Chapter 1
Pragmatism and Pluralism as Methodological Alternatives to Monism, Reductionism and Universalism

Wenceslao J. Gonzalez

Abstract Both pragmatism and pluralism are considered as methodological alternatives to monism, reductionism and universalism, and also to methodological imperialism. First, a historical framework in Suppes ([1978] 1981) provides a precedent for the current emphasis on methodological pluralism, while methodological pragmatism, which is explicit from Rescher (1977), has often had supporters, with greater or lesser intensity and conceived from different epistemological angles. From the 1980’s to the initial years of this century, there has been a renewed interest in methodological pragmatism and pluralism, particularly since 2006. Second, there is a thematic view, which is focused on the central tenets of pragmatism and pluralism to outline their consequences for scientific research as alternative to the influential conceptions mentioned. The emphasis on practice, which leads to efficacy in realizing the collective goals of research, and the recognition of the diversity in scientific research, which is in tune with the polyhedral character of reality (natural, social and artificial) and its ontological levels (micro, meso, macro), contribute to the methodology of science in its twofold condition of analytical and prescriptive (in the sense of indicative patterns). Third, the structure and origin of this book is presented in connection with the previous steps.

Keywords Pragmatism · Pluralism · Methodological · Alternatives · Monism · Reductionism · Universalism

I am grateful to Nicholas Rescher for his remarks on this paper, the final version of which I prepared at the Centre for Philosophy of Natural and Social Sciences (London School of Economics).

W. J. Gonzalez (✉)
Center for Research in Philosophy of Science and Technology, Faculty of Humanities and Information Science, University of A Coruña, Campus of Ferrol, Ferrol, Spain
e-mail: wenceslao.gonzalez@udc.es

© Springer Nature Switzerland AG 2020
W. J. Gonzalez (ed.), Methodological Prospects for Scientific Research, Synthese Library 430, https://doi.org/10.1007/978-3-030-52500-2_1
Pragmatism and pluralism offer methodological alternatives to monism, reductionism and methodological universalism, and also to methodological imperialism. In this regard, the emphasis on the progress of science as a human activity, rather than a mere content oriented to a cognitive goal, and the inquiry made according to the kind of object and the scale of reality studied (micro, meso and macro) can support the advantages of pragmatism and pluralism as philosophico-methodological prospects for scientific research. In addition, the existence of complex systems in the world (natural, social and artificial) (Mainzer [1994] 2007; Mitchell 2009), both structural and dynamic (Bertuglia and Vaio 2005), can play a role in favor of methodological approaches based on pragmatism or pluralism (or even a combination of both).

These advantages in the characterization of scientific advancements include the twofold condition of methodology of science as analytical and prescriptive (in the sense of indicative patterns instead of normative), insofar as (i) it analyzes how science is developed de facto, either in the research made in the past or in the present, and (ii) it proposes how it is possible to improve scientific research, based on how we think science ought to be developed in order to achieve its aims (in the short, middle or long run), according to the level of reality studied. Thus, the attention to human activity, the scale of reality and the structural and dynamic complexity can contribute to central features of the procedures and methods used in science.

Both pragmatism and pluralism are, in principle, open to a diversity of methods in science, in general, in a group of sciences (natural, social or the artificial), and in specific sciences (physics, economics, computer sciences, etc.). This implies that they do not start from a macrotheoretical scheme of unity of science or from the need for a methodological unification of sciences, achieved through an effort of convergence (commonly based on logical, epistemological or ontological criteria).

In addition, they normally consider the practice of science as a relevant factor, rather than just focusing on theoretical contributions to science, and they are generally sensitive to the importance of contexts (social, cultural, economic, etc.) for the advancement of science. Thus, to a large extent, these methodological approaches

---

1 Besides the methodological component, pragmatism and pluralism can be considered in the semantic, logic, epistemological, ontological, axiological and ethical aspects of science.
2 Pragmatism regarding research can take many forms, such as scientific progress focused on “the ways in which inquiry is adapted to meeting human needs,” Kitcher (2015, 475). This view on methodological pragmatism is compatible with scientific realism, cf. Kitcher (2011b, 171–189).
3 Perspectivism can be seen as a form of pluralism, mainly from an epistemological viewpoint, cf. Giere (2006a). Ronald Giere has explored “the extent to which a perspectival understanding of scientific knowledge supports forms of scientific pluralism,” Giere (2006b, p. 26). But the analysis made here is broader than that view. Furthermore, this paper is focused on the methodological approach, which has a connection with an ontological basis and includes the development of the epistemological component.
4 The distinction between “procedures” and “methods,” which has a general character, in the case of scientific prediction is particularly clear, cf. Gonzalez (2015a, 255–273). See also Gonzalez (2020c).
5 The sciences of design are included in the third group, cf. Simon (1996).
Pragmatism and Pluralism as Methodological Alternatives to Monism. Can overcome the key problems of monism, reductionism and methodological universalism as well as that of methodological imperialism.

1.1 A Historical Framework: From Pioneers to Recent Approaches

Regarding the trajectory followed by pragmatism and pluralism as methodological alternatives to monism, reductionism and universalism, we can distinguish three moments. The first corresponds to the pioneers, Patrick Suppes and Nicholas Rescher, who open the methodological debate on pluralism and pragmatism respectively. The second is a series of authors who, from then on, have proposed theses of methodological pluralism or methodological pragmatism, which coexist with other conceptions that, since 1980, have been particularly influential. The third moment, which can be situated in 2006, implies a greater presence of pluralism and pragmatism in the methodological debates.

From a historical point of view, Patrick Suppes can be considered a precedent of the current methodological pluralism. In his famous text “The Plurality of Science” delivered at the Philosophy of Science Association meeting in 1978, he criticizes the idea of unity of science by Otto Neurath and defends the plurality of science (Suppes [1978] 1981). In this respect, Suppes questions the reductionism of language, the reductionism of the subject-matter and reductionism of method (Suppes [1978] 1981, 5–9). He does not find a methodological unity in science but rather diversity. Almost three decades later, in 1996, Ian Hacking — who was co-editor of the volume in which Suppes’ text was published — raises the issue from the perspective of “The Disunities of the Sciences” (Hacking 1996).

