# Science, Institutions, and Values

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## Abstract

This paper articulates and defends three interconnected claims: first, that the debate on the role of values for science misses a crucial dimension, the institutional one; second, that institutions occupy the intermediate level between scientific activities and values and that they are to be systematically integrated into the analysis; third, that the appraisal of the institutions of science with respect to values should be undertaken within the premises of a comparative approach rather than an ideal approach. Hence, I defend the view that the issue be framed in reference to the following question: "What kind of institutional rules should be in place in order for the scientific process to unfold in such a way that the values that we deem more important come to the fore?" Addressing this concern is equivalent to conducting a debate on institutions and their role for science.

## 1. INTRODUCTION

The recurring discussion of the last century about the possibility of a "value-free science" still remains the starting point of many contemporary debates on the relationship between science and values. The original position was formulated by Max Weber in 1904 in a positive way: "Eine empirische Wissenschaft vermag niemanden zu lehren, was er *soll*, sondern nur, was er *kann* und – unter Umständen – was er *will*". ("Empirical science can teach nobody, what he *ought*, but only what he *can* and – possibly – what he *wants*".)[1] The so-called *Werturteilsstreit* was followed by the legendary *Positivismusstreit* in Germany on similar issues.[2] In France the "value-free ideal" was most forcefully advocated by Henri Poincaré in his characteristic sharp style: "Il ne peut pas y avoir de morale scientifique; mais il ne peut pas y avoir non plus de science immorale. Et la raison en est simple; c`est une raison, comment dirai-je? purement grammaticale. Si les prémisses d' un syllogisme sont toutes les deux à l' indicatif, la conclusion sera également à l'indicatif".[3] In the Anglo-American discussion milestones in a preliminary phase include Hans Reichenbach's (1951) view that knowledge and ethics are fundamentally distinct enterprises; Isaac Levi's (1960; 1962) view that canons of inference limit the values scientists can and should use in evaluating whether to accept or reject hypotheses, so that epistemic values are sufficient decision criteria for scientists; and the debate on *epistemic risk* and the need for epistemic values in the acceptance or rejection of hypotheses.[4]

Although the contemporary debate has shifted a lot (e.g. Elliott and Steel, 2017) to include the distinction between epistemic and non-epistemic values and how they both affect science as well as informative case studies and much more, the focus remains

fundamentally the same: the role of values for science. My first claim in this paper is that this discussion misses a crucial dimension, the institutional one. My second claim is that institutions occupy the intermediate level between scientific activities and values and that they are to be systematically integrated into the analysis. My third claim is that the appraisal of the institutions of science with respect to values should be undertaken within the premises of a comparative approach rather than an ideal approach. Hence, I will defend the view that the issue be framed in reference with the following question: "What kind of institutional rules should be in place in order for the scientific process to unfold in such a way that the values that we deem more important come to the fore?" Addressing this concern is equivalent to conducting a debate on institutions and their role for science.

*Section 2* offers the main motivation for the inclusion of the institutional dimension of the debate about the role of values in science. *Section 3* presents an analysis of the institutions of science and how they structure the scientific process. *Section 4* argues for a procedural view in evaluation. *Section 5* introduces a hierarchy of problems, institutions and values in order to systematize the terms of the axiological discussion. *Section 6* provides a framework for a multidimensional evaluation. *Section 7* defends a comparative approach juxtaposing it to the ideal of a well-ordered science presented by Philip Kitcher (2011) and *section 8* concludes by summarizing the argument.

## 2. WHY INSTITUTIONS MATTER

My first claim is that institutions are a critical but missing dimension in the literature on values in science. But why do institutions matter? What is missing, if we ignore or leave

implicit the institutional dimension? Not including institutions in the description of the scientific enterprise makes such a description not only incomplete, but also inaccurate. Erroneous descriptive accounts do not only get the facts wrong. Since every normative appraisal is based on a descriptive account of the situation, the respective evaluations are also bound to be wrong. How can one expect that an appraisal based on an erroneous descriptive account will be sufficient or of high quality? How can one evaluate correctly, if one disregards or actively misrepresents constitutive parts of the situation that is of interest?

My first claim is that science is an arena which cannot be correctly described without including the institutional framework which channels it. Science unfolds within institutions, so that an accurate description of the process of science must pay the due attention to the institutions of science. There are *moral rules* that scientists respect, *social norms* that they follow in their everyday activities and *legal rules* that prohibit certain scientific endeavors. Besides, scientific activities are *funded* by private *organizations* like firms, state *organizations* like ministries and non-profit *organizations* like foundations and charities. And science is largely *conducted* in *organizations* like universities and research centers.

What we call "science" is not a means towards the accomplishment of anything. It is, instead, the institutional embodiment of the process of constructing and criticizing solutions to problems that are entered into by individuals with their multiple abilities and skills. The network of relationships that emerges and evolves out of this process is called "science." It is a setting, an arena, in which scientists attempt to accomplish their own purposes, whatever these may be.

