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Epistemic Line of Explanation for Experimental Phenomenology

The present paper is an extension of a previous work (Sinico, 2010) on the validity of one of the main explanation models in Experimental phenomenology: the deductive-nomological model. This model identified explanation with a deductive and nomological argument characterized by empirical contents and logic validity. The deductive-nomological model is suited to a nomic, deterministic and modal domain. Within experimental psychology, this domain is distinctive of those theoretical conceptions, like Gestalt psychology and, in some ways, Ecological psychology, that take phenomenal dependencies *under observation* as *explanandum* (Bozzi, 1989; McLeod, 1974). The main disciplinary reference for this domain is Experimental phenomenology, a scientific discipline with a long tradition of articulated epistemological and methodological reflection (Stumpf, 1907; Wertheimer, 1923; Katz, 1935; Metzger, 1941; Thinès, Costall & Butterworth, 1981; Kanizsa, 1979; Bozzi, 1989; 1999; Vicario, 1993; Masin, 2002; Sinico, 2003; 2008; Wertsgen, 2005; Zavagno, Antonelli, & Actis Grosso, 2008; Toccafondi, 2012).

1. Epistemic Line of Scientific Explanation

Within the epistemic line of scientific explanation, the reference model is the deductive-nomological model (D-N) put forward by Hempel & Oppenheim (1948), and subsequently by Hempel (1965), within a neo-positivistic approach. According to this model, explanation is a deductive argument and consequently it excludes probabilistic terms (the same authors also formulated an alternative inductive-statistical model). According to Hempel & Oppenheim's framework (1948), the argument is made up of some premises, that is, of a number of statements called *explanans*, and of an inference conclusion which states what has to be explained and is therefore called an *explanandum*-statement. Some statements or *explanans* describe (1) 'particular facts': the single states of things (C_1, C_2, ..., C_k), and (2) some statements that describe uniformities, expressible as laws (L_1, L_2, ..., L_r). Therefore, one refers to the deductive-nomological explanation to indicate an argument by which, based on the *explanans* - more specifically: in keeping with particular circumstances and general laws - the *explanandum* is deductively inferred.

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As I noted earlier (Sinico, 2010), it has to be underlined that explanation uses general laws, for this reason called covering laws, which constitute a crucial part of the model. Hempel & Oppenheim distinguished law-like statements (introduced by Goodman, 1947) which have the value of laws, from law statements (or nomical statements). Salmon:

> "Only true sentences are classified as law-sentences; lawlike sentences have all the characteristics of law-sentences, with the possible exception of truth. Thus every law-sentence is a lawlike sentence, but not all law like sentences are law" (1989, p. 13).

Thus, explanations can be potential, and this is always so when the law is still not checked, when, for instance, it is still a hypothesis. So, the *explanans* can be not true when it has not yet been confirmed. On the contrary, the *explanandum*, as was specified when the issue of evidence was introduced, must always be true.

The logical form is not enough to establish whether the statement expresses a law (Goodman, 1955). The following example uses a universal conditional form: "All the books in my library have fewer than 2271 pages", that is to say (x) (Fx -> Gx). This would be only an accidental generalization. Here, verification is supplied by the fact that a similar statement is unable to support counterfactuals: "If the unabridged version of Belli's Sonnets were in my library it would have fewer than 2271 pages". A second way to verify whether a statement like "All the books in my library have fewer than 2271 pages" is only an accidental generalization is its ability to supply an explanation. For instance "The Divine Comedy is one of the books in my library" does not supply an explanation as to why Dante's masterpiece has fewer than 2271 pages. Otherwise, "All proximal dots group together" (Wertheimer, 1923) corresponds to a perceptual law, so much so that if in any given configuration dots are near one another they would necessarily appear as grouped. This nomic statement coupled with particular conditions like "Dots b and c lie at a distance equal to 1/3 of the distance between dots c and d and between dots a and b" (see Figure 1) is a valid explanation as to why the dots are indeed grouped. Lastly, laws express what is necessary: if b and c are the nearest two dots they will *necessarily* form a group. On the contrary, if a new book is added to my library it will not necessarily have to have fewer than 2271 pages. This is the case even if, according to Salmon (1989), to make sure that a statement is a law of nature it is necessary to know whether it has modal import and it supports counterfactuals. However, to make sure that a statement has modal import it is necessary to know whether it is a law of nature and it supports counterfactuals. Lastly, to make sure that a statement supports counterfactuals it is necessary to know whether it is a law of nature and it has modal import. However, according to Hempel & Oppenheim (1948), a law, in addition to having a generalized form, must not apply to a finite number of cases or individual examples. For this reason the class of events a, b, c, d, etc. must contain only qualitative predicates and not terms like 'solar', 'spatial', 'visual', etc. which would imply particulars. Such a restriction, which limits a law to rigorous particular terms, is problematic because it would not consider as laws also important examples, like Galileo's law of falling bodies, which refers, albeit implicitly, to a reference system: the Earth. For this reason, Hempel & Oppenheim (1948) distinguished between fundamental and derived laws. The latter, of which Galileo's law of falling bodies is an example, would be universal statements derived from the former through deduction (Sinico, 2010).

