

teorema

Revista Internacional de Filosofía

Vol. XXXVIII/3 • 2019

KRK EDICIONES

teorema

Revista internacional de filosofía

Consejo editorial

D. BAR-ON (Connecticut); †R. BENEYTO (Valencia); †J.L. BLASCO (Valencia); R. BODEI (Pisa); C. BOECKX (Barcelona); F. BRONCANO (Madrid); M. BUNGE (Montreal); M. CACCIARI (Venecia); J. CORBÍ (Valencia); N. CHOMSKY (Massachusetts); †D. DAVIDSON (California, Berkeley); J. ECHEVERRÍA (Madrid); †J. FERRATER MORA (Pensilvania); D. FINKELSTEIN (Chicago); †J. FODOR (Nueva York-New Jersey); †J.D. GARCÍA BACCA (Caracas); M. GARCÍA-CARPINTERO (Barcelona); A. GARCÍA SUÁREZ (Oviedo); C. GARCÍA-TREVIJANO (Madrid); †M. GARRIDO (Madrid); H.-J. GLOCK (Zúrich); P. GOCHET (Lieja); C. GÓMEZ (Madrid); A. GOMILA (Illes Balears); S. HAACK (Miami); †S. HAMPSHIRE (Oxford); J. HIERRO (Madrid); CH. HOOKWAY (Sheffield); W. HOPP (Boston); F. JARAUTA (Murcia); M. JIMÉNEZ REDONDO (Valencia); J. DE LORENZO (Valladolid); J. MCDOWELL (Pittsburgh); †F. MONTERO (Valencia); †J. MOSTERÍN (Madrid); C.U. MOULINES (Múnich); C. MOYA (Valencia); K. MULLIGAN (Ginebra); C.P. OTERO (California, L.A.); D.F. PEARS (Oxford); J.L. PRADES (Girona); D. QUESADA (Barcelona); †W.V.O. QUINE (Harvard); M.A. QUINTANILLA (Salamanca); V. RANTALA (Tampere); I. REGUERA (Cáceres); M. SABATÉS (Kansas); †M. SÁNCHEZ-MAZAS (San Sebastián); J. SANMARTÍN (Valencia); J.R. SEARLE (California, Berkeley); J. SEOANE (Valencia); E. SOBER (Wisconsin); G. SOLANA (Madrid); E. SOSA (Rhode Island-New Jersey); †P.F. STRAWSON (Oxford); G. STRAWSON (Reading); †B. STROUD (Berkeley); C. THIEBAUD (Madrid); CH. THIEL (Erlangen); R. TUOMELA (Helsinki); A. VALCÁRCEL (Madrid); A. VICENTE (Vitoria); †G.H. VON WRIGHT (Helsinki).

Consejo de redacción

Lógica: R. BOSCH (Oviedo). *Filosofía de la lógica*: M.J. FRÁPOLLI (Granada). *Filosofía de la ciencia*: M. SUÁREZ (Madrid). *Ciencia cognitiva*: F. CALVO (Murcia). *Filosofía de la mente*: J. ZALABARDO (Londres). *Filosofía del lenguaje*: J.J. ACERO (Granada). *Teoría del conocimiento*: J. COMESAÑA (Arizona). *Metafísica*: D. LÓPEZ DE SA (Barcelona). *Historia de la filosofía*: M. GARCÍA-BARÓ (Madrid)

Director: L.M. VALDÉS (Oviedo); *Secretario*: A. GARCÍA RODRÍGUEZ (Murcia).

teorema *Revista internacional de filosofía* es una publicación cuatrimestral que aparece en febrero, mayo y octubre. Anualmente edita el suplemento **limbo** *Boletín internacional de estudios sobre Santayana*. Aunque se tomarán en consideración artículos pertenecientes a cualquier disciplina filosófica, **teorema** presta una atención especial a aquellos que, preferentemente en español e inglés, discutan temas de lógica, filosofía del lenguaje, filosofía de la lógica, filosofía de la mente, ciencia cognitiva, filosofía e historia de la ciencia, teoría del conocimiento, metafísica, y otras áreas relacionadas. Es propósito de **teorema** dedicar especial consideración al pensamiento español en todas sus épocas y facetas. **teorema** publica también, principalmente por invitación, notas críticas y reseñaciones; sin embargo, las propuestas de publicación en este ámbito son muy favorablemente acogidas. La revista **teorema** sigue el procedimiento de revisión externa y anónima por pares. Los contenidos de la revista están recogidos, entre otras, en las siguientes fuentes bibliográficas: Arts and Humanities Citation Index*, Current Contents®/Arts and Humanities, Carhus Plus+, Dialnet, Dice, Elsevier Bibliographic Databases (SCOPUS), Fuente académica, ISOC-CSIC, Jstor, Latindex, Periodicals Index Online, Répertoire bibliographique de la philosophie, RESH, Sumaris CBUC, The Philosopher's Index, and Ulrich's Periodicals Directory. **teorema** ha sido declarada "revista de excelencia" por FECYT (Fundación Española para la Ciencia y la Tecnología), organismo dependiente del Ministerio de Economía y Competitividad del Gobierno de España.

Los contenidos de **teorema** desde 1971 están accesibles libremente en <www.dialnet.unirioja.es>.

teorema *Revista internacional de filosofía* is a four-monthly journal (issues in February, May and October). **limbo** *Boletín internacional de estudios sobre Santayana* is included as an annual supplement. Although papers in any philosophical discipline will be considered, the main aim of the journal is to publish original articles either in Spanish or in English in Logic, Philosophy of Language, Philosophy of Mind, Cognitive Science, Philosophy and History of Science, Epistemology, Metaphysics and related areas. The study of Spanish Thought from any period or discipline will be given special consideration. Although critical notices and book reviews are usually invited, suggestions are welcome. **teorema** is a blind- and peer-reviewed journal. The contents of **teorema** are indexed and collected in the following bibliographic sources: Arts and Humanities Citation Index*, Current Contents®/Arts and Humanities, Carhus Plus+, Dialnet, Dice, Elsevier Bibliographic Databases (SCOPUS), Fuente académica, ISOC-CSIC, Jstor, Latindex, Periodicals Index Online, Répertoire bibliographique de la philosophie, RESH, Sumaris CBUC, The Philosopher's Index, and Ulrich's Periodicals Directory. **teorema** has been listed as a "journal of excellence" by the Spanish Government Agency FECYT (Foundation for Science and Technology).

