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Instrumentalism: Two different approaches, one epistemic optimality argument?

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Abstract

Instrumentalism plays a central role in two opposing epistemological positions, i.e., Radical Constructivism (RC) and Constructive Realism (CR): RC represents instrumentalism as an *epistemological position* that is consistent with skepticism about the external and incompatible with the concept of *truth*; information theory and cybernetics are adopted for modeling a self-organizing mind (von Foerster 1972; von Glasersfeld 1998). CR-proponents (Popper 1963; Giere 1985; Kuipers 2000), however, accept instrumentalism as *instrumental methodology* but stick to ambitious concepts of *truth* and the traditional certainty/uncertainty-dichotomy. The present paper suggests (i) information-theoretic measures of predictive success and progress, (ii) a principle of inductive inference that is basic enough to apply even to the extreme case of single event prediction on the basis of only one observed event, and (iii) the view of the heuristic *rationale* behind that principle as *optimal* in (almost) all possible worlds.

1. Instrumentalism in Constructive Realism and Radical Constructivism

Within instrumentalism, Kuipers (2000) distinguishes *instrumentalism as an epistemological position* from an *instrumentalist methodology* that should be used irrespective of the given epistemological position (p. 10f). He suggests a transition "from instrumentalism to constructive realism" and stresses the fact that the term *Constructive Realism* was already used in Giere (1985), though in somewhat different ways: "The difference is that Giere does not take truth approximation into account." (Kuipers 2000:8).

Giere (1985) emphasizes the true/false dichotomy (cf. his Figures 3 and 4) and rejects, for example, the phrase of the real system that is "*approximately* captured by the model": If "we are to have scientific hypotheses which /.../ have some reasonable chance of being true, we must avoid claims that any real system is exactly captured by some model." (p. 79) He characterizes *Constructive Realism* as a "decision-theoretic framework" that provides a "functional view" (p. 96) of the relation between theory and experiment, and as a "model theoretic analogue of the view advocated by Grover Maxwell (1962)."

In his comparison between instrumentalism and realism, Maxwell (1962) produces a number of "constructive arguments /.../ for a radically realistic interpretation of theories" (p. 3) and the ontological status of theoretical entities. Lawlike "sentences tell us, for example, how theoretical entities of a given kind resemble, on the one hand, and differ from, on the other, the entities with which we happen to be more familiar." (p. 24). But in contrast to the above cited authors and to Popper (see below) he attacks instrumentalism (as an epistemological position?) without any compromise: It "must be acutely embarrassing to instrumentalists when what was once a 'purely' theoretical entity becomes, due to better instruments, etc., an observable one." (p. 22)

According to Popper (2007), who figures among the proponents of Constructive Realism (cf. Kuipers 2000), "*the scientist aims at finding a true theory or description of the world*" (p. 139), while the instrumentalist rejects that the scientist ever could succeed in finally establishing the truth of a theory; "for if a theory is an instrument, then it cannot be true /.../". He cites Osiander ('nobody should expect anything certain to emerge from astronomy, for nothing of the kind can ever come out of it') and acknowledges that theories are instruments, but offers, as an alternative reason why "there can be no certainty about theories", that our tests can never be exhaustive. (p. 140f)[1] The "*hypothetical character* of a statement – i.e. our *uncertainty as to the truth* – implies that we are making *guesses concerning reality*." (p. 156).

We may summarize: Constructive Realism accepts instrumentalism as *instrumental methodology*: A full theory is both, an attempt to a description (Popper) or model (Giere; Kuipers) of reality, and, at the same time, an instrument providing testable predictions. Increased predictive success – more hits despite equally precisely formulated predictions – is the empirical argument for a preliminary acceptance of the respective assumption.[2]

Radical Constructivism, however, is a variety of *epistemological instrumentalism* (cf. Niemann 2008). Von Glasersfeld (1983) explicitly declares his position as corresponding with an instrumentalist epistemology as already formulated in Osiander (1627).[3] Osiander's instrumentalism obviously fits the external world skepticism of Radical Constructivism much better than mere instrumentalist methodology. Von Glasersfeld emphasizes (1998: 507), moreover, correspondences between Radical Constructivism and both, Claude Shannon's communication theory – series of signals attain meaning only through interpretational processes at both ends of the communication channel – and Norbert Wiener's cybernetics which anticipates the idea of self-organization. It offers, as shown in von Foerster (1972), the potential for generalizing Humberto Maturana's idea of autopoietic systems.

