Epistemic Pluralism

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Introduction

Scientific pluralism entails the acceptance of a valid multiplicity of theories, descriptions, methods, or explanations in science, and is fundamentally motivated by the general idea that some natural phenomena cannot be fully explained by a single theory or fully investigated using a single approach. (Kellert et al. 2006) From this stance, a plurality of explanations, theories, or methods is needed to fully capture a natural phenomenon, suggesting the need for shifts in perspective on the structure of science, scientific method, knowledge, and rationality. In this paper, I begin developing these perspectives through analogies to perception and articulate a network-based epistemic pluralism about science that challenges traditional monist cognitive tendencies in order to motivate an alternative practical view of data and scientific information.

Phenomena and Observation

Phenomena are grasped in perception with a fundamental figure-ground organization. (Wertheimer 1912, Wageman 2012) Phenomena are in the world, yet perceived differently across individuals due to our unique perceptual *milieu*—differences in general situation, background knowledge, experience, training, and social context that structure perception. (Merleau-Ponty 1945) The epistemological problem that arises from this phenomenological reality—as Kuhn (1962) recounts in questioning the validity of "observation-language"—is that:

…modern psychological experimentation is rapidly proliferating phenomena with which that theory can scarcely deal. The duck-rabbit shows that two men with the same retinal impressions can see different things; the inverting lenses show that two men with different retinal impressions can see the same thing. Psychology supplies a great deal of other evidence to the same effect… (§X; see Figure 1)

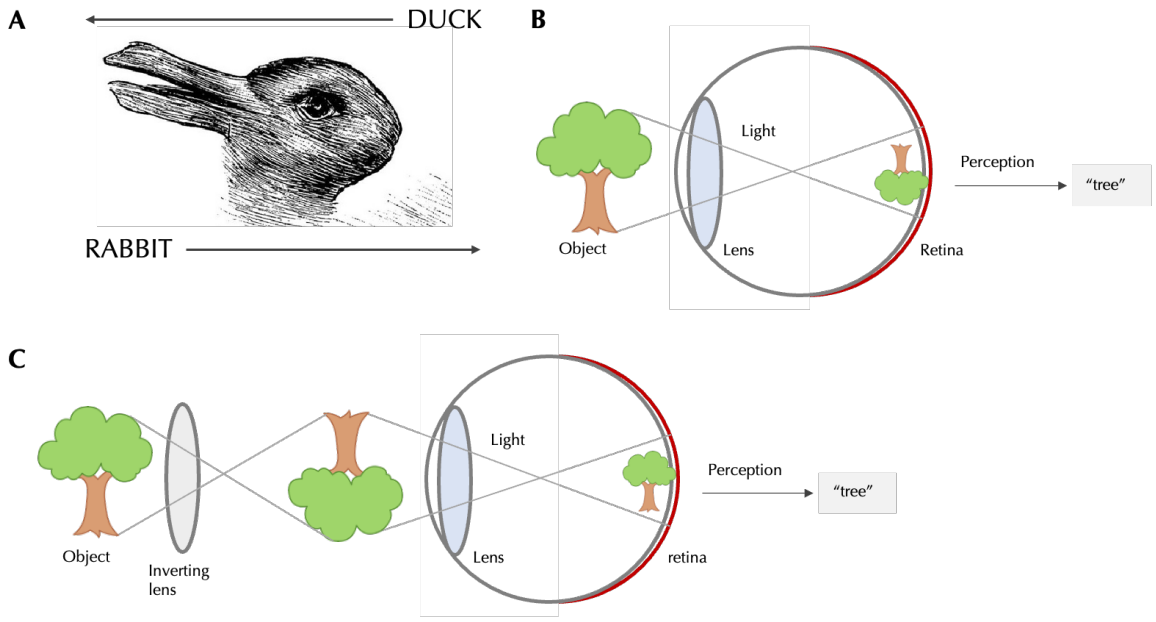

Figure 1: Epistemically significant perceptual phenomena.

A. Kuhn (1962) seems concerned with the possibility of "objective" observation-language because of puzzling phenomena. The duck rabbit is an unstable perceptual figure flipping between duck and rabbit. Which one *is* it? Can we say "both"? **B.** Normal perception of an object via retinal impression that results in the experience of a tree. **C.** Experimental condition using inverted goggles that gives the eye a different (inverted) stimulus, but produces the same perception of the tree in B.

