enjoyed almost canonical status, defended by such men as Laplace, Whewell and Mill at that time, and by such writers as Popper, Hempel and Nagel today. The goals of this paper are therefore twofold. In the first place, we must try to understand the point of insisting on the deductive nomological model of explanation, and try to follow the consequences of this insistence; then we have to raise some of the doubts which have been brought out by critics of this account. Thus, the paper will be arguing that deductive nomological model of explanation is applicable both in the natural and the social sciences as Alan Ryan will put it "I do not propose to argue that the hypothetico-deductive picture of explanation does not apply to the social sciences; for it is my view that its merits and demerits are visible more or less evenly across the scientific spectrum". (p.47)

According to Ehiakhamen J. O., Ernest Nagel in his The Structure of Science identifies four types of explanations which are the deductive nomonological model, the probabilistic model, the functional and the genetic model of explanation (Ehiakhamen, 2005, p.17). This paper thus examines the deductive nomological model of explanation which is mostly attributed to the works of C. G. Hempel. Hempel is unquestionably the most representative advocate of the epistemic interpretation of explanation or the Deductive-Nomological (DN) model, as explained in his covering law. An epistemic theory tackles phenomena only logically, based on the researcher's experience (empiricism and by extension logical positivism) and doesn't physically connect the phenomenon or event that needs to be explained with the actual facts claimed to explain it. In this sense unobservable entities are not necessary to understand why an explanation is true, whereas a realist interpretation of explanation considers these entities as real; *the explanation is a literal description of external reality* (IEP).

• Realist: a true and explanatory theory can describe world's causal structure

• Epistemic: a true and explanatory theory orders our experience to a greater degree

Salmon, on the other hand, has introduced a realistic (non epistemic) model, the statistical relevance model that takes into account flaws and weakness of the Hempel's covering law.

THE DEDUCTIVE-NOMOLOGICAL MODEL

According to the Deductive-Nomological Model (hereafter refer to as the DN model), a scientific explanation consists of two major "constituents": an *explanadum*, a sentence "describing the phenomenon to be explained" (p.18) and an *explanans*, "the class of those sentences which are adduced to account for the phenomenon" (Hempel, 1965 p. 247). For the *explanans* to successfully explain the *explanadum* several conditions must be met. First, "the *explanadum* must be a logical consequence of the *explanans*" and "the sentences constituting the *explanans* must be true". Alan Ryan will say "the *explanans* must entail the *explanadum*". (Alan Ryan, Op. Cit., p.49) That is, the explanation should take the form of a sound deductive argument in which the *explanadum* follows as a conclusion from the premises in the *explanans*. This is the "deductive" component of the model. Second, the *explanans* must contain at least one "law of nature" and this must be an essential premise in the derivation in the sense that the derivation of the *explanadum* would not be valid if this premise were removed. This is the "nomological" component of the model—"nomological" being a philosophical term of art which, suppressing some niceties, means (roughly) "lawful". In its most general formulation, the DN model is meant to apply both to the explanation of "general regularities" or "laws" such as (to use Hempel and Oppenheim's examples) why light conforms to the law of refraction and also to the explanation of particular events, conceived as occurring at a particular time and place, such as the bent appearance of the partially submerged oars of a rowboat on a particular occasion of viewing. As an additional illustration of a DN explanation of a particular event, consider a derivation of the position that "all Edos respect Igue Festivals" amounts to the claim that we cannot find an instance of someone who is both a Edo and yet does not respect the Igue Festival. According to Alan Ryan if we recall the basic point about deductive argument, it was that we cannot both accept the premises and deny the conclusion; so that when one of the premise is a general statement as "All Edos respect the Igue Festivals" the other is a singular statement that here is a man who is a Edo, we have to accept that he respects the new yam ceremonies.

A DN explanation of an occurrence is a valid deduction whose conclusion states that the outcome to be explained did in fact occur. The deductive argument is called an explanation, its premises are called the *explanans* (L: explaining) and the conclusion is called the *explanadum* (L: to be explained). Depending on a number of additional qualifications, an explanation may be ranked on a scale from potential to true. (p. 49)

Thus the DN explanation is an account of the *explanadum* that indicates how it follows deductively from a law of nature ("covering-law" account). The specificity of this explanation is given the conditions of adequacy define what a DN explanation is. In other words, an explanation is a DN explanation if and only if it satisfies conditions 1-4.

