

The Notion of Intellectual Rigor: A Systemic/Cybernetic Approach.

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Abstract

*The main objectives of this article are 1) to show that the notion of rigor has not been adequately addressed, let alone in the context of “intellectual rigor” and that when it is addressed in Science, it is done in an evidently wrong way and even violating the most basic and elemental Predicate Logic, and 2) to show that we can briefly describe a general notion or rigor (including intellectual rigor) as “**achieving objectives**” while being restricted by principles (e.g., axioms, natural laws, accepted theories, etc.) and constraints (e.g., disciplinary semiotic systems and methods, environmental limitations, etc.)*

An additional objective of this article is to initiate a conceptual, notional, intellectual, and/or semantic clarification of “Intellectual Rigor”, i.e. the purpose is to initiate a thematizing process on this intellectually and pragmatically important conception, idea, or notion. The pragmatic value of this clarification process is especially required for peer-reviewing in scientific, technological, humanism, and philosophical publishing. This is even more important for inter- and trans-disciplinary research and communication. Disciplines usually have their own semiotic disciplinary systems which usually provide the means for peer-reviewing. Even so, in a survey of members of the Scientific Research Society, “only 8% agreed that ‘peer review works well as it is’.” (Chubin & J., 1990, p. 192) [Italics added]. Isn’t this situation requiring some research in order to improve it? Should this research not be started with trans-disciplinary research related to clarifying the notion of Intellectual Rigor?

We will try to give an initial baby step oriented to trigger this kind of collective research. We will do it by means of briefly describing the notions of “Intellect” and “Rigor” with the purpose of trying a tentative initial description of “Intellectual Rigor”, with the hope to trigger some reflections and reflexions on this issue, as well as to collect feedback, criticism, more details, other intellectual perspectives, and potentially some collective co-learning and research on this very important issue.

Keywords: Rigor, Intellect, Academy, Science, Engineering, Academic Dialogues, Peer Review, Collective Research.

1. Introduction

The notion, concept, or phrase “Intellectual Rigor” has been mentioned just three times in the *Stanford Encyclopedia of Philosophy*¹. The three times that this phrase was mentioned have been in its much known general meaning. This is a strong indication that “Intellectual Rigor” has been used as an *operative* concept and not as a *thematic* concept, i.e. in Fink’s (Fink, 1968) terms, a **shadow concept**, that stands behind what is being clarified (thematic concepts) but not being clear itself. We think that the importance of clarifying this concept, or notion, is important in both: the intellectual and the pragmatic domain. The latter includes, as we indicated above, *peer review in Scientific, technological, humanities, and philosophical Communication*.

It is really surprising that such an important notion, in essence, of one of the most sacred pillars in scientific, technological, and philosophical publishing has not been addressed yet. Consequently, the objective of this article is to start a very initial baby step in the direction of clarifying this important concept or notion, by means of triggering more research on this issue; potentially via group collective research and co-learning among the respective potential authors. In Fink’s (1968) terms, our objective is to *make “Intellectual Rigor” a thematic concept or notion*, i.e. to initiate what seems to be a *shadow concept or notion*, used to clarify other contexts or notion but not being, in turn, clarified

The origin of this article, as well as of its purpose, is an ongoing project to address the issue of the “Rigor of Inter-Disciplinary Communication”, via research, reflections, and a constructive co-learning process among the authors. During this project (which is still in progress) we noticed that there is no adequate explicit knowledge with regards to *what* rigor is, in an intellectual context. Consequently, we decided to address this issue with a methodology similar to the one we are following in the ongoing project. This is an initial, a seed/base, article which would support a process for publishing a multi-author collection of short articles; which, in turn, would support the publication of a special issue with full articles on the same topic and, potentially, a multi-author book on such an important subject.

The specific objective of this article is to attempt an initial description of the notions² of “Intellect”, “Rigor” and, hence, “Intellectual Rigor”. In doing so, we will try to be oriented by the approach that Ackoff suggested, in his

¹This is easily verifiable at the Stanford Encyclopedia of Philosophy, at <https://plato.stanford.edu/search/search?query=%22intellectual+rigor%22>

² Elsewhere (Callaos N. , 2013) we analyzed with details the “notion of notion”. Suffice it here to refer to our general conclusion. A notion is cognition, an idea which can be, and usually is, represented by the description of a set of related, or relatable, concepts along with their respective definitions. This set is frequently a fuzzy set.

classical book “The Scientific Method” (Ackoff, 1962), specifically in his approach to *conceptual* definitions, because of the nature of the definitions we are looking here for. This is why we will orient our reflections according to the following features that Ackoff presented as *necessary* (though not sufficient) conditions in a scientific definition³, i.e. the search for meaning.

1. ***Explicit definitions are necessary conditions in scientific activities.*** They are at the core of scientific research, as stressed by many authors, e.g. (Bridgman, 1927), (Stevens, 1935), (Bridgman, 1938), (Ackoff, 1962). In spite of this fact, as Ackoff also points out *"too few scientists take it very seriously"*, and ***"the meaning of concepts is too often taken for granted"*** (Ackoff, 1962, p. 174) [Italics and emphasis added]. This is happening contemporaneously, in our opinion and, up to our knowledge, with the notion of “intellectual Rigor”, as well as with notions of “Rigor” and “Intellect.” To foster the filling this gap is the main objective of this article and the consequent publications mentioned above. All of which will be based on research and reflections. The research will include literature research, including the articles of other authors of the same publication. *This will support the process of co-research and co-learning among the different authors of the same publication*, which, in turn, would generate publications internally integrated by the same authors.
2. The definitional process, or the search for meaning, should take into account the *"telos"*, *"the purposes of the definer"* as Ackoff, (1962)) stressed it. This *teleologic* approach harmonizes perfectly with Singer-Churchman’s *pragmatic-teleological truth* (Churchman, 1971). Consequently, our individual search and reflections, as well as our collective and participative research, will be oriented by the stated objective, telos. It would hopefully be participative research where authors would be *acting* on each other reflections and relating them and their respective articles in an internally integrated publication. Consequently, it will be a collective Telos, i.e. a system of telos (individual telos intersecting each other with commonalities and relating to each other what is not common among the different writers)
3. The effectiveness of co-learning, resulting from this participative research, will certainly represent the pragmatic part of the pragmatic-teleological truth; which is what would be orienting this project. Since a notion is a set of related or relatable definitions, concepts, and senses of

³ Conceptual definitions are *necessary condition* for Ackoff, but are not sufficient one in the scientific domain, especially if this domain includes experiments, measurements, and other *operational* activities. This is why in this kind of scientific activities conceptual definitions are necessary input to what he calls *operational definitions*.

the associated word or phrase⁴, then intellectual perspectives from different, disciplinary, trans-disciplinary, or inter-disciplinary fields would enrich the publication as well as the intellect of its authors and its potential readers. Ackoff's approach and intellectual perspective are almost necessary conditions to achieve this objective. The next aspect of Ackoff's (1962) intellectual perspective is almost a must for achieving the description of a notion nurtured by disciplinary, trans-disciplinary, or inter-disciplinary perspectives.

4. Ackoff (1962) stressed the fact by which "historical analysis of the use of a concept can often reveal a trend in the evolution of the concept or a consistent theme of meaning which persists through numerous variations" (Ackoff, 1962, p. 148) and, consequently, in different disciplines or intellectual fields. This is why he exhorts to initiate the defining process by formulating a tentative definition based on the evolving core identified by historical analysis. It is our experience that Ackoff's instruction is a valuable and practical one and that taking it to an extreme, by going to the etymological meaning of the word being defined, is most helpful, especially for suggesting a pre-tentative definition. The *suggestive* effect of historical "linguistic analysis"⁵ has been stressed by several authors, e.g., (Navarte, 1981, p. 158). Etymological meanings, which persisted through historical variations, are the roots of the meanings or senses that followed and were associated with the word or the concept. This is why the word etymology frequently suggests a general concept from which more specific ones were generated through history. This is why it has the potential to support the abstraction of what is common from what is non-common, I.e., what is common in the diversity of conception related to a word or phrase, as well as the senses with which it is used according to the different contexts that provide the potential differences in the senses of its comprehensive meaning. And this is, also, why we think that the etymological source and initial uses of a term could help to abstract a general meaning, from the varieties of the specific ones that appeared through history.

⁴ Elsewhere, we provided more details regarding "The Notion of Notion" (Callaos N. , The Notion of 'Notion', 2013); let's here just summarize a main conclusion: A notion is cognition, an idea, associated with a set of related (and/or potentially relatable) concepts which may have different definitions. This is why notions are not defined but described, according the objective of the article and its space/time restrictions. A concept is an abstraction of a complex reality, but a notion is a system of the different ways in which reality was represented, i.e. notions are complex systems of different ways of simplifying aspects of the complex reality. This means that we may refer to ***notions as mediating between concepts (simplifications via abstraction) and the complex reality represented in the mind via related ideas***, cognitions or notions.

⁵ This historical "linguistic analysis will be highly limited here, to the time and space limitation as well as to the announced purpose of this article.

2. Toward a Description⁶ of the Notion of Intellect

“[S]ince we define in order to judge and judge in order to know truth and being, the end of our entire intellectual operations is [to know truth and] being, the formal object of the intellect.”⁷ Bernard Lonergan.

“[O]ur intellect... is intended to secure the perfect fitting of our body to its environment, to represent the relations of external things among themselves—in short, to think matter.”⁸... The essential function of our intellect, as the evolution of life has fashioned it, is to be a light for our conduct, to make ready for our action on things, to foresee, for a given situation, the events, favorable or unfavorable, which may follow thereupon.”⁹ Henri Bergson (Nobel Prize)

We will try, in this section, to identify a comprehensive notion of ‘Intellect’, sufficiently general, as to cover more specific definitions of this notion. This means that we will try to identify the genus that would include as its species most of the other conceptions of ‘intellect’. We will suggest this general meaning is located in an analysis of its etymological meaning as well as in Aristotle’s notion of “Nous” and the Tomist-Scholastic notion of intellect a “*Habitus Pricipiorum*”, which we will interpret as the ***meta-habit of generating intellectual, mental, thinking or reasoning habits***. This conception of the Intellect explains the multiplication of intellectual disciplines and sub-disciplines. It also explains the existence of the three main kinds of intellects as identified by the Nobel Laureate (in Physics) were named as *Apollonian, Dionysian, and Oddisean Intellects* (Gell-Mann, 1994, p. xiii). We will provide, below, more details regarding this issue. This would prepare us for the following section related to the notion of “rigor” and “intellectual rigor”.

