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Interpretive Internalism and Hermeneutic Realism

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Abstract
Introduction The aim of this paper is to outline the program of a hermeneutic theory of the way in which reality becomes disclosed and meaningfully articulated in practices of scientific inquiry.
Text and Methods I describe the profile of hermeneutic realism by addressing the issue of how objectified factuality is produced within the facticity of inquiry. Hermeneutic realism is characterized as a position that discards foundational epistemology and cognitive essentialism. I argue that the meaningful articulation of domains disclosed in scientific inquiry is an ontologically self-sufficient process. This claim is the kernel of interpretive internalism. At stake in my analysis is the interplay of interrelated scientific practices and the possibilities for doing research, granted that the practices' interrelatedness is projected upon the horizon of possibilities. Three kinds of hermeneutic circularity in this interplay are distinguished. They refer accordingly to the selection of data, the construction of data-models, and the saving of phenomena whereby theoretical objects become contextually envisioned. The main emphasis is placed on the reading of theoretical objects in the articulation of scientific domains.
Conclusion Thus, the kind of philosophy of science pertinent to hermeneutic realism and interpretive internalism aims at revealing reality within the facticity of inquiry.

Keywords Hermeneutic realism · Hermeneutic philosophy of science · Readable technologies · Interpretative fore-structure of inquiry · Interpretative internalism · Textualizing · Re-contextualization · Reading theoretical objects

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The Profile of Hermeneutic Realism

Is it possible to have a philosophical position of realism without essentialist assumptions and residual metaphysics of presence? In this paper, I develop a position of hermeneutic realism as an affirmative answer to that question. In breaking in a radical manner with the "myth of the Given," the hermeneutic realist holds that there is but a meaningful reality. The articulation of meaning within practices is not imposed upon a pre-meaningful (amorphous) reality. Articulating meaning within practices is inextricable from reality. This view, however, does not imply that reality is constructed by scientific practices. Putting practices first is not a kind of constructivism. It means rather that reality is disclosed meaningfully by (and within) practices. Starting out from the modes of being in the world of practices prevents one from an initial hypostatization of a dualism between the epistemic subject and the objective world (and the dualism of conceptual framework and empirical content). Reality is not constructed by (scientific) practices. Any form of constructivism presupposes the dualism of constructor and constructed qua a version of Cartesian dualism.

To be involved in a cultural world of interrelated practices is to participate in an interpretative mode of being in the world. Being in the world of practices amounts to interpreting the world (and one's involvement in it) as a world projected upon possibilities that are engendered by the very interrelatedness of practices. Following Heelan (1983), I will consider each practice of scientific inquiry to be a "readable technology".

The realism debate in the philosophy of science has given the impression that the realist positions are obligatory subjected to a tacit rule: The kinds of realism should carry with them a commitment to a certain range of entities that must be regarded as real (i.e., existing in the physical reality) (Sankey and Ginev 2011). Put otherwise, for the participants in this debate the word "realism" in philosophy usually carries with it a commitment to a certain range of entities which is appropriately specified. Thus, the scientific realist insists on the reality of unobservable theoretical objects; the (ontic) structural realist takes the structures that remain mathematically invariant in fundamental physical theories to be in sense real entities; and the entity realist commits to the reality of those objects of experimentation which can produce manipulative effects in the laboratory work. In all of these cases, the defense of a realist position implies a reification of something that is presupposed in the defending arguments. Even the positions which are most weakened with regard to the essentialist assumptions—like Putnam's "internal realism" or the pragmatist kinds of realism—cannot avoid the pitfall of reification, when asserting the existence of an "external reality out there."

The hermeneutic realist does not try to single out a particular class of entities (objects and/or structures) as having (privileged) existence in the physical reality. Her task is to address the existence of entities—regardless of whether they are empirically identifiable or not—as meaningfully articulated (and procedurally objectified in the process of scientific inquiry), provided that the meaningful articulation interpretively fore-structures the objectification. Both the articulation of

meaning and the interpretive fore-structuring of what becomes objectified take place within practices that project their interrelatedness upon possibilities. The hermeneutic realist is preoccupied with the constitution of all possible entities—be they physical or idealized or even only fictional (virtually real)—as they are situated in the meaningful articulation of reality. The hermeneutic realist is also engaged in overcoming the hypostatization of codices of scientific rationality, epistemological standards of scientific method, and non-contextual criteria for scientific truth. Despite this anti-essentialist engagement, hermeneutic realist puts forward a radical and comprehensive anti-relativist strategy.

Roughly, hermeneutic realism opposes all views that admit the following clauses: (a) the credentials of all truth claims must be checked by a foundational theory of knowledge; (b) the objective reality is organized into distinct objects, and the distinctness of each of them is prior to the constitution of meaning; (c) the mind is isolated from the world in a manner that enables it to represent the world through images, ideas, concepts, and categories; (d) there is an invariant and universal semantic core in mind that contains series of meanings related to the basic structure of objective reality. Roughly speaking, hermeneutic realism is a kind of realism that gets rid of Cartesian dualism, epistemic representationalism, foundationalism, and cognitive (including linguistic–semantic) essentialism. It is a common place for those who subscribe to a certain version of hermeneutic philosophy that (1) the world is not out there, and (2) the mind is always within the world. Hermeneutic realism is opposed above all to metaphysical realism and by implication to scientific realism. Metaphysical realism is criticized for the uncritical postulation of ontic primacy of the dualism between mind and mind-independent objective reality over the totality of being in the "work-world" of practices. The hermeneutic realist raises the critical question of whether mind does not belong to reality. Since most of the metaphysical realists are inclined to argue that mind is a part of objective reality, the hermeneutic realist focuses in her criticism on the predicament concerning the reconciliation of the following two doctrines which in various forms circulate in the realism debate: (a) objective reality is independent of mind (as something opposed to reality), and (b) mind is part of this reality.