CONDITIONS OF ADEQUACY

1. Must be a valid-deductive argument with premises stating the *explanans* and the conclusion stating the *explanadum*.
2. Premises (*explanans*) must contain a law.
3. *Explanans* must have empirical content.
4. *Explanans* must be true.

According to Hempel and the DN model scientific explanations follow the typical structure of an argument, consisting of a set of premises and a conclusion. The conclusion says that the phenomenon to be explained is true and the premises explain why the conclusion is actually true. Hempel argues that a set of premises counts as a scientific explanation of a conclusion only if:

−The argument is deductive (the premises entail the conclusion)

−The premises are true

−The premises consist at least one general law (or law of nature), hence nomological model. He also resembles the relation of explanation and prediction as the two sides of the same coin:

−Every scientific explanation is potentially a prediction

−Every reliable prediction is potentially an explanation.

General laws or particular facts represent the *explanans*, which imply the *explanadum*, (Bruder, 1966. p.63) i.e. the phenomenon to be explained. Regarding the nomological component of this model, Hempel distinguishes between the generalizations that are "accidentally true" and those that are "laws". For example:

"All members of the Greensbury School Board for 1964 are bald'' is only accidentally true.

Here we cannot claim that a particular student belonged to the 1964 Greensbury school board to explain why he is bald.

"All gases expand when heated under constant pressure" is a law.

Thus, we could use this law to explain why a gas has expanded, given the fact that it has been heated keeping pressure constant. It is difficult, however, for philosophers to agree on when generalizations comprise laws and when not and since there is no generally accepted account of lawhood, this will remain an easy point of critic on Hempel's law.

Why suppose that all (or even some) explanations have a DN structure? There are two ideas which play a central motivating role in Hempel's 1965 discussion. The first connects the information provided by a DN argument with a certain conception of what it is to achieve understanding of why something happens—it appeals to an idea about the object or point of giving an explanation. Hempel writes:

… a DN explanation answers the question "Why did the *explanadum*-phenomenon occur?" by showing that the phenomenon resulted from certain particular circumstances, specified in C1, C2, …, Ck, in accordance with the laws L1, L2, …, Lr. By pointing this out, the argument shows that, given the particular circumstances and the laws in question, the occurrence of the phenomenon was to be expected; and it is in this sense that the explanation enables us to understand why the phenomenon occurred. (Hempel, 1965. p.337)

One can think of IS explanation as involving a natural generalization of this idea. While an IS explanation does not show that the *explanadum*-phenomenon was to be expected with certainty, it does the next best thing: it shows that the *explanadum*-phenomenon is at least to be expected with high probability and in this way provides understanding. Stated more generally, both the *DN* and IS models, share the common idea that, as Salmon puts it, "the essence of scientific explanation can be described as *nomic expectability*—that is expectability on the basis of lawful connections" (Salmon, 1989. p.57)

The second main motivation for the *DN* model has to do with the role of causal claims in scientific explanation. There is considerable disagreement among philosophers about whether all explanations in science and in ordinary life are causal and also disagreement about what the distinction (if any) between causal and non-causal explanations consist in. Nonetheless, virtually everyone, including Hempel, agrees that many scientific explanations cite information about causes. However, Hempel, along with most other early advocates of the *DN* model, is unwilling to take the notion of causation as primitive in the theory of explanation—that is, he was unwilling to simply say that X figures in an explanation of Y if and only if X causes Y. Instead, adherents of the *DN* model have generally looked for an account of causation that satisfies the empiricist requirements. In particular, advocates of the *DN* model have generally accepted a broadly Humean or regularity theory of causation, according to which (very roughly) all causal claims imply the existence of some corresponding regularity (a "law") linking cause to effect. This is then taken to show that all causal explanations "imply," perhaps only "implicitly," that such a law/regularity exists and hence that laws are "involved" in all such explanations, just as the *DN* model claims.

Hempel and Oppenheim's essay "Studies in the Logic of Explanation," published in volume 15 of the journal *Philosophy of Science*, gave an account of the deductive-nomological explanation. A scientific explanation of a fact is a deduction of a statement (called the *explanadum*) that describes the fact we want to explain; the premises (called the *explanans*) are scientific laws and suitable initial conditions. For an explanation to be acceptable, the *explanans* must be true.