It is easily inferable from the two above quotes that Henri Bergson is referring to “Human Intellect” and Bernard Lonergan is referring to “Intellect” in general, i.e. what is common to different individual human intellects. In this section, we will be referring to Human Intellects, while trying to identify what may be common to them, but, ***evidently***, not in such a comprehensive way as Lonergan did it in his Great Work, but as related to the *objectives* and *restrictions* (e.g., time, space, intellectual limitation of the writer) of this article. In this context our objective is, as we informed above,

⁶ Notions are usually described while concepts are mostly defined. Notions (which are sets of related or relatable concepts, defections, and senses) should comprehend, cover, the most important concepts/definitions/senses as related to the objective of the description and limited to restrictions like resources, time and space.

⁷ (Lonergan, 2009, p. 606)

⁸ (Bergson, 1911, p. ix)

⁹ (Bergson, 1911, p. 29)

to identify comprehensive notions which may include other more specific notions, i.e. to identify the *genus* of ‘intellect’ which may contain the different *species* that can be found in literature. Since what we predicate from the genus can be predicated from its species, but no vice-versa, then, then the characteristics of Rigor in the genre are certainly also the rigor of its species. This, as we will see, may help us define what is common to the different kinds of rigors found in different disciplines. This is a main purpose of this article, because it will allow a more effective dialogue among intellectual disciplines and, hence, it would support the increasing activities in inter-disciplinary, research, education, and communication. All of this would, in turn, provide more support for a Dialogic Academy and systemic knowledge integration. This internal academic integration will make it more effective in getting integrated into the society supporting it with economic and human resources.

Let us now, take the first step, trying the etymological approach recommended by Kenneth Arrow (Ackoff, 1962, p. 148) for a conceptual definition; which is the first phase of a Scientific Definition. (Scientific Method: Optimizing Applied Research Decisions, 1962)

The word ‘intellect’ derives from ‘*intellectus*,’ past participle of ‘*intellegere*’ (understand or reason), from prefix ‘*intel-*’ (‘*intus*¹⁰’, into) and ‘*legere*’ (read). “***I read within me***”, as Rev. E. Cobham Brewer (1898) wrote it [italics and emphasis added]. Accordingly, Rev. Brewer (1898) adds, Intellect is “The power of reading mentally; hence the power of understanding and quickly grasping what requires intelligence and thought. (Dictionary of Phrase and Fable, 1898). Intellect means “***I read within me***”; no matter what my discipline is, inter-disciplinary or trans-disciplinary field. Consequently, intellect is what is common to the arts, sciences, engineering, technologies, humanities, etc., i.e. to *any kind of knowledge and/or experience*, including esthetic experiences.

Accordingly, the words ‘intellect’ and ‘lecture’ (from ‘*lectus*’ past participle of ‘*legere*’) have the same etymological origin: ‘*legere*’, which means ‘to read,’ and originally “to gather, collect, pick out, choose”. The term ‘elect’ also has the same etymological origin. It derives from the Latin ‘*electionem*,’ from stem of *eligere* “pick out, select,” from ‘*ex-*’ (out) and ‘*-ligere*,’ combined form of *legere* “to choose, read” (Online Etymology Dictionary, 2019). Intellect refers to an ability - that of *discrimination, and abstractions*. *A lecture is a choice collection of facts (and, perhaps, opinions), where we abstract those issues related to the lecturer’s objectives; while intellect is what provides the mental faculty with the capacity to produce a lecture. “The key intellectual event is a lecture” (Collins, 1998, p. 28) [emphasis added]; which is an ex-position.*

¹⁰ (Etimoitaliano, 2019)

Since the notion of ‘intellect’ is etymologically associated with ‘lecture’, ‘elect’, “to gather, collect, pick out, choose”, then, based on its etymological origin, we might hypothesize that *‘intellect’ means “the act, or the mental faculty, of gathering, collecting, picking out, choosing, electing within myself,”* This etymological sense of the term might harmonize with a Constructionist Approach to the notion of ‘intellect.’ Based on its etymological meaning, we could also conceive the notion of ‘intellect’ as “the act or the faculty of “reading within me,” “lecturing within me,” *lecturing myself*” and/or *“the act or the faculty of sharing the product generated by lecturing myself”*.

2.1. Cybernetic relationships between Individual and Collective Intellects

In human societies and organizations, intellects are related and/or able to be related. Consequently, “I read within myself” is related to its polar opposite: “I read without, beyond myself.” “I read within myself” is not always a final *end* in itself, but frequently it is a *means* for sharing the results of this activity with others. On the other hand, what I interiorized from what other intellect shared with me, are ingredients of “I read within myself.” So, it is intrinsic to intellects in human societies and organizations to communicate the results of their activities and to do so, they should exteriorize, ex-*pose* them. *Intellects and expositions seem to be strongly related*. As Collins (1998, p. 858) stated: “Thinking has a social form.” Individual intellects are nodes of intellectual networks, they are immersed in what Collins (1998) calls a ‘sociological cogito’; which requires reciprocal information and knowledge flow among the individual nodes.

The term “exposition” derives from the Latin term ‘*expositio*,’ which in turn derives from ‘*expositus*,’ past participle of ‘*exponere*’ which means “put forth, explain,” (Online Etymological Dictionary). In turn, *exponere* derives from *ex-* (forth) + *ponere* (to put, place). Examples of this kind of expositions, are conference presentations and proceedings, written expositions (journals, books), professorial classes and lectures, educational processes at all of its levels, industrial expositions¹¹, etc.

This differentiation (and *also* the relationships) between “I read within myself” and “I read without, beyond myself” has been reiterated, by philosophers and other thinkers. As an example, let us include the following McPartland’s text before providing a brief description of a systemic/cybernetic approach to identify polar opposition, a dialectic interplay, and, consequently, cybernetic relationships between them.

¹¹ “The meaning of “public display” is first recorded 1851 in reference to the Crystal Palace Exposition in London. Abbreviation *Expo* is first associated with the world’s fair held in Montreal in 1967.” (Online Etymological Dictionary),

Referring to Bernard Lonergan's "Verbum: Word and Idea in Aquinas"¹², McPartland affirms that Lonergan's "problem solving led him to the amazing discovery that, for Aquinas, there was a distinction not only between understating and "**outer words**" (oral or written expressions) but also, more significantly, between understanding and "**inner words**" (concepts). [Italics and emphasis added] This distinction between *intelligere* and *dicere* was more than a bombshell in Thomistic Studies, for it challenged the most pervasive assumption of modern thought, the "confrontation theory of truth"...[i.e.] theory of knowing essentially entails a confrontation of subject and object." (McPartland, 2010, p. 3)

This converges with a *systemic* notion of object and subject, as well as with *Cybernetics*, especially *Second Order Cybernetics*. Subject and object are systemic-cybernetically integrated into the dialectic whole. There is no object with no subject and vice versa. The subject defines the object and the object is part of the subject as it is the case of his/her objectives and the external objects he/she selects as his/her objects, according to his/her objectives.

Figure 1 shows the systemic/cybernetic relationships between subject and object. More details can be found in our article (A Systemic Perspective of the Notions of Subject and Object, 2020)¹³. This systemic notion will be applied to individual and collective intellects (or network of individual intellect), which are related via ex-position, as we will describe below (figure 2).

The subject communicates with the object via perception/action, or information/trans-formation via physical and verbal ex-formation, i.e. providing physical forms (e.g. technology) and mental forms via ex-position (e.g. oral or written expositions)

As we will see below, rigor is related and, even, determined by **objectives and restrictions**. If this is the case, who decides the set the objectives and the restrictions: the social or the personal cogito? Is it by consensus? Is it the result of some kind of power struggle? We think that it is important to answer or, at least, to try to answer this kind of question in order to have a more clear, or less obscure notion (cognition) of what "Intellectual Rigor" means or should mean. This is especially important in Science and Academy, particularly because Academia has been related, since its origin (Plato's Academy), to the public, or semi-public intellectual expositions,

¹² Volume 2 of Lonergan's "Collected works" (Chapters 2-12)

¹³ This article is a section of a larger article because the systemic/cybernetic relationship between Cognition and Knowledge (Callaos N. , 2013b) is based on a systemic perspective of Subject and Object.

where *disagreements are encouraged, not discouraged*. Dialogues¹⁴ are the essences and at the very roots of Academia, while enforcing a doctrine or an intellectual perspective is not.

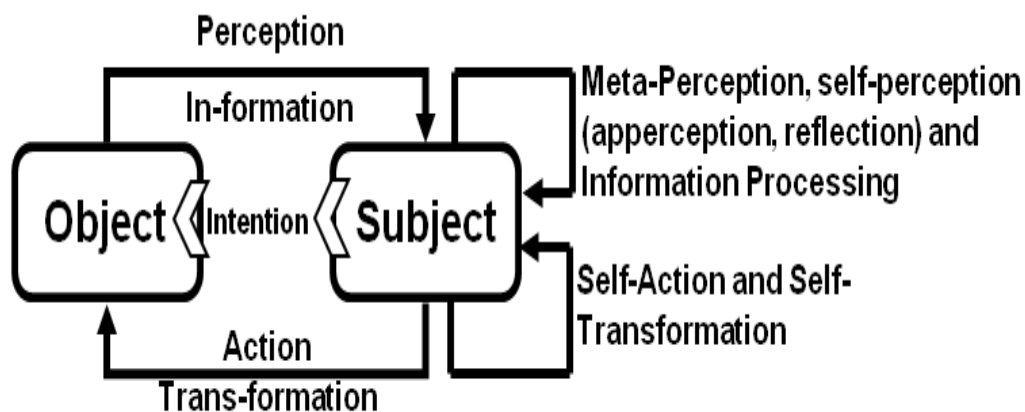


Figure 1: Cybernetic-systemic relationships integrating subject and object into a whole. It is based in 1) an expansion of Singer-Churchman’s (Churchman, 1971) teleological-pragmatic conception of the truth, and 2) 2nd Order Cybernetics by means of which we added subject’s self-perception and self-action

2.2. Relationships between Internal and External Words and Worlds

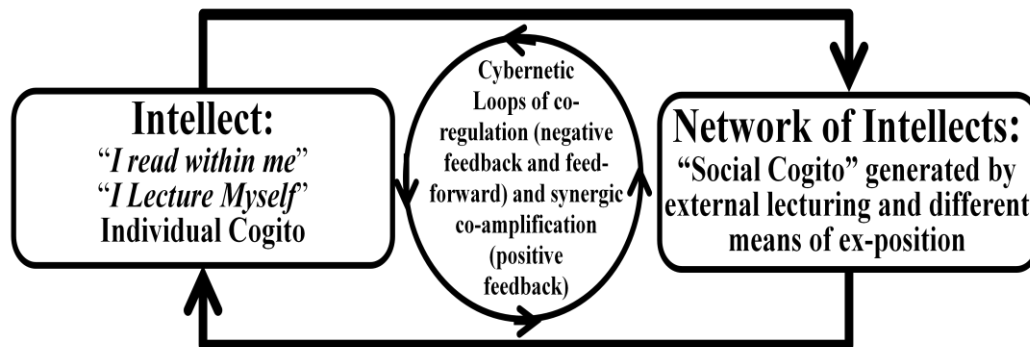
It can be noticed that what represents Figure 2 is coherent with the above mentioned McPartland’s affirmation regarding Lonergan’s “amazing discovery that, for Aquinas, there was a distinction not only between understating and “*outer words*” (oral or written expressions) but also, more significantly, between understanding and “*inner words*” (concepts). In this context, figure 2 represents a cybernetic way of relating “*outer words*” with “*inner words*”, ‘*intelligere*’ and ‘*dicere*’. Consequently, we may adventure a suggestion: *Thinking and logos relate cybernetically with each other. More detail with regards to this issue may be found in Bernard Lonergan’s intellectual perspective and philosophy, as well as in Aquinas’ Philosophy. More details regarding this issue may be found in our unedited paper on the systemic/cybernetic relationships between “Cognition and Knowledge” (Callaos N. , 2013b)*