My aim in this paper is to provide a general profile of hermeneutic realism by taking into account the issue of how reality becomes disclosed by scientific research. One can tentatively admit that what gets articulated in scientific inquiry are entities—already crudely delineated in everyday experience—that can be submitted to controlled observation, experimentation, manipulation through calibrated instruments, possible measurements, quantification and calculation through formalisms and mathematical models, conceptualization by means of theories that put forward verifiable predictions. However, to the extent to which this claim separates meaningful articulation from subsequent processing of entities already meaningfully constituted, the claim is misleadingly formulated. It leaves a wrong impression that scientific inquiry "imports" entities and (possibly even) structures constituted in prescientific practices and experience, and then "transforms" them via its own practices into experimentally testable, formalizable, and quantifiable objects and structures. Thus considered, "pre-scientific life-world's

entities and structures" are, as it were, scientifically reconstituted. Several doctrines of scientific inquiry developed in the phenomenological tradition (and in some constructivist schools of thought) have been inspired by the idea of such "importation," "transformation," and "re-constitution." The hermeneutic realist subscribes to the opposite idea that in scientific inquiry reality is anew disclosed and meaningfully articulated by the interplay of scientific practices and projected possibilities for doing research. What gets constituted in this interplay is by no means to be "derived from" or "reduced to" non- or prescientific entities.

By raising this claim, the hermeneutic realist implies that scientific inquiry is predicated on a kind of *interpretative internalism*: Science articulates reality in a characteristic way due to the unique hermeneutic circularity set up in the research process (Ginev 2006, 48–67). Accentuating interpretative internalism of scientific research does not entail the claim that the process of inquiry is immune to the infusion of external themes, values, or goals in this process. Scientific inquiry constantly reacts to its milieus by incorporating issues, problems, and tasks. The more adequate are the reactions to the milieu; the higher is the process of inquiry's plasticity. Without such a plasticity the external pressure would be destructive. On interpretative internalism, however, what becomes incorporated is not left unchanged. All themes, values, and goals infused in the process of inquiry become circumscribed within the horizon of possibilities for doing research. In other words, their meaning is recast/reconstituted in accordance with the interplay of practices of inquiry and possibilities for doing research. The view of interpretative internalism states that all meaning and meaningful entities in scientific inquiry are constituted in the process of inquiry. Scientific inquiry does not permit the import of external meaning that cannot be made "congruent" with the possibilities generated by the practices of inquiry, i.e., the possibilities whose appropriation—by the same practices which generate them—meaningfully articulates the inquiry's domain.

In claiming the inherence of practices in reality, the hermeneutic realist cannot make use of an objectifying conceptualization of practices that would present them as procedurally identifiable factuality. In the perspective of hermeneutic realism, *practices in their interrelatedness do not possess actual presence (a being as presence), but are constantly characterized by a potentiality-for-being*. It would not be correct to state that practices as discrete units enclosed in their environments are not important to the hermeneutic realist. Yet what is much more significant for the champions of this position is the (hermeneutic and phenomenological) conceptualization of the stream of ever changing configurations of practices—a conceptualization that would not transform the continuity of this stream into manifolds of discrete units. To reiterate, the stream of practices is not to be objectified as something localizable in space and time. By opening the horizons of spatiality and temporality of meaningful articulation, the stream of practices is—through its contextually changing configurations—spatializing and temporalizing what becomes articulated within the horizon of possibilities on which the configured practices project their interrelatedness as potentiality-for-being.

Contextures-of-Equipment and Contexts of Inquiry

It is a commonplace that a (scientific) practice consists of actions that are following a rule in being oriented toward achieving a goal—say, the goal of obtaining an experimental verification of the theoretical prediction (derived from the Standard Model) about how a collection of elementary particles of a certain type behaves. The relevant practice in this case is too complex and operates with a highly sophisticated technical equipment. Together with the entities that the actions enact (make ready-to-hand) and organize environmentally the practice form a "contexture of equipment".

Let us further suppose that this is a certain practice of experimentation in collider physics, say, the production of antiprotons at an accelerator by bombardment of a target with a high energy proton beam. Doubtless, it is composed by procedural actions and rule-following activities of installing an experimental setup and performing a series of experiments. Thus, the experimenters (1) look for matching the protons circumference to the circumference of the antiprotons accumulation within the synchrotron; (2) observe and control the variables of the produced antiproton and the production angle; (3) single out pertinent quantities (like the number of particles produced per interacting proton) that have to be measured experimentally; (4) establish a maximum production of antiprotons around a given antiproton momentum; (5) prepare diagrams for measured antiproton production for various target materials; (6) try to get information as to what extent the Coulomb scattering (provoked by the electric charge of the nuclei) has a negligible effect on the antiprotons productions; (7) choose a suitable lens (in the form of a magnetic horn) for the antiprotons accumulation by employing computer modeling; (8) cool the target (say, tungsten) and try to avoid its oxidation and disintegration; (9) register different types of oscillations for various beams in the synchrotron; (10) interpret the obtained results both in real space and in six-dimensional phase space (position coordinates and the momentum associated to each coordinate) characterizing the density of the antiprotons accumulation, and so on.

These interlinked activities—each of them following its rules and algorithms—and the material resources they utilize form a contexture-of-equipment that involves a basic instrument (Proton Synchrotron) by means of which entities that are ready-to-hand (accelerated protons and produced antiprotons for various target materials) become manipulated. (On this account, ready-to-hand is what has the character of being manipulable. Thus, the incoming particle beam is manipulable by means of dipole magnets like "injection kickers magnets." Furthermore, the beam might be bunched by a radiofrequency system and decelerated). The contexture of this practice of experimentation is devised to be congruent to contextures organized by other scientific practices: There are entities ready-to-hand within it that can be transferred to other contextures. Yet each scientific practice keeps maximally enclosed its "contexture of equipment." The practitioners manage to do this by retaining the entities manipulable within the contexture's "environment." The transfer (and the import) of manipulable entities to (from) other contextures creates some regular links between contextures. Yet transferring and importing such entities

are not sufficient to create and maintain a whole network of contextures. Moreover, the inquirers try to keep the particular contextures enclosed. Enclosing the contexture allows them to represent the outcome of practice's multifarious performance—the experimental results—in a unitary and homogeneous space of representation. In contrast to the contexture, however, this space—as it will be shown in the next section—does not remain enclosed.