According to the deductive-nomological model, the explanation of a fact is thus reduced to a logical relationship between statements: the *explanadum* is a consequence of the *explanans*. This is a common method in the philosophy of logical positivism. Pragmatic aspects of explanation are not taken into consideration. Another feature is that an explanation requires scientific laws; facts are explained when they are subsumed under laws. So the question arises about the nature of a scientific law. According to Hempel and Oppenheim, a fundamental theory is defined as a true statement whose quantifiers are not removable (that is, a fundamental theory is not equivalent to a statement without quantifiers), and which do not contain individual constants. Every generalized statement which is a logical consequence of a fundamental theory is a derived theory. The underlying idea for this definition is that a scientific theory deals with general properties expressed by universal statements. References to specific space-time regions or to individual things are not allowed. For example, Newton's laws are true for all bodies in every time and in every space. But there are laws (e.g., the original Kepler laws) that are valid under limited conditions and refer to specific objects, like the Sun and its planets. Therefore, there is a distinction between a fundamental theory, which is universal without restrictions, and a derived theory that can contain a reference to individual objects. Note that it is required that theories are true; implicitly, this means that scientific laws are not tools to make predictions, but they are genuine statements that describe the world—a realistic point of view.

There is another intriguing characteristic of the Hempel-Oppenheim model, which is that explanation and prediction have exactly the same logical structure: an explanation can be used to forecast and a forecast is a valid explanation. Finally, the deductive-nomological model accounts also for the explanation of laws; in that case, the *explanadum* is a scientific law and can be proved with the help of other scientific laws.

Aspects of Scientific Explanation, published in 1965, faces the problem of inductive explanation, in which the *explanans* include statistical laws. According to Hempel, in such kind of explanation the *explanans* give only a high degree of probability to the *explanadum*, which is not a logical consequence of the premises. The following is a very simple example.

> The relative frequency of *P* with respect to *Q* is *r*
> The object *a* belongs to *P*
> ———————————————
> Thus, *a* belongs to *Q*

The conclusion "*a* belongs to *Q*" is not certain, for it is not a logical consequence of the two premises. According to Hempel, this explanation gives a degree of probability *r* to the conclusion. Note that the inductive explanation requires a covering law: the fact is explained by means of scientific laws. But now the laws are not deterministic; statistical laws are admissible. However, in many respects the inductive explanation is similar to the deductive explanation.

• Both deductive and inductive explanations are nomological ones (that is, they require universal laws).

• The relevant fact is the logical relation between *explanans* and *explanadum*: in deductive explanation, the latter is a logical consequence of the former, whereas in inductive explanation, the relationship is an inductive one. But in either model, only logical aspects are relevant; pragmatic features are not taken in account.

• The symmetry between explanation and prediction is preserved.

• The *explanans* must be true.

According to Alan Ryan, Hempel and Oppenheim's view is threefold:

> the first is the formal requirement that the statements laying down the laws and initial conditions should entail the statement laying down the conclusion; the second is the material requirement that the premises should be true – or more cautiously that they should be well corroborated; the last is a consequence of these requirements, that the explanans should be empirically testable, by being open to refutation should it predict what is not the case. Only under these conditions do we empirically or causally explain why an event had to happen as it did. And it is practically a defining quality of an empiricist philosophy of science that it sets up these standards as the standards for true explanation. (Alan Ryan, Op. Cit, p.53)

Alan Ryan argues that the enumerate generalization usually made by the natural scientists and social scientists alike make them to fall into "deepish waters". He argued that "it is a frequent criticism of social scientists' work that they present us with something less than adequate explanations". That they are prone to leave us with mere enumerative generalizations, without causally analyzing them. Thus the pioneering work on voting behaviour called "Voting" Ryan says "was sometimes criticized because it told us e.g. only that a certain proportion of Catholics vote Democrat; the authors of Voting failed to tell us why Catholics tended to vote Democrat rather than Republican (and even more interesting what were the causes behind the deviation of those Catholics who voted for some other party)". (p.56)

STRENGTHS OF THE DEDUCTIVE NOMOLOGICAL MODEL OF EXPLANATION

Although the *DN* model does not only apply to explanations of particular facts (such as the floating of our ice cube) but it applies to explanations of general regularities. (Example: the derivation of Kepler's laws from Newton's laws of motion and gravitation) However, the D-N model does not apply when laws are probabilistic. For this case, two related models have been introduced, the inductive-statistical (I-S) model for explanations of particular facts by probabilistic laws (example: explaining a patient's recovery from an infection by his taking of penicillin); the deductive-statistical (D-S) model for explanations of probabilistic regularities by more general probabilistic laws (example: the derivation of the half-life of uranium-238 from the laws of nuclear physics). (Hempel, 1965)