Reference to this distinction can be found in an essay by Reichenbach (1947). In the same essay he also dealt with the general issue of laws of nature according to Schlick's formulation, i.e., how to distinguish a nomological universal statement from a merely accidental universal statement, and gave a logical response (Schlick, 1931). A law of nature has the form of a universal conditional, but a universal conditional does not necessarily imply a law of nature. Indeed, a universal conditional may be true but also absurd at the same time. For instance, when the antecedent is always false, or when the consequent is always true, or, again, when the antecedent is not always false and the consequent is not always true.

To deal with this problem, Reichenbach distinguished between original nomological statements and derived nomological statements and imposed some restrictions. First of all an original nomological statement must be a 'for-each' statement, so as to exclude pure existential statements like 'The square is red'. Secondly, an original nomological statement must be shown to be true inductively, so as to exclude accidental true statements such as "All the books in my library have fewer than 2271 pages". Thirdly, an original nomological statement must be exhaustive (that is to say, none of the terms of the disjunction into which the statement can be expanded must be false) so as to exclude statements with an always false antecedent and statements with an always true consequent. Lastly, an original nomological statement must be universal and therefore must not refer to individual cases nor be limited to a given time-space. Once original nomological statements have been defined, derived (derived from the original) nomological statements, which cannot be universal or wholly exhaustive, can also be defined. According to Reichenbach's proposal, nomological statements can then be expressed with a special universal implication, developed on the material implication, which takes into account the above restrictions. This type of universal implication, based on empirical evidence, on inductive empirical verification, supplies a valid formal description of a natural law.

In Hempel & Oppenheim's essay, whose terminology does not coincide with Reichenbach's, the adopted formal language is the first-order predicative language without identity, and without open formulas, where all the individual variables are quantified: quantifiers express generalizations. Continuing with a simplification, the two authors used the following sentences: 1. Atomic sentence, which contains no quantifiers, no variables and no sentential connectives, attributes a particular property to a given individual (e.g., "The sun is yellow"); 2. Singular sentence, which contains no quantifiers and no variables, can contain binary connectives (e.g., "The sun lights the earth or the sun lights the moon"); 3. Generalized sentence, which contains one or more quantifiers and is followed by an expression containing no quantifiers (e.g., "All humans are mortal"); 4. Generalized sentence, which contains only universal quantifiers; 5. Purely generalized sentence, which does not contain proper names of individuals; 6. An essentially generalized sentence, which is not equivalent to any singular sentence. Based on these terms, the following definitions can be supplied: a fundamental lawlike sentence is a purely generalized sentence (while a fundamental law is a purely generalized true sentence). A derivative law is a sentence that is essentially, but not purely, generalized and is deducible from a given set of fundamental laws. Lastly, a law is either a fundamental or a derived sentence.

As I noted earlier (Sinico, 2010), according to Hempel & Oppenheim, <T, C> is the potential *explanans* of the *explanandum* only if T is a general sentence, C is a singular sentence (which contains no quantifiers and no variables, can contain binary connectives) and the *explanandum* is derivable from T and C jointly. In any case, this definition of potential *explanans* is a necessary but not sufficient condition. Indeed, if E is a true sentence, then C must be true as it is a material implication by which the consequent is a true sentence. This means that, through this definition alone, a potential explanation of any particular fact could be supplied by means of any true lawlike sentence. A restriction was needed to avoid C being established as true on the basis of the *explanandum*. The authors then imposed a procedure that could verify the truth of C without also automatically verifying the *explanandum*. The explanation was then defined as follows: <T, C> is the *explanans* of the *explanandum* only if < T, C> is a potential *explanans* of the *explanandum*, T is a theory, and C is true. Successively, another condition was added (Kim, 1963): if C is expressed in the conjunctive normal form (in which each of the conjunct terms is a disjunction of statement variables or of their denial), the *explanandum* must not entail any of the conjunct terms that are in C. In the explication of explanation, Hempel and Oppenheim used the notion of theory. The distinction between laws and theories, though, was based on the possibility for theories to contain existential quantifiers and for laws to contain only universal quantifiers, even if, according to Salmon (1989), many laws and many theories contain existential quantifiers (Sinico, 2010).