Now, the practice composed by the aforementioned actions and activities (and its contexture-of-equipment) does form a unit of the process of inquiry, but it does not provide the necessary conditions under which a domain of inquiry might exist as a reality *sui generis*. Had this practice become isolated from the inquiry's texture of orchestrated practices, it would have lost its meaning. A scientific practice gains (and manages to maintain) its existence (and reproduction) but through its being entangled with the processual interrelatedness of scientific practices within a domain of inquiry. Only this interrelatedness turns out to be endowed with autonomous (ontologically self-sufficient) existence, and accordingly, with the capability to disclose the domain's autonomous reality.

To put it in an extended formulation: The interrelatedness of scientific practices—and not the particular practices per se—of the process of inquiry which articulates meaningfully a scientific domain enables the opening of the domain's meaningful being. This being has to be strongly distinguished from the total scope of possible entities, events, and phenomena that can be objectified and constituted as objects of inquiry represented by objectified factuality. A plausible way of identifying extensionally this scope is through envisioning the set of all possible data-models that might (semantically) interpret the theoretical models derivable from the domain's basic theory. Although this is a (potentially) infinite set, the total scope of a domain thus (semantically) delineated is an actual presence. It is fixed by a formal structure of objectification—the theory's formalism (and all specifications it undergoes in the construction of particular theoretical models). (An alternative formulation concerning the domain's extensionality can be spelled out in terms of the semantic approach which characterizes a domain's basic theory by a set-theoretical predicate in such a way that connects this approach to standard [formal-semantic] model theory. On this account, the set of all possible semantic models of domain's theory presents the extensionality of domain's scope).

In contrast to the extensional-semantic delineation of the domain's scope as the latter is determined by the basic theory's postulates (and their symmetry and invariance group), the processual interrelatedness of scientific practices opens the domain's being as an ongoing *meaningful articulation* that never becomes a mere presence (Eger 1999, 271–275). Seemingly, the epistemologically organized objectification "receives" the reality of this articulation. Accordingly, the subject performing this objectification commences to apply norms and criteria to what is "received," thereby trying to get objective knowledge by presupposing—and only occasionally reflecting upon—the domain's articulation within and through the interrelatedness of practices. However, drawing such a conclusion leads us to a distortive doubling of reality. This view wrongly implies that the reality of objectified entities (and "saved phenomena") somehow supervenes upon the reality of meaningful articulation. Assuming that such a supervenience takes place in

scientific research entails that there is some order of determination (possibly involving chronological sequences) between the "two realities." It goes without saying that this assumption and the concomitant doubling and diremption of reality are incompatible with the tenets of hermeneutic realism as they were discussed so far.

The practice being commented appeals—in its implementation—to a wide range of other practices. These are, to mention only a few, practices of (a) experimentation with pion-nucleon scattering, (b) selecting data through statistical analysis for conceptualizing various phenomena of hadron collisions, (c) calculating probabilities of experimental outcomes conditional on measurement, (d) constructing measurable parameters that can be represented by a data-model, (e) working out theoretical models that (for instance) introduce hypothetical quark, (f) elaboration on toy mathematical models in quantum electrodynamics (like the Cheng-Wu model at the end of the 1960s), and, of course, (g) engineering practices of accelerator building (including practices of improving the collider like adding a superconducting low-beta section). Depending on how these practices are configured, they provide various contexts of objectifying the domain of inquiry. Thus, suppose that the practice of experimentation with the production of antiprotons is related to scientific practices aiming at detecting the theoretical objects called "Intermediate Vector Bosons." Being interrelated with them, this practice of experimentation becomes specified as experimenting with hadronic collisions at an energy large enough to provide observable rates. For the sake of illustration, let me mention some of the practices with which the experimental production of antiprotons has been interrelated: practice of creating data-models for interpreting the Standard Model of the electroweak theory whereby properties of the "Intermediate Vector Bosons" are to be compared with the predictions of the Standard Model; practice of devising techniques of renormalization; practice of conceptualizing various phenomena of the weak interaction; practice of investigating the role of electroweak bosons in the generation of scalar bosons; practice of using broken symmetries to predict elementary particles' properties; and practices of coping with arbitrary features of the Standard Model as it has become constituted by the symmetries of the electroweak theory and quantum electrodynamics. Each of these practices represents the Intermediate Vector Bosons in a characteristic manner. Cases in point are Feynman diagrams, gauge boson mass matrix, measurements and data-models of eigenvalues as associated with eigenvectors, quanta of vector fields, combinations of quark flavors, etc.

The context constituted by a configuration of scientific practices enacts a circulation of representations—what is represented in the space of a particular practice is already deferred in the spaces of representation of other practices. In other words, the context does not provide a fixed and static representation of what is contextualized. The context enacts a circulation of representations, granted that each practice of the contextualizing configuration has its own space of representation. Through the circulation of representations, the researchers identify the existence of contextualized objects and/or structures. Let me formulate this idea also in an alternative manner. Within a particular context, the spaces of representation—as related to the specifically configured scientific practices—are interpenetrating each

other[1]: The representation of measurements is already deferred in the space of designing new experiments, the outcome of experimentation is deferred in the space of interpreting theoretical models, the data-models by means of which one interprets a theoretical model penetrate in the space in which new measurements are initiated, and so on. The meaning of what is read by a certain technology in its space of representation is to be seen in the next space corresponding to another readable technology. In this ongoing deferral of what has been represented in a given space by pushing it in a space of another practice, a quasi-semiotic play of signifier and signified often takes place: What is represented as a signified outcome in a certain space becomes a tool of representation (signifier) in a next space (Rheinberger 1997, 102–113). The overlapping spaces of representation prompt the ways in which the configured readable technologies work in concert. What becomes meaningfully articulated in a certain context of scientific research is a unity of experimental data, measurements, data-models, observable and unobservable phenomena, and theoretical model(s) entitled to save the phenomena. This is a unity constituted through the contextually configured readable technologies and the integral representation within the overlapping spaces.

Since each scientific practice functions as a readable technology, what becomes contextually represented is already read. I will call a "text" the outcome of reading and representing within a context of configured scientific practices. Tentatively, a "text" is constituted by a circulation of representations and a synergy of practices' readable technologies. The contextual constitution of a "text" inevitably contains a kind objectification that creates objectified factuality related, for instance, to such quantifiable variable as mass values, charge asymmetries, decay modes, production cross-sections, and distributions. Within a "text" isolated from the process of inquiry, the factual existence of objects and structures amounts to manifolds of values of quantifiable variables that might be represented, for instances, by phase diagrams. In the process of inquiry, the kind of objectification (involved in the "text") is still entangled with (and fore-structured by) domain's meaningful articulation.