Put differently, perception has a *world-contingent form* and *individual-contingent content*. This distinction is useful in philosophy of science if we understand scientific activity (observation, and classification within a framework) as a specialized case of this perceptual dynamic. For instance, a biologist and a physicist may study the same molecular interaction, but explain it in different terms or concepts and so too for scientists within the same discipline. Crucially, scientists can *observe* the same phenomenon, but validly *classify* it differently, and the conditions for the possibility of this state-of-affairs is epistemologically and practically interesting for science studies. Figure 1 on the next page is a pictorial representation of the dynamics inherent to observation in science and perception.

Convergent observations with valid divergent classifications are a fundamental structure of science and scientific knowledge, but seem at odds, and so suggest a need to re-examine both concepts from a philosophical perspective. Complex natural phenomena such as wave-particle duality, genomic regulation, health and disease, cognition, behavior, agency, and consciousness resist epistemologically monistic rational treatments, signaling a deficiency in such methods for generating stable scientific knowledge. If the aim of science and force of scientific progress is to maximize informational contact with reality to learn as much as possible, (Chang 2012) *pluralism* is key to developing theories and methods that make maximum contact with natural phenomena and their different aspects. Under pluralism, like in Kuhn's musings, two individuals may have the same *knowledge that* X is the case but may *correctly and validly differ in knowledge how X* is the case. One analysis is not necessarily better or worse than another, and they together condition a more robust explanation of X. Cognition for example has biological, neuroscientific, psychological, computational, and philosophical aspects, and this plurality of perspectives and approaches taken together explains the phenomenon more thoroughly than any single component approach or unified interdisciplinary theory.

This epistemic dynamic between disciplines or approaches targeting the same natural phenomenon maps onto the perceptual distinction between world-contingent form and individual-contingent content, and is consistent with Kuhn's worries about phenomena. Scientific theories and observation are contingent on phenomena out in the world *and* contingent on one's field, purpose, and sensibility. Moreover, multiple scientific fields and scientists can approach the different aspects of a phenomenon concurrently and reach seemingly disparate conclusions about its nature. In my view, this suggests that science is a networked, dimensional field of theories and knowledge mutually concentrated on phenomena rather than a field of competing independent frameworks grasping for the *single* best way to interrogate them with the highest probability of relative success. Under scientific pluralism, theories and explanations may differ within and across disciplines, but together they constitute a *valid plurality* that maximizes contact with reality to capture different aspects of natural phenomena and generate scientific knowledge about the natural world.

From this perspective, we find that scientific topics are bound to admit to more than one rationally justified treatment (Chang 2012), and so are inherently open to pluralist treatments. If this is the case, many traditional monist values of science such as theoretical unity and single "correct" theories lose their sense and force to the possibility of more robust, pluralist explanatory models that take multiple perspectives, theories, data sets, failed experiments, and differential conclusions into consideration. Furthermore, since pluralist models of explanation are enriched by multiple perspectives, they minimize dependence on a single set of evidence, method, or approach, and maximize contact with phenomena and with reality.

Epistemic Pluralism and Science

Scientific pluralism challenges traditional conceptions of singular scientific explanations as "objective truths" about the natural world *without* fatally undermining the epistemological force of

scientific explanation. Under pluralism, scientific explanation looks like a knowledge network rather than rather than a collection of isolated packets of knowledge. (Figure 2, inspired by Bowman 2012)

Pluralism does not pursue *a* "fundamental theory" or "right answer" or debate the primacy of one theoretical framework over another, and moves beyond such controversies by replacing motivation toward monistic unity and "objective truth" with pursuit of robust, enriched plurality of explanation. Pluralism sharply diverges from traditional views about scientific structure and progress as linear, phased, and event-based (Kuhn 1962, Figure 3) and stimulates the development of unconventional and interesting accounts of scientific classification and knowledge generally, such as Dupré's (1981, 1993) promiscuous realism about scientific kinds (i.e. that scientific kinds definitively are natural kinds) and Fayerabend's (1975) anarchistic approach to epistemology (i.e. that all possible means of knowledge gathering should be pursued and developed concurrently), that may ultimately play a crucial role in the progress and advancement of science.