For free access to back issues of **teorema** from 1971 up to last year go to <www.dialnet.unirioja.es>.

REDACCIÓN/EDITORIAL OFFICE: **teorema**. Universidad de Oviedo, Edificio de Servicios Múltiples, Campus de Humanidades, E-33071, Oviedo, Spain. **teorema**, apartado 702, E-33080, Oviedo, Spain.
Phone: (34) 98 5104378, fax: (34) 98 5104385, teorema@uniovi.es, www.uniovi.es/Teorema, www.revistateorema.com
SUSCRIPCIONES/SUBSCRIPTIONS: Ediciones Krk, Álvarez Lorenzana 27, E-33006 Oviedo, Spain;
phone & fax: (34) 98 5276501, correo@krkediciones.com, www.krkediciones.com. DL:AS-1736-2015

ÍNDICE/TABLE OF CONTENTS

SECCIÓN MONOGRÁFICA/SPECIAL SECTION

LA EXPLICACIÓN EN CIENCIA/EXPLANATION IN SCIENCE

GUEST EDITOR: VALERIANO IRANZO

V. IRANZO, <i>Introduction: Explanation in Science</i>	5
J. REISS, <i>Causal Explanation Is All There Is to Causation</i>	25
S. PSILLOS and S. IOANNIDIS, <i>Mechanistic Causation: Difference-Making is Enough</i>	53
S. PÉREZ-GONZÁLEZ, <i>The Search for Generality in the Notion of Mechanism</i>	77
J. SUÁREZ and R. DEULOFEU, <i>Equilibrium Explanation as Structural Non-Mechanistic Explanations: The Case of Long-Term Bacterial Persistence in Human Hosts</i>	95
W. ROCHE and E. SOBER, <i>Inference to the Best Explanation and the Screening-Off Challenge</i>	121
J. N. SCHUPBACH, <i>Conjunctive Explanations and Inference to the Best Explanation</i>	143

NOTA CRÍTICA/CRITICAL NOTICE

J. CORBÍ, <i>La racionalidad como virtud de la agencia</i> (F. Broncano, <i>Racionalidad, acción y opacidad</i>)	163
--	-----

OBITUARIO/OBITUARY

J. L. PRADES, In Memoriam: *Barry Stroud (1935-2019)*

173



AGING
THOUGHTFULLY

CONVERSATIONS ABOUT
RETIREMENT, ROMANCE,
WRINKLES, & REGRET

MARTHA C. NUSSBAUM
& SAUL LEVMORE

teorema

Vol. XXXVIII/3, 2019, pp. 77-94

ISSN: 0210-1602

[BIBLID 0210-1602 (2019) 38:3; pp. 77-94]

The Search for Generality in the Notion of Mechanism

Saúl Pérez-González

RESUMEN

En este artículo, introduzco y analizo un principio general compartido por los nuevos mecanicistas: *la búsqueda de generalidad*. Los nuevos mecanicistas consideran que una noción de mecanismo aceptable ha de ser adecuada para la mayoría de las áreas científicas en que los mecanismos son relevantes. El desarrollo de nociones de mecanismo generales se lleva a cabo mediante dos estrategias diferentes y alternativas, a las cuales denomino *la estrategia de extrapolación* y *la estrategia a-través-de-las-ciencias*. Después de analizar ejemplos paradigmáticos de éstas, planteo que ambas estrategias tienen problemas significativos y que las posibilidades de superarlos son escasas. Se concluye que sería recomendable abandonar la búsqueda de generalidad.

PALABRAS CLAVE: *mecanismo, explicación científica, generalidad, mecanismo de transmisión monetaria, selección natural.*

ABSTRACT

In this paper, I introduce and discuss a general principle shared by new mechanists: *the search for generality*. New mechanists agree that an appropriate notion of mechanism has to be suitable for most of the fields of science where mechanisms are relevant. The development of general notions of mechanism is pursued with two different and alternative strategies, which I call *the extrapolation strategy* and *the across-the-sciences strategy*. After analysing paradigmatic examples of them, I argue that both strategies face outstanding difficulties and that the prospects for overcoming them are dim. It is concluded that it would be advisable to abandon the search for generality.

KEYWORDS: *Mechanism, Scientific Explanation, Generality, Monetary Transmission Mechanism, Natural Selection.*

I. INTRODUCTION

The new mechanism emerged in the mid-90s.¹ *Discovering Complexity: Decomposition and Localization as Strategies in Scientific Research* (1993) by William Bechtel and Robert C. Richardson marked the beginning of this approach. Although it became much more influent some years later with

the publication of “Mechanisms and the Nature of Causation” (1996) by Stuart Glennan and “Thinking about Mechanisms” (2000) by Peter Machamer, Lindley Darden, and Carl F. Craver (henceforth MDC). The new mechanism is both a philosophy of science (i.e. philosophical inquiry into science) and a philosophy of nature (i.e. philosophical inquiry into the constituents of real things). Not only is it concerned about the role of mechanisms in science, but also about the nature of mechanisms, which are part of the real world.

The aim of this paper is to discuss a general principle of the new mechanism that I call *the search for generality*. Its structure is as follows. Section II introduces the main features of the new mechanism. Section III characterizes the search for generality and the two strategies that are adopted in order to achieve that purpose. Section IV argues that both strategies for achieving generality face outstanding difficulties. Section V shows that the problems of the search for generality undermine some arguments in support of the mechanistic approach (e.g. the mechanistic account of explanation). Finally, section VI concludes.

II. THE NEW MECHANISM

Within the framework of the new mechanism, several proposals have been raised. The most relevant ones are those of Glennan (1996), (2002), (2017), MDC (2000), Bechtel and Abrahamsen (2005), (2010), and Illari and Williamson (2012). In spite of the disagreements among those proposals, some general ideas are shared by all of them. Recent books such as *The New Mechanical Philosophy* (2017) by Glennan and *The Routledge Handbook of Mechanisms and Mechanical Philosophy* (2018) edited by Glennan and Illari have underlined the great deal of consensus existing within the new mechanism.