In such a conceptualization of science the main descriptive issue consists in the ways that the *diverse aims* of individual scientists (Elliott and McKaughan, 2014) and scientific organizations produce patterns of social interaction. Modern institutional theory[5] can provide the analytic tools for the analysis of such processes of social interaction. I will provide next a brief account and application of these tools to the case of science.

## 3. THE INSTITUTIONS OF SCIENCE

Institutions are normative social rules, that is the rules of the game in a society, enforced either through the coercive power of the state or other enforcement agencies that shape human interaction.[6] Institutions as normative patterns of behavior offer a general platform of coordination and conflict resolution to a society, in virtue of constituting the rules of the socio-economic game.

Institutions must be distinguished from organizations (North 1990, p.4f.). Institutions are the *rules of the game*; organizations are *corporate actors*, that is, groups of individuals bound by some rules designed to achieve a common objective (Coleman 1990). There are several types of organizations, like economic organizations (e.g. corporations), political organizations (e.g. political parties) or research organizations (e.g. universities). Organizations and individuals are the *players in the game*. Hence, when organizations and individuals interact with other organizations, they are all constrained by those general social rules that we have called institutions, that is, the general rules of the game.

A very fruitful and widely used distinction among types of institutions is based on the criterion of the enforcement agency of institutions. In other words, there are different types of institutions according to their enforcement characteristics. A first broad

distinction is the one between *informal institutions* which are self-enforcing or are enforced by other group members and *formal institutions* which are enforced by the state. A more refined classification of institutions according to this criterion is shown in the following table:

| | | |
|---|---|---|
| **Informal Institutions** | Conventions | Self-policing |
| | Moral Rules | First Party |
| | Social Norms | Third Pary: Other Individuals in the Group |
| **Formal Institutions** | Law | Third Party: State |

It is not the place to analyze in detail here how every type of institution emerges, so it should suffice to stress that there are two general mechanisms: institutions emerge either spontaneously or deliberately, that is, either as a product of a *spontaneous process of social interaction* or as a *product of collective action.* The spontaneous emergence of institutions is explained by sophisticated explanatory patterns (Bicchieri 2006 and 2016) and are "establishments which are indeed the result of human action, but not the execution of any human design" (Ferguson, 1767/1996). Thus, what is common to all types of informal institutions is that *they all emerge as the unintended outcome of human* action in a process that no individual mind can consciously control. Institutions emerge

deliberately, on the other hand, by the intentional collective action aimed at establishing them.[7] What is common to the social rules that I have called formal institutions, that is the legal rules, is that they are products of a collective decision-making process. Law is created by the state as an organization which either constructs new formal institutions or provides by suitable adaptation existing informal institutions with legal sanctions (Mueller, 2003). The collective decisions that lead to the creation of legal rules are the result of the political process during which individuals and organizations succeed to a greater or lesser degree by mobilizing the resources that they have and by using their power in order to impose rules that further their interests (Moe 2005).

What interests us most here is how the whole intricate matrix of informal and formal institutions makes up the rules of the game and, more specifically, shapes the activities of individuals and organizations in the distinct way that we call the *game of science*. There are three distinct, but interconnected mechanisms that coordinate individual and organizational scientific activities and give rise to specific scientific outcomes. The first is scientific *competition*, which is an evolutionary process of trial and error among individual scientists and organizations pursuing many different aims, varying from the search for truth to peer recognition and monetary rewards.[8] The second mechanism is the emergence and adoption of the *informal institutions* of science that constitute what is commonly known as the Ethos of Science (Merton 1942/1973), that is, the *moral rules* that scientists adopt (Bright 2017), and the *conventions* and *social norms* that scientists internalize during their apprenticeship as young researchers. Finally, the third mechanism relates to the content and enforcement of the *formal institutions* of science, that is the legal rules designed to regulate the scientific process which are imposed and enforced by

the organs of the state. (These rules can vary tremendously, historical examples including the rules enforced by the Papal states to the rules regulating science in the former Soviet Union).

The interconnection of these three mechanisms shapes the *institutionally constrained scientific competition*. The arena that we have called science is both highly *competitive*[9] *and* highly *cooperative* (Boyer-Kassem, Mayo-Wilson and Weisberg 2018; Heesen 2017; Wilholt, 2016). The specific mix of competition and cooperation depends on the concrete characteristics of the institutional framework of science[10]. Since the outcomes of the game of science are historically contingent (Kitcher 1993 and 2001) it is the specific *content* of the informal and formal institutions that structure the *competitive game* in an *appropriate* way that enables the *advancement* of science to take place – if at all[11].