But Hacking, who highlights the role of the history of science for philosophy of science, approaches the topic (unity vs. disunity, unification vs. plurality) from the perspective of the sciences — plural — rather than science (singular), as Suppes does. In this regard, Hacking sees precedents of scientific pluralism in terms of disunity between sciences in the nineteenth century, following diverse styles in doing science. He looks at the scientific differences pointed out by William Whewell and August Comte, two thinkers who had clearly different philosophico-methodological approaches (Hacking 1996, 37–39).

---

6Some of the problems can be seen in the trajectory followed by the methodological conceptions of logical positivism, logical empiricism and the received view, which were focused on verification, verificability and empirical confirmation, cf. Suppe ([1974] 1977).

7“One form or another of reductionism has been central to the discussion of unity of science for a very long time,” Suppes ([1978] 1981, p. 5).

8On the characterization of methodological universalism and methodological imperialism, see Gonzalez (2012).
Over the past few decades, the issue of pluralism has been present in philosophy and methodology of science from two main angles. First, from a general point of view, commonly according to four main approaches: naturalism (Dupré 1993), the social turn in science (Longino 1990), scientific realism (Cartwright 2004; Psillos 2009), and conceptions based on probability theories (Galavotti 2008). Second, in the analysis of positions within various sciences, be they disciplines investigating nature, such as biology (Mitchell 1992, 1993), or researching society, as in the case of economics (van Bouwel 2004). These analyses show a combination of novelty and continuity in philosophy and methodology of science.

Meanwhile, a pioneer in the approach to methodological pragmatism is Nicholas Rescher, who published a book on the subject in 1977. Since his volume (Rescher 1977), methodological pragmatism — with greater or lesser intensity and conceived from different epistemological angles — has often had supporters. In fact, approaches for methodological pragmatism can be found in conceptions situated epistemologically in the four general lines indicated: naturalist thinkers, supporters of the emphasis on the social dimension of science (Kitcher 2011a; cf. Gonzalez 2011), philosophers prone to scientific realism and Bayesians of various tendencies (Gelman 2011; Bergman 2009). In addition, authors together with authors of a more personal stamp, such as Rescher, who develops a conceptually based pragmatic idealism (Rescher 1973, 1992).

After these pioneers — since the 1980s — some general philosophico-methodological approaches were particularly influential: (1) the “naturalist turn,” which includes a cognitive characterization of science, based on cognitive sciences, the “normative naturalism,” developed upon an interpretation of history of science, and other kinds of naturalisms centered on other sciences (mainly biology); (2) the “social turn,” where the social concern for science puts the emphasis on the external perspective of scientific activity and the relations between science, technology and society; (3) the interest in “scientific realism,” which led to a plethora of realist conceptions on science, because it can follow many lines (semantic, logical, epistemological, methodological, ontological, axiological, ...), where the structural realism initiated by John Worrall and Philip Kitcher’s analysis of the advancement of science have an important role; and (4) the emphasis on

---

9The social turn in science is also dominant in the book edited by Galison and Stump (1996).
10Also, from a critical point of view, see Chang (2012).
11These epistemological differences can be seen in the basis of the initial conceptions of American pragmatism. Rescher drew attention to these differences and has opted for Charles S. Peirce. See Rescher (2012b).
12In the problem-solving of naturalist kind, there can be pragmatic components of an internal character — in the heuristic processes — and of an external nature (how to do the research with collaborators), including the sciences of the artificial as empirical sciences. See Simon, “The Scientist as a Problem-Solver,” in Simon (1991, 368–387).
13“In my interpretation, Peirce accepted the basic idea of the correspondence theory, but wanted to find a coextensive characterization of this concept.” Niiniluoto (1999, p. 101).
the probabilistic viewpoint of science, where the Bayesian approach is discussed intensely.\(^{14}\)

During recent years, these general philosophico-methodological approaches to science have continued to be influential and very much alive, such as the scientific realism debate, and some of them are compatible with versions of pragmatism and pluralism (Gonzalez 2020a). But there is now a renewed philosophico-methodological interest in pragmatism and pluralism, especially conceived as alternatives to monism, reductionism and universalism as well as to methodological imperialism. This is the starting point of this book on methodological prospects for scientific research.\(^{15}\)

Besides the renewed interest in methodological pragmatism in science, either per se — focused on the importance of science as a practice, diversified according to the goals sought, and its effectiveness in achieving results — or in connection with other views, such as scientific realism (Gonzalez 2020b), there has been an increasing attention to methodological pluralism in modes related to science itself, groups of sciences and specific sciences. This is the case at least since the publication in 2006 of the book Scientific Pluralism in the Minnesota Studies in the Philosophy of Science (Kellert et al. 2006a).

Thereafter, this topic has become a trend for new analyses in favor of a polyhedral vision of scientific research: (a) As regards science itself, these views commonly think of the problem of the unity of science in a different way from the past.\(^{16}\) This view is normally critical of methodological universalism and emphasizes elements of diversity in scientific research in empirical sciences instead of seeking a clear-cut monism (i.e., a single, complete and comprehensive scheme of the world, as a whole, or of a given realm).\(^{17}\) (b) Concerning the group of sciences, there is a clear interest in interdisciplinarity,\(^{18}\) multidisciplinarity, transdisciplinarity and crossdisciplinarity. This is based on a methodological view open to novelty, which is different from traditional forms of reductionism and in favor of cooperation and complementarity among disciplines. (c) Regarding specific sciences, methodological pluralism is in favor of taking into account the idiosyncrasies of the disciplines

---

\(^{14}\)These conceptions with their bibliographical contributions can be found in Gonzalez (2006).

\(^{15}\)This is a broader discussion than the methodological controversy between natural sciences and social sciences around the distinction Erklären-Verstehen, where there are at least nine options, cf. Gonzalez (2015b, 173–179) available in: https://doi.org/10.1080/02698595.2015.1119418 (accessed on 25.1.2017).

\(^{16}\)Nevertheless, some authors have “explored an alternative vision of the ‘Unity of Science’ offered by the work of Vienna Circle cofounder Otto Neurath, which sees an irreducible variety of scientific disciplines cooperating for concrete purposes” Kellert et al. (2006b, p. vii). In this vein, see Richardson (2006).

\(^{17}\)On the characterization of monism, see Kellert et al. (2006b, x).