New mechanists consider that a mechanism is an organized compound that is part of the real world. They discriminate between a mechanism, which is a real entity, and a model of it, which is often a piece of scientific reasoning. In this sense, Glennan says that “mechanisms and their constituents are things in the world that exist independently of the models we made of them” [Glennan (2017), p. 10]. They also agree that mechanisms are nested and form a hierarchy [Machamer, Darden, and Craver (2000), p. 13]. A component part of a mechanism is often a mechanism itself. For instance, a heart is both a mechanism and a component part of a mechanism (e.g. a circulatory system). Nevertheless, this idea does not lead them to reductionism regarding mechanisms. They reject that it is possible

to reduce higher level mechanisms to lower level mechanisms [Andersen (2014), p. 281]. Another shared idea is that a mechanism is always a mechanism for some phenomenon [Bechtel and Abrahamsen (2005), p. 42; Craver (2007), p. 123; Glennan (1996), p. 52]. The identification and delimitation of a mechanism (i.e. the fixation of a mechanism's boundaries) depend on the phenomenon for which it is responsible [Kaiser (2018)]. In the new mechanism, the notion of mechanism is not equivalent to the notion of machine. Although human-built machines (e.g. a vending machine) can often be considered mechanisms, most mechanisms are not machines.

There are also some general agreements regarding the principles that guide new mechanists' research. All their proposals emerge from a focus on scientific practice [Glennan (2017), p. 12]. Scientists' considerations about mechanisms are the main reference for the development of new mechanists' notions of mechanism. Another shared trait is the interest in how the discovery and decomposition (i.e. the identification of components and their organization) of mechanisms works [Bechtel and Richardson (1993); Darden (2018)]. They are not only interested in the role of mechanisms in science, but also in how scientists discover and decompose them. Due to the fact that a mechanism is always a mechanism for some phenomenon, the discovery of a mechanism begins with the identification of a puzzling phenomenon.

According to the new mechanism, the role of mechanisms in science is usually associated with the scientific objective of explaining. New mechanists have developed a mechanistic account of scientific explanation. They consider that a phenomenon is explained by means of specifying the mechanism that is responsible for it.² In this sense, MDC say: "To give a description of a mechanism for a phenomenon is to explain that phenomenon" [Machamer, Darden, and Craver (2000), p. 3]. A well-known example of mechanistic explanation is the standard explanation of the phenomenon of chemical transmission at synapsis [Machamer, Darden, and Craver (2000)]. This phenomenon is explained by the interactions (e.g. transporting, inserting, diffusing...) among cell membrane, vesicles, microtubules, molecules, and ions that are responsible for it. The mechanistic approach to scientific explanation has been developed as an alternative to the covering-law model [Bechtel and Abrahamsen (2005); Craver (2014)].³ The covering-law model, which was developed by Carl G. Hempel (1965), is based on the idea that to explain a phenomenon is to subsume it under a law. This proposal gave rise to a consensus regarding the notion of scientific explanation that lasted from the late 1940s to the mid-1960s [Salmon (1989), p. 3]. However, since

the early 1960s, several critiques and counterexamples have noted that subsuming a phenomenon under a law is neither necessary nor sufficient condition for explaining it. The mechanistic approach, as other current approaches (e.g. unificationist account of explanation, pragmatic theories of explanation...), try to account for scientific explanation avoiding covering-law model's problems.

New mechanists consider that mechanisms are relevant in science and that their relevance is mainly associated with explaining. Thus, they support a mechanistic account of scientific explanation. According to it, a phenomenon is explained by means of specifying the mechanism that is responsible for it. In what follows, I will discuss one problematic aspect of the new mechanism related to the notion of mechanism, i.e., the search for generality.

III. THE SEARCH FOR GENERALITY

Through the previous section, several well-known general principles of the new mechanism have been noted. Nevertheless, there is another one that has not been previously identified and deserves attention. It is *the search for generality*. New mechanists consider that mechanisms are relevant in most scientific fields. And they agree that an appropriate notion of mechanism has to be suitable for most of the fields where mechanisms are relevant. In this sense, in his foundational "Mechanisms and the Nature of Causation", Glennan [(1996), p. 50] claims that mechanisms are relevant in all scientific fields except fundamental physics. His proposal aims to suit those fields.

Despite the fact that the search for generality is a trait shared by all mechanistic proposals, it is not always pursued with the same strategy. This difference with respect to the strategies has made difficult to identify this common feature. Within the new mechanism, there are two strategies for proposing general notions of mechanism. I call them *the extrapolation strategy* and *the across-the-sciences strategy*.

The extrapolation strategy consists of developing a notion of mechanism taking one or a few fields of science as reference, and then applying that notion to many other fields. This strategy goes from certain kind of mechanisms to a general notion of mechanism, so that, the notion is applied to kinds of mechanisms that were not taken into account for its development. MDC (2000), for instance, follow the extrapolation strategy. Their notion of mechanism was developed taking neurobiological and molecular mechanisms as reference. The mechanisms of chemi-

cal transmission at synapsis and protein synthesis are their paradigmatic examples of mechanisms. But they consider that their notion of mechanism could be applied to other fields of science. In this sense, they say: “We suspect that this analysis is applicable to many other sciences, and maybe even to cognitive or social mechanisms” [Machamer, Darden, and Craver (2000), p. 2].⁴ The extrapolation strategy was also adopted by Glennan (1996), (2002). He developed his notion of mechanism taking physical mechanisms (e.g. a float valve, a voltage switch...) as reference. Nevertheless, he considered that it suited many other kinds of mechanisms: “my analysis is in no way limited to mechanisms that are physical in nature. It is meant to equally apply to chemical, biological, psychological and other higher-level mechanisms” [Glennan (1996), p. 61].