Reading and representing are instrumental in all manipulations within a contexture-of-equipment. Each scientific practice works out its characteristic space of representation and its resources for being a readable technology. Reading and representing are applied by the activities composing a practice to what is immediately ready-to-hand in practice's contexture. Yet reading and representing change their function on the level of the interrelatedness of practices in a domain of inquiry. Within the contexts constituted by configured practices, reading and representing are textualizing what is disclosed by this interrelatedness. This textualizing is no longer dealing with directly manipulable things. Now, it would not be correct to conclude that reading and representing occupy an intermediate position (between direct manipulation and textualizing) in a domain's meaningful

[1] The notion of context in scientific inquiry refers to a relatively autonomous configuration of readable technologies and spaces of representation. Thus considered, the context is not confined to an experimental situation in the research process that takes place in a contexture-of-equipment. As I will argue, the context involves a three-stage interpretative circularity of meaningful articulation. Unfolding this idea shows that several experimental situations might take place in a certain context of inquiry.

articulation. Reading and representing are not somewhere in-between. They are rather operating on both levels, but serving essentially different functions. While unifying the interpretation and the representation of what is obtained in a contexture-of-equipment, reading and representing constitute "texts" within the contexts of configured practices. Reading and representing qua textualizing articulate a domain of research meaningfully by working out the immediate meaning and transforming it into meaning contextualized and inter-contextualized by configured spaces of representation and readable technologies. (This non-immediate meaning—produced not in contextures-of-equipment but in contexts of configured practices—is entirely trans-subjective meaning. It is constituted by the interplay of practices and possibilities in scientific inquiry).

Differentiating between constitution of meaning within, respectively, contextures-of-equipment and contexts of configured practices allows one to discriminate between a purely empirical and an interpretive-ontological perspective on a domain's articulation. In the former perspective—typified by cognitive sociology and ethnomethodology—the meaning that goes beyond the factuality of the immediate contextures-of-equipment should be regarded as a "second order" meaning.[2] The latter is based upon the meaning generated via direct manipulation of what is ready-to-hand in scientific inquiry. This perspective is still consonant with the undesired doubling of domain's reality. In the interpretive-ontological perspective, by contrast, the meaning generated in contexts of configured practices (and not in immediate contextures) is the "primary meaning" of a domain of research since it discloses the domain's meaningful being. Hermeneutic realism follows this perspective.

The domain's meaningful articulation is contextualized by changing configurations of interrelated practices. Let me emphasize that the domain's meaningful entities and the whole meaningful articulation are not detachable from the interrelatedness of scientific practices. There is meaning in a domain of research if and to the extent to which there are configured scientific practices. Their configured interrelatedness manages at once to contextualize and to dissipate/disseminate this meaning over multiple contexts of inquiry (i.e., to inter-contextualize it). Though the particular practices are composed by goal-oriented, rule-following actions and activities, a configuration of scientific practices through which a domain's being gets disclosed is by no means an extended composition of action and activities. *A decisive caesura marks the passage from a particular practice to the interrelatedness of practices*. A whole configuration endures no longer thanks to agency's goal orientation and rule-following. It owes its formation, stability, and reproducibility to the very meaningful articulation it launches and carries out. The multiplicity of relations within a configuration—or the totality of interrelations it comprises—projects itself upon possibilities whose appropriation articulates what becomes disclosed through the interrelatedness. Thus, the articulation takes place in the hermeneutic circularity of projected whole and articulated units. It is this

[2] Let me draw the attention that in this perspective the factuality of the immediate contextures (as objectified, for instance, in sociological terms) is not to be confused with the objectified factuality (experimental data and measurements) within the particular contextures.

circularity that replaces the regulative and teleological character of the activities composing a particular practice. Because of this replacement, the interrelatedness of scientific practices cannot be conceptualized in terms of motifs, intentions, rules, norms, resources for performing activities, and goals.

Kinds of Hermeneutic Circularity in Scientific Research

Admittedly, scientific research is by no means starting from the constitution of meaningful objects and/or structures. There is a much lower level of disclosing the meaningful articulation of reality in the research process. The elementary units of the reality's meaningful articulation within the interplay of scientific practices and projected possibilities for doing research are the data. Beginning with a celebrated paper of Bogen and Woodward (1988), there is an established tradition of making distinction between data and phenomena in the philosophy of science. In elaborating on this distinction, Brown (1994, 125) observes that the reality is "full of data, but there are relatively few phenomena." Notoriously, the authors working in this tradition claim that theories predict and explain phenomena (that are usually unobservable), but not data. Phenomena are procedurally stabilized and can resist changes over different experimental contexts. Their characteristics are repeatable in a more or less wide range of contexts. In other words, these characteristics are detectable by different configurations of scientific practices (or readable by different technologies). By contrast, data are idiosyncratic to the contextures-of-equipment in which they have been obtained (Bogen and Woodward 1988, 319). More often than not data enjoy stability not in a whole context of configured practices, but only in the experimental contexture/setting/situation in which they have been articulated. The initial collection of data obtained through a particular experimental practice is in many cases an unstable composite that only begins to make sense when a set of the collected data shows patterns, provided that phenomena correspond to characteristically patterned data.

The articulation of data should not be restricted to experimentation and measurement. Indeed, data refer to individual events recorded by particular detectors. Yet the articulation of data as meaningful units takes place in the hermeneutic circularity of contextual reading where a much larger class of scientific practices are at work and act in concert. Regardless of how contingent and indexical are the collected data, their recognition as (relevant) data depends on instrumental technologies and statistical techniques that tacitly participate in the aforementioned circularity. Franklin (1990, 104) argues that the acceptance of data is based upon various strategies that "distinguish between a valid observation or measurement and an artifact created by the experimental apparatus." What is important in these strategies is that they appeal to scientists' reflexive attitude toward the whole interpretative context of constituting data. Accordingly, scientists become committed to practices of instrumentation that are closely related to several kinds of analytical practices opening always more possibilities for data detection than actually recorded data in a given context.