To sum up the last two sections: Science is indisputably one of the greatest and most astonishing cultural achievements of the human species. The successive endeavors of many generations of scientists have produced an increasingly accurate image of the natural and social world, an image constituted by a huge variety of empirically tested representations, in the form of theories, models and artefacts. Modern science is embedded in a social context without which it could not exist. Its characteristic form largely depends on a specific pattern of institutions that enable the activities of the working scientists and channel the scientific process. The scientific venture is, hence, a social process[12] embedded in the institutional framework of the society consisting of informal institutions, like *conventions*, *moral rules* and *social norms* and formal institutions, most importantly *legal rules*.

## 4. EVALUATION: A PROCEDURAL VIEW

Such an institutionalist understanding of science is meant to answer more adequately the descriptive question on how the scientific process evolves over time. The normative task still remains, however, on how to evaluate the different scientific activities and on what grounds. The traditional normative discourse has been centered around the goodness of the scientific outcomes rather than the goodness of the rules. Most conceptions suppose explicitly or implicitly that there is an ideal model of science towards which one should strive. A prominent variation of this view is Kitcher's conception of "well-ordered science" which I will discuss later at more length.

Despite the merits of such conceptions, however, there is a fundamental point of criticism: why should there be a specific model of science that should serve as an ideal and an eternal standard of reference waiting to be discovered by scientists, philosophers or anybody else? Good science emerges because good rules are followed and working out the criteria of goodness is not an once-for-all matter, but rather a continuous enterprise. Instead of the vain search of a general model to serve as a reference for good science applicable at all times and under all conditions, the more modest proposal that I would like to endorse is the continuous critical analysis of the institutions of science with respect to different values. Such an analysis takes into consideration the fact that science is an evolutionary process unfolding within institutional rules which are themselves changing. However, their rate of change is lower than the rate of change of the process which they are channeling. They are the 'relatively absolute absolutes' (Buchanan, 1989)

which can be the target of evaluation. This *procedural* approach is the opposite of an *outcome* approach which attempts to evaluate directly concrete scientific activities either directly praising them or repudiating them. Instead of forming judgements about the goodness of specific scientific actions it is possible, preferable and more operational to form judgements about the goodness of specific rules. Such an approach takes into account the social character of science unfolding within rules and at the same time honors its evolutionary, procedural character.

In order to offer a first, intuitive understanding of these two opposite conceptions before proceeding with a more detailed description of my own proposal, I would like to give the example of the 'Lysenko affair'. Trofim Denisovich Lysenko was an agronomist who rose to prominence in the former Soviet Union in the 1930s in a situation where the authorities wanted to increase the production of wheat after years of very poor harvests. Lysenko's experimental program promised to deliver a dramatic improvement of crop yields, if only the first generation of seeds were treated, since the effects of the treatment would be inherited. His proposal ignored the genetics that had been developed by Morgan in the wake of the rediscovery of Mendel. In other words his proposal was at odds with classical genetics, which consistently rejected the inheritance of acquired characteristics (Lamarckism). Lysenko's ideas were endorsed by the communist party and became official Soviet policy, and indeed official Soviet science whereas prominent scientists supporting orthodox genetics were denunciated, prosecuted and imprisoned. The 'Lysenko affair' has many facets and has been analyzed from different perspectives, but what concerns us here is that it is a clear case of an *outcome* approach. Political authorities were instrumental in evaluating a specific outcome, orienting themselves

towards what they took to be an ideal model of science, 'Soviet science'. On the basis of the *procedural* approach, on the contrary, one first evaluates a concrete scientific activity with respect to the rules of the game to check whether it is consistent with them and when there is a dissensus with respect to which rules should be relevant and should be followed, a further evaluation of the different institutional rules with respect to different values takes place. How exactly this can happen is the issue to which I turn next.

## 5. THE HIERARCHY OF PROBLEMS, INSTITUTIONS, AND VALUES

In order to systematize the discussion, I would like to introduce a hierarchical model with *problems* at the *lowest* level, *institutions* at the *intermediate* level and *values* at the *highest* level.

The view of science as an evolutionary enterprise taking place in historical time goes hand in hand with the view of scientific activity, individual and collective, as oriented towards the solution of theoretical *problems*[13]. The focus on scientific *activity* is not meant to marginalize accounts of the products of such an activity, mainly in the form of theories, models and artefacts. But it can better capture the procedural character of science, that is, the endless flow of the activities of working scientists which permanently generates products while unfolding.