James Woodward (2002) also follows the extrapolation strategy in his study of mechanisms.⁵ He focuses on mechanics (e.g. a block sliding down an inclined plane), although he takes into account molecular biology too. However, he claims that “a notion of mechanism very similar to that characterized by **MECH** is employed in many other fields of science — for example, in psychology” [Woodward (2002), p. S376].

The across-the-sciences strategy consists of thinking about mechanisms across all the sciences and developing a notion of mechanism that includes their common features. This strategy goes from all mechanisms to a general notion of mechanism. All kinds of mechanisms to which the notion is applied are taken into account for its development. The across-the-sciences strategy was introduced by Illari and Williamson (2012), who underlined its difference from the previous developments of notions of mechanism (i.e. the extrapolation strategy). Their aim is to consider mechanisms in general and to propose “a characterization that gives an understanding of what is common to mechanisms in *all* fields” [Illari and Williamson (2012), p. 120]. They underline the need of a consensus account of mechanisms in order to address several philosophical issues (e.g. causal explanation, inference, and modelling). The across-the-sciences strategy has recently been adopted by Glennan (2017). He has abandoned his previous notion of mechanism [see Glennan (1996), (2002)] and proposes a minimal characterization of it, which tries to include what all mechanisms share in common. His aim is to develop a notion of mechanism “broad enough to capture most of wide range of things scientists have called mechanisms” [Glennan (2017), p. 18]. In the next section, I will show that both the extrapolation strategy and the across-the-sciences strategy face outstanding difficulties.

IV. THE DIFFICULTIES OF THE SEARCH FOR GENERALITY

Generality is a valuable purpose here. There are several kinds of mechanisms in science (e.g. molecular mechanisms, social mechanisms, computing mechanisms...). A notion that could account for all of them would be useful for both scientific research and philosophical understanding. It would facilitate collaboration among fields of science where mechanisms are relevant. Besides, the will of generality is also present in many philosophical issues related with mechanisms. For instance, philosophers of science try to develop a notion of causal explanation that suits all explanations where the *explanans* makes reference to the causes of the *explanandum* phenomenon. A general notion of mechanism would help to address these issues. However, I will argue below that both suggested strategies for pursuing generality face outstanding difficulties. In order to identify and analyse those difficulties, I will focus on MDC's and Illari and Williamson's proposals, which are paradigmatic examples of the extrapolation strategy and the across-the-sciences strategy respectively.

IV.1. *The Difficulties of the Extrapolation Strategy*

MDC's proposal, one of the most relevant ones in the current debate, follows the extrapolation strategy for developing a general notion of mechanism. However, their notion of mechanism, which is developed taking certain kind of mechanisms as reference, does not suit many other kinds of mechanisms. MDC define mechanism as follows:

Mechanisms are entities and activities organized such that they are productive of regular changes from start or set-up to finish or termination conditions [Machamer, Darden, and Craver (2000), p. 3].

A mechanism is an organized collection of entities (with their properties) and activities. Entities are things that engage in activities. They are usually spatiotemporal located, structured, and oriented. Examples of entities are neurotransmitters, neurons, DNA bases... Activities are productive happenings. They have temporal order, rate, and duration. Examples of activities are transporting, neuromodulating, recycling... Mechanisms' components are organized. Their organization has temporal, spatial, and active aspects [Craver and Darden (2013), p. 20]. MDC hold that mechanisms are regular and "work always or for the most part in the same way under the same conditions" [Machamer, Darden, and Craver (2000), p. 3].

Although MDC consider that their notion of mechanism could be applied to most fields of science (see section III), it is unlikely the case. For

instance, the application of MDC's notion of mechanism to evolutionary biology would be very problematic. Evolutionary biologists often refer to evolutionary causes (e.g. natural selection, mutation, migration...) as mechanisms that bring about changes in populations. In this sense, Graham Bell says: "Selection is an effective mechanism for producing adaptation" [Bell (2008), p. 499]. Other evolutionary biologists who refer to several evolutionary causes as mechanisms are Jon C. Herron and Scott Freeman (2014). However, MDC's notion of mechanism is not able to account for evolutionary causes as mechanisms. Robert A. Skipper and Roberta L. Millstein (2005) have argued that natural selection does not meet MDC's characterization of mechanisms.⁶ For instance, relevant productive relationships among component entities of natural selection cannot always be understood as activities. Natural selection often depends on passive selection processes (e.g. being poisonous, having certain colour...) that can hardly be considered activities. Skipper and Millstein also say that natural selection does not satisfy the requirement of regularity.⁷

MDC's notion of mechanism is also unable to account for economic mechanisms. Economists often refer to economic mechanisms (e.g. markets, price mechanisms...). Well-known examples of economic mechanisms are monetary transmission mechanisms. A monetary transmission mechanism is a mechanism responsible for the influence of a central bank in output, employment, prices, and inflation of a country or a political and economic union (e.g. European Union) [Samuelson and Nordhaus (2010), p. 484]. It is an organized collection of entities (e.g. banks, central banks, securities broker-dealers...) and activities (e.g. buying and selling government securities, trading reserve balances at a central bank, changing the legal reserve-ratio requirements...). It could seem that MDC's notion of mechanism suits monetary transmission mechanisms, but it is unlikely the case.

MDC consider that mechanisms are regular. Lane DesAutels (2016) has recently showed that in order to meet MDC's requirement of regularity a mechanism has to be process regular and not be affected by internal sources of irregularity. However, monetary transmission mechanisms are not process regular and are affected by internal sources of irregularity. Process regularity consists in that "the constituent entities and activities of a mechanism behave in roughly the same way each time the mechanism operates" [DesAutels (2016), p. 16]. But, component entities of monetary transmission mechanisms do not always behave in the same way. For instance, given an undesirably low level of inflation, a central

bank (e.g. European Central Bank, U.S. Federal Reserve System...) does not always behave in the same way in order to influence in it. Central banks often buy government securities for increasing the level of inflation. But sometimes they also modify the reverse-ratio requirements or borrow money with a discount rate. Monetary transmission mechanisms are affected by internal sources of irregularity too. For example, a change in the behaviour of the U.S. Federal Reserve System can be the result of a change in which presidents of regional Federal Reserve Banks are voting members of the Federal Open Market Committee.