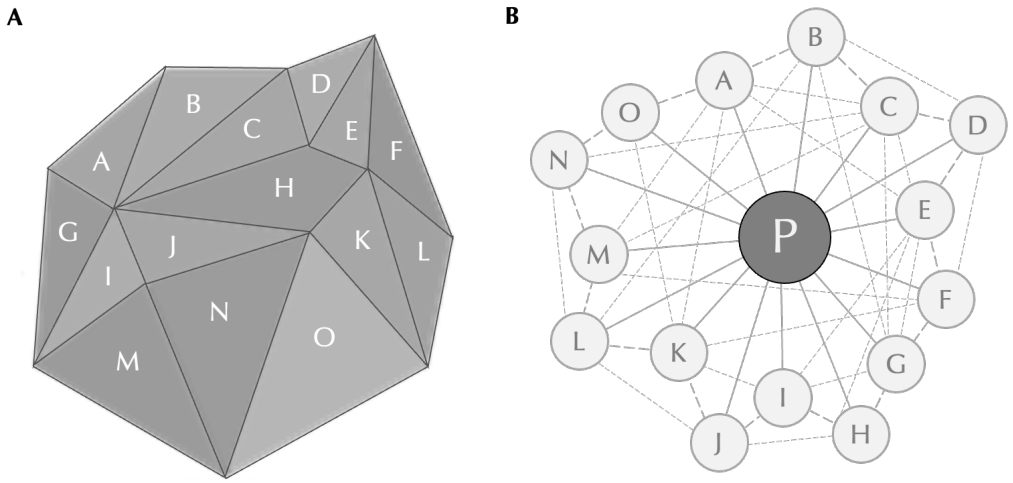

Figure 2: Phenomena and epistemic networks.

A. Pictorial representation of a phenomenon (gray surfaces) with multiple aspects (letters) open for investigation. **B.** Epistemic network constituting scientific knowledge of the phenomenon (P) through a plurality of approaches (node letters) targeting the phenomenon (solid lines) that are independent (gray outlines) yet interconnected (dashed lines).

Since pluralism holds that no theory or discipline *necessarily* makes stronger contact with reality than any other, it is the *network* of theories and explanations about a particular natural phenomenon generated by different disciplines, approaches, or individuals taken together that best accounts for that phenomenon. It follows from this network structure that science can sustain coexisting, independently developing nodes of inquiry targeting the same phenomena without issue, for no line of inquiry in principle aims to debase, replace, integrate or transpose any other to serve its own aims. Instead, explanations and theories from independent lines of inquiry all refer to the target phenomenon, constituting a network of scientific knowledge about it whose nodes may interconnect and interact as a result of shared aims, but still exist, function, and develop independently to generate knowledge about natural phenomena.

If the structure of science is networked and dynamic as I've suggested, pluralism challenges rational inclination toward constraint by hypothesis, "unified" scientific theories, explanations or disciplines, and blind adherence to accepted mainstream scientific narratives. It also helps cope with the *underdetermination of scientific theories by evidence*: Theories are said to be *underdetermined* when we do not have access to all the evidence of a phenomenon (Harding 1976, via the Quine-Duhem Thesis), i.e. nearly always. As such, theories are *always* subject to revision in light of new evidence, challenging the explanatory sufficiency of any singular theory, or other monism generally, for explaining natural phenomena. A high correlation between a phenomenon and some evidence classified within a particular frame of reference, theory or model drives the generation of evidence-based explanations in science. On Kuhn's (1962) traditional view of scientific revolutions, such explanations eventually become scientific orthodoxy until enough anomalous observations and evidence necessitate a paradigm shift and associated theoretical revisions or replacements by which scientists start *seeing the world differently*. (Figure 3)