Whenever there is a divergence of opinion on how to construct and solve adequate solutions to theoretical problems, a resolution is possible by moving one level up in the

hierarchy, that is, by appeal to the rules of the scientific game. These rules can on the one hand be *methodological* rules, that is, rules of conducting experiments, assessing evidence, collecting data, conducting tests, etc.; and they can be very general like "formulate testable hypotheses" or quite specific like "always conduct randomized control trials in medical research". They comprise the epistemic norms of the scientific community and can be regarded as part of the informal institutions that structure the game of science; in terms of the classification proposed above, the methodological rules constitute the *specific social norms* of the specific type of game we called "science" – along with the moral rules and conventions. The appeal to these rules is often not conscious – to the degree that these rules have been adopted during the learning process of the participating scientists. And often the appeal is not explicit – to the degree that the participating scientists share a community consensus on the kinds of rules that are supposed to solve the problems at hand. But an appeal to the legal rules that structure the scientific enterprise is also common when conflicts emerge in the process of the social interaction, so that both the *informal* and the *formal institutions* constitute the *intermediate level* in the *hierarchy* of normative appraisal.

Science cannot be plausibly viewed either as a completely *consensual* enterprise or as an arena of permanent *dissensus*. It is never the case that there is a standardized, let alone algorithmic way that a disagreement about theoretical problems can be brought to closure only by collecting more evidence or by following the appropriate rules for assessing evidential support as has been long contented by traditional philosophy of science.[14] But it is neither the case that there is a permanent dissensus about everything (Carrier, 2018): about which problems should be regarded as relevant, about what are the appropriate

methodological rules to study them and according to which standards one should pick up the proposed solutions. As argued in section 3 above, the prevailing institutions determine the blend of cooperation and competition among the participants in the game of science, and thus regulate the degree and intensity of scientific consensus and dissensus. There will therefore always remain a residue of competition or dissensus with respect to a range of issues in any scientific endeavor. Coming to terms with this presupposes moving one level up in the hierarchy, that is, the *axiological level of values*. Values, as normative principles of highest generality, can serve as highest reference points in the appraisal of the various informal and formal institutions. These can be epistemic values, such as truth, accuracy, simplicity, consistency, fruitfulness, etc., or non-epistemic values (i.e. moral or aesthetic values) such as honesty, integrity, beauty, etc. There is, naturally, value pluralism.

To summarize: theoretical *problems* lie at the *lowest* level and are solved with the help of *institutions* at the *intermediate* level. Whenever disagreement about the appropriateness of the institutions emerges, either regarding the informal institutions, mainly the methodological rules, or regarding the formal institutions, mainly the legal rules constraining scientific research, an appeal to *values* becomes necessary. Epistemic and non-epistemic values lie at the *highest* axiological level. Figure 1 summarizes the hierarchical model.

**Values**

(epistemic and non-epistemic)

**Institutions**

(informal and formal)

**Problems**

(mainly theoretical)

*Figure 1: The Hierarchical Model*

## 6. A FRAMEWORK FOR A MULTIDIMENSIONAL EVALUATION

The appraisal of the mix of formal and informal institutions prevailing at every moment of time in a society with respect to epistemic and non-epistemic values can be most effectively conducted following a comparative approach. Let us start with the simplest case: evaluating different rules with respect to one value. Such an evaluation takes place within the standard means-ends framework: rule X (of type a), compared with rules Y and Z (of the same type) is more accurate – that is, closer to attaining the value of accuracy; rule A (of type b), compared with rules B and C (of the same type) is more empirically adequate – that is, closer to attaining the value of empirical adequacy etc. Such a comparative evaluation can be based on unambiguous judgements with respect to whether the respective rules are closer or not to the attainment of a specific value. Laudan (1984, p. 31f) has provided a useful example of this case long ago (rejecting the alleged danger of pervasive relativism that Kuhn associated with the subjectivity of such judgements): "Suppose that a scientist is confronted with a choice between specific versions of Aristotle's physics and Newton's physics. Suppose moreover that the scientist is committed to observational accuracy as a primary value. Even granting with Kuhn that 'accuracy' is usually not precisely defined, and even though different scientists may interpret accuracy in subtly different ways, I submit that it was incontestable by the late seventeenth century that Newton's theory was empirically more accurate than Aristotle's. Indeed, even Newton's most outspoken critics conceded that his theory was empirically more accurate than all its ancient predecessors".

Let me continue with the more complex case. This is the case when we want to evaluate different rules with respect not only to a single value, but with respect to more values. Here, a *multidimensional evaluation* is necessary in order to adequately address which values should be effective when judging the quality of the methodological rules of scientific research or the quality of the legal rules that regulate scientific research in a pluralistic framework. Values provide the fixations of normative resources that can help judge the goodness of institutions that have emerged during the historical development of science.[15] *Different sets of rules can be evaluated with respect to different values* – this is the main tenet of a multidimensional evaluation approach. *Appraisal is always a comparative matter* – we always form evaluative judgments with respect to one value or more values by comparing different alternatives. Figure 2 summarizes the argument so far and provides a diagrammatic conceptualization.