Other aspect of MDC's proposal that does not suit monetary transmission mechanisms is the fixation of mechanisms' boundaries. It is considered that "mechanisms are always mechanisms *of* a given phenomenon" [Craver (2007), p. 123]. Regarding boundaries, Craver says: "The boundaries of mechanisms —what is in the mechanism and what is not— are fixed by reference to the phenomenon that the mechanism explains" [Craver (2007), p. 123]. A mechanism *of* certain phenomenon is composed of those entities, activities, and organizational features that are part of the system whose behaviour is the phenomenon of interest and are relevant for that phenomenon. A part is relevant for a phenomenon if it meets the requirement of mutual manipulability [Craver (2007)]. Therefore, a part X is a component of the mechanism *of* phenomenon Y if some interventions on X bring about changes in Y, and vice versa. Craver appeals to the notion of intervention developed by Woodward (2003). Woodward claims that "an intervention on some variable X with respect to some second variable Y is a causal process that changes the value of X in an appropriately exogenous way, so that if a change in the value of Y occurs, it occurs only in virtue of the change in the value of X" [Woodward (2003), p. 94]. Nevertheless, this proposal does not suit monetary transmission mechanisms. A monetary transmission mechanism is a mechanism of a phenomenon (i.e. the influence of a central bank in output, employment, prices, and inflation). But it is not composed of all entities, activities, and organizational features that are part of the system whose behaviour is the phenomenon of interest and are relevant for that phenomenon. Consider the South Korean monetary transmission mechanism. That mechanism is responsible for the influence of the Bank of Korea in the South Korean output, employment, prices, and inflation. Samsung Electronics, which is the largest South Korean firm, is part of the system whose behaviour is the phenomenon of interest (South Korea). It also meets the requirement of mutual manipulability and is relevant for the phenomenon. Some interventions on Samsung Electronics produce changes in the influence of the Bank of Korea in the South Kore-

an economy, and vice versa. However, it is not part of the South Korean monetary transmission mechanism. In sum, MDC's proposal does not properly fix monetary transmission mechanisms' boundaries.⁸

MDC follow the extrapolation strategy for developing a general notion of mechanism. However, as it has been argued, their notion does not suit many kinds of mechanisms. It introduces certain requirements that are not met by those kinds of mechanisms. This also seems to be the case for the other proposals that follow the extrapolation strategy. For instance, Glennan's (2002) and Woodward's (2002) proposals do not suit neither economic mechanisms nor evolutionary mechanisms. They consider that properties of mechanisms' parts must remain stable in absence of interventions. However, properties of economic mechanism's parts (e.g. firms) and evolutionary mechanisms' parts (e.g. populations) may change even if no intervention has been done [Skipper and Millstein (2005)]. Consider the following hypothetical example of a firm. During a lunch at the office, there is a strong discussion between the CEO of firm X and the director of its department of publicity. As a consequence of this event, the CEO decreases the budget of the department of publicity. Due to the reduction of the budget, the department of publicity has to introduce changes in the advertising strategy of the firm (e.g. the number of ads on TV is decreased, while the number of ads on radio is increased). In this example, different properties of firm X (e.g. budget of its departments, number of ads on TV...) changed without any exogenous intervention.

IV.2. *The Difficulties of the Across-the-Sciences Strategy*

Illari and Williamson, who introduced the across-the-sciences strategy, follow it for developing a general notion of mechanism. Nevertheless, on my view they propose a vacuous and overly broad notion of mechanism. Illari and Williamson offer the following definition of mechanism:

A mechanism for a phenomenon consists of entities and activities organized in such a way that they are responsible for the phenomenon. [Illari and Williamson (2012), p. 120]

A mechanism is an organized collection of entities and activities. No restrictions on regularity, internal structure, size, boundaries or robustness are imposed on them. Examples of entities are electrons, stars, black holes, x-rays... While examples of activities are colliding, relaxing, collapsing, radiating... Mechanisms' organization is merely defined as "whatever relations between the entities and activities discovered pro-

duce the phenomenon of interest” [Illari and Williamson (2012), p. 128]. There are several possible forms of organization (e.g. spatial, temporal, equilibrium, self-organization, feedback...). What forms of organization are relevant in a particular mechanism is an empirical question.

My main objection here is that Illari and Williamson’s notion of mechanism is vacuous.⁹ Their definition of mechanism relies on the concepts of entity, activity, organization, and being responsible for. Nevertheless, they do not properly characterize those concepts. For instance, consider the concept of entity. They offer neither a definition of entity nor a set of necessary conditions to be an entity nor a set of sufficient conditions to be an entity. Besides, they refuse to introduce restrictions on entities. They certainly present some examples of component entities of astrophysical and molecular mechanisms. Nevertheless, those examples are not numerous and diverse enough to properly characterize entities across the sciences. It could be argued that the concept of entity is too general, and a proper characterization of entities is not possible. However, other authors have already raised more concrete characterizations of component entities [see Machamer, Darden, and Craver (2000)]. Illari and Williamson’s notion of mechanism is not precise enough. It is not clear what features would characterize mechanisms. They increase the scope of their notion of mechanism (i.e. the number of mechanisms that it subsumes) at the cost of decreasing its precision.

Another problem for Illari and Williamson’s notion of mechanism is that it is overly broad. Although they consider that their characterization “is not so broad that it captures non-mechanisms” [Illari and Williamson (2012), p. 129], it subsumes things that could hardly be accepted as mechanisms. For instance, their notion would admit a group of cows grazing in a field as a mechanism. It is an organized collection of entities (e.g. cows) and activities (e.g. grazing) that are responsible for a phenomenon (i.e. the removal of the grass of the field). However, it could hardly be considered a proper mechanism. It is actually a mere aggregate, whose components are not actively organized [Craver and Darden (2013), p. 20]. Cows do not interact and make a difference to each other in order to remove the grass. Other examples of things that Illari and Williamson’s notion would wrongly admit as mechanisms are a traffic jam and a group of babies napping.