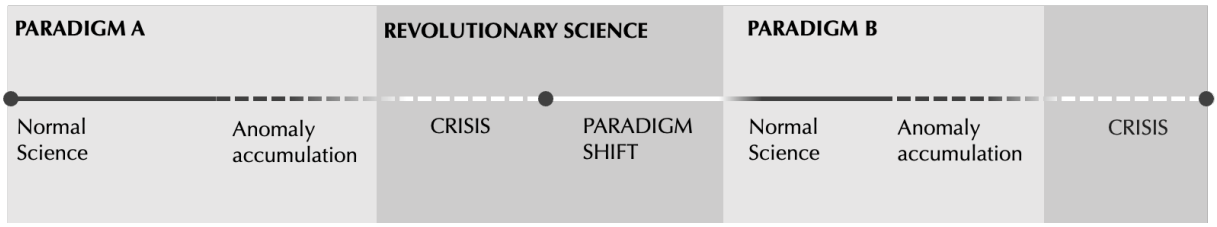

Figure 3: Kuhn's (1962) Structure of Scientific Revolutions.

An historical, temporal, event-based conception of scientific progress.

Since scientific pluralism embraces a plurality of theory and explanation and constantly considers multiple aspects of natural phenomena, it combats the underdetermination of scientific theories by evidence at ground floor and can assuage Kuhn's concern for infinite patterns of crisis as necessary for scientific progress—especially when scientific theories, explanations and disciplines are viewed as nodes of epistemic networks.

Pluralism further suggests that the traditional hypothesis-driven picture of scientific rationality as an iterative process of observation, hypothesis generation, experimentation, data collection, analysis, hypothesis revision, and theory building is oversimplified and underpowered. The process as presented is idealized, and never takes place in the intellectual vacuum it implicitly suggests—that is, science never happens truly *de novo*, and is strongly shaped by the particular centricities and basic assumptions of any scientific field or individual scientist, and also by human factors such as motivation, intention, and creativity. Pluralism can accommodate these eccentricities through its suspension of value judgments about particular theories, disciplines, or approaches, and allow both traditional hypothesis-driven work and less conventional approaches to flourish concurrently if they positively contribute to building and enriching the epistemic network around a particular phenomenon.

Pluralism in Practice

Above I've argued in favor of scientific pluralism as a philosophy of science that understands science's epistemic structure as a robust network with self-sustaining yet interconnected plurality of results and conclusions taken together *constitute* scientific knowledge. My aim now is to unpack the practical implications of this position by showing how pluralism about classifying phenomena, collecting data, constructing databases, and analyzing information opens up new possibilities about the character and scope of scientific inquiry. (Figure 4) Like philosophical scientific pluralism, practical pluralism about data accepts a valid multiplicity of information about natural phenomena, with no type or piece of information should weighted, prioritized, privileged, or eliminated over another, and the aim is rich, robust, dimensional analysis of information instead of hypothesis-driven data structuring and manipulation. Data sets should be maximized for breadth and cross-sectional analyses pursued.

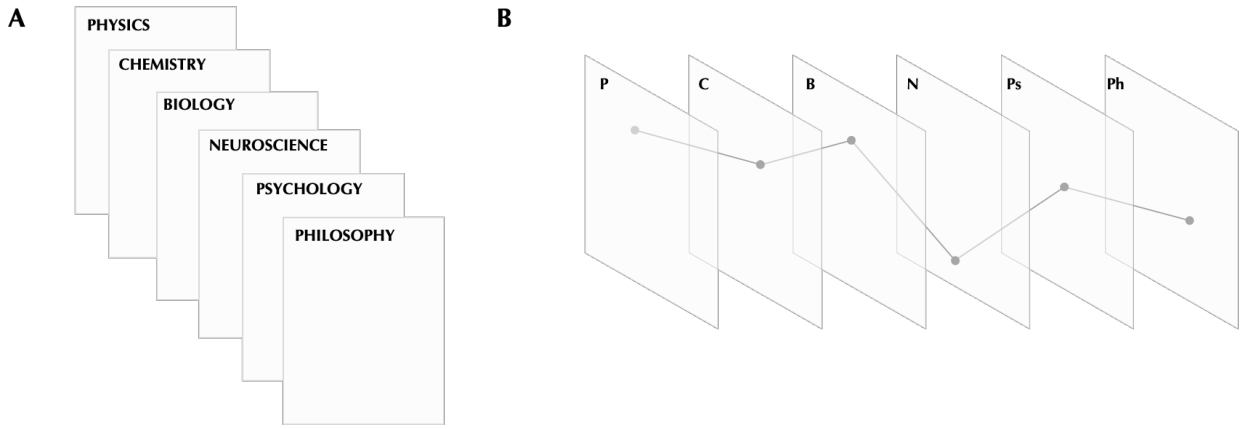

Figure 4: Epistemic Pluralism and Information

A. "Traditional" arrangement of scientific disciplines in which domains and data are isolated. Monistic treatments strive to transpose or translate explanations from the terms of one domain into another without explanatory loss. **B.** Pluralistic treatment of information in the sciences. Explanatory transposition is not an aim—points within the plurality are connected and considered together to ascertain facts and generate explanations with pluralities of aspects.

