

A Brand New Type of Inductive Logic Reply to Diderik Batens*

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The correspondence to which Diderik Batens refers dates from the autumn of 1971, and resulted in my very first publication in English, albeit a very short one (Kuipers 1972). Ever since, he has been for me one of the few role models as a philosopher trying to bridge the gap between logic and philosophy of science. Although he certainly is much more of a logician than I am, in many cases, as in the present one, he remains driven by questions stemming from philosophy of science. I am not the only Dutch speaking philosopher influenced by this role model. In Belgium, notably Ghent, he shaped the interests of Jean Paul Van Bendegem, Erik Weber, Helena de Preester and Joke Meheus, to mention only those who have contributed to one of the present two volumes. Certainly the great example in the Netherlands is Evert Willem Beth. Unfortunately I was too young to ever meet him. Although Beth exerted a powerful influence on a whole generation of Dutch philosophers, their emphasis was even more on (mathematical or philosophical) logic and, later, its computational and linguistic applications. Happily enough, Hans Mooij is one of the few exceptions. He was the first supervisor of my dissertation and has now contributed to the present volume. At one time, Johan van Benthem, Beth's indirect successor, seemed to become the great example from and for my own generation. However, after his review-like programmatic paper "The Logical Study of Science" (1982) on general philosophy of science, he, unfortunately for my field, directed his logical skills to other areas. But times seem to change, witness his contribution to the present volume.

Batens' contribution is a typical example of doing logic in the service of philosophy of science. Since his contribution is already an impressive logical sys-

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tem, it may be seen as the idealized point of departure for a really rich logic of induction and so I would like to focus my reply on some points that may be relevant for further concretization. However, before doing that, I would like to situate Batens' project in the realm of different approaches to inductive logic.

1. Kinds of inductive logic

It is interesting to see how Batens deviates from the old approaches to a logic of induction or an inductive logic. Basically, I mean the two approaches initiated by Carnap, the first being based on the idea of first assigning degrees of inductive probability to hypotheses, prior and posterior relative to the evidence, and then basing rules of inference on them that avoid paradoxes, notably the lottery paradox. Hintikka and Hilpinen made serious progress along these lines, although at the price of assigning non-zero prior probabilities to genuine generalizations. Carnap was not willing to pay this price, which makes him a dogmatic skeptic, to use Niiniluoto's (1999) apt phrase for this attitude. Be that as it may, Carnap made the decision-theoretic move by restricting the task of inductive logic to the probability assignments to be used in decisions, taking relevant utilities into account. As can be derived from Ch. 4 of my (2000), even this restricted program of inductive logic, despite its dogmatic skeptic nature, was certainly successful, internally and externally, falsifying Lakatos' premature claim that it was a degenerating program.

It is true that the general idea of an "inductive logic" has several other elaborations. Bayesian philosophy of science is sometimes described this way. As a matter of fact, its standard version can be seen as one of the three basic approaches in the second sense indicated above (see Kuipers 2005, Section 4; and more extensively 2001, Section 7.1.2), viz. the one rejecting dogmatic skepticism, that is, by taking "inductive priors" into account, but also rejecting "inductive (or adaptive) likelihoods". Carnap, in contrast, rejected inductive priors in favor of inductive likelihoods. Finally, Hintikka has chosen the "double inductive" approach, that is, inductive priors and inductive likelihoods. The common feature of these three approaches is that they aim at realizing the property of instantial confirmation or positive instantial relevance: another occurrence of a certain outcome increases its probability for the next trial.

Besides these (restricted or unrestricted) probabilistic approaches to inductive logic, there are a number of totally different approaches. Besides that of Batens, three of them should be mentioned, all of a computational nature. The first one is that of Thagard c.s. (Holland *et al.* 1986; Thagard 1988), leading to

the computer program **PI** (Processes of Induction). The second operates under the heading of “inductive logic programming” (see Flach and Kakas 2000) and the third under “abductive logic programming” (see Kakas *et al.* 1998). Whereas the first is not so much logically inspired, but connectionistic, the other two typically are. Batens’ approach is, at least so far, a purely logical one and hence is rightly called a “logic of induction”. It is a specialization of his own adaptive version of dynamic logic aiming at deriving (inductive) generalizations of the type: for all x , if Ax then Bx .

2. Points for concretization

I shall not concentrate on technical matters regarding Batens’ logic of induction. Although it is presented in a very transparent way by first giving a more informal description of the main means and ends, I do not want to suggest that I have grasped all the details. Incidentally, readers will find in Meheus’ paper another nice entry into adaptive logic. Although Batens writes of modifications rather than concretizations, his contribution, like several others, nicely illustrates that not only the sciences but also philosophy can profit greatly from the idealization & concretization (I&C) strategy.¹ I shall concentrate on some points of concretization that are desirable from the point of view of philosophy of science.