The relationship between internal and external words, internal and external communication, internal and external reading has been central to academic activities since the born of the word “Academia”, in the Platonic Academia, which may be perceived and conceived as the first organizational informal structure representing what Figure 1 schematizes, which necessarily requires intellectual tolerance in order to approach “truth”, in any of the

¹⁴. After examining the etymological meaning of “dialogue”, quantum physicist David Bohm associated dialogues to “*stream of meaning*” and “*shared meaning*,” he affirms Contrast this meaning of dialogue“ with the word ‘discussion’, which has the same root as ‘percussion’ an ‘concussion’. It really means to break things up. He emphasizes the idea of analysis, where there may be many points of view, via dialogue.

senses in the meaning of the word, or in any of the conceptions of its notion. *Is there in the academic world the required intellectual tolerance among scholars from different disciplines?* Consequently, Figure 1 should also represent the relationships that should exist between intra-disciplinary communication and inter-disciplinary communication as well as with trans-disciplinary communication.

Required for lecturing and communicating with others intellects; which generates "Social Cogito" via different means of Ex-position. Regulates "Social Cogito" via negative feedback and feed forward and amplify it via individual creativity. And analogical thinking



Provides Input or "Social Cogito" to "personal cogito" for a more comprehensive "reading within" and lecturing oneself. It regulates intellectual production, via negative feedback and feed forward and amplify intellectual comprehensiveness via positive feedback

Figure 2: Individual intellects relates with each other, via different ex-position means, in a network on intellects, generating a Social Cogito, which feedbacks to its constitutive individual intellects generating cybernetic loops via co-regulative and co-amplificatory feedback, which generate, in turn, synergies.

It might even be conceived that academic networks of intellects should also develop *NON-disciplinary communication*, as many Nobel laureates did, in order to expand the disciplinary of inter-disciplinary sociological Cogito into a *Societal Cogito*. All of these require intellectual tolerance which requires an understanding of different conceptions of "intellectual rigor", which, in turn, requires an explicit understanding of the notions of "intellect" and "rigor". As we said above, this is the purpose of the babe steps we are trying to make in this article, in order 1) to increase awareness about the *Societal importance of inter-, trans- and inter-disciplinary communication which require tolerance and empathy to different conceptions of "intellectual rigor,"* and 2) to foster more steps oriented to similar purposes. **Tolerance and empathy** are, in our opinion, intellectual faculties that can be developed, if there is a will for it. As we will see below, this would increase intellectual rigor, because it will increase the objective to be met as add semiotic restrictions.

Let us go back to ancient Plato's Academy, which was, also, oriented to the general public, i.e. to translate from philosophical semiotic systems to the

natural language, which is another semiotic system. Consequently, in Plato's Academy, the rules of more semiotic systems have to be addressed. This requires more rigors in both: internal and external communication.

Echoing (Glucker, 1978)¹⁵ and (Chermis, 1980)¹⁶, are referenced, sometimes even textually, by Igor Kondrashin (World Philosophical Forum, 2019), who affirms that

“In ancient Athens, the Academy was first and foremost a public park dominated by its gymnasium, and the connection between it and Plato's school was only one of the numerous historical reminiscences in an area rich in history.

All the evidence points unmistakably to the same conclusion: the Academy was not a school in which an orthodox metaphysical doctrine was taught or an association of members who were expected to subscribe to the theory of ideas. Plato's influence on these men, then, was that of an intelligent critic of method, not that of a technical mathematician with the skill to make great discoveries of his own; and it was by his criticism of method, by his formulation of the *broader problems* to which the mathematician should address himself, and by arousing in those who took up philosophy interest in mathematics that he gave a great impulse to the development of science.” (Kondrashin, 2019) [Italics added]

Consequently, the Academy, since their very origin was related to a place where ideas *plurality* was respected or, at least, tolerated; and *broadening the intellectual perspective beyond disciplinary frontiers were encouraged*. This is required in order to relate internal with external communication, individual and collective intellects, “inner words” with “outer words”, “inner world” with “outer world”, internal with external neural nets, individual cogito with sociological and societal cogito.

With regards to this issue, intellectuals usually go beyond their disciplinary frontiers (if they have any) and address their knowledge from a broader perspective, attempting to include *not just the truth, but the whole truth*; not just the epistemological perspective of the truth as a *correspondence*, but also a perspective of the truth as *coherence*. (Fuller, 2006, p. 52). These two perspectives of the notion of truth answer two different questions: Truth as correspondence asks “does this claim correspond to reality (or does it miss the mark)?” The truth as *coherence* asks: “is a reality all what is claimed (or

¹⁵ Glucker, J., 1978, *Antiochus and the Late Academy*; Göttingen: Vandenhoeck & Ruprecht GmbH & Co KG: Referenced in www-groups.dcs.st-and.ac.uk/~history/Societies/Plato.html

¹⁶ Chermis, H., 1980, *The riddle of the early Academy*; New York, London: Garland Pub. Referenced in <http://www-groups.dcs.st-and.ac.uk/~history/Societies/Plato.html> (and accessed on 11-24- 2019)

something crucial has been left out)? (Fuller, 2006, p. 52). The first one is more analytically oriented and the second one is more comprehensive and synthetically oriented... Both intellectual perspectives regarding these two truths complement each other, from a systemic perspective. Correspondence truth may provide input for RE-search, and coherence theory may potentially identify related elements which, in turn, in turn, may require more research for potentially more correspondence truths.

This is why we suggest that these kind of perspectives reinforce and are reinforced by the notion of cybernetic relationships between individual intellect and social cogito (Figure 2). *If this is correct, or makes any preliminary sense, then the notion of “Intellectual Rigor” should be the subject of continuous dialogues, especially with regard to 1) **what** is or should be its meaning and 2) **how** to achieve & evaluate it.* For example, “peer-review” should be the subject of continuous dialogues regarding what is, or should be its quality assurance in scholarly publishing and how it may be achieved. This requires methodological research via a combination of Action-Research, Action-Learning, and Action-Design of different methodologies in order to be able to assess them and selects the most adequate for a given purpose.

It seems evident that, in human societies and organizations, intellects are necessarily ex-positional intellects (is a non-expositional intellect an intellect at all?), and intellects need intellectual expositions. Human intellects feed each other via cybernetic loops, via negative (regulative) and positive (synergic) feedback loops. Academic lectures, journal publishing, conference presentations, books, publishing, etc. are examples of intellectual expositions restricted by artificial disciplinary frontiers, top-down enforced definitions of different kinds of intellectual rigor and expositional methodologies, etc. A more comprehensive Intellectual Exposition should allow and include different disciplines, different kinds of rigor, a comprehensive market of ideas, a Global Market of Ideas.

2.3 Additional remarks based on the etymological meaning of Intellect

The Latin term “*intellectus*” was used to translate the Greek *nous* (νοῦς or νόος). As a translation of *nous*, ‘intellect’ or ‘*intellectus*’ have, or can have, all the Greek senses of ‘*nous*’ (Ferrater-Mora, 1969a, p. 974). Modern thinkers used the term “understanding” to mean “intellect” or “intellectual faculty” (Ferrater-Mora, 1969a, p. 974) “Understanding” and “intellect” are “the same words in most European languages, *intellectus* in Latin, *intelectto* in Italian, [*intelecto, intellección*, in Spanish,] *nous* in Greek.” (Cary, 2006, p. 24)

Consequently, for a more comprehensive meaning of ‘intellect’, it is helpful to briefly note the Greek meanings of “*nous*”, “*intellectus*” in the medieval

age, and “understanding” in the modern age, in the context of the topic of this article.

The Greeks used *nous* to mean 1) mind, thinking faculty, intelligence, spirit, and sometimes wisdom, 2) objective thinking, and/or 3) an entity, penetrated by intelligence, which guides all processes in the Universe. *Intellectus* is the term usually used to mean the thinking faculty (sense 1 of *nous*) objectively oriented to produce an objective understanding (sense 2 of *nous*) (Ferrater-Mora, 1969b, pág. 304). These two senses are the ones we find in dictionaries, e.g. Intellect is

“a: the power of knowing as distinguished from the power to feel and to will: the capacity for knowledge

b: the capacity for rational or intelligent thought, especially when highly developed” (Merriam-Webster.com)

The adjective ‘noetic’ is used in English as “relating to or based on the intellect (Merriam-Webster.com). Similar words are found in other languages with the same meaning as, for example, ‘*noético*’ in Spanish. We will use the translation, provided by Schroeder and Todd (1990), of the semantically related triad *Nous/Noein/Noêton* by using the terms intellect/think/object of thought.¹⁷ (1990, p. xi). We will also use the term ‘noetic’ to refer to Intellect when it is used in the context of a specific philosopher because the set of senses and, consequently, its comprehensiveness and meaning would not necessarily be exactly the same.

The notions¹⁸ of ‘Intellect’ and ‘*Nous*’ are highly related, including the third sense of *Nous*, i.e., as “an entity, penetrated by intelligence, which guides all processes in the Universe”. The notion of Universal Intellect has been the most important base of what is called Rational Theology, which was largely and profoundly treated in the Middle Age, especially by Christian and Muslim theologians and philosophers. But, this is not the place, nor our objective to even make a brief description of how it evolved along with the history of the term, especially because it is highly related to its meaning Greek Philosophy and especially in Plato and Aristotle.

Furthermore, tons of books and articles had been written about “*Nous*” and ‘*nous*’. Consequently, the references that we will make here are selected according to the objective of this article and its space/time restriction. For the time being, let us provide a preliminary suggestion based on a *relational interpretation of the Intellect and based on the three senses of the meaning of ‘nous’*. This relational interpretation is based on the ***System Approach***;

¹⁷ The corresponding Latin triad is *intellectus/interlegere/intelligible* (Schroeder & Todd, 1990, p. xi)

¹⁸ I.e., from a systemic perspective, sets of related (or relatable) senses denoted and/or connoted by the term.

which, as it is known, emphasizes the relationships among the parts. This would allow us to have a cybernetic approach, by means of identifying cybernetic relationships. With this perspective, our preliminary suggestion is that the three main senses of the word ‘nous’ provide the main general notions (set of senses) of ‘intellect’; as follows.