The deductive-nomological model requires three conditions of logic adequacy: 1) the *explanandum* must be a logical consequence of the *explanans*; 2) the *explanans* must contain at least one general law; 3) the *explanans* must have empirical contents (it must be testable); 4) the *explanans*-statements must be true, thus making sure that also the *explanandum* is true. Furthermore, isomorphism between the logical and the empirical plane is then taken as implicit.

2. Critiques

So that the deductive-nomological model can supply an adequate explanation, some conditions must be met. First, three conditions of logic adequacy: the *explanandum* must be a logical consequence of the *explanans*; second, the *explanans* must contain at least one general law; third, independently of the *explanandum*, the *explanans* must have empirical contents, that is to say it must be testable. Therefore, in this way possible ad hoc hypotheses can be ruled out. To these three conditions an adequacy condition is added by which the *explanans*-statements must be true, thus making sure that also the *explanandum* is true. Correspondence between the logical and the empirical plane is then taken as implicit.

Two kinds of critiques in the literature have to be considered: those on the role of causality and those on the importance attributed to laws. Let us start from the latter, with Railton, who maintains:

> "Where the orthodox covering-law account of explanation propounded by Hempel and others was right has been in claiming that explanatory practice in the sciences is in a central way law-seeking or nomothetic. Where it went wrong was in interpreting this fact as grounds for saying that any successful explanation must succeed either in virtue of explicitly invoking covering laws or by implicitly asserting the existence of such laws" (Railton, 1981; p. 248).

Railton cannot certainly be challenged with the argument that many scientific explanations, even the most widely accepted, do not, even implicitly, refer to a law. However, the fact remains that the scientific aim of explaining by means of a law is of paramount importance. Obviously, the degree of importance will depend on the specific object being investigated by the discipline considered.

Salmon (1989), instead, has put forward a systematic critique of the deductive-nomological model focusing on the difficulties of accounting for causal relationships, and in his criticism he has used some counterexamples to the model. Slightly adjusting Bromberger's counterexample (1962), let us consider a tower and its shadow. Given the height of the tower and the position of the sun, the length of the shadow can easily be deduced; this would be an acceptable deductive-nomological explanation. Within this model, the following explanation would also fit very well: given the length of the shadow and the position of the sun, the height of the tower can easily be deduced. According to Salmon (1989), however, many would not be ready to accept the latter as an explanation because the shadow does not cause the height of the tower. Salmon argues that an explanation must be able to account for causal relationships. Not everyone agrees with that. Van Fraassen (1980), for instance, maintains that in some cases this type of explanation would be acceptable.

A second counterexample focuses on the phenomenon of the eclipse of the moon, which can be explained, via the deductive-nomological model, based on the relative positions of the earth, sun and moon the moment prior to the eclipse and on the laws of the mechanics of celestial bodies. The explanation is just as valid if the same premises are considered the moment after the eclipse. However, according to Salmon, the *explanandum* must always precede the *explanans*. On the contrary, in dealing with the issue, Hempel never thought he had to impose a time restriction on his model (1965).

The third counterexample is Scriven's (1959). Syphilis progresses in three phases, the first two are latent and the third manifests itself with a paresis. There are cases in which the patient is not treated over the first two phases and, consequently, paresis develops. This argument is also a deductive-nomological explanation. However, Scriven explains, a paresis appears only in about 25% of patients affected by syphilis in its primary and secondary forms. Therefore, the model cannot give an accurate prediction of the destiny of a patient affected by untreated latent syphilis. Scriven's criticism is about the predictive ability because, according to Hempel & Oppenheim's model, prediction and explanation are two symmetrical terms. However, the symmetry proposed by Hempel & Oppenheim did not include statistical explanations. Consequently, the third counterexample would not go against the deductive-nomological model, but, if anything, against the statistical-deductive model elaborated by Hempel at a later date (Hempel, 1962).

The fourth counterexample is a more serious problem for the symmetry between explanation and prediction assumed by the deductive-nomological model. Given the drop of the needle on a properly functioning barometer and a law stating that a storm takes place with low barometric pressure, a storm may be inferred to happen. However, Salmon (1989) argues, the occurrence of the storm is not at all explained by the move downwards of the barometer needle, as both phenomena respond to a common cause: specific atmospheric conditions. Therefore, symmetry between prediction and explanation, in the presence of causal relationships, is not sustainable.