The instrumental observations of measurable data are within the horizon of possibilities for a further calibration of instruments, new manipulations of experimental entities, a change of the statistical technique for data analysis, a new dealing with artifacts that are known in advance to be present in the experimental situation, a redesigning that improves the apparatus's sensitivity, alternative implementations of experimental apparatus due to changes in the background knowledge, and so on. These are as yet (within the current context) non-actualized possibilities for recording data whose appropriation would exceed the bulk of recorded data. The practices of calibration—called by Franklin (1997, 31–33) "experimental strategy" for legitimating the reliability of the achieved results—are perhaps the most important device for reducing the diversity of data.[3] Of course, this statement is true under the condition that there is no plurality of incompatible numerical scales for the measurements. The practices of calibration prepare and ensure the stability of data which is necessary for constructing data-models. Thus, these practices play a role in representing phenomena by measurable data. They manage to do this by means of their own interpretative resources—in particular, the interpretations they advance of how to convert performed operations with instruments into a definite value of what is measured (Soler et al. 2013, 282–285).

In adhering to the view that the detection and selection of data are within an open horizon of interpretation, the hermeneutic realist challenges the validity of the post-empiricist thesis of theory-ladenness. True, scientific theories interfere on very low levels of objectification and cognitive structuration of factuality, including the level of selecting relevant data and constructing an appropriate empirical basis for theorizing. Nevertheless, the thesis is dubious in two respects.[4] First, it can only be formulated by assuming the scheme-content distinction—an assumption that, as already indicated, the hermeneutic realist denies. Second, and more importantly, the thesis presupposes an intra-theoretical enclosure of the production of data (cum a kind of theoretical holism). The observation that something (represented by data) exists—so my argument against the thesis goes—in accordance with a model does not imply that the detected and selected data are determined by the intrinsic logic of theorizing. Like theorizing itself, the production of measured data patterned by a

[3] On Franklin's approach, calibration is to be viewed as the use of surrogate signal to standardize an instrument. What the experiment aims to investigate is unknown phenomena. A substitute for these phenomena is a signal of supposedly already known properties. Calibration acquires a status of experimental strategy when we assume that if "an apparatus reproduces known phenomena (i.e. the known characteristics of the surrogate signal), then we legitimately strengthen our belief that the apparatus is working properly and that the experimental results produced with that apparatus are reliable." (Franklin 1997, 31) Franklin develops this conception in the aftermath of his debate with Harry Collins about the capability of calibration to stop the "experimenters' regress". Calibration is experimental strategy—so Franklin's argument goes—because it provides an epistemological justification (for eschewing the regress) that is independent of social factors.

[4] The objections against the thesis of theory-ladenness raised from the viewpoint of hermeneutic realism are not to be confused with the criticism of this thesis suggested by Bogen and Woodward. According to these authors, the thesis is invalid because there is no direct epistemological link between theories and observations (data). Phenomena are produced from data but without the help of theories. I do not agree with this line of reasoning since it epistemologically cuts the research process in separate units that only post-factum can be assembled and presented as a unitary epistemic system.

model is situated in the horizon of interplaying scientific practices and possibilities for doing research. Moreover, the hermeneutic realist holds—without disputing the significance of the logical and semantic reconstructions of theoretical structures—that the concept of scientific theory has to be reconsidered by putting the "practices of theorizing" first. There is nothing in the structure of scientific theories that is not constituted by practices like elaborating on equations to serve as theoretical models, harmonizing semantic interpretations of concepts with basic equations, adjusting general theoretical formulations to be invariant under certain transformations, extending a formalism to cover new phenomena by avoiding ad hoc hypotheses, or devising scenarios for testing experimentally theoretical predictions.

The hermeneutic circle in which data are meaningfully constituted characterizes the primary form of scientific articulation of reality. However, this circle—though being initial with regard to the methodical treatment of the research process in a scientific domain—takes place already in the interpretative circularity of creating data-models as the next step of the reality's articulation. The logic of scientific inquiry suggests a transition from data to data-models. The chronological unfolding of the research process corresponds to this logic. Yet it would be a non-sequitur from a hermeneutic viewpoint to say that the interpretative circularity of creating data-models is a (subsequent) extension of the primary hermeneutic circle in scientific research. The detection and selection of data are "always already" within the horizon of possibilities for constructing data-models (in particular, graphical representations). A data-model—being itself in a horizon of possibilities of conceptualizing and theorizing—does not determine the selection of data. Yet it instructs the experimentalists in the choices of relevant data. Technically speaking, the construction of data-models instructs how to cut the random and systematic errors in data collection. The data-models alert to possibilities that uncontrolled variables may exercise systematic effects into the production of data. The construction of data-models is entitled, however, to serve also more sophisticated hermeneutic functions in data collection. Thus, this construction may alert to wrong expectations stemming from biased preconceptions.

van Fraassen (2008, 172), following Patrick Suppes's suggestions, cogently argues that "through construction of data models the experimentalist is in general bringing the theoretician small rational structures, constructed carefully from selected data." It is the data-model as such a small structure ("empirical algebra") that can be integrated in a theoretical model's larger structure. This is why in constructing data-models, the experimentalist employs practices of idealization as well. Such practices are hidden in the detection of data, but their interplay with the possibilities they engender affords both this detection and (to a greater extent) the subsequent selection of data. Furthermore, the idealizing practices in the construction of a small structure of data open possibilities for representing phenomena by repeatedly measured parameters. Data-models can represent phenomena by means of reading items that are immediately ready-to-hand under laboratory conditions within contextures-of-equipment. Following a line of reasoning of the preceding section, data-models are the most typical representational device mediating between contextures of single practices and contexts of configured practices. Creating data-models by reading measurable parameters and quantitatively representing

phenomena broadens the horizon of the interplay of practices and possibilities, thereby opening new contexts of inquiry.