1. ***What relates Spirit and Matter*** (i.e., “thinking faculty, intelligence, spirit and, sometimes, wisdom; the first sense mentioned above.)
2. ***What relates Subject and Object*** (e.g., “objective thinking”; the second sense mentioned above.)
3. ***What relates Faith and Reason*** (via “an entity, penetrated by intelligence; which guides all processes in the Universe”; the third sense mentioned above.)

This conclusion may have more importance to what initially may seem, especially in the context of the purpose of this article: *Shouldn't the three senses given above be taken into account when assessing the intellectual rigor of internal or external communication? Shouldn't 'intellectual rigor' depend on WHAT we are relating, or trying to relate? Can we define 'intellectual rigor' independently from WHAT the intellect is trying to relate?* For example: Should theological studies be judged for their ‘intellectual rigor’ by the Empirical Science? How can we judge the intellectual rigor of Darwin, Freud, Jung, etc. from the perspective of experimental science? Should we recommend the refusal of a non-experimental study because there is no way to replicate it? I frequently read refusal recommendations of reviews arguing that what is written in the article cannot be replicated? Does that make any sense with what had been written by people like Darwin, Freud, Jung, etc? This kind of absurdity is more frequent than what could be imaginable.

Going back to the three senses of intellect, mentioned above, we probably may adventure a conjecture: *the above three opposites are polar ones and, consequently, require each other in the context of the dialectic whole.* A systemic/cybernetic approach may be an adequate intellectual framework to address related issues. Simple diagrams, like the ones provided in figures 1 and 2, may be used as visual instruments to reflect on the meaning of the reciprocal arrows in a way that would show the cybernetic nature of such a multi-dialectic whole.

3. Apollonian, Dionysian, and Oddisean Intellects [Nobel Laureate (Gell-Mann, 1994, p. xiii)]

Let us now present more specific meanings of the ways in which ‘nous’ had been used, in order to:

- 1) Provide specific cases, or examples, of the above three senses of ‘nous’ or ‘intellect’
- 2) To reference some historical origins of the contexts in which a term has been used, especially because the respective denotations and connotations, with which it has been used, might be fruitful for the identification of a conceptual definition, as it has been suggested by Kenneth Arrow (as mentioned above) in the case the first of the two phases in the process of a scientific definition. (Scientific Method: Optimizing Applied Research Decisions, 1962).
- 3) 1 and 2 would support the identification of relationships with other concepts or notions... This would provide more context and, hence, a more systemic and comprehensive meaning, because of the new contexts added by the related terms or concepts.

Homer used *nous* to mean mental activities in general. Homer’s Odysseus is conceived as a “*Hero of Practical Intelligence*” (sense 1 above). Anaxagoras distinguished two senses in the meaning of *nous*: as cosmic order or as thinking activity or faculty; which reflects the said cosmic order. This means that Anaxagoras used ‘nous’ (intellect) (in the senses 1 and 2 above).

The pre-Socratics and Aristotle used *nous* to signify knowledge and reason, as opposed to sense perception. In both cases, ‘nous’ (intellect) was used in its senses 1 and 2 (above) as practical intelligence and relating subject and object. But, ‘nous’ mostly used in its third sense, i.e. as a mind ruling the Universe.

The Stoic identified *nous* with *logos*, *the whole cosmic reason which contains the human reason as part of it*, i.e. the third sense of ‘nous’, i.e. ‘Nous’ or Universal Logos containing the human ‘nous’, i.e. the third sense but containing the other two senses. Something similar may be suggested from Leibniz’s *Monadology* and philosophical perspective.

Anaxagoras distinguished two senses in the meaning of *nous*: as cosmic order or as thinking activity or faculty; which reflects the said cosmic order. This means that Anaxagoras used ‘nous’ (intellect) in the above first and third sense:

Aristotle, based on an initial differentiation made by Plato, preferred to present a different kind of ‘nous’ and explicitly refers to them with different words. He did it differentiating between various *functions* of ‘nous; or ‘intellect’, i.e., we may say that he identified different species of the genus ‘nous’, and did it based on the different functions of ‘nous’. These three

species of the genus intellect are the following, and important to be distinguished, even by the terms chosen by Aristotle:

1. **Intuitive ‘nous’** or ‘*noesis*’: "the ability to sense or know something *immediately*"
2. **Discursive ‘nous’** or ‘*dianoia*’: “the capacity for, the process of, or the result of *discursive* thinking” which includes both
 - a. The theoretical *episteme* (knowledge) and
 - b. The more practical *techne*, i.e. “a disposition (*hexis*) that produces something by way of true reasoning; it is concerned with the bringing into existence (*peri genesin*) of things that could either exist or not.” (Parry, 2014) [emphasis added]

For Aristotle “Truth and falsity is the goal of all thinking, but with practical thinking, the goal is truth and falsity in relation to correct desire”. (Parry, 2014). What is necessary and sufficient in episteme or knowledge, is also necessary for techne but not sufficient. It also requires effectiveness of the action that brings “into existence (*peri genesin*) of things that could either exist or not”.

Consequently, ‘techne’ has more requirements and restrictions than episteme. If we include implicit knowledge in the notion of episteme then it may be concluded that technical thinking is more rigorous than scientific thinking as long as it is effective in “the action that bring “into existence (*peri genesin*) of things that could either exist or not” (Parry, 2014). We will see below the reasons for this affirmation.

Let us now make what seems like a digression. Our intention is to make insertions related to the main purpose of this article, which is to foster awareness regarding the necessity of increasing the level of clarification regarding “Intellectual Rigor” in General, which is a necessary condition 1) identify what is common to all kinds of intellectual rigors and, consequently, 2) to differentiate among the different species in the genus. We should be careful about confusing different species, let alone confusing genus with species. Human beings ARE rational animals, but animals ARE NOT necessarily humans. This is elementary in Predicate Logic: You can predicate from the species what is predicted from its genus, but not vice versa. This is evident, but it is not infrequent to find this kind of confusion in literature, let alone in oral communication between intellectuals, including reputable scientists. Now, let us make what seems a digression in the context of this part of the article.

Should Intellectual Rigor be defined in exactly the same way for Episteme as for Techne? Should scientific results be reviewed and, consequently, judged in the same way as engineering and technological results? Is it

*Vice versa?*¹⁹ A hyperbolic question may be asked in order to express the idea in a few words: Should we measure the impact factor of Bill Gates or Steve Jobs in the same way we measure the impact factor of scientific geniuses like Einstein or Bohr? Even the word “impact” has a completely different meaning in both cases. So, can we apply the same measure to, for example, scientists and engineers? Usually, scientists publish before making an impact, shouldn’t engineers impact and then publish their specific impact? Why do we still confuse what has been very clear since Aristotle and still valid now, because the supporting reasoning is a logical one, hence atemporal, i.e. it was, it is and it will be intellectually truthful.

Going back to interpreting Aristotle’s Noesis and Dianoia, in a contemporary context, we would like to reference the intellectual perspective of Murray Gell-Mann, who received the Nobel Prize in Physics for his work on the theory of elementary particles and who affirmed that

“The philosopher F. W. J. von Shelling introduced the distinction (made famous by Nietzsche) between ‘Apollonians,’ who favor logic, the analytical approach, and a dispassionate weighing of evidence [Dianoia], and ‘Dionysians,’ who leans more toward intuition, synthesis, and passion [Noesis]. These traits are sometimes described as correlating very roughly with emphasis on the use of the left and right brain respectively. But some of us seem to belong to another category: the ‘Odysseans,’ who combine the two predilections in their quest for connections among ideas. Such people often feel lonely in conventional institutions.” (Gell-Mann, 1994, p. xiii)

Gell-Mann’s suggestion, with regards to those who combine ‘Nosis’ with ‘Dianoia’ (i.e. intuition with discursive thinking, analysis with synthesis, reason with passion, logical with analogical reasoning, etc.), triggers the identification of 1) relationships among them, potentially cybernetics ones and 2) as polar opposites, they may form a dialectic Whole; with its corresponding potentiality of emergent properties and synergies. If this is possible, then it might be related to Gell-Mann’s ‘Odysseans’. Figure 3 schematizes the mentioned potential relationships.

3.1. Dialogical Academy

If we take what Murray Gell-Mann (Nobel Laureate in Physics) affirmed (figure 3) and combined it with what was schematized in Figure 2 (regarding individual and collective intellects: reading *in* myself, ex-positions to others, and reading from others’ ex-positions) it is would be evident to conclude that Academy need dialogues among disciplines and fields of

¹⁹ In the section on Scientific and Engineering Rigor, below, we will provide details on this issue

knowledge in order to be more effective via systems of different kind intellectual production which may potentiate the emergence of a Whole Complex Intellectual Systems with its respective potential emergent properties and internal cybernetic loops.

Even if we don't include Murray Gell-Mann's Apollonian, Dionysian, and Oddisean Intellects, we still can make the same conclusion. For example, we may say that Science, Engineering, and Technology are produced just by the *Discursive (Apollonian) Intellect*, but their fundamentals and final ends are based on the *Intuitive Intellect ('nous')*.

To **communicate** different individual intellects, so they can interact with each other (Figure e), it is essential to identify what is **common** to them. This means we need to identify the notion of 'intellect' as a genus that covers all other species. This would support the increasing necessity of Academic Dialogues now reduced to intra-disciplinary communication but also inter-disciplinary ones. The latter requires identifying what is common to different manifestations of rigor, so academics from different disciplines would be aware of intellectual rigor, in general, and not just about intellectual rigors in their own disciplines. This *two-tier awareness* is the cause and effect of inter-disciplinary dialogues and, hence, of a Theological Academy; which, in turn, would increase the effectiveness of the network of intellect, or the sociological cogito (Figure 2) and even the individual intellect, via internal dialogues triggered by the external ones. We may say, that this is a main objective of this article: to increase the awareness of the reader about this required two-tier awareness about the meaning of "Intellectual Rigor" and, consequently foster Academic inter-disciplinary dialogues or at least, means for inter-disciplinary communication.

The Intellect is required for any scientific, engineering, technological, humanities, and art production. It is the origin of all rational activities, including thinking and reasoning. This is one of the reasons why Aquinas, and other Scholastics, conceived the intellect as "*Habitus Pricipiorum*" and differentiate it from "*Habitus Conclusionum*", which is associated with reason. In this context, Paul Vincent Spade (1972) affirms that "For Aquinas. Each science is a single, simple habit of the intellect. Although this habit may extend to many things, each of these things must share in a *ratio* [reason] which is the formal object of the habit. The unity of science is thus ensured by the unity of its formal object [i.e. by Reason]. (Spade, 1972, p. 203). Consequently, we may suggest the following:

1. By analogical thinking, we may associate (or relate) the scholastic conception of Intellect, as "*Habitus Pricipiorum*" to the Aristotelian "Nous", as a genus, and scholastic "*Habitus Pricipiorum*" with Aristotle's kinds of intellects or intellectual faculties, i.e. Intuitive and

discursive nous. The latter includes the theoretical episteme and the practical techne.