Information theory provides, and methods of model selection use, quantitative measures for the *growth of knowledge*. In terms of information theory, an increasing success of guesses – of guesses in Shannon's guessing game technique, or of "highly informative guesses" (Popper) deduced from explicit theories – reflects a measurable *reduction of uncertainty* or *gain of redundancy,* and an *in-*

1 Some further reasons may concern the methods and conceptual structures available at a given time (Oeser 1976: 107, 125f) as well as the relevance of testable hypotheses for the theory as a whole.

2 In terms of Radical Constructivism, where *experience* rather figures as a selective process (Glasersfeld 1983, 1998): Only "viable" and internally consistent concepts survive.

3 He is reciting Osiander from the first edition of Popper's "Conjectures" (p. 98): "There is no need for these hypotheses to be true, or even to be at all like the truth; rather, one thing is sufficient for them – that they should yield calculations which agree with the observations."

crease of mutual information (=transinformation) between guesses and observations concerning certain aspects of a certain domain.

Philosophers, however, tend to maintain the traditional certainty/uncertainty dichotomy; recall e.g. von Glasersfeld's claim of a principal uncertainty about the external or Popper's claim of a principal uncertainty as to the *truth* of any empirical theory. Both Popper and Kuipers view increasing predictive success as functional for "truth approximation". But what is the advantage of the concept of *truth,* if there can be "no certainty about theories" (Popper) and no "guarantee that the more successful theory is nearer to the truth" (Kuipers 2000: 163), but at best "some reasonable chance of being true" (Giere)? On examination, the concept of *truth* is neither necessary nor "viable" for describing a given status of a certain theory or the evolution of scientific knowledge.

2. Predictions and oracles

Predictions require at least one law-like proposition among the premises from which they are deduced; but their reliability depends on the quality of the respective law-like propositions. But what is a law? Armstrong (1983) distinguishes between laws on the one hand and mere regularities or uniformities on the other. He states that Hume conceived of the relation between cause and effect "as a mere regularity" (p. 4), and almost half of Armstrong's book is a critique of a *regularity theory of law* that mistakes regularities as laws: If "laws of nature are nothing but Humean uniformities, then inductive scepticism is inevitable" (p. 52). And: If "everybody in a certain room is wearing a wristwatch", this is a case of a mere uniformity, while laws are "genuine relations between universals" (p. 84). Intuitively, his point is clear. But could even laws of nature change (cf. Lange 2008)? And how to distinguish – in unfamiliar contexts, in advance and with "certainty" – between mere regularities and universal laws? Whatever the answer is, the inductive method applies anyway (see Section 3).

In his reply to Hume, Reichenbach (1949: 475) claims that, "if the aim of scientific method is attainable it will be reached by the inductive method" which "can be justified as an instrument that realizes the necessary conditions of prediction". But note that Reichenbach's term "inductive method" addresses, more specifically, an asymptotic method of inferring to frequency limits.[4] If there is no such limit, "we shall certainly not find one – but then all other methods will break down also." Predictions of individual events are included as the "special case that the relative frequency is =1" (p. 475). Any oracle by prophets or soothsayers would loose its mystical glamour as soon as it is subject to a test by his rule of induction.

Schurz (2008) qualifies Reichenbach's attempt at a justification of the inductive method as a wrecked attempt at an "optimality justification": Since "object induction", i.e., methods of induction applied at the level of events, cannot be demonstrated as an optimal prediction method, Reichenbach has "failed to establish an optimality argument with respect to the goal of predictions." (p. 281) Schurz proposes, instead, a "meta-inductivist" method deriving optimal predictions from "the predictions and the observed success rates" of other players. But while e.g. "evolutionary optimality" addresses optimality in a defined niche (Vilarroya 2002), Schurz's (2008: 280) concept of *epistemic* optimality claims optimality in "*all* possible worlds", "including all kinds of *paranormal* worlds in which perfectly successful future-tellers /../ do indeed exist." (p. 280) The major advantage of his method is this "radical openness towards all kinds of possibilities" (p. 304), and the goal underlying his optimality argument is maximization of "true predictions", i.e. hits, "and this is clearly an epistemic and not a practical goal." (p. 282). But why not also a practical goal?

Our basic principle of induction (see Section 3) concerns the rationality of decisions – decisions even under extreme degrees of uncertainty – by each individual cognizer, be he a member of a group or an isolated shipwrecked man on an island in the Pacific. Cognizers in the plural could, however, make use of several advantages, such as the application of Schurz's meta-inductivist strategy, or, less sophisticated, a calculation of the *mean* of individual, independently produced guesses which tops, due to statistical error compensation, in many cases the best one of the individual guesses. In both procedures the final overall output will benefit from a high prognostic performance of single individuals, and in both cases is the calculation of the output again a procedure that follows the inductive method.