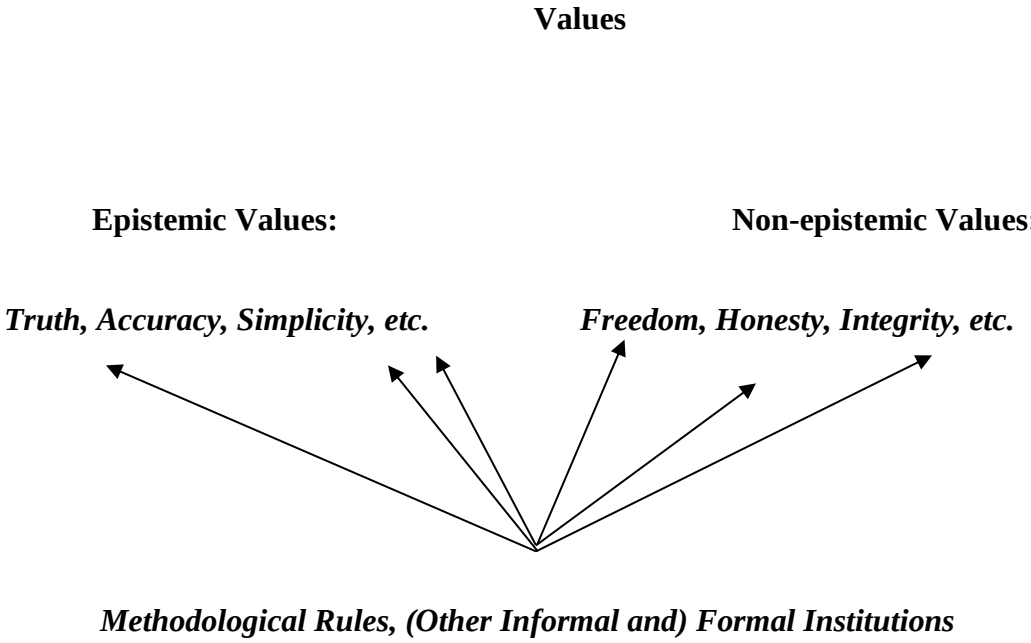


*Fig. 2 The Multidimensional Model*

In order to be even more specific, let us start with the *methodological rules*: these are the *specific social norms of science* according to the proposed classification, i.e. the rules that scientists follow in order to solve theoretical problems that are enforced by other scientists in the community. Rules of representation (linguistic, diagrammatic, pictorial etc.),[16] rules of inference,[17] rules of conducting experiments, of collecting data, of conducting tests, etc. are the *constitutive* rules of the game of science: without them there is no scientific activity. All these rules can be evaluated with respect not only to one value, but to a series of epistemic values: truth, accuracy, simplicity etc.

Formal institutions that regulate the scientific process can mainly be evaluated with respect to non-epistemic values, as, for example, freedom. This is factually the case in many Western democracies of our time where all formal institutions governing science respect freedom of expression, of opinion and/or research (Wilholt, 2010). Art. 5.3. of the German Grundgesetz is a good example: "Kunst und Wissenschaft, Forschung und Lehre sind frei. Die Freiheit der Lehre entbindet nicht von der Treue zur Verfassung". ("Arts and sciences, research and teaching shall be free. The freedom of teaching shall not release any person from allegiance to the constitution".) According to the First Amendment to the United States Constitution: "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the Government for a redress of grievances." And article 11 of the European Union Charter of Fundamental Rights stipulates: "Everyone has the right to freedom of expression. This right shall include freedom to hold opinions and to receive and impart information and ideas without interference by public authority and regardless of frontiers."

It should be clear that although it will be more common that methodological rules will be evaluated with respect to epistemic values and formal institutions will be evaluated with respect to non-epistemic values, this does need not be always the case. Consider the example of a rule of representation. This can be evaluated also according to social and political values. Suppose in medical textbooks, researchers tend to publish schematic drawings of human bodies that are simplistic and regular in order to promote learning for a reader. But if those features of the schematics often mean ignoring 'non-typical' bodily

features, such as the representation of skin conditions on Black patients in dermatology textbooks (which is a very real issue impacting rates of diagnosis), then this rule can be evaluated based on social values of inclusion. Other similar examples would include rules of representation for graphs, especially with misleading y-axes, that can be evaluated based on their ability to promote public understanding of scientific findings or tendency to serve political or economic interests[18].

Why is it appropriate to frame the discussion on values and science in institutional terms? The answer to this question can be formulated with the help of a counterfactual: if we possessed an external criterion or an ultimate justification of a certain value or a set of values, then we would not need a discussion and a respective decision-making process. For centuries, indeed millennia, humans believed in the existence of such external criteria or the possibility of the ultimate justification of a certain value or values. This belief was nicely encapsulated in the *principle of sufficient justification* which exemplified the demand for an ultimate justification of all convictions and positions.