A first point is the restriction to generalizations not referring to individual constants. In my opinion Batens defends this idealization in Section 3 too strongly by referring – as such correctly – to the history of the laws of Galileo and Kepler according to which the reference to the earth and the sun, respectively, disappeared in a way in light of Newton’s theory (see also his Notes 9 and 10). Typically of inductive methods, rather than hypothetico-deductive ones, I would suggest that in particular in the heuristic phase of inductive research programs (see Kuipers 2000, Section 7.5.4) reference to individual objects seems very normal. Indeed, the work of Galileo and Kepler may well be seen from this perspective, whereas Newton indeed saw earth and sun merely as objects of a kind. Moreover, in many areas, e.g. in the humanities, many (qua-

¹ In Kuipers (forthcoming) I illustrate this conceptual version of I&C, as a variant of the empirical version, in terms of the theory of (confirmation, empirical progress, and) truth approximation presented in my (2000). In this illustration the two versions of I&C meet each other: revised truth approximation is a conceptual concretization of basic truth approximation, accounting for empirical concretization, e.g. the transition from the ideal gas law to the law of Van der Waals.

si-) generalizations seem only to make sense when linked to individuals. More precisely, dispositions of human beings are frequently bound to one individual. People may have more or less unique habits. Hence, a realistic logic of induction should be able to deal with generalizations that merely hold for individual objects. Happily enough, Batens claims, also in his Note 9, that it is at least possible to reduce the effect of the relevant restriction to zero.

A second possible concretization is leaving room for falsified background knowledge. In Note 11 Batens explains that it would be possible to do so by moving to paraconsistent logic. To be sure, Batens is the leading European scholar in this enterprise. Although his formulation might suggest otherwise, I am fairly sure that he does not want to suggest that this paraconsistent move requires a complete departure from the present adaptive dynamic approach. What is at stake here seems to be a matter of the order of concretization. The concretization to paraconsistent adaptive logic is a general concretization of that logic, not specifically related to inductive ends. Hence, the question that intrigues me is how important the concretization to paraconsistency is from my philosophy of science point of view. In this respect it is important to note first that I fully subscribe to Batens' first sentence of Note 11: "Scientists may justifiably stick to hypothetical knowledge that is falsified by the empirical data, for example because no non-falsified theory is available" (p. 12). In a way, this sentence could be seen as the main point of departure of my (2000). However, my book develops an explication of this observation that, at least at first sight, completely differs from the paraconsistent move. In this respect it may be interesting to note that paraconsistent logic is still very much "truth/falsity" oriented, whereas my book is basically "empirical progress and truth approximation" oriented. (See Kuipers 2000, Ch. 1, for this distinction.) The strange thing, however, is that although "being falsified" of a theory becomes from my perspective a meaningful but non-dramatic event for a theory, the falsification of a hypothetical inductive generalization (or a first order observational induction, Kuipers 2000, p. 65) is a crucial event. Since the data at a certain moment (t) are composed of (partial) descriptions of realized possibilities $R(t)$ and inductive generalizations based on them, summarized by $S(t)$, a falsification of one of the latter means that the "correct data" assumption is no longer valid. In other words, we have to weaken $S(t)$ in a sufficient way, preferably such that it is just sufficient. Note that this not a concretization move. Note moreover, that it not only holds for the basic approach but also for the refined approach (Kuipers 2000, Ch. 10). To be sure, one may argue in particular that taking falsifications of $S(t)$ into account in some sophisticated way might further concretize the refined approach. However, I submit that scientists will be more in-

clined to adapt $S(t)$ as suggested. Hence, from my point of view, the concretization to paraconsistency is not particularly urgent or even relevant for the role of inductive generalizations in aiming at empirical progress and truth approximation. This attitude seems to be supported by Batens and Haestert (forthcoming) where they extend and improve upon Batens' present contribution. Of course, when genuinely inconsistent theories are at stake the paraconsistent move may become unavoidable.

Another possibility for concretization intrigues me very much. Batens argues at the beginning of Section 6 that it becomes relevant to search for confirming and falsifying instances of “for all x if $A(x)$ then $B(x)$ ” of the type $A(x) \& B(x)$ and, of course, $A(x) \& non-B(x)$, respectively. Although he refers in Note 25 to qualitative confirmation in the sense of Ch. 2 of my (2000), it remains unclear whether my analysis of kinds of non-falsifying instances in terms of two types of confirming instances ($A(x) \& B(x)$ and $non-A(x) \& non-B(x)$) and one type of neutral instances ($non-A(x) \& B(x)$) plays any role. More specifically, from that perspective one would expect, in line with general dynamic logic intuitions, that one starts either with A -cases, and finds out whether they are B or $non-B$, or with $non-B$ -cases, and find out whether they are A or $non-A$. All this in order to avoid searching for neutral cases. If I am right that this selective search does not yet play a role, a concretization in this direction would certainly lead to a more realistic and more efficient logic.²

Let me conclude with a point that has nothing to do with concretization, but that puzzles me a lot. Although I think I can follow why (\dagger) holds in the logic, I do not understand why it is a “simple and intuitive fact” (p. 24) of which it is “unlikely that [it] will be discovered if one does not handle induction in terms of logic” (p. 25, Note 26). The combination seems implausible, but knowing Batens, he must have something serious in mind.

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² Unfortunately, I had difficulties in understanding precisely the core of the paragraph starting with “So in order to speed up our journey towards the stable situation...” (p. 25). Maybe this paragraph entails selective search.

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