- 1) Relate Apollonian and Dionysians , 2) Catalyze the Collective feedback loops, i.e. the Social Cogito between Apollonians and Dionysians, and 3) Get intellectually nurtured by both of them

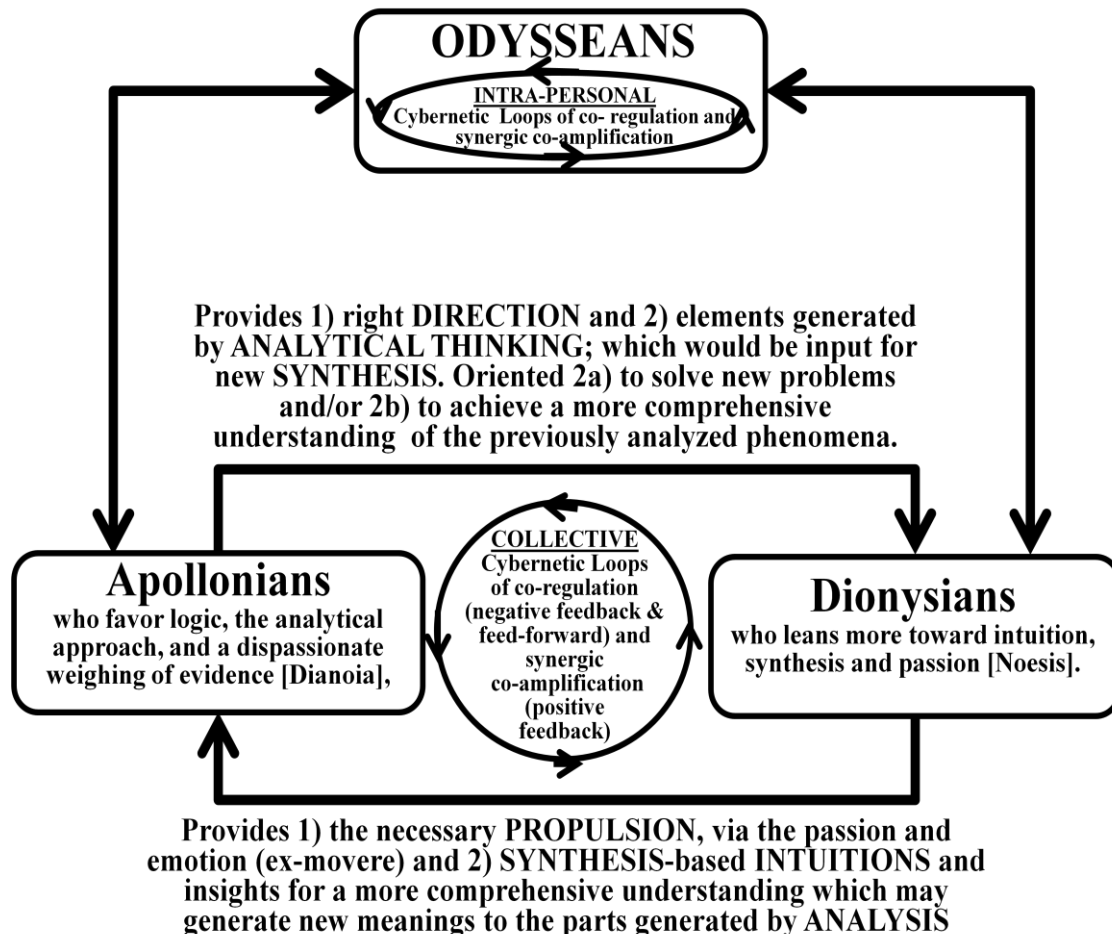


Figure 3: Cybernetic relationships between Apollonians and Dionysians, at the collective level, i.e. at the social, sociological cogito, or networks of intellects and at the intra-personal level of the Odysseans intellects.

2. Intellect, as “*Habitus Pricipiorum*” It might be interpreted, in other words, that the Aristotelic-Scholastic Intellect is a *meta-habit*, i.e. the habit of having different habits (via “*Habitus Conclusionum*”, reason) that generate different sciences and techne, as well as the above mentioned “noesis”, or “Intuitive ‘nous’”. i.e., immediate (non-discursive) apprehension, or insight

This means that what is *common* to academics, researchers, and professionals from different disciplines is their Intellect as “*Habitus Pricipiorum*” and what differentiates them is their different “*Habitus Conclusionum*”. Consequently, what *communicates* them is their “*Habitus*

Pricipiorum". In Aristotelic terms, 'Nous' would be what is common and 'noesis' and 'dianoia' (including *episteme* and *techne*) is what generates different intellectual developments, discursive reasoning, production, etc.

This conclusion is important if we want to address "Intellectual Rigor" in a general form (i.e., a way that would include different intellectual manifestations). Intellect, as 'Nous' or as "*Habitus Pricipiorum*", is what got to be taken into account. The importance of this conclusion will be evident below, when we will suggest a notion of "Intellectual Rigor that could be applied to any intellectual manifestation and, consequently, it would be a necessity (or, at least, a desirable_ condition for a Dialogical Academy, knowledge integration and especially the effectiveness of interdisciplinary research, education, and communication. It would facilitate the translation between disciplinary semiotic systems while avoiding judging the intellectual rigor in other disciplines because it does not fit the rigor established in the discipline of the judging academic. Unintentional disciplinary biases would also be avoided.

Furthermore, relating the notion of intellect as a meta-habit, is coherent with the notion of intellect as "reading in myself" (in me) and reading from other intellects (figure 2). In this context, it would be 1) the habit of "reading in myself" and 2) the habit of reading from other intellectual habits, i.e. a meta-habit: the habit of having habits. These intellectual habits may change according to what I am reading and the changes in the environment, as well as in the objectives, restrictions emerging new problems, etc. Consequently, intellect is the meta-habit of having habits; which may be changed because of the required adaptation to the telic nature of human intellects and the new environmental situations. Using contemporaneous notions and words, we may adventure the conception of the intellect as a *complex system* with the capability of changing its behavior, according to the changes produced in the external (emergent problems and uncertainties) and internal environment (objectives, values, experience, etc.)

Consequently, the more restricted is my access to other intellects, the less diversified is my intellect and my mental 'habits'. This is one of the many reasons of why academic *intra*-disciplinary communication (with me and others) should avoid *intra*-disciplinary "intellectual blinders" for the sake of their integral intellectual developments and, even, for the sake of their own discipline. It is well known that the context in which a word is used provides it with its meaning. This also applies to concepts, notions, theories, etc., consequently, *the meaning of a given discipline increases and gets more comprehensive if such discipline is inserted in its intellectual context. This can be done with inter-disciplinary and trans-disciplinary communication and would lead to a Dialogical Academy, which the essence of Academy, since Palo's Academy.*

Consequently, intellect, as a habit, should include the habit of inter-disciplinary dialogues with others and with oneself. This should be applied even among the disciplines produced by the Apollonian intellects (discursive, logical thinking)

The intellectual product of applied scientists, engineers, and technologists are both theoretical and practical, related to (at least) *episteme* and to *techne*, to knowledge and to experience, to the truthful and to the useful, to the traditional science and to the new approaches to science, as is the case of:

1. The Systems Approach, based on focusing on the relation among the parts, on wholes, and on the pragmatic-teleological truth, and
2. Cybernetics, especially Second Order Cybernetics (based on the Copenhagen Interpretation of Quantum Phenomena).

Even in the context of Discursive (Apollonian) Intellects, rigor depends on the intellectual purpose, the means that are adequate for such a purpose, and the restrictions that characterize a) these means and b) and environment of the intellect(s). Furthermore, there are many disciplines in Science, Engineering, and Technology, which should increasingly be related to the solution of real-life problems, which are also created because of scientific, engineering, and technological advancement. This means that inter-disciplinary communication is increasingly being needed and produced, as a *cause and effect* of inter-disciplinary fields.

Consequently, interdisciplinary dialogues and a Theological Academy are being required in increasing importance and urgency. This, in turn, requires an understanding or, at least, the acceptance of the different species of 'Intellectual Rigor', i.e., and intellectual empathy to different research and communication rigor 'standards', in different disciplines.

If this is being required even in the context of Apollonian intellects, it is even more required (for the sake of the essence of the Academy) in the more comprehensive intellectual context of Murray Gell-Mann's Apollonian, Dionysian, and Oddisean Intellects (Figure 3). The intellect, as a system gets even more complex, which does not mean more complicated. The Academy, as a Whole, as a Collective Intellectual Network (Figure 2) that includes Apollonian, Dionysian, and Oddisean Intellects (Figure 3), has even more internal differences in the objectives, the means, the approaches to knowledge, the epistemic values, and the non-epistemic values. This means that Academy, to be an effective and fruitful systemic/cybernetic network, a system of individual intellects, needs to have a clear conception of

- a) The different *species* of intellectual rigors as well as with

- b) What is *common* to these intellectual rigors, i.e. the necessary understanding of the "what" defines "Intellectual Rigor" as a genus, which actually has many species.

Understanding and accepting what Intellectual Rigor means, in general, and the differences in its species is a *necessary condition* in the generation of an Academic Social Cogito, which is, in turn, a necessary condition to increase the effectiveness of a network that relate Apollonian, Dionysian, and Odyssean Intellects, consequently, the effectiveness of Academy as a whole, and not as a just a set of intellects, in conflicts frequently with each other. Notice that we are using the word "conflict" and not tension between polar opposites. The latter may be creative, but conflicts are almost always destructive, at least at the level of individual intellects.

Universities are a multi-disciplinary set of researchers, educators, and problem solvers. The more related is this collectivity,

- 1) the more is the potentiality of cybernetic relationship and, hence, of emergent properties and synergies and
- 2) the more this collectivity became a Whole, a complex Whole, instead of a set of dispersed subsets of disciplinary scholars.

Universities and the Academic World, in general, should foster relationships, not just among different disciplines in Science and Engineering, i.e. not just among Apollonian intellects but also among *Apollonian, Dionysian, and Odyssean Intellects* (Figure 3).

This would increase the intellectual effectiveness of each type and in the Academic Organization as a whole, but it requires 1) an understanding of the *differences* among different intellect and what is *common*, hence, *communicate* them, and 2) tolerance and empathy with other intellectual perspectives and/or intellectual rigors. If this minimum of conditions is not met, then the "network of intellects", or the "Social Cogito", would be a limited one with the risk of being mainly a *set* of individual intellects, and not a system of intellects, where they may feedback and feed-forward each other, hence, relating them to a Whole that it is larger than the sum of its parts. Academic organizations should make more explicit and foster awareness about the desirability of co-learning, co-researching, co-education processes. In the cases of real-life problem solving, these processes are necessarily required for an adequate co-solving of the target problem.