With this schema for data collection, classification, and analysis of phenomena, information can be treated in new and creative ways unconsidered and unexplored in hypothesis-constrained scientific settings. Since the data is free of constraint by a regulating hypothesis at the structural level, inquiry remains open in light of actively accumulating data, and many different possible analyses could be in principle conducted—the information can be seen differently, with perceptions of what it may reveal unconstrained by the self-imposed rational boundaries. Data structures incorporating multiple aspects of the target phenomenon starts the process, *then* hypotheses are made against what the structure *could* reveal by treating the data with different analytical methods. This allows for a period of free, yet data-driven association not enabled by traditional scientific method. With this approach, a preconceived hypothesis does not constrain or eliminate what information about the phenomenon could become available for consideration. Instead, creative ideas about what rich, data structures comprising a plurality of variables *could* demonstrate become a driving force of scientific inquiry, observation, and classification. This way, investigators work from the phenomena up rather than the hypothesis down, with the limits of inquiry only constrained by creativity and the limits of available analytical tools. With the rapid maturation of data science, analytics, and artificial intelligence since the millennium, the possibilities are, in a word, dizzying. This robust pluralistic approach thus changes the scope of scientific inquiry from hypothesis-laden

observation to open association, moves away from the rational boundaries of monism, and suggests a smart way to do research that maximizes contact with reality.

Final Musings and Future Directions

With this short study, I hope to have conveyed the value of scientific pluralism in theory and practice, and to have illuminated some shortcomings of monistic approaches to science and philosophy. Perhaps the reason we remain so attached to monism about science is grounded in the tendencies of human rationality—we simply can't help but see unity as a figure on our rational background, and this creeps into our scientific worldview because of science's strong epistemic force. The way to cope with this tendency as to prevent philosophical and practical unrest however is likely *not* integration and interdisciplinarity, for integration is a monistic function that strives to unify. Rather, we ought to support the independent development of novel approaches to capturing phenomena and contacting reality in the proper epistemic context so to optimize it's potential. With pluralism, we can investigate the physical, biological, technological, social, and ethical questions on into multiplicity, and must *maintain the independent integrity of each approach*. Pluralistic attitudes very consciously recognize the individual integrity of knowledge domains and disciplines, and consider how different techniques may interrogate the same phenomenon—the aim is *not* to join different approaches or angles, but to see how they may create a networked, systematic explanation with many aspects *taken together*. The rational distinction is admittedly subtle, yet vastly important. There is an attractor (the phenomenon) and differential analyses about it that reveal these aspects piece by piece, facilitating a richer understanding of the natural world through epistemic networks. Wrapping these aspects together in cross- or interdisciplinary theories and approaches may ultimately water down these aspects down instead of elevating them epistemically.

What's left is to consider how pluralism suggests we should see science historically and ahistorically. Historically, pluralism suggests that science may not have a clean, linear narrative. Thus, we should reconsider framing science as a temporal series of replaced theories, and incorporate the spontaneity of motivation, creativity, irrationality, and humanity that drives science in practice. Maybe the histories to tell are those that embrace the concurrent and sometimes incongruous discoveries and events that constitute what we retrospectively perceive as logically progressive scientific progress. Ahistorically, pluralism presses us to restructure our scientific worldviews—in my view, with networks of theory, practice, and explanation that aim to better grasp natural phenomena with a plurality of theoretical and experimental techniques. Pluralism also challenges us to abandon traditional rational affinities for objective truth from singular theories and be skeptical of 'ultimate explanations' or 'unified theories of everything'—such things may be inaccessible artifacts or mirages of human rationality tempting us to search for black cats in empty dark rooms when there may be no cat—and more than one room.

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