The aim of Illari and Williamson is to develop a wide notion of mechanism that could encompass mechanisms of all fields. As it has been noted, they decrease the precision of their characterization in order to increase its scope. Nevertheless, Illari and Williamson’s notion of mechanism does not suit many kinds of mechanisms. For instance, it

would not fit evolutionary mechanisms. Illari and Williamson, as MDC, consider that mechanisms are collections of entities and activities. Hence, their notion of mechanism cannot account for those cases of evolution in which natural selection depends on passive selection processes that can hardly be considered activities. Their notion of mechanism would also be unable to account for economic mechanisms. Like MDC, they consider that a mechanism for a phenomenon is composed of those parts (e.g. entities, activities...) that are relevant for it. In this sense, they claim: “mechanisms are functionally individuated by their phenomena” [Illari and Williamson (2012), pp. 123-124]. But, as it has been argued, this idea does not suit economic mechanisms’ (e.g. monetary transmission mechanisms) boundaries. In conclusion, despite of the fact that the across-the-sciences strategy is developed as an alternative to the extrapolation strategy, Illari and Williamson do not avoid the problem of the latter (see subsection IV.1).

Illari and Williamson follow the across-the-sciences strategy for developing a general notion of mechanism. Nevertheless, they do not satisfactorily achieve that purpose. The main problems of their notion of mechanism are that it is vacuous and overly broad. The other proposals that follow the across-the-sciences strategy seem to face the same kind of problems. For example, Glennan’s (2017) recent proposal is overly broad too. It subsumes things that could hardly be accepted as mechanisms (e.g. a group of cows grazing, a traffic jam...). In addition, Glennan’s notion is also unable to account for many kinds of mechanisms. As Illari and Williamson, he considers that mechanisms are collections of entities and activities, and that a mechanism for a phenomenon is composed of those parts that are relevant for it. Therefore, it does not suit evolutionary mechanisms and economic mechanisms either.

V. THE SEARCH FOR GENERALITY AND THE ARGUMENTS IN SUPPORT OF THE MECHANISTIC APPROACH

Mechanisms are relevant in several fields of science. In most of those fields (e.g. neuroscience, cognitive science, molecular biology...), a mechanistic stance has been adopted. From this fact, new mechanists have raised an argument in support of the mechanistic approach. They argue that the adoption of the mechanistic approach in a field of science would improve its relationship with the numerous fields in which this approach has already been adopted. Mechanisms would be the subject of

study of all of them. The fields would only differ in which kind of mechanisms they study. Different fields of science would just study different parts of the hierarchy of mechanisms. In this sense, Craver and Alexandrova say that one reason why neuroeconomics should be a mechanistic science is that “the rest of neuroscience, cognitive science, and biology have adopted a largely mechanistic stance [...] The search for mechanisms provides a common goal toward which researchers in different fields can contribute” [Craver and Alexandrova (2008), p. 398].

A related argument can be raised in favour of the mechanistic account of scientific explanation [Hedström and Ylikoski (2011)]. As it has been said (see section II), supporting a mechanistic account of scientific explanation is a trait of the new mechanism. New mechanists consider that a phenomenon is explained by means of specifying the mechanism that is responsible for it. The explanation of a phenomenon is often presented by means of a mechanistic model. A mechanistic model has two components: phenomenal description and mechanistic description [Glennan (2017), p. 66]. The phenomenal description is a model of the phenomenon and the mechanistic description is a model of the mechanism responsible for it. In a mechanistic model, the phenomenal description is (or represents) the *explanandum* and the mechanistic description is (or represents) the *explanans* [Glennan (2005), p. 448]. Due to the fact that mechanisms are relevant in several fields, new mechanists argue that a mechanistic account of scientific explanation could be adopted in most fields of science. Hence, it would be an all-encompassing account of scientific explanation. This can be presented as an argument in favour of it.

As it was pointed at the beginning of this paper, the mechanistic account of scientific explanation has been developed as an alternative to the covering-law model. A well-known problem of the covering-law model is that there are fields of science where only a few laws are known, such as evolutionary biology [see Beatty (1995); Scriven (1959)]. A nomological account of explanation can hardly be defended for those fields. Nevertheless, several mechanisms are often known in those fields where laws are not available. A mechanistic account of explanation could be adopted for them. The broad applicability of the mechanistic account of scientific explanation would be an argument to prefer it rather than other options.

Both previously presented arguments rely on the same assumption. They assume that the same notion of mechanism exists in all the fields where mechanisms are relevant. It is considered that the adoption of the mechanistic approach in various fields would improve the relationships among them because their subjects of study would be very similar. But

they would be similar only if mechanisms are understood in a similar way in all fields. If those fields understood mechanisms in a very different way, the adoption of the mechanistic approach would not imply similar subjects of study. Likewise, it is considered that the mechanistic account of scientific explanation could offer a unified account of explanation because in several fields of science phenomena could be explained by means of referring to mechanisms. But it would be a unified standpoint only if mechanisms are similarly understood in all fields. If those fields understood mechanisms in a very different way, the mechanistic account of scientific explanation would not be unifier. Although several fields could refer to mechanisms, they would not refer to the same kind of things.

The assumption on which both arguments rely is challenged by the difficulties faced by the search for generality. It is considered that the same notion of mechanism is shared by all fields of science where mechanisms are relevant. The search for generality constitutes the real attempt of identifying that shared notion. New mechanists try to propose a notion of mechanism that suits most of the fields where mechanisms are relevant. Nevertheless, as it has been argued, both strategies for pursuing generality (i.e. the extrapolation strategy and the across-the-sciences strategy) face outstanding difficulties. This means that the assumption that the same notion of mechanism is shared by all fields is not justified and requires additional support. Not only is that shared notion unknown, but also several attempts of achieving it have failed. Therefore, both previously presented arguments in support of the mechanistic approach are not acceptable in their current form. They should not be used for endorsing the mechanistic approach.

VI. CONCLUSION

The search for generality is a general principle of the new mechanism. New mechanists consider that an appropriate notion of mechanism must be suitable for most of the fields of science where mechanisms are relevant. In order to propose a general notion of mechanism, two strategies have been adopted: the extrapolation strategy and the across-the-sciences strategy. As it has been argued, both of them face outstanding difficulties. The problems of the search for generality undermine some arguments in support of the mechanistic approach, which rely on the assumption that the same notion of mechanism exists in all fields where mechanisms are relevant.