\(^{18}\)Interdisciplinarity is one of the most acute challenges of contemporary science and university policy. It is widely believed that the most fertile novel ideas are born in the interface areas of various disciplinary approaches. The progress of science – including natural, human, and social sciences – thus requires the creation of research environments which foster interaction between scholars from different fields” (Niiniluoto 2020, 231).
rather than having a direct interest in a methodological imperialism (Gonzalez 2007).

1.2 A Thematic View: The “Internal” Side and the “External” Facet

Certainly, from a thematic viewpoint, methodological pluralism cannot be merely the existence of a plurality of sciences, to which Hacking refers when he mentions nineteenth century authors such as Whewell and Comte (Hacking 1996, 37–39), since these thinkers really thought of scientific methods that could be used in the various sciences. From the methodological point of view, they did not think of highlighting a diversity in scientific research but rather of what was common or shared by various sciences when investigating nature or society.

However, there is a diversity of objects of study, procedures and research methods, and solutions to the problems raised, which depend on the questions put forward and the context in which they are posed. Methodological pluralism adds more elements, above all because of its connection with an epistemological pluralism in posing the problems and an ontological diversity in terms of the diversity of levels of reality and the very polyhedral texture of the real. Thus, it is not a mere de facto “plurality of sciences,” but rather a plurality of science in its different methodological expressions: formal and empirical; basic, applied and of application; natural, social and artificial; and within each science, such as pharmacology (as ongoing research on Covid-19 shows every day).

On the methodological side, pragmatism “pivots on the idea that the resolution of philosophical problems and issues should be developed in the light of consideration of effectiveness, efficiency, and success in matters of goal realization” (Rescher 2019, 58). Within the field of science this — as Rescher insists — does not mean instrumentalism, since it does not rest on criteria of utility but on the search for truth within the practical sector. Thus, from a methodological point of view, “successful praxis is seen as adequacy indicative with respect to our generalized criteria of acceptance and verification. The link between truth and praxis is not seen as direct, but as mediated by the methodology of inquiry. Our justificatory rule is: Truth claims via methods and methods via praxis” (Rescher 2019, 83).
1.2.1 Main Methodological Elements Involved

If we use the concept of “consensus” in its two main meanings — in a substantive sense and in its procedural dimension — we then have the following. (a) Methodological pluralism implies that there is no methodological consensus in the substantive sense, insofar as it maintains that a universal or universalizable scientific method is not suitable, either now or in the possible future. (b) With respect to the methodological pluralism of consensus in the procedural dimension, which considers that we can come to agree on a series of common or shared features among all research methods, there are nuances according to the different orientations of methodological pluralism. For a scientific realist open to methodological pluralism, we can think of it in terms of *in pluribus unum*; while for a methodological pluralist who relies on relativist conceptions (for example, of Kuhnian inspiration within the “social turn” in philosophy of science) it may be something unviable.

Thematically, methodological pragmatism is focused on research processes that have to be effective and, if possible, efficient. Thus, as Nicholas Rescher states in his paper, “pragmatism adopts the procedure of assessing process by product, of evaluating ways of doing things on the basis of their functional efficacy in realizing the collective objectives. This can be done either *directly* by assessing the quality of the product, or *obliquely* by assessing the efficacy of procedures and methods in engendering high quality products. Methodological (as contrasted with Productive) Pragmatism adopts the latter approach” (Rescher 2020, 69). In this regard, he considers that “its prime advantage is its greater reliability in providing for quality control thanks to the superior realism of the evaluations it underwrites” (Rescher 2020, 69).

Following the recent trajectory in the methodological prospects to science, there are two main features involved: (I) an “internal” side, which is directly related to the scientific progress seen in pragmatist and pluralist perspectives, and (II) an “external” facet, which is connected to at least three kinds of social mediations: (i) the scientists as researchers that interact with other colleagues, (ii) the organizations where they develop basic science, applied science or application of science, and (iii) the public policy on scientific research (international, national or regional) due to the guidelines and economic support for research, development and innovation (R + D + i).

---

19The notion of “consensus” has been considered by Rescher, who has defended pluralism against a “dogmatic uniformitarianism” and a “relativistic indifferentism.” See Rescher (1993).

20The distinction between applied science and application of science is suggested by Ilkka Niiniluoto (1993, 1–21; especially, 9 and 19). A development of this methodological distinction is in Gonzalez (2013a) and Gonzalez (2015a, 2, 4, 12, 18, 31–34, 37–40, 70–71, 149–151, 317–321, 325, 330 and 335).

21Scientific research during the crisis generated by Covid-19 has clearly exemplified the three kinds of social mediation.
Concerning the “internal” side, pragmatist and pluralist perspectives need to be better off than monism, reductionism and universalism in order to tackle the levels of reality (micro, meso and macro) according to the diverse angles of research, which are those related to the aims of the inquiry, the kind of processes to be used and the expected results of this human activity. This includes considering the limits of the methods used. In this regard, Nicholas Rescher, a well-known pragmatic idealist,\(^2\) criticizes the possibility of a pragmatic completeness of science: “could we ever be in a position to claim that science has been completed on the basis of success of its practical applications?” (Rescher 2012a, 156).

Methodological pragmatism highlights the primacy of the practice based on the activity of our science. It looks at the results obtained and the efficacy in realizing the collective goals of the scientific research (cf. Rescher 2020). Meanwhile, methodological pluralism emphasizes diversity. Thus, following the analytical condition of the methodology of science, it accepts the existence of multiple approaches in scientific research, each revealing different sides of a phenomenon. Thus, “there can be plurality of representational or classificatory schemes, of explanatory strategies, of models and theories, and of investigative questions and the strategies appropriate for answering them” (Kellert et al. 2006b, ix).

Regarding the “external” facet, what is involved is, at least, decision making by the researchers, the organizations where they work and the entities responsible of the public policy. In one way or another, they need to deal with methodological conceptions that have been very influential over the years. De facto, monism based on a key science (physics, biology, neuroscience, ...) has received a lot of attention in research projects, which have often assumed the legacy — implicit or explicit — of the ideal of “unified science.”

It happens that some version of monism appears very frequently in the presentation of science in terms of “scientism” through social media, either of a general character or focused just on the primacy of one kind of scientific approach (physicalist, biologist, neuroscientist, etc.). Furthermore, reductionism — both implicit and explicit — is still in place in textbooks. This is also the case of methodological universalism, which has a number of options (Gonzalez 2012, 156–162), and which is commonly accepted each time that “the” scientific method is presented.\(^2\)

According to pragmatism and pluralism as methodological alternatives to monism, reductionism and methodological universalism, there is a large number of options, due to the scope to deal with the objects to be studied (processes, actions, etc.), the characteristics of the methods to be used to address the problems (basic, applied or the application) and the results that can be expected (in the short, middle

\(^2\)Among his works on pragmatism in recent years are Rescher (2012b, 2014).