Since *DN* explanations are characterized by the fact that the explanans contains at least one law of nature, we need to know how to distinguish laws from other general statements. Consider the two statements from Salmon:

1 No gold sphere has a mass greater than 100'000 kg.

2 No enriched uranium sphere has a mass greater than 100'000 kg.

Both statements are completely general and (most probably) true. What is the difference between them? Statement 1 is a lawful generalization, while 2 is an accidental generalization. But what is lawfulness? Statement 2 supports counterfactuals, while 1 does not. But the notion of counterfactual depends on the notion of law. Consider the example: "The impact of my knee on the desk caused the tipping over of the inkwell." (Salmon, 1989) This statement seems perfectly explanatory, but it does not have a *DN* structure. Possible reply by the proponent of the *DN* model: would read "cause" needs to be analyzed in terms of regularities (and, ultimately, laws), so the example really has a hidden *DN* structure. However, it is not clear whether the hidden structure strategy can be made to work.

One can explain the length *l* of the shadow cast by a flagpole by deriving it from the height *h* of the pole, the angle of the sun above the horizon and laws about the propagation of light. But in the same way, one could "explain" the height of the pole by deriving it from *l* and the same laws.

All males who take birth control pills fail to get pregnant.

James Musa is a male who has been taking birth control pills.

James Musa fails to get pregnant.

To those that argued that the *DN* model does not state sufficient conditions for what it is to be an explanation; something can conform to the *DN* scheme without being an explanation. Some possible reactions have been to find additional conditions, which, together with the *DN*-conditions are sufficient (unificationist model of explanation). Note that this approach still relies on the hidden structure strategy.

WEAKNESSES OF THE DEDUCTIVE NOMOLOGICAL MODEL OF EXPLANATION

In his *The Philosophy of the Social Sciences,* Alan Ryan discusses four weaknesses of this model of explanation. The first is the problem of probabilistic explanation and the other three is concerned in ways in which the existence of theories must modify this account. The problems pose by the existence of theories can be summarized as, first, the picture of scientific progress offered does various kinds of violence to the actual course of scientific advance, second that the statements occurring in theories do not seem in any clear way to be generalizations of, or from, the statements describing the events they explain, and third, that a more coherent account of the nature of theories and of explanation generally can only be given when we give due weight to the importance of causal sequences. (Alan Ryan, *Op. Cit*, p.68)

In addition, his opponents claim that Hempel's model is too strict because *it excludes some bona fide scientific explanations*. While others claim that it is too liberal because it allows explanations as scientific that obviously aren't. (Okasha, 2002. p.23) This occurs due to the asymmetric relation of explanation, which contradicts Hempel's implication: if x explains y, given a general law and additional facts, then we cannot take for granted that y explains x, given the same laws and facts. There are several counterexamples to the sufficiency of the *DN* model. The most known ones are the following:

The story of James not being pregnant after taking birth-control pills. Here the need of relevant information is emphasized. Irrelevant information to the phenomenon's occurrence can easily lead to non-realistic explanations of the phenomenon. James is not pregnant, not because of taking contraception pills, but because he is actually a man (explanatory irrelevance).

Three kinds of objections to the *DN* account have also been especially important for the subsequent development of the philosophy of explanation. The first kind of objection, developed by Kyburg, Salmon, and others, points to the *DN* theory's inability to account for judgments of explanatory relevance. The paradigm is the following argument, which satisfies all of the *DN* account's criteria for a good explanation of the event of a particular teaspoon of salt's dissolving:

The teaspoon of salt was hexed (meaning that certain hand gestures were made over the salt),

The salt was placed in water,

All hexed salt dissolves when placed in water, thus

The salt dissolved.

The explanation appears to attribute the salt's dissolving in part to its being hexed, when in fact the hexing is irrelevant. There are various responses to the counter-example that aim to preserve as much of the *DN* account as possible, for example, holding that the generalization about hexed salt is not a true law, or imposing the requirement that a *DN* explanation use the most general law available. Salmon's much less conservative reaction is to conclude that Hempel is wrong to think of explanation in terms of expectability, therefore of explanations as kinds of argument. The relation between the factors cited in an explanation and the *explanadum* itself, Salmon holds, is not epistemic, but ontic; it should be a physical relevance relation—a relation of statistical relevance, he first proposes (Salmon, 1970), or a relation of causal relevance, as he later comes to believe. The faulty explanation of the salt's dissolving is to be discarded, argues Salmon, not because of some formal or logical defect, but because it cites an event, the hexing of the salt, that fails to bear the appropriate relevance relation to the *explanadum*.