It seems that current notions of mechanism are unable to properly account for all kinds of mechanisms. Moreover, it is doubtful that a general notion of mechanism could be developed. As Petri Ylikoski argues, “[t]he entities and processes studied by different sciences are quite heterogeneous, and it is probably impossible to propose a mechanism definition that would be both informative and cover all the prominent examples of mechanisms” [Ylikoski (2012), p. 22]. Giving this scenario, it would be advisable to abandon the search for generality. In each field of science, a notion of mechanism must be developed taking the activity of the scientists of that field as the main reference. How mechanisms are understood in other fields should not heavily influence in that development. It does not mean that philosophers of science must not think about similarities among mechanisms across the sciences. It could be very useful, after the development of the field-specific notions of mechanism, to compare the different notions of mechanism and identify their common features. Nevertheless, the output of that comparison would not be a proper notion of mechanism in general. In the same way that a list of the common features of English laboratories would not be a general definition of English laboratory. It would just be a list of traits that are shared by mechanisms across the sciences. It is an open question if, in spite of not being a definition, some of those shared traits may be necessary or sufficient conditions to be a mechanism. But that question exceeds the scope of this paper.

*Departament de Filosofia
Universitat de València
Av. Blasco Ibáñez 30, 46010 Valencia, Spain
E-mail: saul.perez@uv.es*

ACKNOWLEDGEMENTS

I would like to thank Marc Artiga, Raffaella Campaner, and Valeriano Iranzo for their valuable comments. This work was supported by the Spanish Ministry of Science, Innovation and Universities under grants FPU16/03274 and FFI2017-89639-P.

NOTES

¹ Several classifications of the proposals raised within the new mechanical (or mechanistic) philosophy have been proposed [see Kuorikoski (2009); Reiss (2008)]. A particularly useful classification has been recently offered by Stuart

Glennan and Phyllis Illari (2018). They have distinguished two trends within the new mechanical philosophy: the new mechanism and the social scientific mechanism. In this paper, I will focus on what they call the new mechanism. It involves the senses of the term ‘mechanism’ that Holly Andersen (2014) has named as mechanism₁ and mechanism₂. The main ideas of the social scientific mechanism can be found in the works of Jon Elster (1989), (1999) and Peter Hedström (2005).

² There is a disagreement among new mechanists about whether mechanistic explanations are ontic (i.e. they explain because they fit the *explanandum* phenomenon into the causal structure of the world) or epistemic (i.e. they explain because they successfully increase our understanding of the world) [see Illari (2013)]. Nevertheless, all of them agree that mechanistic explanations refer to the mechanism responsible for the *explanandum* phenomenon.

³ Bert Leuridan (2010) has claimed that mechanistic accounts are not genuine alternatives to nomologic accounts. Taking the pragmatic account of laws by Sandra Mitchell (1997) as his starting point, he argues that mechanistic models epistemologically depend on laws and cannot replace them as a model of explanation in science. However, Andersen (2011) shows that mechanistic models are not dependent on laws, but on regularities, which are not synonymous with laws.

⁴ Peter Hedström [(2005), p. 25] has developed the application of MDC’s notion of mechanism to sociology.

⁵ Although Woodward is not properly a new mechanist, his work has strongly influenced many new mechanists [see Craver (2007); Glennan (2002); Woodward (2002), (2011)].

⁶ Since the publication of Skipper and Millstein’s paper, there has been a debate about how natural selection could be understood as a mechanism [see Barros (2008); DesAutels (2016); Illari and Williamson (2010); Pérez-González and Luque (2019)].

⁷ Lane DesAutels (2016) has recently argued that natural selection is only irregular in aspects that are not relevant in order to meet MDC’s requirement (e.g. product regularity, regularity regarding external sources of irregularity...).

⁸ For other critiques against the mutual manipulability account of constitutive relevance see Leuridan (2012).

⁹ Rosenberg (2018) has underlined the strategic vagueness of some mechanistic proposals. He claims that mechanists are often cagey in order to avoid counterexamples against their proposals.

REFERENCES

ANDERSEN, H. K. (2011), ‘Mechanisms, Laws, and Regularities’, *Philosophy of Science*, vol. 78, pp. 325-331.