\(^2\)John Worrall has made it explicit Karl Popper did not believe in something like “the” scientific method, conceived as a systematic way to achieve well founded results (Worrall 2001, 114). “As a rule, I begin my lectures on Scientific Method by telling my students that scientific method does not exist” (Popper [1956], 1992, 5).
or long run). These pragmatic and pluralist approaches can have a wide spectrum of possibilities, because they can have a quite different level in the intensity of the view held, such as modest and radical interpretations\(^\text{24}\) or weak and strong conceptions.\(^\text{25}\)

Commonly, these characterizations depend on the distance from the methodological relativism and the extent of their openness to objectivity in scientific research. Furthermore, if objectivity is accepted in the methodological approaches, then there is a variety of possibilities for scientific progress. These include a number of consequences for basic science, applied science and application of science as well as for the research made according to the scales of reality (micro, meso and macro) and the kind of reality involved (natural, social or artificial). Among them are some key methodological aspects.

### 1.2.2 Consequences of Pluralism and Pragmatism: Some Key Methodological Aspects

Based on the contributions made by pluralism and pragmatism within the thematic perspective, a number of particularly relevant methodological consequences can be highlighted. They deal with the issues raised by monism, reductionism and methodological universalism. They seek to reflect how research processes actually are and how they ought to be. Thus, they address the analytical aspect, which studies the procedures and methods used in scientific research, and the prescriptive component, which considers how to improve the way in which scientific knowledge is advanced.

(i) The monist aspiration to a single and full account of reality — at least of nature — is increasingly more difficult for a number of reasons. These include, firstly, the development of new sciences in the study of nature and society, but above all in the artificial realm (such as the sciences of the Internet) (Gonzalez and Arrojo 2019). They raise new objects of study, hitherto unsolved problems, and new methods in line with these problems, as is the case of design sciences (Gonzalez 2008, 2017). Secondly, within each discipline there is the principle of proliferation of questions regarding the reality researched, where every solution given to a problem raises a new question, which has to be answered.\(^\text{26}\)

As a consequence of the widening of the field of study and the deepening of the areas already known, comes the novelty. In some cases, such as the sciences

---

\(^\text{24}\)This is the case of pluralist interpretations, cf. Kellert et al. (2006b, xi–xiii)

\(^\text{25}\)“Philosophers who advocate pluralism can and do differ as to the extent of the plurality they attribute to the sciences, the strength of the pluralism they adapt, and the broader philosophical implications they draw from it” (Kellert et al. 2006b, p. x)

\(^\text{26}\)This principle is an issue that Rescher insists on in the context of the future knowledge. Cf. Rescher (2012a).
of design related to the Internet (Tiropanis et al. 2015), the novelty is vertical or transversal. Meanwhile, in other cases, there might be a horizontal or longitudinal novelty, insofar as there is a structural similarity in the phenomena studied. Both types of novelty highlight the dynamic complexity of the phenomena and, consequently, the historicity of science (cf. Gonzalez 2018).

(ii) Any attempt to reduce one science into another one can involve certain epistemological, methodological and ontological costs. A methodological reduction can, in principle, be thought of in several ways, among which there are three: (a) as a simplification of theoretical contents, due to certain procedures and methods, in favor of a common ground of some scientific theories, (b) as a type of methodological subsumption, where some elements in one scientific level (micro, meso, macro) can be integrated in another level of knowledge or reality, and (c) as “the explanation of a theory or a set of experimental laws established in one area of inquiry, by a theory usually though not invariably formulated for some other domain” (Nagel 1961, 338).

But there are clear problems with methodological reductionism. Thus, besides the issue of the emergency of properties within a given system, an important factor is the existence of complexity, both structural and dynamic. This often leads to new aspects in the sciences already known and even to the development of new sciences to deal with the new objects, the novel problems and the methods to achieve the solutions. This methodological novelty is also the case when the complex systems are hierarchical and capable of near-decomposability. Furthermore, it seems clear that some sciences have been commonly neglected in the philosophical analysis of science, and the philosophico-methodological results are often obtained in the analyses made in few sciences (mainly, natural sciences).

Historically, both in terms of the analytical aspect of methodology of science and regarding its prescriptive component, it seems clear that there has been a more intense level of philosophico-methodological attention to some sciences (physics, biology, ...) and to the group of natural sciences in comparison with the group of social sciences. Meanwhile, the sciences of the artificial have received little overall attention. This trajectory could be for several reasons, including a combination of structural elements and dynamic components. Among these reasons, there are three structural factors that can be emphasized.

First, the existence of a well-established field conceived as a model for other sciences, such as physics for the group of natural sciences and even for science, in general. Second, the development of a domain having many epistemological

---

27 On the issue of the “formal” and “nonformal” conditions for reductions in science, see the influential analysis made in Nagel (1961, 354–366). This double set of conditions can be used to consider the philosophico-methodological costs of the reduction.

28 An analysis that highlights the dynamic aspect of the emergency, as opposed to the traditional emphasis on the structural facet of the emergency, is found in Humphreys (2016).

29 See, for example, the case of economics, Rosser ([1999], 2004).

30 One of the contributions of Herbert Simon was in the configuration of studies on complex systems, cf. Simon (1977, 1999, 2001).
and methodological influences on other scientific subjects, such as biology (mainly through the influential Darwinian approach). Third, the presence of a scientific terrain having a lot of practical consequences, especially by dint of being an applied science (such as economics, psychology or computer sciences) (Gonzalez 2013b, p. 1).

Nevertheless, there are other reasons that include clear dynamic traits. These can contribute to understanding the preferences among philosophers of science in favor of some disciplines rather than others as well as preferences towards one group of sciences instead of others. Among such reasons three can be recalled: “(a) the novelty of the scientific field, which makes the philosophical-methodological analysis more difficult; (b) the scarcity of explicit influences of the science beyond the ‘boundaries’ of the field; and (c) the strong interweaving with technology, which makes the distinction between the scientific approach and the technological constituent particularly difficult” (Gonzalez 2013b, 1).

