# Qualitative and quantitative inference to the best theory. reply to iikka Niiniluoto

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# QUALITATIVE AND QUANTITATIVE INFERENCE TO THE BEST THEORY

## REPLY TO ILKKA NIINILUOTO

Let me start with quoting from my Foreword to SiS:

> I like to mention Ilkka Niiniluoto's *Critical Scientific Realism* (1999) as, as far as I know, the most learned recent exposition of some of the main themes in the philosophy of science in the form of an advanced debate-book, that is, a critical exposition and assessment of the recent literature, including his own major contribution, viz. *Truthlikeness* of 1987. Despite our major differences regarding the topic of truth approximation, I like to express my affinity to, in particular, his rare type of constructive-critical attitude in the philosophy of science.

In the debate between realists and instrumentalists, I share with Niiniluoto a non-essentialist version of realism, taking truth approximation, and hence false theories, seriously. Our first major difference is his emphasis on what I call "actual truth approximation," whereas I focus on "nomic truth approximation." To be sure, he can deal with both, as far as first order languages are concerned, by adding modal operators for nomic truth approximation. Our second major difference is that I seek to remain "qualitative" for as long as possible, whereas Niiniluoto does not hesitate to go "quantitative," even though that makes arbitrary choices necessary. In this reply I will make some remarks on the first point, but focus on the second.

Niiniluoto starts with a clear survey of Peirce's main view on abduction, concluding with the important distinction between "singular" and "theoretical abduction" or between "individual" and "rule abduction" – to use Thagard's (1988) favorite terms – or simply between "individual" and "general abduction." Many expositions fail to make this distinction, but it is essential. In SiS (pp.75-6) I write

> [A]fter an explanation of an individual event by subsumption under a law the really important issue then is to explain this law. In my opinion the core of explanation lies in the explanation of observational laws by subsumption under a theory, in short, theoretical explanation of (observational) laws. After a successful theoretical explanation of a law, we get as an extra bonus a theoretical explanation of the individual events fitting into that law.

In: R. Festa, A. Aliseda and J. Peijnenburg (eds.), *Confirmation, Empirical Progress, and Truth Approximation* (*Poznań Studies in the Philosophy of the Sciences and the Humanities,* vol. 83), pp. 276-280. Amsterdam/Atlanta, GA: Rodopi, 2005.

Hence, theoretical or general abduction is the main kind of abduction in scientific research. This is not to say that individual abduction is nowhere important. On the contrary, in application contexts, e.g. when human experts or expert systems perform diagnostic reasoning, using a knowledge base, individual abduction is the primary form of abduction.

## The Why and When of a Qualitative Approach

After surveying the three (probabilistic) ways in which abductive arguments can serve the justification of the relevant hypothesis, with (standard) "inference to the best explanation (as true)" (IBE) as the most far-reaching one, Niiniluoto turns his attention to IBE's functionality for truth approximation. He appreciates my turn to "inference to the best theory (as the closest to the truth)" (IBT), in particular for its symmetric character (unlike IBE, not only the premise but also the conclusion of IBT is comparative) and its basis in the Success Theorem, according to which "more truthlikeness" guarantees "being at least as successful." His main objection is that my qualitative notion of "more successfulness" and "more truthlikeness" are not frequently applicable. He concludes Section 3 with the correct observation: "in many cases there will be no single theory which is better than all the available alternatives, so that a rule like IBT is inapplicable" (p. 264). However, instead of forcing the existence of a best theory by going quantitative, as Niiniluoto favors, even when the subject matter gives no plausible distances between the structures (or sentences) to be compared, I am interested in the clues given by my analysis when there is no best theory or, more generally, when two theories are incomparable. In SiS I have been more explicit in this than in ICR:

> Finally, it is important to stress that the strict [qualitative] strategy does not lead to void or almost void methodological principles. If there is divided success between theories, the Principle of Improvement amounts, more specifically, to the recommendation that we should try to apply the Principle of Dialectics: "Aim at a success preserving synthesis of the two RS-escaping theories" [where RS refers to the Rule of Success, the purely methodological side of IBT]…. Similarly, for truth approximation aims: if there is reason to suppose that two theories cannot be ordered in terms of 'more truthlikeness' in the strict sense, the challenge is to construe a theory which is more truthlike than both. In sum, the restricted applicability of strict notions of comparative success and truthlikeness does not exclude the possibility of clear challenges being formulated in cases where they do not apply, on the contrary." (SiS, p. 250).