Combining figures 1, 2, and 3, show the increasing importance of fostering a Comprehensive Dialogical Academy, where Inter- and trans-disciplinary dialogues (not necessarily debates) should be stimulated, even via academic promotion. Providing academic promotion to just intra-disciplinary

intellectual production actually *inhibits inter-disciplinary dialogues* and understanding of other species of intellectual rigor, which frequently ends up in *mutually generated and reciprocally reinforced intellectual discriminations*.

On the opposite side, Inter-Disciplinary Dialogues

- 1) Enhance the *intellectual understanding* of disciplinary researchers or scholars,
- 2) Provide *intellectual context* of disciplinary research, improving its meaning,
- 3) Foster *analogical thinking* which is required as input to logical thinking, e.g. hypothesis formulation (for experimental design, in induction), conjectures (for mathematics, in deduction proofs), plausibility (for empirical testing in abductive thinking), etc., and
- 4) Increase the complexity of the Social Academic Cogito, which, in turn,
 - a. enhances the individual intellects development and
 - b. increases the synergies in the intellectual systems by means of increasing its potential systemic/cybernetic relationships.

Going back to Aristotle, it is to be noticed that his followers were basically more oriented to identifying the intellect with its intuitive function. They emphasized the faculty of the intellect as related to *understanding the first principles of our reasoning and the final ends of our actions*. This is important to be considered, below, in the description of the notion of ‘rigor’ and even more important in conceiving the notion of ‘intellectual rigor’.

Aristotle also conceived two parts in the intellect, one *passive*, receiving material from the senses, and the other *active*, acting upon the received sensorial material in order to *create and relate ideas*. (Reese, 2019) (Ferrater-Mora, 1969a). Aristotle conceives ‘sensation’ in a more comprehensive way than the Modern Thinkers. For Aristotle, sensations have some kind of knowledge, hence ‘sensible apprehension’ has an intellectual component, but it is not knowledge in the proper sense of the word, it is not what characterizes human knowledge. The active intellect is what characterizes human intellect. In St. Thomas Aquinas’ Aristotelian perspective, sensible apprehension is a necessary condition for the human intellect to get access to intellectual knowledge (Gilson, 1956, pág. 214). But if sensible apprehensions are to generate intelligible things or knowledge, they require 1) intellects and *intellectual actions* to discursively, rationally, generate knowledge according to the *ends* of the intellectual; and 2) *intuitions* to grasp the *first principles* of our reasoning and the *final ends* of our actions. These differentiations between principles means and ends will be essential in the below section on Intellectual Rigor.

Up to our knowledge, the other conceptions and notions on “Intellect” are similar or special cases of the comprehensive Aristotelic-Thomist conception of it. We will not visit each of the great thinkers in order to place each conception in the context of the generic one we briefly described here. This is because it is not directly related to the purpose of this article and space and time restrictions would not allow it.

But, we think that Henry Bergson’s conception of Intellect is an interesting one, especially in the context of this article. Our description of it will not be a complete one but limited to the purpose of this article. Our interpretation will also be oriented toward this purpose. Henry Bergson’s purpose-oriented toward his philosophy of the *Élan Vital* will require more time and space than what is desirable here for both: the author and the reader.

4. Intellect as a Time-Space Processor or Converter

Similar to the Aristotelic-Scholastic tradition, Henry Bergson (1859–1941) provides a very general, hence, comprehensive meaning to the notion of Intellect. But he presents intuition as opposed to reason. In Aristotelic terms, Bergson opposes *Noesis* and *Dianoia* (*episteme* and *techne*), i.e., they are not different species of the genus “*nous*” but are opposites. Interpreting this opposition as a polar one (and there are reasons to make this interpretation), then they can get into a systemic/cybernetic dialectic, i.e. as parts of a dialectic whole, requiring each other and producing the tension required for change, which is a fundamental pillar in Bergson’s *Creative Evolution* (*Élan Vital*) philosophy. It would be a systemic/cybernetic interpretation of Bergson’s philosophy. This is the intellectual perspective being used in this article for interpreting Bergson’s Philosophy, as briefly as possible in the context of the purpose of this article.

The opposition between “intuition” and “thought” is, in Bergson, parallel to the opposition between “space” and “time”, “mechanism” and “life”, “permanent” and “change”, “logical” and “temporal”, “matter” and “memory”.

Julian Marías, (*History of Philosophy*, 1967) affirms, that for Bergson, “[S]pace is an aggregate of points, from any one of which we can pass to any other; time, on the other hand, is irreversible, it has a *direction*, and every moment of time is unsubstitutable, irreplaceable, a true *creation* which cannot be repeated and which cannot return.” (p. 387) [Author’s italics]. But, for Bergson, time is a *duration*, it is not something that can be measured as we measure in space. It is not the time that is marked by a clock, but it is “a duration”, the time that takes, for example, for the sugar to dissolve in a teacup. So, time is not absolute in Bergson, but relative to life, it is a *living time* of a living being, as it is present to living memory. It is

what is saved in memory. Consequently, For Bergson, “[S]pace and time – (Marías, 1967) affirms – are to each other as matter to memory, as the body to the soul; they correspond to two basically different and even, in a certain sense, *opposite intellectual modes of man: thought and intuition.*” (p. 388) [Italics and emphasis added], i.e. mediate and immediate apprehension.

It makes sense to interpret this opposition as a polar one. With this perspective, intellectual intuition and thought provide the tension required for what Aristotle called the active intellect as opposed to the passive intellect. It is this tension that allows the intellect in *potency* to become intellect in *act*, or in *action*. This applies to both intellectual modes: thought and intuition. Each mode requires its opposite to transform its potency in act, its capacity in possibilities, its identity in multiplicity.

Since memory is a spatial entity, then it easily may be concluded that being time durations saved in memory, they are actually saved in spatial neural networks. Consequently, intellects transform time, like duration, into space (via neural nets). Purposes and objectives intuited as possibilities, trigger thoughts in order to make them realities via an action (plans, methods, etc) which trigger chronological actions, temporal processes in the mind and out of it. This means that spatial memory plus intuited objectives, trigger temporal processes in and out of the brain. Consequently, the intellect may be conceived as transformers of time (Bergson’s durations) into space (neural nets) and vice versa: space (neural nets used supporting memory) into temporal actions and processes, triggered by intuiting possibilities that generate purposes, objectives, goals, etc. By similar reasoning, we can conceive the Intellect as mediating between and relating opposites like logical and chronological, atemporal and temporal, spirit and matter, Theology and Science, Time and Space, Yin and Yang, particles and anti-particles, matter and anti-matter, right and wrong, good and evil, theory and practice, past and future, etc. If we accept this suggestion or conclusion, then it would be evident that intellects are complex dialectic systems, which emergent properties are due to both their complexity and to its dialectical nature. This interpretation is coherent with Bergson’s philosophy of Creative Evolution, of the “Élan Vital”, along with its respective self-organization and spontaneous morphogenesis, via emergent properties that characterize complex systems with an internal tension between its opposites that allow changes to new emergent properties and, hence, new self-organization and spontaneous morphogenesis in a creative process as the one that Bergson conceived.

5. Intellectual Rigor

In this section we will, initially, try to identify the meaning of “rigor” in the context of “Intellectual Rigor”, in order to address the latter with more details.

A quick search on the web with regard, for example, to “Scientific Rigor” shows 1) a large number of differences in the perspectives regarding what is understood by “Science” and 2) many pieces of evidence of many authors reduce the notion of Science to their specific field of science. The latter is evidence of how many scientists, academics, and researchers *confuse genus with species*, by means of naming the species with the name of the genus. This is a huge source of unintentional logical errors, even according to the most elemental predicate logic. Let us show just one example of what we are trying to convey. It is a platitude to say “A dog is an animal and an animal is not necessarily a dog.” Similarly, a given scientific discipline is Science, but Science is not necessarily this specific science, i.e. Science as a Genre cannot and should be reduced to one of its species. Let us explain with a very specific example.

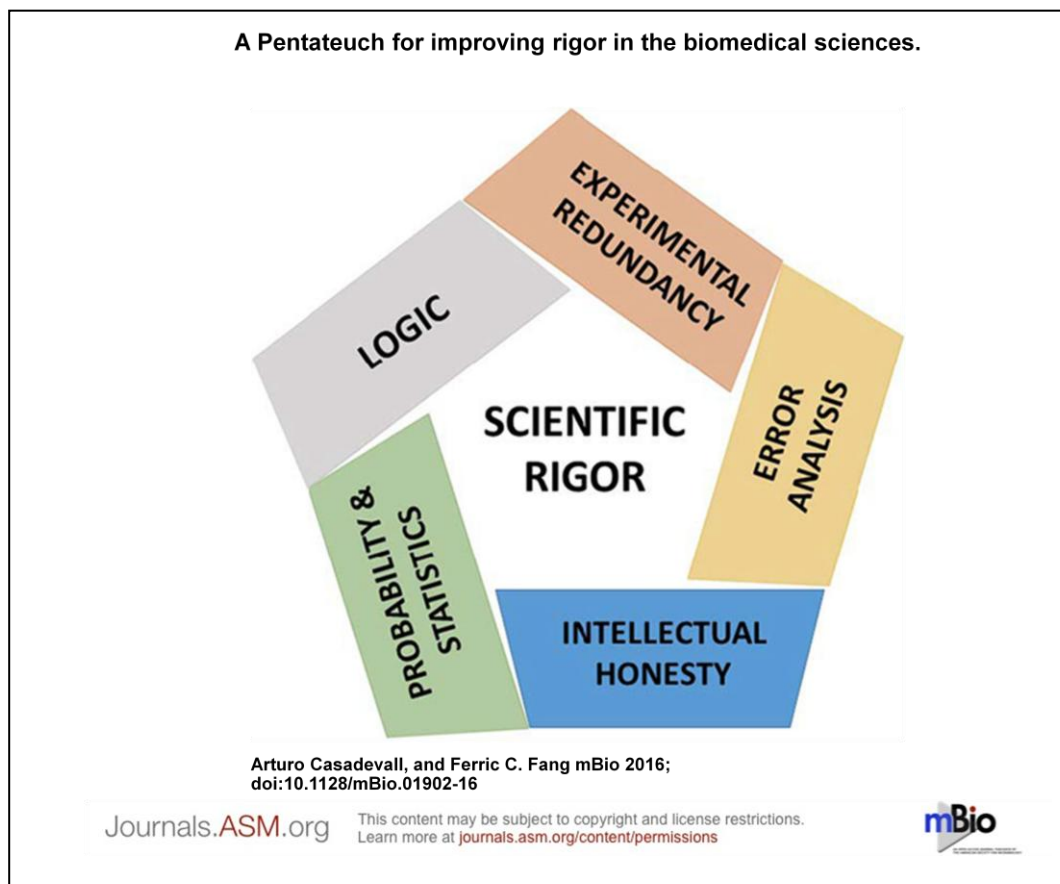


Figure 4: A Pentateuch for improving rigor in the *biomedical sciences*, according to Arturo Casadevall, Ferric C. Fang (Rigorous Science: a How-To Guide, 2020). This figure is copied from a slide provided in the mentioned article.