(iii) Increasingly, there are more problems for methodological universalism and for the proposals being made of methodological imperialism. De facto, the search for a universal method, valid in principle for all the sciences, or a methodological imperialism (of physics, for all the empirical sciences, and of economics, for the social sciences as a whole), does not fit the variety of objects and problems that can be discussed, many of them completely new — in all the sciences, but particularly in the sciences of the artificial — that lead to new methods instead of a priori methods or the mere convergence of the methods already available.

Certainly, following a methodological pluralism, “scientists and philosophers should recognize that different descriptions and different approaches are sometimes beneficial because some descriptions offer better accounts of some aspects of a complex situation and other descriptions provide better accounts of other aspects” (Kellert et al. 2006b, xxiv). But to develop scientific activity requires going beyond description in order to get explanation or prediction (basic science), to obtain prediction to do prescription (applied science) or to be able to use the applied knowledge in the diverse contexts, according to the circumstances of each setting or case. Thus, the plurality of descriptions needs to be focused towards those scientific tasks.

(iv) Connected to the previous methodological consequences is the increasing difficulty of justifying a branch in any science that might be fundamental for the whole discipline, i.e., a part of a science that is the main or necessary support for the entire building of the discipline or offers the general scaffolding for the rest of the science and characterizes the key subject-matter for the research to be made. Thus, following pragmatic or pluralistic views in methodology of sciences makes it harder to propose any “fundamental” physics, chemistry, biology, psychology, etc.

(v) Other consequences — highlighted by methodological pragmatism — are the need to assess the efficacy of procedures and methods of scientific activity in engendering high quality results in the research made, rather than a kind of a priori configuration (monist, reductionist or universalist). This is in tune with the relevance
of internal and external contextual factors for methodology of science\textsuperscript{31} and the recognition of a plurality of stratagems for making research in empirical sciences (natural, social and of the artificial). Furthermore, there is the need for an ethical component while developing scientific methods, because values should have a role in scientific research.\textsuperscript{32} This leads to multiscale modeling connected to levels of reality (micro, meso and macro).

### 1.3 Structure and Origin of this Book

In tune with the historical and thematic frameworks presented here of the pluralist and pragmatist methodological approaches, this book deals with the topic the methodological prospects for scientific research from different angles. It tries to offer a polyhedral perspective on science rather than a monist, reductionist or universalist conception of scientific activity. The main aim of this volume is to present a broader methodological scope, open to people with different backgrounds.

This can be seen in the structure of the volume, which has five parts: (I) A New Framework for Methodological Prospects to Scientific Research; (II) Pragmatist Approaches to Methodology of Science; (III) Contextual Factors for Methodology of Science; (IV) Methodological Pluralism in Natural Sciences and in Sciences of the Artificial; and (V) Methodological Pluralism in Social Sciences and Ethical Values. Each section has two papers. In this regard, parts I and II have a more general character than parts III, IV and V.

A new methodological framework begins with “Levels of Reality, Complexity, and Approaches to Scientific Method” by Wenceslao J. Gonzalez (University of A Coruña), which offers the configuration of a new framework for procedures and methods of scientific research. The procedures contribute to the initial stages of the scientific inquiry, whereas the methods enlarge our knowledge according to well-established ways or follow research processes that have been tested concerning their reliability. Scientific research needs methods that deal with objects and problems, whose diversity offers reasons for the unfeasibility of universal method for science and poses problems for methodological imperialism. The existence of levels of reality (micro, meso, and macro) and the features of structural and dynamic complexity pave the way for the methodological diversity. Thus, empirical sciences show different approaches to scientific method, according to the kind of science (natural, social and of the artificial) and also within sciences. Consequently, the

\textsuperscript{31}The methodology of science deals with the advancement of knowledge, so, from an internal point of view, it presupposes the distinction between data, information and knowledge. From an external point of view, the methodology of science is the expression of the research activity of some agents in institutions (public or private).

\textsuperscript{32}This also has consequences for technology, cf. Gonzalez (2015c).
relations of the scientific methods with the levels of reality and complexity require a deeper view than the conceptions already available.

“Multiscale Modeling: Explanation and Emergence” by Robert W. Batterman (University of Pittsburgh) offers a critique of methodological reductionism in physics, since in the physical phenomena studied in the text it is not necessary to start from a “Fundamental Physics.” In this sense, there is a degree of autonomy in the scales of physical phenomena. It is — in his judgement — an explainable autonomy, so that this rethinks the question of emergence. On the basis of multiple realizability, there is room for success in research and autonomy of the continuum modeling. His conception leads to a theory that is “neither purely bottom-up nor purely top-down.”

Then the pragmatist approach is available in “Methodological Pragmatism” by Nicholas Rescher (University of Pittsburgh), a key figure in this field. He focused his view on the efficacy of procedures and methods in engendering high quality products. This quality of the processes has to be assessed. In this regard, he considers that methodological pragmatism has the advantage of greater reliability due to the superior realism of the evaluations. I must stress that, in this text, Rescher expressly addresses the issue of the sphere of applied science, as opposed to the usual tendency in his conception to focus on basic science.

There is an analysis of Rescher’s approach in “Methodological Incidence of the Realms of Reality: Prediction and Complexity” by Amanda Guillan (University of A Coruña). With a view from the ontology of science, the text insists that there are important limitations to the different varieties of methodological universalism. This paper takes into account the perspective of complexity and pays attention to the problems posed by methodological universalism to scientific prediction. On the one hand, the limits of methodological universalism are seen from the realms of reality, which leads to distinguish the natural, the social and the artificial. On the other, complexity — both structural and dynamic — requires attention, which leads to attention to modes of complexity and historicity.

After that a number of contextual factors for methodology of science are considered in “Information and Pluralism: Consequences for Scientific Representation and Method” by Giovanni Camardi (University of Catania). They belong to the “internal” context, insofar as the methodology of science the depends on epistemology, to the extent that it is based on information and representation. In this regard, a pluralist methodology comes from “inside,” to the extent that it can be connected to a theory of information and seeks to interact with computational models. Based on the concept of information, the author considers possible the converge of Patrick Allo’s notion of informational pluralism, Wesley Salmon’s treatment of statistical relevance and James Woodward’s analysis of the “data-phenomena” relationship.