The fifth counterexample is Kyburg's (1965). Some hexed salt is put in water. All hexed salt dissolves in water. Therefore, that is the explanation as to why the salt will melt. In this case, the issue is not witchcraft but the explicative relevance. And yet this, too, is a good example of deductive-nomological explanation.

These counterexamples have the function of binding the degree of adoptability of the deductive-nomological model. This model needs all the knowledge available on the *explanandum*, a nomic reference and laws must connect the various terms of the model. These bonds confine the model to a discipline whose aim is nomic, deterministic and modal knowledge.

3. Deductive-Nomological Model for Experimental Phenomenology

Because of the difficulty of supporting a model of general scientific explanation, valid in all disciplines, among theorists of scientific explanation the prevailing position is not of prejudicially repudiating the epistemic approach, notwithstanding the difficulties that it encounters, which in any case concerns statistical explanations (Jeffrey, 1969) more than the deductive-nomological model (Von Wright, 1971). Indeed, for some disciplinary ambits, especially those oriented to the explanation of particular phenomena rather than of general uniformities (on the latter Hempel and Oppenheim themselves admitted to some difficulties), the deductive-nomological model seems more fitting than alternative models of scientific explanation (Sinico, 2010). In particular, the constraints imposed on the deductive-nomological model are basically suitable to Experimental phenomenology.

The phenomenological attitude adopted in Experimental phenomenology coincides only in part with Husserl's method of reduction: with the negative instance of the *epoché*, that is to say that attitude which releases the mind from prejudices and turns 'back to the things themselves'. A general definition of the phenomenological attitude in the scientific phenomenology was formulated by Koffka in his *Principles of Gestalt Psychology*: "For us phenomenology means as naive and full a description of direct experience as possible" (Koffka, 1935; p. 73). Thus, through direct and immediate experience, the phenomenological method allows only the phenomenal world to filter through. With this attitude, Experimental phenomenology is primarily oriented toward discovering intra-phenomenal dependences. According to the gestalt psychologist Kanizsa:

> "Experimental phenomenology, (…), has been able to establish some laws which rule the phenomena of vision (…). Apart from the often very different interpretative models proposed by the scientists who have made such discoveries, these empirically ascertained regularities are not hypotheses, they are facts and as such they must be accepted. They can be discussed, but not denied nor neglected" (Kanizsa, 1991; pp. 80-81).

Within this perspective, laws of Experimental phenomenology are considered an autonomous field of knowledge, but they can also be assumed to be the *explanandum* of other scientific fields. Thus, the domain of Experimental phenomenology is 'nomic' because its principal goal is the formulation of laws of qualitative phenomenal experience, that are characterised by 'If …, then …', even if they are not causal. Indeed, Experimental phenomenology cannot isolate the essences that cause perceptual phenomena: its own ontological level is the intra-phenomenal dependences. This kind of perceptual law has primarily phenomenal content. Nevertheless, these perceptual laws can also be formally formulated without using hypothetical terms (Sinico, 2008).

This domain is also 'deterministic' because it regards phenomena determined by field dynamics, which excludes any probabilistic reference. According to Köhler: "Such truth [purple is a visual quality which as such has its place between the red and the blue] has no degrees of accuracy (…), the relation of the colors red, blue and purple is determined completely and finally" (Köhler, 1938; p. 51). Thus, the domain of experimental phenomenology is modal: a condition of necessity in relationships between perceptual variables is inscribed. Following the same example of the three colors: "Considering merely the degrees of similarity which prevail between the three qualities we cannot arrange them otherwise. The order is `required´" (Köhler, 1938; p. 50). I do not consider here logical modalities of course but what is phenomenally necessary.

What is implied by assuming that explanation is an argument? In Experimental phenomenology, the contents of the immediate experience are completely defined in the states of things under observation. The perceptual laws are observable dependencies between two or more phenomenal variables. However, the perceptual laws are also expressible in formal terms, as universal form: "in all cases when conditions of kind F are realized, conditions of kind G are realized as well" (Hempel, 1966, p. 55). On the formal plane these laws cannot be granted an ontological status. According to Wertheimer (1923), the immanent nature of *Gestalt* prevents a logical definition of '*Gestalt'*. Nevertheless the formal plane is a cognitive help for a generalization of the contents of immediate experience. In the same way, terms of explanation have validity on the formal plane. And so, explanation can be accepted as an argument.