What has been called the “*Pentateuch for scientific rigor*” has been compared to the five pillars of the most traditional religions. The well-cited and prolific authors Arturo Casadevall, Ferric C. Fang (*Rigorous Science: a How-To Guide*, 2020) affirm that “Traditional Chinese philosophy, Hinduism, Islam, and Judaism are each founded on five elements, pillars, or sacred texts. In Judaism, the first five books of the Hebrew Bible are collectively referred to as the Pentateuch.” Then, they present the Pentateuch of *Scientific Rigor* as it is shown in Figure 4.

As it could be noticed, the title of the slide is correct: it refers to the rigor related to *Biomedical Sciences*. The title of the paper (rigorous science) is wrong or, at least, misleading. What is presented in the article is not a Guide for Rigorous Science, rigor in Microbiology or in Biomedical Sciences, and, even potentially, for Experimental Science. But, this is not true for Science, in general, or as a genus. To confuse genus with species is dangerous terrain. *It goes against the most elemental Predicate Logic: ALL that you can predicate from the genus, it can be predicted from its species, but not vice versa.* A human being is an animal, But an animal is not (necessarily) a human being. Furthermore, it is a confusion of the whole where one of its parts, a set with one of its subsets. All of these are platitudes. This is why we never were able to understand this kind of confusion among reputable scientists. *This kind of confusing genus with its species is more frequent than what anyone may imagine.* To name a whole by one of its parts, or vice versa, is Synecdoche, a literary device, sometimes a very good device. But, in our opinion, it may be really dangerous to use it in Science and in general in discursive thinking and reasoning.

Experimental sciences are Science, but Science cannot and should not be reduced to experimental sciences. If we do so, then Darwin, Freud, Jung, etc. would not be scientists. Even theoretical physicists, including Einstein, might not consider as assets. Experimental Sciences are Science but the inverse cannot be affirmed as many authors, intentionally and/or implicitly, do.

Having said so, let us make a brief analysis of the diagram in figure 4 to identify potential generalization at the general intellectual level.

Logic and intellectual honesty do not depend on a given species of Science. *Logic* is associated with Aristotle’s *discursive ‘nous’* or *‘Dianoia’* (*episteme and techne*) and with the scholastic *‘Habitus Conclusionum’*. The question that remains open is: what kind of logic? The answer depends on the scientific species, which, in turn, depends on the scientific discipline and, more generally, on the objectives of the scientist and not just on his/her scientific disciplines. This may be easily concluded from what we briefly described (Figure2), especially regarding “reading in myself”, as essence on

the individual intellect and the reading from others in the context of the intellectual collectivity of “sociological Cogito.

Intellectual Honesty, is another feature that may be generalized to any intellectual activity. Actually (Casadevall & Fang, 2020) use the adjective “Intellectual”. It may be suggested that this term maybe, even, more generalized by means of the notion of “Ethos”, as used in the context of the Trivium “**Ethos, Pathos, and Logos**”. It is to be noticed that the Trivium includes two terms of what (Casadevall & Fang, 2020) proposes. What about *pathos*? Is it possible for a medical doctor, not to have empathy with his/her patients? Is effective an information system engineer with no empathy for the users of the systems s/he is developing?

The other three words used by (Casadevall & Fang, 2020) are *experimental redundancy*, *error analysis*, and *probability and statistics*. All of these may apply to experimental sciences, but not to any kind of Science, let alone to any intellectual processes and production. The generalization of these three terms may be found with the notion of “**method**”; which essentially is *s* means to go from an initial situation for a sought one²⁰.

Let us copy a paragraph from above, with regards to species of the genre “intellect” and relate them to the conclusion we just made. Using Aristotelean terms, the following are the kinds of intellectual activities, as written above

1. **Intuitive ‘nous’** or ‘*noesis*’: “the ability to sense or know something *immediately*”. For example, sense-data in empirical sciences and axioms in non-empirical deductive processes. In both cases, we are referring to the departure of intellectual processes, i.e. an initial situation of the following reasoning process, i.e. the departure point of a method.
2. **Discursive ‘nous’** or ‘*dianoia*’: “the capacity for, the process of, or the result of *discursive* thinking” which includes both
 - a. The theoretical *episteme* (knowledge) and
 - b. The more practical *techne*, i.e. “a disposition (*hexis*) that produces something by way of true reasoning; it is concerned with the bringing into existence (*peri genesin*) of things that could either exist or not.” (Parry, 2014) [emphasis added]

In both cases, we have a process and a product, i.e. an ex-ante or ex-post method and its final situation, or the product of the process.

²⁰ Details will be provided below with references to more details regarding the notion of “method”.

For Aristotle “*Truth and falsity is the goal of all thinking, but with practical thinking, the goal is truth and falsity in relation to correct desire*”. (Parry, 2014) [Italics and emphasis added].

Consequently, it is evident that intellects have principles, ends, and a known (or to be known) method that moves our intellect from principles to ends. We affirmed that, for example, Aristotelians “emphasized the faculty of the intellect as related to *understanding the first principles of our reasoning and the final ends of our actions*.” We would add, that it is implicit the means, the method, we use to move from first principles to the ends. All of this provides a conceptual substratum, or cognitive infrastructure of *principles-end logic* or *means-end logic*, which also means *method logic*, i.e. *methodology*.

An explicit a-priori method is an established method; which necessarily depends on its principles and its end. Consequently, as principles and/or ends change, then the method would change. Intellectual rigor requires moving *effectively from principles to ends*. Any change in the principles of in the ends would change the intellectual process or the intellectual method. Consequently, intellectual rigor is necessarily based on principles and ends. There is no way that all human beings would have the same ends in their intellectual lives, let alone in their very personal lives. For example, the ends of the sciences are inherently different from the ends of engineering. In the same sciences, the ends are different depending on what is understood by the notion of the Truth and what would be the established method to achieve it.

6. Intellectual Rigor in Science and Engineering

Elsewhere (Callaos N. , The Essence of Engineering and Meta-Engineering: A Work in Progress, 2013a) we provided a detailed description of what is engineering, meta-engineering, and what differentiates and relates them to Science. Let us here be as brief as possible, while inserting one of the conclusions in the context of “Intellectual Rigor”.

Let us start with Rev. Lowell E.Grisham’s (2012, p. 34) question: “Is science an *end in itself*, or is science always *a means to some other end*? (Italics added). His answer seems to be a consensual, though not unanimous one. He affirms that “In earlier centuries, science was considered the handmaiden of theology. Arguably, handmaiden has become the handmaiden of colonization, war, consumerism, globalism, and a host of another purpose since the industrial era. Nuclear technology can be used to produce efficient electricity or devastating bombs.” (Grisham, 2012, p. 34)

Based on (Grisham, 2012), we would like to suggest that *Science is a means* 1) for finding truth, or truthful knowledge, according to the different notions of “truth” and/or 2) for an adequate action creating technologies via engineering and/or meta-engineering. Consequently, in the context of its relation with Engineering, Science is one of the means for engineering activities and engineering may be one of the means for scientific activities. To provide some details regarding this conception, we schematized, in figures 5, a conclusion we can make regarding the “intellectual rigor” in each case, and, in figures 6 and 7, we schematized other conclusions made in a more comprehensive analysis (Callaos N. , 2013a)

It is evident that Science is one of the means of Engineering and, in this sense, the respective disciplinary or inter-disciplinary system would restrict Engineering, but the objectives may, and usually are different, so the intellectual rigor in each case is different. Furthermore, engineering activities necessarily require other means and other semiotic systems; which both have to add additional restrictions to be fulfilled. So, ***how on earth can we apply scientific rigor to engineering rigor? Consequently, how can we make peer review of engineering research, professional activities, and their respective papers, using the same criteria employed in scientific research papers? Objectives are different, restrictions are different, so how can we not differentiate between Scientific and Engineering Rigors?*** Engineering is not applied science but applied science is one of the means used by engineering. How come this intellectual confusion has been made with an astonishing frequency and for an unbelievable period of time?

More details may be provided with regards to the differences between scientific and engineering objectives/restrictions. Both intellectual domains maintain synergic relationships and, in many instances, they are opposites, polar opposites; which. Evidently, we should not be confused with contradictory opposites. At least, since Aristotle, this distinction is explicitly being made.

The cybernetic/synergistic relationships between Science and Engineering support the knowledge and technological development that, in turn, support industrial/business/societal development (figures 6 and 7), encompassing organizational development, which includes higher education and scientific organizations

It is important to notice that figure 6 shows Cybernetic relationships between Science and Engineering as well as between Industry/Business/Society and Engineering. These cybernetics loops include co-regulative negative feedback and feed-forward and co-additive or co-amplificatory loops via positive feedback. This supports the evident synergies between 1) Science and Engineering, 2) Engineering and Society, and, consequently, 3) between Science and Society. Social or individual

purposes generate intention for adequate action and this produces implicit or explicit designs (*designium*) which is the essence of implicit or explicit, mental, or extra-mental design and hence, engineering, activities. Any purposes generate a plan to achieve it, which is one form of design (*designium*).

Figure 7 provides a little more details regarding the input and the outputs of engineering activities as well as a little more details regarding its cybernetic relationships with Industry/Business/Society. Notice that Science is just one of the several means used in Engineering. Science provides the propositional knowledge, i.e. the “*know-that*”. But Engineering necessarily requires other means, mostly related to

1. *Techne*, i.e.
 - a. Procedural knowledge, i.e., “*know-how*”, and
 - b. Design (potentially including art) and craftsmanship
2. *Praxis*, i.e.
 - a) Personal and/or tacit knowledge (including subjective assessments and valuations)
 - b) Ethics.

7. Is there any explication or interpretation?

There are more questions than answers, as conclusions of this article.

How come we can find, even in recent literature confusions related to scientific rigor? How could it be explained that we frequently find evident errors of predicate logic as the example we provided in figure 4? How we can accept the reduction of the notion of Scientific Rigor to how it is defined in one of its disciplines, or worst to one of its sub-, or sub-sub-, or even sub-sub-sub-disciplines. A dog is an animal, an animal is not a dog. This is 101 predicate logic. It goes even against any informal logic and common sense. So, what is happening in the Scientific Community when someone tries to describe Scientific Rigor? What is happening with the peer reviewers of these articles or books? Are we wrong in our above analysis? If so, please, help me understand where I am wrong? What is the mistake or the error of this article that would nullify its conclusions?