Another angle in favor of pluralism based on contexts — this time from “outside” — is taken in “The Methodology of Theories in Context: The Case of Economic Clustering” by Catherine Greene and Max Steuer (London School of Economics). They argue that scientific theories are revealing in an “external” context (geographical, organizational, etc.) and, in the case of economic theories, they are
incapable of universal application. One of the reasons is that they maintain that laws play little if any role in economics. In addition, they think that a single methodology of economics cannot be applicable to the variety of endeavours of economists. In the area of empirical inquiry, they see progress in the interaction between observations and theories, where “theories-in-context” is different from simple common sense. Economic clustering is used as an example of a pluralist approach to economic methodology.

Directly focused on pluralistic research strategies in nature is “Plurality of Explanatory Strategies in Biology: Mechanisms and Networks,” by Alvaro Moreno (University of the Basque Country) and Javier Suárez (University of Barcelona). The focus here is connecting a pluralistic methodology of science and an ontology of science, i.e., the plurality of research strategies followed in life sciences and the existence of emergent levels of reality in that realm. Thus, the difference of explanatory strategies comes from the existence of an ontological diversity, which generates variations in causation. In this regard, mechanistic modelling and network modelling are connected to two ontological regimes of causation.

Another area where the pluralistic methodology of science meets an ontology is in “Scientific Prediction and Prescription in Plant Genetic improvement as an Applied Science of Design: The Natural and the Artificial” by Pedro Martínez Gómez (Higher Council of Scientific Research, Murcia). To exemplify methodological pluralism, the author turns to plant genetic improvement, which is methodologically dual: it is a science of nature, which analyses the genetic variation in the plant kingdom, and it is a science of the artificial, which is developed as an applied science of design to get new plants or different varieties. In addition, there are methodological differences in the levels involved: molecular biology, genetic constitution of the individuals and the release of new individuals. Prediction plays a key role, because it anticipates the possible future and serves the task of design. Again, internal and external factors related to the variables being studied need to be taken into account.

More specifically from a methodological point of view is the issue of validity, which is related to the link between the object of study, the problem posed and the solutions proposed. This consideration of methodology from “inside” leads to pluralism in the social sciences, as stated in “Challenges to Validity from the Standpoint of Methodological Pluralism: The Case of Survey Research in Economics” by María Caamaño-Alegre (University of Valladolid). She associates the development of a pluralistic methodology in economics with the possibility of improving the validity of empirical research. In this sense, the conditions of “internal” methodological validity are the preconditions for “external” methodological validity.

Any methodology of science does not deal with value-free research processes but with value-related processes, where ethical values have a place. This is particularly clear in methodology of economics, which is the axis of the paper “Economic Method and its Ethical Component: Pluralism, Objectivity and Values in Amartya Sen’s Model” by Alessandra Cenci (University of Southern Denmark). This means that the plurality of economic methods requires an ethical component that overcomes the shortcomings of reductionist-monist economics.
Several of these papers were originally presented at the “Conference on Approaches to Scientific Method: Pluralism versus Reductionism” held at the University of A Coruña, Campus of Ferrol, on 12 and 13 March 2015. Thus, many of the topics are connected to the discussions held during those days. Like the XX Workshop on Contemporary Philosophy and Methodology of Science (XX Jornadas sobre Filosofía y Metodología actual de la Ciencia), it enlarges the topics already addressed in the set of volumes of previous workshops, which are gathered under the general title of Gallaecia Series. Studies in Contemporary Philosophy and Methodology of Science.\textsuperscript{33}

It is my pleasure to thank the authors of the papers presented here for their efforts to offer new approaches to scientific method, taking into account the enlargement of the field in order to discuss novel topics. In addition to them and the other participants at the conference, I am very pleased to thank the editor of this Synthese Series — Otávio Bueno — for his interest in this new contribution to the ongoing discussions on the pragmatism and pluralism about scientific research.

Finally, my recognition again to the persons and institutions that cooperated in the original event. First, my appreciation to the Rector of the University of A Coruña, the Vice-rector of the Campus of Ferrol and Social Responsibility as well as to other academic authorities that have cooperated to this aim. Second, my acknowledgement to the organizations that gave their support: the Diputación of A Coruña, the City Hall of Ferrol, and the Santander Bank. My appreciation includes the Society of Logic, Methodology, and Philosophy of Science in Spain for its academic endorsement. In addition, let me express my gratitude to Jessica Rey, Pablo Vara and Amanda Guillan for their contribution to the edition of this book.

\textsuperscript{33}This collection includes the following titles: Progreso científico e innovación tecnológica (1997), El Pensamiento de L. Laudan. Relaciones entre Historia de la Ciencia y Filosofía de la Ciencia (1998), Ciencia y valores éticos (1999), Problemas filosóficos y metodológicos de la Economía en la Sociedad tecnológica actual (2000), La Filosofía de Imre Lakatos: Evaluación de sus propuestas (2001), Diversidad de la explicación científica (2002), Análisis de Thomas Kuhn: Las revoluciones científicas (2004), Karl Popper: Revisión de su legado (2004), Science, Technology and Society: A Philosophical Perspective (2005), Evolutionism: Present Approaches (2008), Evolucionismo: Darwin y enfoques actuales (2009), New Methodological Perspectives on Observation and Experimentation in Science (2010), Scientific Realism and Democratic Society: The Philosophy of Philip Kitcher (2011), Conceptual Revolutions: From Cognitive Science to Medicine (2011), Freedom and Determinism: Social Sciences and Natural Sciences (2012), Creativity, Innovation, and Complexity in Science (2013), Bas van Fraassen’s Approach to Representation and Models in Science (2014), New Perspectives on Technology, Values, and Ethics: Theoretical and Practical (2015), The Limits of Science: An Analysis from “Barriers” to “Confines” (2016), Artificial Intelligence and Contemporary Society: The Role of Information (2017), and Philosophy of Psychology: Causality and Psychological Subject (2018). See https://cifcyt.udc.es/coleccion-gallaecia/ (Accessed on 9.5.2020).
References

Bergman, B. (2009). Conceptualistic pragmatism: A framework for Bayesian analysis? *IIE Transactions*, 41(1), 86–93.

Bertuglia, C. S., & Vaio, F. (2005). *Nonlinearity, chaos and complexity. The dynamics of natural and social systems*. Oxford: Oxford University Press.

Cartwright, N. (2004). Causation: One world, many things. *Philosophy of Science, 71*(5), 805–819.