Of course, when the subject matter suggests meaningful distances and probabilities, one may want to go further. Moreover, we should like to have as the quantitative variant of the (backward) Success Theorem, the expected success (ES) principle (ICR, p. 303, p. 310): the expected success increases with increasing closeness to the truth. Using Niiniluoto's plausible concept of

"estimated truthlikeness" as the probabilistic specification of (quantitative) success we get (ICR, p. 314): the expected value of the estimated truthlikeness increases with increasing closeness to the truth. This would justify the quantitative use of IBT, but other (non-) probabilistic specifications of success might be defensible as well. Be that as it may, Niiniluoto focuses on the "forward" version of a kind of ES principle, his principle (19), according to which estimated truthlikeness increases with being a better approximate explanation, which, assuming a quantitative specification of the latter, amounts to: estimated truthlikeness increases with increasing success. To be sure, this sounds like a justification of the quantitative use of IBT, but it has a circular feature: success and estimated truthlikeness are based on the same evidence. Hence, for a genuine justification of such a use of IBT what we would need, besides meaningful distances and probabilities, is an additional link between estimated truthlikeness and "true" or "objective" truthlikeness, that is, something like the ES principle.

## Monadic First-Order Languages

In Section 5 Niiniluoto compares several qualitative and quantitative principles in the special case of a (non-modal) monadic first-order language. Whereas I have to concede that the Clifford distance measure (roughly, counting the number of elementary differences) is rather arbitrary in this case and that inductive probabilities have no objective basis, I would also like to remark, in contrast to what Niiniluoto seems to think, that non-modal monadic constituents are directly interesting from the nomic perspective, for they allow straightforward nomic illustrations. For example, theories classifying chemical elements, such as the periodic table, may not only be read as claims about actually existing elements, but also, or even preferably, as claims of nomically possible existing elements, whether or not they have already been produced by nature or artificially. Hence, although a modal formalization is certainly possible, this is not necessary in this case.

Let me summarize the main results claimed by Niiniluoto. By (21) he specifies the Success Theorem for "constituent-theories" (and later informally for arbitrary theories and, in a restricted form, for theories with theoretical terms) and adds that only "very few" false constituents are comparable in my qualitative, set-theoretic way. However, apart from the general relativization of incomparability given above, the question is: what is "very few" in this context? Given a certain constituent, and hence a certain symmetric difference relative to the true constituent, the number of constituents closer to the truth, and hence, the number of possible qualitative improvements, is equal to the number of subsets of that symmetric difference. Hence, in absolute terms, this number may be very high.

The same holds for the number of possible worsenings. To be sure, *relative* to the number of qualitatively incomparable changes, both numbers are small, as a rule.

Niiniluoto concedes that (22), that is, his favorite quantitative, generalized, version of the success theorem (21) is invalid. This is so because the antecedence of (22) allows evidence in which relatively many of the correct Q-predicates of a less truthlike constituent are instantiated. Later Niiniluoto argues that the generalization of (22) to arbitrary theories and to theories with theoretical terms is invalid for similar reasons. In sum, the lesson is that the success theorem (21) is only valid for the qualitative case, which is only applicable in *relatively* few cases. More generally, I think that expecting (21) to be valid in any deterministic quantitative sense, however restricted, is too much. It seems more plausible to think in terms of the (probabilistic) ES principle mentioned above, and I am puzzled why Niiniluoto does not pay attention to it. In correspondence Niiniluoto refers to a theorem in this direction in (Niiniluoto 1984, (12), p. 92 and (16), p. 170) in terms of "true" and "fully informative" (or "non-misleading") evidence. However, this is still of a very limited kind, for the theorem's condition amounts to the claim that "the constituent corresponding to the evidence" is the true one. The theorem says that under that condition the estimated truthlikeness of that constituent, that is, the true one, approaches the maximum value. The remaining challenge is to generalize this result to the comparative case: increasing closeness to the truth should lead to an increasing expected value of the estimated truthlikeness.

Turning to the "upward" (or "forward") problem of abduction, and using Hintikka's system of inductive probabilities, Niiniluoto specifies (19) (estimated truthlikeness increases with increasing success) by (23) for monadic constituents and argues that a similar specification can be given of the non-symmetric variant of (19), viz. (20), and plausibly claims that both can be generalized to arbitrary theories and theories with theoretical terms.

Since all these claims presuppose a context, such as a monadic first-order language, in which all relevant theories are available, including the true one, this is not yet realistic. For this reason, Niiniluoto finally surveys three different ways of dealing with theories sharing a false idealizing presupposition as developed in his (1987). Here only the first one may have a qualitative counterpart. More specifically, it would be interesting to investigate its relation to my treatment of truth approximation by concretization, based on refined qualitative truthlikeness, in ICR (pp. 268-71), including Niiniluoto's interesting suggestion of "modifying …. the basic idea of the Converse Consequence principle," according to which confirmation of a concretization of an idealized assumption entails (some kind of) confirmation of that assumption.

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