Such a demand was known in the context of ancient skepticism – more specifically in the context of the discussion of *Agrippa's* five tropes[19] – and in contemporary philosophy it was shown to lead to a situation with three alternatives, all of which are unacceptable: the *Münchhausen Trilemma*. The backdrop for this name for the trilemma is the story of the Baron von Münchhausen, a German nobleman who lived in the eighteenth century and had become famous as a storyteller. In one of his famous stories he managed to pull himself and the horse on which he was sitting out of a swamp by his own hair.[20] It involves three options: one has the choice between an infinite regress, a logical circle, or a dogmatic suspension of the process at a particular point.[21] Since the first two options

are commonly viewed as unacceptable, one usually dogmatically suspends the argumentation at some point using terms such as "self-evident", "intuitive", etc. The ultimate "given" is then professed as an Archimedian point, depending on what is favored by the respective philosopher.

The dogmatism and the Münchhausen Trilemma can be avoided by substituting the *principle of critical examination* for the principle of sufficient justification. According to the principle of critical examination, a discussion of problems of epistemology, political philosophy or ethics need not refer back to some ultimate reasons in order to be convincing or rational. Instead, all issues arising in the sphere of cognition or in the sphere of praxis are to be critically discussed on the basis of alternatives which are to be worked out creatively. It is the *creation of alternatives* with the aid of imagination and the *reasonable choice* in light of the *critical discussion* that epitomizes the principle of critical examination at work. This approach goes hand in hand with fallibilism, that is, the position that all our knowledge, activities, and rules are prone to error. In all areas of cognition and praxis, we constantly make mistakes, but we can learn from our mistakes by means of criticism.

A fallibilist treats all problem solutions as hypothetical: (s)he provisionally accepts them instead of searching for an ultimate secure foundation for them. The fallibilistic stance can be applied to many different areas: ethics, politics and science. What concerns us more here, *values can all be accepted as hypotheses amenable to criticism*. Therefore is it appropriate to frame the discussion on values in science at an institutional level: it consists in provisionally accepting a series of values that have emerged and in inquiring into how different rules help to achieve them.

## 7. DEFENDING THE COMPARATIVE APPROACH

Every discussion about the merits of an institutional change at any level has to take into account a very simple matter of fact: "we always start from here". Any change that is to be introduced has to take into consideration the existing scheme of things, the status quo. For whatever reasons, there is always a set of rules at work, the *institutional a priori*, regulating the behavior of agents in the respective social domain. Moving from here to there involves showing the path from the given situation to the one deemed important and desirable.

For such a move, the acceptance and indeed the availability of an ideal approach is neither sufficient nor necessary. To consider an analogy, the fact that a person regards *The School of Athens* as the best fresco in the world, does not reveal how she would rank a Monet against a Rubens. The search for an ideal *well-ordered science* as proposed by Philip Kitcher (2011), for example, is an engaging task in itself, but irrespective of whether we think of it in terms of the gradeless "right" or in the framework of the graded "best", it does not give us information about the comparative merits of many institutional arrangements. In making a judgment that some institutional rule *x* is better than an alternative rule *y*, we do not need to maintain that some quite different alternative *z* is the "best" or "right" institutional rule.[22]

Besides, different societies have evolved along different trajectories, so that working out an ideal for the appropriate place of science in them may not be feasible, and it must certainly undergo adaptation as these societies continue to evolve and priorities change. A comparative approach is certainly much more useful than the provision of a general

model able to serve as a reference, which is supposed to apply to all times and under all conditions. The concrete specification of the institutional rules that govern scientific activities must proceed from an analysis of the prevailing situation, and it must get by without an atemporal abstract ideal.

I would like to provide an example of how a comparative approach can be used and how it is to be applied. In the aftermath of the global financial crisis of 2008 a discussion was triggered and still continues on the way that neoclassical economics explains economic phenomena (e.g. Rodrik, 2015). The predictive accuracy and the scope of application of the mainstream economic theory have been questioned. The explanation of economic phenomena is provided by economists in virtue of following specific rules of representation, rules of inference and rules of scope. The rules of representation, for example, can be natural language or formal mathematical models aiming to represent the phenomena of interest. The rules of inference act on the representations provided and these can be law-like statements or formal logical requirements. The rules of scope are rules specifying the scope of phenomena to which economic explanations should apply. All these rules as they are currently employed by economists have been questioned with respect to their quality. According to the comparative framework defended here, the rules of representation, the rules of inference and the rules of scope of neoclassical economic theory make up the methodological rules, i.e. the specific social norms of economic science. Each type of rules can be evaluated with respect to different epistemic or non-epistemic values. The highly formal mathematical models used by economists working within the parameters of the neoclassical research program, for example, can be evaluated with respect to their truth, accuracy (epistemic values) or beauty (non-epistemic value).