The hermeneutic circularity of constructing data-models transcends not only each of its particular outcomes, but also goes beyond itself as a whole by indicating a further articulation of meaning related to the theoretical interpretation of the phenomena which these models represent. At this point, I would like to stress James McAllister's view that since all the infinitely many patterns that are exhibited in a data collection have equal claim to correspond to phenomena, the inquirers are those who stipulate what to count as a relevant phenomenon to be saved by choosing which pattern is corresponding to the phenomenon. This is why the phenomena are those patterned data or data-models that the inquirers "intend to study or hope to explain" (McAllister 1997, 224). Let me sum up the point of the preceding considerations: *Prima facie* the construction of data-models seems to be a (chronologically) next step of extending the hermeneutic circularity of reading/representing by taking into account practices and possibilities specifically involved in the processing of data. But the "chronological logic" of scientific inquiry is not in agreement with the "hermeneutic logic" of the reading process since the data collection and selection (by applying, in particular, filters for reducing noise stemming from various sources) take place within the horizon of constructing possible data-models that might quantitatively represent the investigated phenomenon.

A data-model is constructed (at least in mathematical physics) from a statistical analysis of data—an analysis that allows one to summarize relative frequencies of what is measured. The object measured is located in a logical space—understood as an ensemble of logical possibilities—characteristically associated with the unity of readings by interrelated readable technologies (including inter-contextually related technologies).[5] The construction of data-models is always already within the horizon of saving possible (observable and unobservable) phenomena by means of possible theoretical models. Put differently, the construction of data-models describing measurable phenomena is within the horizon of possible theoretical models of saving these phenomena. As already pointed out, the interpretative circularity that characterizes this saving enables one to appropriate possibilities of embedding phenomena (as represented by data-models) in theoretical models. Building on the semantic view of scientific theories, the minimal algebraic structure of a data-model becomes a substructure of a larger mathematical structure. On a

[5] Notoriously, the identity of object measured is complicated when the measuring apparatus is interacting with the system which the object belongs to. The issue of entangled measurement is of prime importance in this regard. The paradigmatic illustration for tackling this issue is the so-called von Neumann measurement in quantum mechanics: In deviating from the Copenhagen interpretation, one describes the quantum measurement in quantum–mechanical terms as interaction between the measured system and the measuring apparatus. Both ingredients are formally construed as basic vectors in a Hilbert space. Accordingly, one may arrange entanglement dynamically in a way in which the final superposition would involve both the system and the apparatus. In so doing, one would be no longer able to attribute an individual state vector to the system or to the apparatus. Since the traditional interpretation of measurement is no more relevant to this case, one has to take a reflexive stance in order to determine the observables that are measured. The observables are not uniquely defined by the final state of von Neumann measurement. (For the formal difficulties in this connection—in particular, how to cope with simultaneous measurement of non-commuting observables—see Schlosshauer 2007, 53–58).

central claim of hermeneutic realism, *always when a phenomenon becomes saved by fitting a data-model in a theoretical model, a theoretical object becomes partially envisioned (read and represented) in the respective context of inquiry*.

The envisioning of a theoretical object by saving phenomena evolves from the interpretative circle of reading data-models as representing phenomena that will be saved via theoretical models. It is a circle between a phenomenon represented by a particular set of measurements and the whole of possible models that might save this phenomenon. The envisioning of a theoretical object may take place also in contexts of inquiry that cross two or more domains of inquiry. A case in point is the construction of data-models representing a measurable phenomenon that by being saved through theoretical resources of a given domain indicates the existence of an unexpected phenomenon that is beyond the domain's phenomenal scope, but is quite relevant to another domain. Interestingly enough, the indicated phenomenon has been ruled out by data-models of the other domain. It is the task of saving it that leads to envisioning a theoretical object within contexts and spaces of representation crossing different domains. Here is an illustration of this case.

Within the domain of paleomagnetism—the studies of the historical changes of the earth's magnetic field—the phenomenon of reverse polarity of this field has been known as early as the mid-1950s. Data-models for representing and measuring this phenomenon were constructed from collecting data of lava samples and self-reversing minerals in rocks pertinent to magnetic measurements. These data-models showed that changes in polarity were not random in time, but "that groups of normal and reverse lavas followed each other in stratigraphic order and appeared to be time-dependent" (Opdyke 2003, 97). The phenomenon of reversing polarity of the geomagnetic field became—after a decade of intensive work on data collection carried out by six research teams, and in spite of the geophysical community's skepticism to the phenomenon's existence—represented by proper data-models. Constructing data-models of reverse polarity indicated the possibility of another—strongly rejected by several scientific communities in the preceding three decades—phenomenon, that of continental drift. This possibility was nurtured in the early 1960s by paleomagnetic data-models of polar wandering. At that time, one began to relate data of paleomagnetism and other numerical data—like those collected in surveying through marine magnetometer the magnetic anomaly pattern—to data of paleoclimate. Matching both types of data created data-models for representing the phenomenon of continental drift. Yet this phenomenon could not be saved through theoretical models of existing domains.

It was the formation of the domain of plate-tectonics which began to provide the proper theoretical models. The theoretical object they introduced (with reference to isostasy) was that of the "convection currents in the earth's mantle" as the cause for horizontal movements of continents. The theoretical models advanced by plate-tectonics were successful in saving phenomena like the sea floor magnetic stripes, the similarities of magnetic events in terrestrial and sea floor basalts, and the preservation of a symmetrical pattern of the periodic reversal of geomagnetic field by rocks across the ocean floor's medial rift. The theoretically saved phenomena envisioned the ways in which the "convection currents in the earth's mantle" operate as providing causal mechanism for continental drift. Plate-tectonics

succeeded in diversifying the general phenomenon of continental drift in a series of phenomena, each of them savable by domain's particular theoretical model, and able to envision further the theoretical object in question.

Envisioning a theoretical object through saving phenomena is the most significant event in the meaningful articulation of a domain as it is disclosed in scientific inquiry. The interplay of practices and possibilities and the hermeneutic circularity of inquiry in which this event takes place make the visualization of theoretical objects that part of the facticity of domain's articulation which brings into being the integrity of what I called a process of textualizing. Before unfolding this assertion, however, some summarizing considerations concerning the three stages of meaningful articulation and objectification of a research domain are in place.