The second important objection to the *DN* account is perhaps also the most famous: it shows, most philosophers would agree, that the *DN* account pays insufficient attention to the explanatory role of causal relations. The height of a flagpole can be cited, along with the position of the sun and the law that light travels in straight lines, to explain the length of the flagpole's shadow. The *DN* account is well able to make sense of this explanation: it can be cast in the form of a sound, law-involving argument. But now take this same argument and switch the premise stating the height of the flagpole with the premise stating the length of the shadow. You now have a sound, law-involving argument for the height of the flagpole that cites, among other things, the length of the shadow—thus, according to the *DN* account, you have an explanation of the height of the flagpole that cites, as in explainer, the length of the shadow. This consequence of the *DN* account—that the height of a flagpole can be explained by the length of its shadow—seems obviously wrong, and it is wrong, it seems, because a cause cannot be explained by its own effects.

A further famous example strongly suggests that effects can only be explained by their causes, together with the laws and background conditions in virtue of which they are causes. Suppose that the arrival of a certain kind of weather front is always followed by a storm, and that a certain reading on a barometer is a sure sign that such a front has arrived. Then a barometer reading of this sort is always followed by a storm. The storm cannot be explained, however, by citing the barometer reading and the fact that such readings are always followed by storms, though these two facts together satisfy the requirements of the DN account. A constant, robust correlation is not, it appears, enough for explanation. What is needed, as Salmon eventually concludes, is a causal relation. Hempel for a long time resisted the suggestion that facts about causation played any special role in explanation (Hempel, 1965). Over the years, however, due in part to the development of sophisticated empiricist accounts of causation, this has become a minority view.

The third class of objections to the *DN* account focuses on the account's requirements that every explanation cite a law, and that (except in probabilistic explanation) the law or laws be strong enough to entail, given appropriate boundary conditions, the *explanadum*. One way to develop the objection is to point to everyday explanations that cite the cause of an event as its explanation, without mentioning any covering law, as when you cite a patch of ice on the road as the cause of a

Motorcycle accident. More important for the study of explanation in science are varieties of explanation in which there is no prospect and no need for, either the entailment or the probabilification of the *explanadum*. Perhaps the best example of all is Darwinian explanation, in which a trait T of some species is explained by pointing to the way in which T enhanced, directly or indirectly, the reproductive prospects of its possessor. Attempting to fit Darwinian explanation into the *DN* framework creates a host of problems, among which the most intractable is perhaps the following: for every trait that evolved because it benefited its possessors in some way, there are many other, equally valuable traits that did not evolve, perhaps because the right mutation did not occur, perhaps for more systematic reasons (for example, the trait's evolution would have required a dramatic reconfiguration of the species' developmental pathways) (Scriven, 1962. pp.477-482). To have a DN explanation of T, you would have to produce a deductive argument entailing that T, and none of the alternatives, evolved. You would have to be in a position, in other words, to show that T had to evolve. Not only does this seem close to impossible; more importantly, it seems unnecessary for understanding the appearance of T. You can understand the course of evolution without retrospectively predicting it's every twist and turn.

Hempel is aware of the problem with Darwinian explanation. His response is to argue that there is no such thing: faced with a choice between the DN account and Darwinian explanation, we should opt for the former, and consider Darwinian stories to be at best partial explanations of traits (Hempel, 1965). He advocates a similar deflationary treatment of functionalist explanation in sociology and of historical explanations that are not entailments.

As a result of these weaknesses some critics opted for Inductive Statistical model (IS). The inductive-statistical or IS account, in many ways parallels the DN account of deterministic event explanation. Like a DN explanation, an IS explanation is a law-involving argument giving good reason to expect that the *explanadum* event occurred. However, whereas a DN explanation is a deductive argument entailing the *explanadum*, an IS explanation is an inductive argument conferring high probability on the *explanadum*. Hempel's example is the explanation of James Musa's swift recovery from a strep infection. The probability of a swift recovery without the administration of penicillin, Hempel supposes, is 0.1, while the probability with penicillin is 0.9. Citing Jones's infection, his treatment with penicillin, and the resulting high probability of recovery, then, confers a high probability on Musa's swift recovery; in the circumstances you would expect him to recover swiftly. This inductive argument is sufficient, in Hempel's view, to explain the swift recovery.