- (2014), ‘A Field Guide to Mechanisms: Part I’, *Philosophy Compass*, vol. 9, pp. 274-283.
- BARROS, D. B. (2008), ‘Natural Selection as a Mechanism’, *Philosophy of Science*, vol. 75, pp. 306-322.
- BEATTY, J. H. (1995), ‘The Evolutionary Contingency Thesis’, in Woltersand, G. and Lennox, J. G. (eds.), *Concepts, Theories, and Rationality in the Biological Sciences. The Second Pittsburgh-Konstanz Colloquium in the Philosophy of Science*, Cambridge, MIT Press, pp. 45-81.
- BECHTEL, W. and ABRAHAMSEN, A. (2005), ‘Explanation: A Mechanist Alternative’, *Studies in History and Philosophy of Biological and Biomedical Sciences*, vol. 36, pp. 421-441.
- (2010), ‘Dynamic Mechanistic Explanation: Computational Modelling of Circadian Rhythms as an Exemplar for Cognitive Science’, *Studies in History and Philosophy of Science*, vol. 41, pp. 321-333.
- BECHTEL, W. and RICHARDSON, R. C. (1993), *Discovering Complexity: Decomposition and Localization as Strategies in Scientific Research*, Princeton, Princeton University Press.
- BELL, G. (2008), *Selection. The Mechanism of Evolution*, Oxford, Oxford University Press.
- CRAVER, C. F. (2007), *Explaining the Brain: Mechanisms and the Mosaic Unity of Neuroscience*, Oxford, Clarendon Press.
- (2014), ‘The Ontic Account of Scientific Explanation’, in Kaiser, M. I., Scholz, O. R., Plenge, D. and Hüttemann, A. (eds.), *Explanation in the Special Sciences: The Case of Biology and History*, Dordrecht, Springer, pp. 27-52.
- CRAVER, C. F. and ALEXANDROVA, A. (2008), ‘No Revolution Necessary: Neural Mechanisms for Economics’, *Economics and Philosophy*, vol. 24, pp. 381-406.
- CRAVER, C. F. and DARDEN, L. (2013), *In Search of Mechanisms: Discoveries across the Life Sciences*, Chicago, University of Chicago Press.
- DARDEN, L. (2018), ‘Strategies for Discovering mechanisms’, in Glennan, S. and Illari, P. M. (eds.), *The Routledge Handbook of Mechanisms and Mechanical Philosophy*, Abingdon, Routledge, pp. 255-266.
- DESAUTELS, L. (2016), ‘Natural Selection and Mechanistic Regularity’, *Studies in History and Philosophy of Biological and Biomedical Sciences*, vol. 57, pp. 13-23.
- ELSTER, J. (1989), *Nuts and Bolts for Social Sciences*, Cambridge, Cambridge University Press.
- (1999), *Alchemies of the Mind. Rationality and the Emotions*, Cambridge, Cambridge University Press.
- GLENNAN, S. (2002), ‘Rethinking Mechanistic Explanation’, *Philosophy of Science*, vol. 69, pp. S342-S353.
- (2005), ‘Modeling Mechanisms’, *Studies in History and Philosophy of Biological and Biomedical Sciences*, vol. 36, pp. 443-464.
- (2017), *The New Mechanical Philosophy*, Oxford, Oxford University Press.
- GLENNAN, S. and ILLARI, P. M. (2018), ‘Introduction: Mechanisms and Mechanical Philosophies’, in Glennan, S. and Illari, P. M. (eds.), *The Routledge Handbook of Mechanisms and Mechanical Philosophy*, Abingdon, Routledge, pp. 1-9.

- GLENNAN, S. S. (1996), 'Mechanisms and the Nature of Causation', *Erkenntnis*, vol. 44, pp. 49-71.
- HEDSTRÖM, P. (2005), *Dissecting the Social. On the Principles of Analytical Sociology*, New York, Cambridge University Press.
- HEDSTRÖM, P. and YLIKOSKI P. (2011), 'Analytical Sociology', in Jarvie, I. C. and Zamora-Bonilla, J. (eds.), *The SAGE Handbook of The Philosophy of Social Sciences*, London, SAGE Publications, pp. 386-398.
- HEMPEL, C. G. (1965), *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*, New York, The Free press.
- HERRON, J. C. and FREEMAN, S. (2014), *Evolutionary Analysis*, Upper Saddle River, Pearson Education.
- ILLARI, P. M. (2013), 'Mechanistic Explanation: Integrating the Ontic and Epistemic', *Erkenntnis*, vol. 78, pp. 237-255.
- ILLARI, P. M. and WILLIAMSON, J. (2010), 'Function and Organization: Comparing the Mechanisms of Protein Synthesis and Natural Selection', *Studies in History and Philosophy of Biological and Biomedical Sciences*, vol. 41, pp. 279-291.
- (2012), 'What is a Mechanism? Thinking about Mechanisms across the Sciences', *European Journal of Philosophy of Science*, vol. 2, pp. 119-135.
- KAISER, M. I. (2018), 'The Components and Boundaries of Mechanisms', in Glennan, S. and Illari, P. M. (eds.), *The Routledge Handbook of Mechanisms and Mechanical Philosophy*, Abingdon, Routledge, pp. 116-130.
- KUORIKOSKI, J. (2009), 'Two Concepts of Mechanism: Componential Causal System and Abstract Form of Interaction', *International Studies in the Philosophy of Science*, vol. 23, pp. 143-160.
- LEURIDAN, B. (2010), 'Can Mechanisms Really Replace Laws of Nature?', *Philosophy of Science*, vol. 77, pp. 317-340.
- (2012), 'Three Problems for the Mutual Manipulability Account of Constitutive Relevance in Mechanisms', *The British Journal for the Philosophy of Science*, vol. 63, pp. 399-427.
- MACHAMER, P., DARDEN L. and CRAVER, C. F. (2000), 'Thinking about Mechanisms', *Philosophy of Science*, vol. 67, pp. 1-25.
- MITCHELL, S. D. (1997), 'Pragmatic Laws', *Philosophy of Science*, vol. 64, pp. S468-S479.
- PÉREZ-GONZÁLEZ, S. and LUQUE, V. J. (2019), 'Evolutionary Causes as Mechanisms: A Critical Analysis', *History and Philosophy of the Life Sciences*, vol. 41, pp. 1-23.
- REISS, J. (2008), *Error in Economics. Towards a More Evidence-Based Methodology*, Abingdon, Routledge.
- ROSENBERG, A. (2018), 'Making Mechanism Interesting', *Synthese*, vol. 195, pp. 11-33.
- SALMON, W. C. (1989), *Four Decades of Scientific Explanation*, Minneapolis, University of Minnesota Press.

- SAMUELSON, P. A. and NORDHAUS, W. D. (2010), *Economics*, Boston, McGraw-Hill/Irwin.
- SCRIVEN, M. (1959), 'Explanation and Prediction in Evolutionary Theory', *Science*, vol. 130, pp. 477-482.
- SKIPPER, R. A. and MILLSTEIN, R. L. (2005), 'Thinking about Evolutionary Mechanisms: Natural Selection', *Studies in History and Philosophy of Biological and Biomedical Sciences*, vol. 36, pp. 327-347.
- WOODWARD, J. (2002), 'What is a Mechanism? A Counterfactual Account', *Philosophy of Science*, vol. 69, pp. S366-S377.
- (2003), *Making Things Happen*, New York, Oxford University Press.
- (2011), 'Mechanisms Revisited', *Synthese*, vol. 183, pp. 409-427.
- YLIKOSKI, P. (2012), 'Micro, Macro, and Mechanisms', in Kincaid, H. (ed.), *The Oxford Handbook of Philosophy of Social Science*, New York, Oxford University Press, pp. 21-45.