The first stage—the collection of data and the search for patterns in the collected data—takes place within the contextures-of-equipment of scientific inquiry. But detecting and selecting data are unavoidably fore-structured by configured practices and projected possibilities of constructing data-models. Articulating the reality of a scientific domain in patterned sets of data that represent phenomena as ensembles of measurable parameters is the second stage of reality's meaningful articulation and objectification. In fore-structuring the collection of data within contextures-of-equipment, the construction of data-models becomes on its part fore-structured by the interplaying practices and possibilities of saving phenomena, i.e., by the interplay and the corresponding hermeneutic circularity which enable the third stage of the meaningful articulation and objectification of domain's reality. On this account, each new stage (a) fore-structures the former stage and (b) transcends itself, thereby expanding the horizon of interplaying practices and possibilities, and the hermeneutic circularity of domain's articulation and objectification. Though justified in several respects, the use of the image of stages in the process of inquiry might suggest the wrong impression of hierarchically ordered levels in revealing reality through this process. The impression is, as it were, strengthened by the tacit corollary to the conjunction of (a) and (b) that the third stage of reality's articulation and objectification within scientific inquiry remains without being fore-structured in a proper form. Yet this corollary is wrong for the third stage does not break with the hermeneutic circularity of meaning constitution. According to (b), this stage also transcends itself, which implies that the way of saving phenomena via theoretical models projects itself upon possibilities that are to be contextually appropriated. In being contextually situated and transcended, the articulation and objectification of a domain's reality as a manifold of saved phenomena are hermeneutically fore-structured. The third stage of revealing reality within scientific inquiry is fore-structured by the other two stages which—in line with the integral circularity of inquiry—the practices and possibilities of saving phenomena are fore-structuring.

Here again I have to invoke the image of the integral hermeneutic circle of the process of inquiry in a scientific domain. The interpretative fore-structuring of the domain's reality disclosed in scientific inquiry consists in an integral hermeneutic circle of meaningful articulation that—by enabling the domain's objectification—involves the circularities of detecting and selecting data, constructing data-models, and saving phenomena through theoretical models. Thanks to this circle the stages of inquiry that are fore-structured serve the function of fore-structuring as well.

My efforts now will be directed to clarifying this unity by having recourse to the reading and representing the theoretical objects. As already pointed out, the interplay of practices and possibilities through which theoretical objects become partially/contextually envisioned via saving phenomena provides the broadest horizon of articulation in scientific inquiry. It is this horizon in which the stage of domain's articulation through saving phenomena becomes fore-structured by the practices and possibilities of the other two sages. Saving a phenomenon by means of a theoretical model remains situated in and transcended by the interplay of experimental, instrumental, and measuring practices and the possibilities for selecting, patterning, and arranging in proper orders of data. The kind of contextual reading and representing of science's theoretical objects as entities (or structures) that might reveal their being through what is ready-to-hand within contextures-of-equipment is much more complicated than the other kinds of representation as in the research process. Yet, to stress again, it is the reading/representing of theoretical objects that constitutes relatively autonomous "text" that is amenable to a further re-contextualization in the articulation of a domain. My point is that reading and representing theoretical objects contextually are tantamount to the whole meaningful articulation of reality of a domain disclosed in scientific inquiry. This claim analytically follows from the thesis that the integral hermeneutic circle of reality's meaningful articulation in scientific inquiry is the circle of saving phenomena by means of reading theoretical objects. Like the interplay of practices and possibilities for doing research, the theoretical objects' reading/representing is an infinite process. Science's theoretical objects are either related to mathematical idealizations (such as "absolute black body") or to hypothetical explanatory scenarios (such as "regulatory genes"). (No doubt, this division ought not to be absolutized. As a rule, the theoretical objects involve in its being mathematical idealization and hypothetical status of existence. It has to be stressed that in the perspective of hermeneutic realism the theoretical objects related to mathematical idealizations are not epistemic constructions, but ontological entities articulated within modes of being in the world).

The theoretical objects are always predicated on a dual existence: They are at once "inscribed" on horizons of possibilities—thereby having constantly potentiality-for-being—and empirically identified in contexts of inquiry. (Roughly, this duality corresponds to their meaningful articulation within facticity, and their factual identification). The search for a unity in the dual existence is justified by the following observation: For each particular theoretical object, there are possibly an infinite number of contextual (partial) realizations of the objects' potentiality-for-being, given that a partial realization comes to the fore through an actualization of a class of possibilities upon which the objects' being is projected. Thus characterized, a theoretical object is constantly envisioned (in particular, visualized) in contexts of inquiry, but can never be empirically identified in a definitive manner with respect to the totality of the factual manifestations of its constitutive properties. (Put differently, there is no final context in which the object can be read and represented as something existing per se, or as something whose intrinsic properties and ontic identity are totally revealed).

From the viewpoint of hermeneutic realism, a theoretical object does not amount to a theoretical term with a possible observable referent. The birthplace of science's

theoretical objects—regardless of whether they are introduced by a hypothesis, or through mathematical idealizations, or by a convention (in Poincaré's sense)—is the facticity of inquiry. By contrast, the theoretical terms exist only within conceptual frameworks whereby they get factual content. Consequently, these terms have a debut after the formation of epistemic relationship within the facticity of inquiry. Scientific theories (as conceptual frameworks) fix the (semantic) meanings of the theoretical terms by assigning to each of them observable referent and factual content. This fixation results from a conceptualization (within theory) of certain contextual interpretations of a theoretical object. By the same token, the factual content of a theoretical term becomes intra-theoretically fixed by disentangling a limited number of a theoretical object's contextual interpretations from the ongoing interplay of practices and possibilities. By contrast, the theoretical object is never "fixed" by a theory since its meaning (and mode of being) is projected upon possibilities that always already transcend each and every conceptualization of factuality. This is why I am holding that a theoretical object has first and foremost a being in facticity of meaningful articulation, regardless of whether it is designated by a proper term. Once emerged from this facticity, the theoretical object becomes constantly exposed to a pertinent conceptualization and an intra-theoretical stylization that make it expressible via theoretical terms with fixed factual content. Yet again, reading theoretical objects within conceptual frameworks is only one among many possible ways of contextualizing these objects in the course of domain's articulation and objectification.