If we can find this kind of flagrant logical errors when defining or describing scientific rigor, it is not surprising to find even more flagrant mistakes when trying to unexplainably, incomprehensibly, and unreasonably, reduce engineering to Applied Science and/or to identify scientific rigor with engineering rigor. Is there any comprehensible and reasonable explication for this kind of confusion, mistake, or oversight?

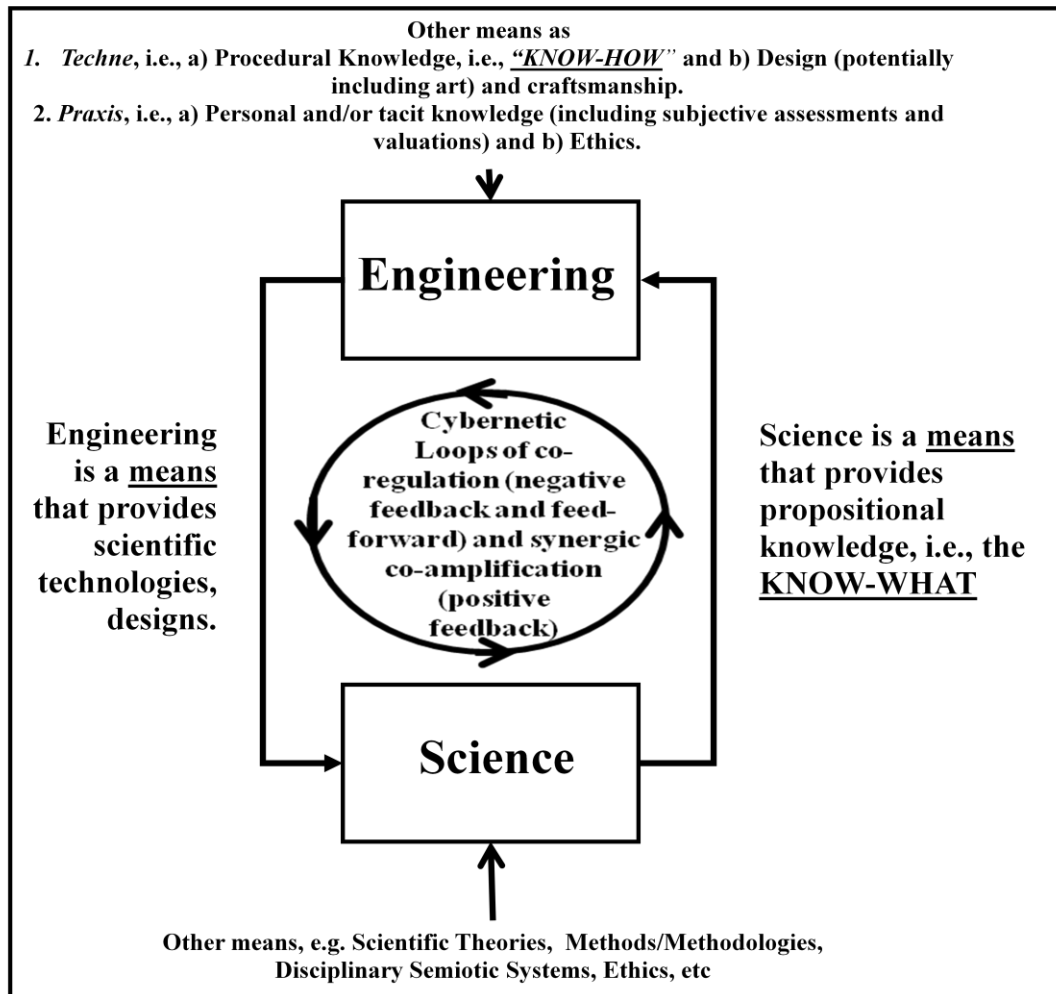


Figure 5: Science and engineering have cybernetic/synergistic relationships. Each is one of the means of the other and vice versa. They have different means, hence methodical or methodological constraints, not identical semiotic systems, and hence different semiotic restrictions/constraints. Both also have different objectives. Consequently, the respective intellectual rigor is completely different. *So, how on earth the respective activities and articles can be peer reviewed according the same criteria?*

The only explanation I have is the unconscious tendency to reduce rigor to what research is doing, a professor is teaching, a thinker is thinking, a doer is doing, or a writer is writing. How come a religious rigor is not confused with another religious rigor, but scientific rigor of a sub-sub-sub-discipline is confused with scientific rigor, in general, and, hence between and among sub-disciplines. This is a huge source of weaknesses of peer-reviewing. A more extended and detailed article on these weaknesses can be found in (Callaos N. , Peer Reviewing: Weaknesses and Proposed Solutions, 2011)

If we can find this kind of oversights between and among different scientific disciplines and confusions between scientific and engineering rigor, can

anyone imagine the confusions with other intellectual productions, as for example, the Humanities, Philosophy, Theology, Systemics, Cybernetics, and other trans-disciplinary fields?

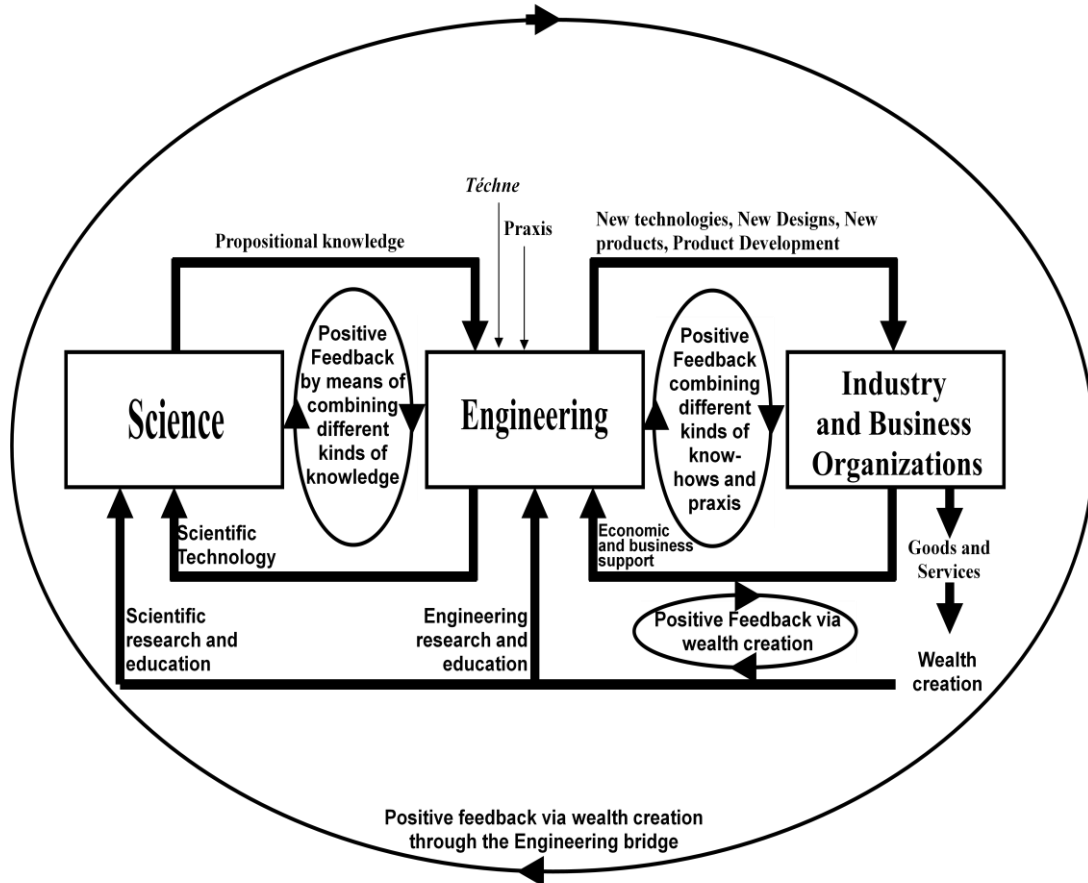


Figure 6: Cybernetic relationships between Science and Engineering as well as between Industry/Business/Society and Engineering. These two different cybernetics relationships are what support the relationships between Science and Society. Engineering always mediates between Science and Society, be it in an explicit or in an implicit way. Engineering is essentially “Design” and design is intention, or triggers an intention to action or to achieve an objective or a

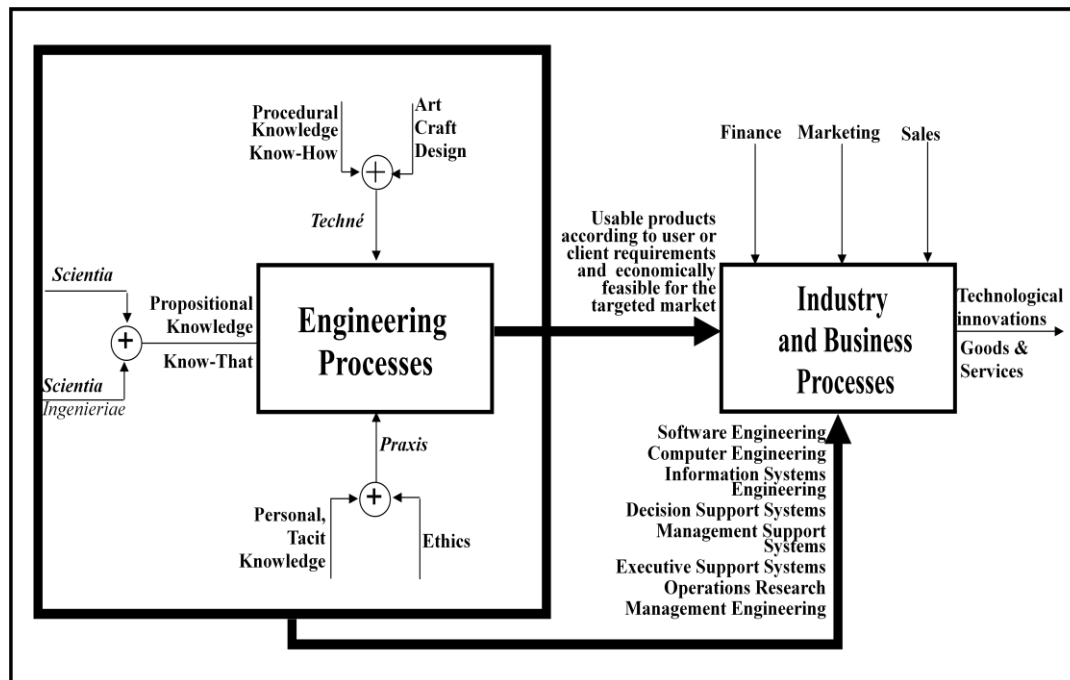


Figure 7: Some details regarding the relationships between Engineering and Industry/Business/Society. Notice that Science and Engineering Science are just two means, along with other means used in engineering activities.

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