As we see, the argument is made up of some premises (*explanans*), and of an inference conclusion (*explanandum*). Some statements or *explanans* describe (1) 'particular facts', which, say, making reference to perceptual proximity grouping, would be some dots placed at different inter-distances, and (2) some statements that express laws, a case in point being Wertheimer's law of proximity (1923): '*Ceteris paribus*, all proximal dots group together'. Consequently, the *explanandum* is deductively inferred.

Figure 1.a *Figure 1.b*

Fig. 1. In Figure 1.a no particular organization is seen. In Figure 1.b is seen a couple of dots.

Let's turn now to the critiques against the deductive-nomological model. Within Experimental phenomenology, the aim is nomic and the laws are qualified as not being of the causal type in a mechanistic sense. Therefore, there is no likelihood of counterexamples of the first type in which the height of the tower, in the sunlight, causes the length of the shadow. In Experimental phenomenology the variables in play are on the same phenomenal plane: possible dependence relationships between variables are therefore necessarily symmetrical. The same is true for the counterexample of the fourth type, where the relationships between the terms of the law respond to an underlying common cause. Substantial reliability of the symmetry between explanation and prediction, at least within this field, can then be established.

Based on such symmetry, possible counterexamples of the second type can also ultimately be eluded. The particular conditions (C_1, C_2, ..., C_k) of the *explanans* may actually not be antecedent. When the *explanans* is known, it will be possible to infer, or better to see with hindsight, that the *explanandum* has actually occurred. In addition, it must be underlined that a structural, non-causal law contemplates no temporal priority of one of the terms. Without a causal constraint (position of the stars that cause the eclipse) that establishes a before-after time relationship, also the counterexample of the second type would be neutralized.
The counterexamples of the third and fifth type are excluded in Experimental phenomenology to the extent that a statistical-inductive explanation is excluded. With the counterexamples of the third type the exclusion is apparent, as indeed is the existence of a percentage of countercases that would compromise the validity of the explanation. Also the last type of counterexamples, concerning explicative relevance, turns out to be efficacious especially for statistical explanations; as far as deductive-nomological explanations are concerned, resorting to the data under observation has the consequence of binding the connection between the covering law and the phenomenon to be explained. From a formal point of view, in any case, it would be fairly easy to avoid this type of counterexample by adding a requisite that excludes irrelevant factors (see Salmon, 1979).

Lastly, confining the ambit of explanation to Experimental phenomenology means to delimit background knowledge, accepted assumptions and context. In this sense, the instances of the pragmatist line would be, at least partly, contained. If Hanson (1958) maintains that death in an accident can be explained as caused by a multiple haemorrhage by a doctor, the driver's negligence by a lawyer, brake failure by a mechanic, and some bushes growing on the road by an urbanist, then a given perceptual phenomenon, such as an optical-geometrical illusion, has without a doubt a restricted range of 'antithesis-class' (to use van Fraassen's terminology).

And so, at least for particular facts, within an Experimental phenomenology, the deductive-nomological explanation could be deemed as a valid model.

Summary

The present paper focuses on the epistemic line of scientific explanation that identified explanation with a deductive and nomological argument characterized by empirical contents and logic validity. Critiques of and objections to the deductive-nomological

model are discussed. The aim of the paper is to show that constraints imposed on the deductive-nomological model are suitable for Experimental phenomenology. Indeed Experimental phenomenology takes phenomenal dependencies under observation as *explanandum* and is directed towards nomic, deterministic and modal knowledge.
Keywords: Explanation, experimental phenomenology, deductive-nomological model, perception, nomic, deterministic, modal.

Zusammenfassung

Die vorliegende Arbeit stellt die erkenntnistheoretische Linie wissenschaftlicher Erklärungen in den Mittelpunkt, in der Erklärungen mit deduktiv-nomologischer Argumentation gleichgesetzt wurde, charakterisiert durch empirischen Gehalt und logische Gültigkeit. Kritische Einwände gegen dieses schlussfolgernd-nomologische Modell werden erörtert. Die Absicht der Arbeit ist zu zeigen, dass für die experimentelle Phänomenologie Einschränkungen des schlussfolgernd-nomologischen Modells angemessen sind. Tatsächlich stellt die experimentelle Phänomenologie als *Explanandum* phänomenale Abhängigkeiten unter Beobachtung und ist auf nomologisches, deterministisches und modales Wissen ausgerichtet.
Schlüsselwörter: Erklärung, experimentelle Phänomenologie, deduktiv-nomologisches Modell, Wahrnehmung, nomologisch, deterministisch, modal.

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