Chang, H. (2012). *Is water H2O? Evidence, realism and pluralism*. Dordrecht: Springer.

Dupré, J. (1993). *The disorder of things: Metaphysical foundations of the disunity of science*. Cambridge, MA: Harvard University Press.

Galavotti, M. C. (2008). Causal pluralism and context. In M. C. Galavotti, R. Scazzieri, & P. Suppes (Eds.), *Reasoning, rationality, and probability* (pp. 233–252). Stanford: CSLI Publications.

Galison, P., & Stump, D. J. (Eds.). (1996). *The disunity of science: Boundaries, contexts, and power*. Stanford: Stanford University Press.

Gelman, A. (2011). Bayesian statistical pragmatism. *Statistical Science, 26*(1), 10–11.

Giere, R. N. (2006a). *Scientific Perspectivism*. Chicago: The University of Chicago Press.

Giere, R. N. (2006b). Perspectival pluralism. In S. H. Kellert, H. E. Longino, & C. K. Waters (Eds.), *Scientific pluralism. XIX Minnesota studies in the philosophy of science* (pp. 1–28). A Coruña: Nethiblo.

Gonzalez, W. J. (2006). Novelty and continuity in philosophy and methodology of science. In W. J. Gonzalez & J. Alcolea (Eds.), *Contemporary perspectives in philosophy and methodology of science* (pp. 26–41). Minneapolis: Minnesota University Press.

Gonzalez, W. J. (2007). The role of experiments in the social sciences: The case of economics. In T. Kuipers (Ed.), *General philosophy of science: Focal issues* (pp. 275–301). Amsterdam: Elsevier.

Gonzalez, W. J. (2008). Rationality and prediction in the sciences of the artificial: Economics as a design science. In M. C. Galavotti, R. Scazzieri, & P. Suppes (Eds.), *Reasoning, rationality, and probability* (pp. 165–186). Stanford: CSLI Publications.

Gonzalez, W. J. (2011). From mathematics to social concern about science: Kitcher’s philosophical approach. In W. J. Gonzalez (Ed.), *Scientific realism and democratic society: The philosophy of Philip Kitcher*, Poznan Studies in the Philosophy of the Sciences and the Humanities, (pp. 11–93). Amsterdam: Rodopi.

Gonzalez, W. J. (2012). Methodological universalism in science and its limits: Imperialism versus complexity. In K. Brzechczyn & K. Paprzycka (Eds.), *Thinking about provincialism in thinking*, Poznan Studies in the Philosophy of the Sciences and the Humanities (Vol. 100, pp. 155–175). Amsterdam/New York: Rodopi.

Gonzalez, W. J. (2013a). The roles of scientific creativity and technological innovation in the context of complexity of science. In W. J. Gonzalez (Ed.), *Creativity, innovation, and complexity in science* (pp. 11–40). A Coruña: Nethiblo.

Gonzalez, W. J. (2013b). From the sciences that philosophy has ‘neglected’ to the new challenges. In D. Dieks, W. J. Gonzalez, T. Uebel, M. Weber, & G. Wheeler (Eds.), *New challenges to philosophy of science* (pp. 1–6). Dordrecht: Springer.

Gonzalez, W. J. (2015a). *Philosophico-methodological analysis of prediction and its role in economics*. Dordrecht: Springer.

Gonzalez, W. J. (2015b). From the characterization of ‘European philosophy of science’ to the case of the philosophy of the social sciences. *International Studies in the Philosophy of Science, 29*(2), 167–188, available in: https://doi.org/10.1080/02698595.2015.1119418. Accessed on 25.1.2017.

Gonzalez, W. J. (2015c). On the role of values in the configuration of technology: From axiology to ethics. In W. J. Gonzalez (Ed.), *New perspectives on technology, values, and ethics: Theoretical and practical* (Boston Studies in the Philosophy and History of Science) (pp. 3–27). Dordrecht: Springer.
Gonzalez, W. J. (2017). From intelligence to rationality of minds and machines in contemporary society: The sciences of design and the role of information. Minds and Machines, 27(3), 397–424. https://doi.org/10.1007/s11023-017-9439-0.

Gonzalez, W. J. (2018). Complejidad dinámica en Internet como plataforma de información y comunicación: Análisis filosófico desde la perspectiva de Ciencias de Diseño y el papel de la predicición. Informação e Sociedade: Estudos, 28(1), 155–168.

Gonzalez, W. J. (2020a). Novelty in scientific realism: New Approaches to an Ongoing Debate. In: W. J. Gonzalez (Ed.), New Approaches to Scientific Realism (pp. 1–23). Boston/Berlin: De Gruyter. https://doi.org/10.1515/9783110664737-001.

Gonzalez, W. J. (2020b). Pragmatic realism and scientific prediction: The role of complexity. In: W. J. Gonzalez (Ed.), New Approaches to Scientific Realism (pp. 251–287). Boston/Berlin: De Gruyter. https://doi.org/10.1515/9783110664737-012.

Gonzalez, W. J. (2020c). Levels of reality, complexity, and approaches to scientific method. In W. J. Gonzalez (Ed.), Methodological prospects for scientific research: From pragmatism to pluralism, Synthese Library. Dordrecht: Springer.

Gonzalez, W. J., & Arrojo, M. J. (2019). Complexity in the sciences of the Internet and its relation to communication sciences. Empedocles: European Journal for the Philosophy of Communication, 10(1), 15–33.

Hacking, I. (1996). The disunities of the sciences. In P. Galison & D. J. Stump (Eds.), The disunity of science: Boundaries, contexts, and power (pp. 37–74). Stanford: Stanford University Press.

Humphreys, P. (2016). Emergence: A philosophical account. Oxford: Oxford University Press.

Kellert, S. H., Longino, H. E., & Waters, C. K. (Eds.). (2006a). Scientific pluralism. XIX Minnesota Studies in the Philosophy of Science. Minneapolis: Minnesota University Press.

Kellert, S. H., Longino, H. E., & Waters, C. K. (2006b). The pluralist stance. In S. H. Kellert, H. E. Longino, & C. K. Waters (Eds.), Scientific pluralism. XIX Minnesota Studies in the Philosophy of Science (pp. vii–xxix). Minneapolis: Minnesota University Press.