Paul Krugman in an acclaimed article diagnosed that "the economics profession went astray because economists, as a group, mistook beauty, clad in impressive-looking mathematics, for truth" (2009)[23]. The rules of representation in the form of mathematical models can, thus, be judged positively with respect to the value of beauty, but negatively with respect to truth. The rules of inference in the form of law-like statements used by neoclassical economists such as, for example, the statement that the market forces of supply and demand tend to bring about an equilibrium, can also be judged according to different epistemic values. With respect to simplicity, this general rule of inference is to be judged positively, but it is debatable whether it should also be judged positively with respect to truth, since a series of markets do not reach an equilibrium. Finally, the main rule of scope followed by neoclassical economists prescribes where economic theory should be applied: to all market phenomena irrespective of the historical context. This rule calls for a dramatically divergent evaluation with respect to the values of simplicity and empirical adequacy: although it is certainly a simple rule, experimental economics of the last decades has shown that it is not empirically adequate (Holt, 2019).

In a nutshell, as this example shows, the different rules that are followed by scientists working in a specific problem area in their daily activities can be evaluated according to a great array of values. The overall judgment of the "goodness" of the rules will depend on how one trades off between values; and the decision about which rules to adopt and which to discard will be a reasonable decision to the extent that the insights of the critical discussion make it an informed decision; but it will remain a fallible decision, nevertheless.

## 8. CONCLUSION

The relation between science and values is an institutional issue both in the abstract sense of how the rules of the game of science reflect the weighing of values and in the practical sense of real world institutional choice. It is certainly important and fruitful to continue the inquiry about how the *methodological rules* of science, which make up the specific social norms of science, should relate to values such as, for example, truth. It is imperative that this traditional enterprise of philosophy of science continues to be undertaken, since these are the *constitutive rules* of the game of science: without them there is no scientific activity. However, the relation between values and the *rest of the informal institutions* of science, i.e. the moral rules and conventions, as well as the *formal institutions* of science, must also take center stage.

A key in successfully addressing this institutional issue is knowledge of the facts, that is, the knowledge of the working properties of the different kinds of rules and their effects on the performance of science. But we will still have to make fundamental choices. In making these choices reasonably we must imaginatively create alternatives, deliberate on them and critically discuss them. In this process we will make errors, but we can learn from our errors. This is all that we have. As in many other cases, this is our predicament.

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## ENDNOTES

[1] See Max Weber (1904/1985, p. 151). It is a serious misunderstanding that Max Weber was in favor of a "value-free science" since he has passionately advocated that only the value of truth should play a role in scientific endeavors. His position was rather that a social scientist is not entitled to utter value judgments qua social scientist, but only qua citizen, in juxtaposition to the position held by the so-called Kathedersozialisten. (The debate on this issue took place in the Verein für Socialpolitik in 1913; see the contributions in Nau 1996). On the position of Max Weber see the excellent discussion by Keuth (1989, part 1). See also Albert and Topitsch (1979).

[2] The protagonists in this latter debate, Karl Popper, Hans Albert, Theodor Adorno and Jürgen Habermas, were arguing about the appropriate role of the social sciences in a society and what form criticism of the fundamental rules of the polity should take. See Adorno et al. (1969). For the contemporary German discussion, see Schurz and Carrier (2013).

[3] See Henri Poincaré (1919, p. 225).

[4] See Carl Hempel (1965, p. 92): "Such acceptance (of a scientific law) carries with it the 'inductive risk' that the presumptive law may not hold in full generality and that future evidence may lead scientists to modify or abandon". See also the classic contributions by Richard Rudner (1953) and Richard Jeffrey (1956). Later defenders of a "value-free ideal" include Ernan

McMullin (1982) and Hugh Lacey (1999). An important critic of the ideal is Heather E. Douglas (2009).

[5] New Institutionalism has provided a series of mechanisms for the explanation of the ways that institutions shape human interaction in society, markets and politics. New Institutional Economics, for example, has become widely accepted, mainly as it has been shaped by the works of Ronald Coase (1937) and (1960); Douglass C. North (1981), (1990) and (2005) and Oliver Williamson (1985) and (1996), who all won the Nobel memorial prize in Economic Sciences. In Sociology and Political Science, New Institutionalism has been shaped by the work of a series of authors in three different versions. One is *historical* institutionalism (see Hall, (1986); Thelen (2004); Mahoney and Thelen (2015), and Pierson (2004)). Another is *rational choice* institutionalism (see Riker (1980), Alt and Chrystal (1983), Shepsle (1986), (1989) and (2016), Levi (1988), Knight (1992), Tsebelis (2002) and (2017)). A further is *sociological* institutionalism (DiMaggio and Powell (1991), Nee and Brinton (1998), Meyer (2010), culminating with the Nobel memorial prize in Economic Sciences awarded to the political scientist Elinor Ostrom for her interdisciplinary work on institutional analysis (1990) and (2005). There is also an ongoing discussion on New Institutionalism in Anthropology (see e.g. Ensminger (1992) and Ensminger and Henrich (2014)), but also in Classics (see e.g. Ober (2015) and Bresson (2016)) and other fields. In the philosophical discussion of the last decade, the approach of Searle (1995, 2010) to institutions has become increasingly prominent. This is a social ontological approach which will not be followed here (nor other social ontological approaches).