It is hard to understand why the advantages of both these procedures are widely neglected in practical decisions. Take for instance the meta-inductivist strategy: A political party that is over years monitoring the prognostic performance of different polling institutes before making a contract, follows in principle the meta-inductivist strategy but would do so more systematically if it maintained that monitoring and accounted for the predictions of the competing institutes with calculated weights. An advantage of the meta-inductivist strategy beyond this kind of maximization of predictive success is, to my view, restricted to "paranormal worlds" with "paranormal", unearthly inspired players.

3. Uniformity and optimality

To start with the most general point:

(i) *So far there is no argument, neither empirically nor logically, for considering that our world is or could turn to be non-uniform*:

The evolution of anticipative behavior and of "feed forward" information processing in perception as well as in science could not have happened in a non-uniform world. Uniformity is a presupposition of induction. But it need not be an "all-or-none affair"; nature appears to be uniform to some extent and some degree (Salmon 1966: 53). In other words: It appears to be *redundant*, or regular to some degree. Inductive methods are so far – at least to some extent and some degree – functional; otherwise we have not the slightest reason to assume that this might change. *Thus there is no concrete reason to query either uniformity or the functionality of the inductive method for the future.* I can't see any circularity in that pattern of argument. But it is of course no "reliability" justification of induction.

ii) *Induction and prediction is, in principle, an intuitive or explicit calculation of (changes of) relative frequencies and their extrapolation to the future. (We have no other choice – with the exception of irrational decisions, such as the "gambler's fallacy".)*

4 Salmon (1966) criticizes Reichenbach's method of induction by enumeration on the grounds of "descriptive simplicity" as "patently inapplicable" (p. 89). But computer-simulations by Juhl (1994: 859) attest Reichenbach's straight rule of induction, apart from applicability, at least speed-optimality: "amongst asymptotic rules, no other rule gets closer to the truth faster than the straight rule."

This principle of induction is basic enough to apply to a prediction even of an individual event on the basis of nothing else but one individual observed instance (Fenk 2008: 90), in which case the best wager relative to what we know is that the future instance would be similar to the observed one. Let me illustrate this building on Armstrong's example of a mere regularity: From 101 persons in a certain room those 100 persons "tested" so far are wearing a wristwatch (relative frequency = 1). What would be our guess concerning the last person X if we had to guess in the absence of any additional knowledge? The usual generalization of relative frequencies suggests that the probability for X to wear a wristwatch is higher than to wear e.g. a pocketwatch or no watch at all. A *consequent application* of that generalization amounts to the same guess ("wristwatch!") for a yet unknown instance even in the case of the smallest possible "sample-size" of only one person "tested" so far (observed relative frequency of wearing a wristwatch = 1) or the slightest overhang (from the 100 persons "tested" so far, only 51 are wearing a wristwatch; relative frequency = .51).

(iii) *Since a justification of induction is not possible and heuristic strategies cannot claim to be "true", it is tempting to search at least for optimality arguments.*

The *rationale* behind any kind of instrumentalism can be viewed as a fundamental epistemic optimality argument. The respective *maxime* reads as follows: *Never give up the assumption of uniformity!* Anything else would be a premature decision for the following reasons:

- The presupposition of inductive uniformity is, of course, appropriate in every (to some extent and some degree) uniform world.
- In a world, where even "true" laws of nature could change, it is the only assumption that would allow identifying, first of all, the change as such, and moreover possible reasons and "meta-" or "higher-order" laws responsible for that change. (Which means, at the same time, that the inductive uniformity assumption could be maintained despite changing laws of nature.)
- And in a world without any "uniformity" or redundancy, our *maxime* is again optimal – no worse than any other heuristic principle, if or as long as this world remains in this state, but the only principle that would allow recognizing a possible turn or return to uniformity.
- Note: The fictional cognitive subject that could live in that fictional totally non-uniform world could never decide whether his breakdown in predictive performance is his or the world's fault; a proof of regularity is, with some reservation, possible, a proof of randomness is not.

To summarize: Universal applicability of a heuristic principle implies a minimum of restrictions. Our epistemic optimality argument applies irrespective of (a) the size of the sample from which the inferences are drawn and (b) the availability of any additional contextual knowledge or any knowledge about predictions of possible other players, and irrespective of whether one presupposes (c) an inductively uniform or non-uniform world, or something in between, or (d) "true" laws or mere uniformities, and if laws, irrespective of the question of whether they could change or not.

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