Kitcher, P. (2011a). Science in a democratic society. In W. J. Gonzalez (Ed.), Scientific realism and democratic society: The philosophy of Philip Kitcher, Poznan Studies in the Philosophy of the Sciences and the Humanities (pp. 95–112). Amsterdam: Rodopi.

Kitcher, P. (2011b). Scientific realism: The truth in pragmatism. In W. J. Gonzalez (Ed.), Scientific realism and democratic society: The philosophy of Philip Kitcher, Poznan Studies in the Philosophy of the Sciences and the Humanities (pp. 171–189). Amsterdam: Rodopi.

Kitcher, P. (2015). Pragmatism and Progress. Transactions of C. S. Peirce Society, 51(4), 475–494. https://doi.org/10.2979/trancharpeirsoc.51.4.06. (Accessed on 8.7.2019).

Longino, H. (1990). Science as social knowledge. Princeton: Princeton University Press.

Mainzer, K. (2007). Thinking in complexity: The complex dynamics of matter, mind, and mankind (5th ed.). New York: Springer.

Mitchell, S. (1992). On pluralism and competition in evolutionary explanations. American Zoologist, 32, 135–144.

Mitchell, S. (1993). Biological complexity and integrative pluralism. Cambridge: Cambridge University Press.

Mitchell, M. (2009). Complexity: A guided tour. Oxford: Oxford University Press.

Nagel, E. (1961). The structure of science. Problems in the logic of scientific explanation. New York: Harcourt, Brace and World.

Niiniluoto, I. (1993). The aim and structure of applied research. Erkenntnis, 38(1), 1–21.

Niiniluoto, I. (1999). Critical Scientific Realism. Oxford: Clarendon Press.

Niiniluoto, I. (2020). Interdisciplinarity from the perspective of critical scientific realism. In W. J. Gonzalez (Ed.), New approaches to scientific realism (pp. 231–250). Boston/Berlin: De Gruyter.

Popper, K. R. ([1956], 1992). Preface, 1956. In K. R. Popper, Realism and the aim of science. From the postscript to the logic of scientific discovery: Vol. I, edited by W. W. Bartley III, Hutchinson, London, 1983; reprinted by Routledge, London, 1992, pp. 5–8.
Psillos, S. (2009). Causal pluralism. In R. Vanderbreeken & B. D’Hooghe (Eds.), Worldviews, science and us: Studies of analytical metaphysics. A selection of topics from a methodological perspective (pp. 131–151). Singapore: World Scientific Publishers.

Rescher, N. (1973). Conceptual Idealism. Oxford: Blackwell (reprinted in Washington: University Press of America, 1982).

Rescher, N. (1977). Methodological pragmatism: A system of pragmatic idealism. Vol. I: Human knowledge in idealistic perspective. Oxford: Blackwell; New York: New York University Press.

Rescher, N. (1992). A system of pragmatic idealism. Vol. I: Human knowledge in idealistic perspective. Princeton: Princeton University Press.

Rescher, N. (1993). Pluralism. Against the demand for consensus. Oxford: Clarendon Press.

Rescher, N. (2012a). The problem of future knowledge. Mind and Society, 11(2), 149–163.

Rescher, N. (2012b). Pragmatism: The restoration of its scientific roots. New Brunswick: Transaction Publishers.

Rescher, N. (2014). The pragmatic vision: Themes in philosophical pragmatism. Lanham: Rowman and Littlefield.

Rescher, N. (2019). Philosophical clarifications: Studies illustrating the methodology of philosophical elucidation. Cham: Palgrave Macmillan.

Rescher, N. (2020). Methodological pragmatism. In W. J. Gonzalez (Ed.), Methodological prospects to scientific research: From pragmatism to pluralism (pp. 69–80), Synthese Library. Dordrecht: Springer.

Richardson, A. W. (2006). The many unities of science: Politics, Semantics, and Ontology. In S. H. Kellert, H. E. Longino, & C. K. Waters (Eds.), Scientific pluralism. XIX Minnesota Studies in the Philosophy of Science (pp. 1–25). Minneapolis: Minnesota University Press.

Rosser, J. B. Jr. (1999, 2004). On the complexities of complex economic dynamics. Journal of Economic Perspectives, 13(4), 169–192. Reprinted in: J. B. Jr. Rosser (Ed.), Complexity in Economics, v. 1 (pp. 74–97). Cheltenham: Edward Elgar.

Simon, H. A. (1977). How complex are complex systems? In F. Suppe & P. D. Asquith (Eds.), Proceedings of the 1976 biennial meeting of the Philosophy of Science Association (Vol. 2, pp. 507–522). Ann Arbor: Edwards Brothers.

Simon, H. A. (1991). Models of my Life. N. York, NY: Basic Books.

Simon, H. A. (1996). The sciences of the artificial (3rd ed.). Cambridge, MA: The MIT Press, (1st ed., 1969; 2nd ed., 1981).

Simon, H. A. (1999). Can there be a science of complex systems? In Y. Bar-Yam (Ed.), Unifying themes in complex systems: Proceedings from the international conference on complex systems 1997 (pp. 4–14). Cambridge, MA: Perseus Press.

Simon, H. A. (2001). Complex systems: The interplay of organizations and markets in contemporary society. Computational and Mathematical Organization Theory, 7(2), 79–85.

Suppe, F. (1974) 1977). The search for philosophic understanding of scientific theories. In: F. Suppe (Ed.), The structure of scientific theories (pp. 1–241). Urbana: University of Illinois Press.

Suppes, P. (1978) 1981). The plurality of science. In P. Asquith and I. Hacking (eds.), PSA 1978, East Lansing: Philosophy of Science Association, (vol. 2, 1981, pp. 3–16). (Reprinted in P. Suppes, Probabilistic Metaphysics (pp. 118–134). Oxford: B. Blackwell, 1984.4

Tironis, T., Hall, W., Crowcroft, J., Contractor, N., & Tassiulas, L. (2015). Network science, Web science, and Internet science. Communications of ACM, 58(8), 76–82.

Van Bouwel, J. (2004). Explanatory pluralism in economics: Against the mainstream. Philosophical Explorations, 7, 299–315.

Worrall, J. (2001). De la Matemática a la Ciencia: Continuidad y discontinuidad en el Pensamiento de Imre Lakatos. In W. J. Gonzalez (Ed.), La Filosofía de Imre Lakatos: Evaluación de sus propuestas (pp. 107–128). Madrid: UNED.