[6] See Mantzavinos (2001, p. 83).

[7] See Knight (1990, chs. 2 and 3).

[8] Competition for recognition has been paid a great deal of attention in the literature and is often conceptualized as a search for credit on the part of scientists. On the role of the *priority rule* in this context which requires that the lion's share of credit goes to the person who discovered a

phenomenon first see Strevens (2006a). On the role of the so-called *Matthew effect* according to which, when discoveries are made nearly simultaneously, or by teams of scientists working together, most of the credit is conferred on the more famous of the discoverers, see Strevens (2006b). See also Zamora Bonilla (2002) and (2013). On the problematic that scientific outcomes have the character of public goods see the locus classicus Nelson (1959). According to Congleton (1989, p. 185), the status-seeking behavior can help to solve the public goods problem when those seeking status produce something that is beneficial to others. For a discussion and further references, see Zollman (2018).

[9] See Albert, Schmidtchen and Voigt (2008); Albert (2011).

[10] The metaphor of the invisible hand (Leonard 2002, p. 143) can be used to describe the simultaneous working of the three distinct mechanisms referred to in the text, but there is nothing that guarantees that the results of such an invisible-hand process will be in some sense "beneficial" (Hall 1997). Even James Buchanan, the liberal economist and Nobel Laureate, in his article "Law and the Invisible Hand" , having the case of markets in mind, but stating a more general point about invisible hand explanations, has observed that they "may be as applicable to 'orders' that are clearly recognized to be undesirable as to those that are recognized to be desirable".

[11] It is a historical contingency that the informal and formal institutions of modern science have come to prevail in a long evolutionary process in the West. On the one hand, there were the *informal institutions* encapsulating the critical tradition coming from the Ancient Greek philosophy, weakened in the course of many centuries and revived during the Scientific Revolution; and on the other hand, there was the emergence of *competitive political structures* (Bernholz, Streit and Vaubel 1998; Jones 2003) that has considerably increased individual freedom allowing at the same time criticism without pernicious consequences for the critic.

[12] See Hull (1988), Longino (1990) and (2002), Albert (2010), Mantzavinos (2013) and (2016).

[13] The view of science as a problem solving activity has been defended by a series of authors; the most prominent probably are Karl Popper (1972) and Larry Laudan (1977).

[14] See the useful discussion of Laudan (1984, chapter 1).

[15] The traditional philosophy of science has focused, instead, its efforts in developing the criteria for the evaluation of the adequacy of theories. In other words, reflecting the dominance of the view that the center of scientific activity lies in the generation and evaluation of theories and models, which constitute the fundamental, if not the exclusive representational resources, most of the debate has concerned the goodness of these representations and their appropriate use.

[16] On visual representations, see Perini (2005a) and (2005b). On scientific representation more generally, see van Fraassen (2008) and Frigg and Hunter (2010).

[17] See e.g. Suárez (2004) and (2015).

[18] I am extremely thankful to an anonymous reviewer for insisting on the possibility and importance of evaluating methodological rules also with respect to non-epistemic values. I am also grateful for his or her pointing at the concrete examples that I have referred to in the text.

[19] The five tropes or modes have been among the most famous arguments of ancient skepticism and are attributed to Agrippa by Diogenes Laertius. They are also given by Sextus Empiricus in Book 1, Chapter XV entitled "Of the Five Modes" in his *Outlines of Pyrrhonism* (1933, pp. 164-169).

[20] Gottlob Frege in the preface of his *Grundgesetze der Arithmetik* (1893/1998, p. XIX) had already referred to Baron von Münchhausen in the context of the quest for an ultimate justification: "Wo ist denn hier der eigentliche Urboden, auf dem Alles ruht? oder ist es wie bei Münchhausen, der sich an eigenen Schopfe aus dem Sumpf zog?" Karl Popper in his *Logic of Scientific Discovery* (1959/2002) also discusses a similar problematic in §25.

[21] The most thorough discussion of the Münchhausen Trilemma is provided by Hans Albert in his *Treatise on Critical Reason* (1968/1985, p. 18f.) He is the one that has introduced the term in

contemporary philosophy in the first place and made the distinction between the Leibnizian principle of sufficient reason and the principle of sufficient justification.

[22] Amartya Sen (2006, p. 222) makes a similar point in juxtaposing what he calls the "transcendental approach to justice" to the "comparative approach to justice".

[23] On a criticism of Krugman see Cochrane (2011) and Collander (2011). On the values that economists tend to respect see van Dalen (2019).