Inductive soundness imposes one additional requirement that has no parallel in deductive logic. Suppose you know that Jones's strain of strep is resistant to penicillin. An inductive argument is said to be sound only if all relevant background knowledge is taken into account; consequently,

an inductive argument for Jones's swift recovery must cite the infection's penicillin resistance. But once the new premise is added, the argument will no longer confer a high probability on its conclusion. This is what is wanted: there ought to be no inductive argument for swift recovery—you ought not to expect swift recovery—when the strep is known to be resistant.

Hempel imposes a similar requirement on IS explanations, which he calls the requirement of maximal specificity. In virtue of this requirement, it is not possible to explain Jones's swift recovery by citing treatment with penicillin when the infection is known to be penicillin resistant. As with the DN account of explanation, a number of objections to the IS account have exerted a strong influence on the subsequent development of the philosophical study of explanation. Versions of both the relevance and the causal objections apply to the IS account as well as to the DN account. I will briefly describe two other important criticisms.

First is the complaint that it is too much to ask that explanations confer high probability on their *explanandum*. In many ways, this is the analogue of the third objection to the DN account above; in the same paper that Scriven expresses doubts about the existence of a DN treatment of Darwinian explanation, he describes the following example, best conceived of, I think, as an objection to the is account. The probability that John Jones contracts paresis, a form of tertiary syphilis that attacks the central nervous system, given that he has untreated secondary syphilis, is very low. But only syphilitics contract paresis. It seems reasonable to cite untreated syphilis, then, as explaining John Jones's paresis, though the explanation confers only a low probability on the *explanadum*. (Scriven, M. Op. Cit., pp.170-230)

The proponent of the IS account is committed to rejecting such attempts at explanation, as Hempel does, arguing that in such cases we have only a partial explanation of why the patient contracted syphilis. This is perhaps one of the most convincing of Hempel's defenses, but the paresis example is nevertheless widely regarded as posing a serious problem for the expectability approach to explanation. A second objection to the IS account focuses on the requirement of maximal specificity. The requirement insists that all relevant background knowledge must be included in a probabilistic event explanation, but it does not require that relevant but unknown information be taken into account. In particular, if John Jones's infection is penicillin resistant, but this fact is not known to the explainer, then the IS account deems the explainer's appeal to the administration of penicillin as a perfectly good explanation of Jones's swift recovery.

As Coffa argues, this is surely not correct. If the infection is resistant to penicillin, then the administration of penicillin cannot explain the recovery, regardless of what the explainer does and does not know. The requirement of maximal specificity makes probabilistic explanation relative to the explainer's epistemic situation, then, in a way that it very much appears not to be. This objection hits right at the heart of the expectability conception of explanation, suggesting that explanation is not an epistemic matter in the least. (Coffa, 1974, pp.141-163)

Salmon identifies three types of Hempel's law challengers; interpretivists, nomological skeptics and critical theorists (Salmon, 1984, p.326). Interpretivism - interpretivists consider explanations of human action completely different from causal explanations or any law-related explanations. Interpretivists strongly believe that it is a logical error to use empirical laws to relate a cause to an action.

Nomological skepticism as a philosophical stream doubts that there are actually laws in social sciences to construct covering-law explanations. These doubts are pragmatic in contrast to the logical ones of the interpretivists. Skeptics believe that the great variability and complexity of human behavior pose practical barriers to framing generalizations that are at once informative and true. Critical theorists argue that lawful explanations threaten human autonomy and they focus attention on the ethical implications of trying to explain human behavior in the same manner that we explain the actions of non-conscious physical objects.

CONCLUSION

With this assessment of the DN model of explanation we might want to ask "Are social sciences really sciences?" considering the fact that they both uses the model of DN method of explanation. Can we explain everything just by using physics as the fundamental science? We are strongly of the view that the social sciences are sciences. Science itself do not enjoy a single method (some have even argued that anything should go) and they sometimes make value judgment. One can then say that the method of DN model of explanation despites it's various weaknesses, can serve as a method of explanation both in the social and natural sciences. Furthermore, the demarcation between science, non-science, pseudo-science and social science is facile given the tenability of the DN model of explanation.

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