A theoretical object is, as it were, scattered over its possible contextual readings and representations (and, by implication, over a greater diversity of contextures-of-equipment). The object's being is distinguished by a growing "dispersal" of its contextual identifications (Ginev 2009). The ways in which one ascribes to a theoretical object contextualized empirical identities are dictated by the scenarios of how to save particular phenomena. *The theoretical objects are existing in both factuality and facticity—and accordingly, in the ontic-ontological unity of reality (as being objectified and being projected upon horizon of possibilities). Their being is (a) contextually scattered, (b) characterized by absent presence with regard to the attempts of their comprehensive factual identification, and (c) distinguished with a potential "inexhaustibility" with respect to their possible interpretations*. This claim opposes at once the view that the theoretical objects are predicated on actual presence in the hypostatized factual reality, and the view that they are but convenient instruments for conceptualization and conceptual organization of data.

I argued that the contextual reading of at least one theoretical object gets "recorded" in a "text." A relatively autonomous "text" becomes constituted in scientific inquiry through the circulation of representations and the synergy of readable technologies within a contextualizing configuration of scientific practices. The totality of items being read/represented in such a configuration "records" a way of existence of theoretical object(s) whereby the "text" which incorporates the record—if it becomes isolated in a proper manner and constituted as a body of knowledge—gains its semantic self-sufficiency. However, because of being fore-structured the "text" remains open to re-contextualization and revisionary re-reading. Accordingly, within the process of inquiry the "text's" semantic self-

sufficiency is always subsidiary to its hermeneutic openness. On a further definition, a "text" articulated in research as textualizing is the totality of meaning constituted by readable technologies in a configuration of scientific practices and represented in their spaces.

I will conclude this paper with spelling out the main facets of the concept of "text." Until now the concept was touched upon with the vague formulation that a "text" is the outcome of readable technologies' synergy within a contextualizing configuration of practices, granted that this outcome remains interpretatively fore-structured in a domain's meaningful articulation, and that its potentiality-for-meaning is inter-contextually dispersed. On this reading, the "text" is an ontological concept—characterizing scientific inquiry's facticity—though it is primarily recognized as a complex body of knowledge, i.e., its primary identification is when it is isolated from the process of textualizing. (It is much more easy to recognize a "text" in terms of the epistemological context of justification than in terms of the ontological context of constitution). The claim that within this process the "texts" have only a relative autonomy correlates with the thesis that there is no mere presence of extra-textual entities that might play the role of a transcendental signified, being capable to determine an absolute semantic interpretation in terms of "texts" reference to these entities as alleged denotata. The two approaches to which the study of a "text" can be submitted—the isolation of a "text" as semantically self-sufficient body of knowledge, and its treatment as a unit of a scientific domain's meaningful articulation and objectification that is "always already" amenable to a re-contextualization—complement each other. The traits, whose formulation takes into consideration the complementarity of the two approaches, are:

(1) There is in each "text" objectified factuality obtained by a manipulation of what is ready-to-hand within contextures-of-equipment. This factuality is organized as a set of data-models.
(2) Each "text" contains a set of theoretical models—usually one model—constructed in a manner that allows one to define (in mathematical terms) a kind of morphism between them and the data-models. By means of this morphism, the "text" becomes semantically complete. From a semantic point of view, the "text" is equally tolerant to the ontic existence of objects and structures.
(3) In each "text" a group of symmetries and principles of invariance—necessary in particular for the covariance of the domain's basic equations—makes the "text's" structure syntactically coherent. Like data-models and theoretical models, the construction of such a group presupposes the domain's whole objectification.
(4) In each "text" a theoretical object is partially interpreted both in an empirical and a semantic way. The empirical interpretation shows the theoretical object's existence in the domain's factuality, whereas the semantic interpretation specifies the relevant data-models that can appropriately represent it.
(5) Regardless of whether it is procedurally isolated (and represented as standard knowledge) or remains in its relative enclosure within a context (that inevitably refers to other contexts of a domain's articulation), each "text" is

hermeneutically fore-structured by the possibilities in its new reading in other configurations of scientific practices.

(6) Since there is a semantic interpretation involved in each "text," there is no "text" that can avoid a characterization in terms of a semantic notion of truth. (The same is valid with regard to an epistemological notion of truth). Yet characterizing a "text" in terms of semantic and epistemological truth plays only a subordinate role. Each "text" is first and foremost distinguished by a kind of hermeneutic truth. The latter consists in the way in which the "text" at once reveals and conceals the total meaning of a scientific domain. In each "text" certain possibilities projected by the domain's interrelatedness of practices become actualized. The "text" positively defines a domain's meaning in terms of the actualized possibilities by pushing away other possibilities and announcing still other possibilities to be unachievable. Through the way in which it shifts and de-actualized possibilities, the "text" defines a domain's meaning negatively. By displacing possible meaning that is part of the total potentiality-for-meaning of a scientific domain, the "text" conceals the latter. (It is another question that a re-contextualization of the "text" might recast and revive the displaced possibilities, thereby presenting them as interesting and achievable ones).

(7) Each "text" incorporates certain (local and contingent) cognitive interests and values that are informed by a scientific community's thought style (in Ludwik Fleck's sense). Yet this pragmatic orientedness of the "texts" does not contradict (what I called) the "interpretative internalism" of scientific inquiry. The incorporated interests and values are not externally imposed, but are formed within the leeway of possibilities for constituting objects of inquiry by means of interrelated scientific practices.

(8) There are "texts" which incorporate the readable technologies through which they have been constituted. These are "texts" constituted by a process of textualizing for which it is impossible to draw a demarcation between objectified factuality (through relations between data-models and theoretical models) and the practices of experimentation, instrumentation, conceptualization, formalization, etc. These practices (and their readable technologies) remain "engraved" on the objectified factuality. Since the non-detachability of readable technologies requires reflexivity on the part of inquirers, these "texts" might be considered as reflexive ones. For a reflexive "text," drawing a clear demarcation line between it and its context is impossible. For most of the "texts," however, the readable technologies are completely detachable.

(9) Each "text" contains—through referring to its past and future re-contextualization—a "narrative" about the domain's ongoing meaningful articulation. This trait is closely related to—and has to be further elucidated in connection with—the trait (6). More specifically, it is a narrative that—if reconstructed in an appropriate manner—would make explicit the historicity of the domain's articulation, i.e., the historicity of articulating meaningfully the domain's theoretical objects. Each "text" of a domain might render the story of domain's articulation.

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