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Empirical progress and nomic truth approximation revisited

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ABSTRACT

In my *From Instrumentalism to Constructive Realism* (2000) I have shown how an instrumentalist account of empirical progress can be related to nomic truth approximation. However, it was assumed that a strong notion of nomic theories was needed for that analysis. In this paper it is shown, in terms of truth and falsity content, that the analysis already applies when, in line with scientific common sense, nomic theories are merely assumed to exclude certain conceptual possibilities as nomic possibilities.

1. Introduction

The intuitive idea underlying the notion of truth approximation can be expressed as follows: one theory is closer to the truth than another when the first says more things about the domain under investigation and more of all things said are true. The first formal definition of 'closer to the truth', or 'more truthlike' or 'more verisimilar', was proposed by Popper (1963). According to Popper, a theory is more truthlike than another if the former implies more true sentences and fewer false sentences than the latter. Notwithstanding its intuitive appeal, Popper's definition was shown to be untenable by Tichý (1974) and Miller (1974), who independently proved that, according to this definition, a false theory can never be closer to the truth than another (true or false) theory. The Tichý-Miller theorem opened the way to the post-Popperian approaches to truthlikeness, which have emerged since 1975. Such approaches escape the strictures pointed out by Tichý and Miller, allowing for a comparison of at least some false theories with regard to their closeness to the truth. Excellent surveys of most post-Popperian accounts of verisimilitude can be found in Niiniluoto (1998), Zwart (2001) and Oddie (2008).

In Kuipers (1982, 1984, 2000) I have developed the so-called *nomic* account. The intuitive idea underlying the notion of *nomic truthlikeness* can be expressed as follows. Given a domain of inquiry, let U be the set of all relevant *conceptual possibilities* which might occur within this domain. U may be construed as the conceptual frame of a given scientific inquiry, specifying the relevant kinds of objects, events or states of natural systems or artifacts under investigation. As an example, U may contain four kinds of object: 'black raven', 'black non-raven', 'non-black raven' and 'non-black non-raven'. One may assume that there is a unique subset **T** of U, including precisely all *nomic possibilities*, i.e., all conceptual possibilities which are 'really' possible in the domain of inquiry. Here, 'nomic possibilities' may assume different meanings, depending on the particular context: e.g., **T** may concern the physical, chemical, biological, psychological or socio-economical possibilities of the domain. Of course, the set U−**T** is then the set of the *nomic impossibilities*, i.e., the set of those conceptual possibilities which are impossible as a matter of fact. For example, **T** might contain the conceptual possibilities 'black raven', 'black non-raven', and 'non-black non-raven', whereas U−**T** might contain the conceptual possibility 'non-black raven'. Since theory-oriented

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scientists usually aim at understanding and discovering the nomic features of the world, **T** can be construed as the target, or 'the great unknown', of scientific inquiry. Accordingly, **T** may be construed as the (whole) *nomic truth* about the domain and the *nomic truthlikeness* of a nomic theory may be defined as its similarity or nearness to the nomic truth **T**. The *logical* problem of nomic truthlikeness thus amounts to the explication of the idea that a given theory is closer to **T** than another.

As long as **T** is unknown, solving the logical problem of nomic truthlikeness by an explication does not enable direct applications. The *empirical* problem of nomic truthlikeness is to relate the explication to empirical evidence in a convincing way, i.e., in such a way that we may have good empirical reasons to conclude, for the time being, that a new theory is closer to the nomic truth than an old one. That is, that we approximate the nomic truth better or more by the new one than by the old. It is plausible to try to link truth approximation in this tentative sense to (an explication of the idea of) empirical progress, a notion that is used by realists and instrumentalists.

More specifically, explicating 'empirical progress' and '(nomic) truth approximation' should do justice to some basic instrumentalist/empiricist and realist Conditions of Adequacy.

> ***CA-instrumentalist***: the explication of 'empirical progress' (1) should at most make use of inductive steps and (2) should not be laden by realist notions, notably, 'the truth' and 'closer to the truth'.
> ***CA-realist***: the explication of 'truth approximation' and 'empirical progress' should be such that (1) 'truth approximation' explains 'empirical progress' and (2) 'empirical progress' supports the 'truth approximation'-hypothesis.

The first condition is important in order to convince instrumentalists that the realist intentions in the second condition pertain to their crucial notion of empirical progress. The notion of 'estimated progress' of Niiniluoto (1987, 2011) cannot work in this respect. It evidently does not satisfy the first condition, for it is defined as (the degree of) increase of estimated verisimilitude, a highly plausible, but typical realist notion for it is based on Niiniluoto's well-known quantitative measure of verisimilitude.

After 30 years, I discovered in 2012 that my qualitative approach to nomic truth approximation and empirical progress (Kuipers, 1982, 1984, 2000) can be presented in a much more general way than I always thought. The definition of 'closer to the truth' can already be conceptually motivated by assuming that the claim of a theory only excludes certain conceptual possibilities as nomic possibilities, i.e. the 'exclusion claim'. I always thought that the 'inclusion claim' had to be added that the not excluded possibilities were nomically possible. The new, simplified approach to nomic truth approximation was strongly stimulated by the related work of Gustavo Cevolani, Vincenzo Crupi and Roberto Festa (2011).

In Section 2 the simplified story based on the exclusion claim will be presented in its 'basic' form, that is, the explication of nomic truth approximation and its relation to empirical progress assuming that there is just one language that generates the conceptual possibilities. In Section 3 the story will be concretized by taking the crucial (theory-relative) distinction between an observational language and a theoretical language into account. In this case, nomic truth approximation is of course explicated in terms of the theoretical language and empirical progress in terms of the observational language. Finally, in Section 4 several perspectives of the simplified account will be presented.

2. The basic story

Let me start with my favorite toy example of theory oriented science. To represent an electric circuit with several switches and bulbs the language will have elementary propositions that enable to indicate which switches are on and which are off and also to indicate which bulbs give light and which do not. Among the conceptually possible states there will at any moment be one actual state, but several other states are also physically possible. To represent these states by one proposition or theory one will have to design a complex proposition, the nomic truth. All states in which this proposition is true are physically possible, all others are not. All propositions that can be formulated in the indicated language may be considered as candidates for being this nomic truth and, at least intuitively, one proposition may be closer to the truth than another. This may be a toy example for representing theory oriented science, but in present day epigenetics there is even a close analogy: genes are considered as switches that may be on or off. However this may be, only the general tenet of the example is relevant: theory oriented science is ultimately aiming at characterizing what is physically or biologically possible and theories are tested by experiments which are realizations of possibilities.

Let U, as above, indicate the set of *conceptual possibilities* in a given context (e.g. the possible states of a system), generated by a descriptive vocabulary V in which U is, and subsets of U, e.g. X, Y, R, S, can be characterized. Let (bold) **T** indicate the subset of *nomic*, e.g. physical, *possibilities*, and hence c**T** (the complement of **T**, $U - \mathbf{T}$) the subset of nomic *im*possibilities. By the bold '**T**' we indicate that we do not (yet) dispose of a characterization of it in terms of V. See Fig. 1. The *target of research* is identifying, if possible, **T**'s boundary in V-terms, indicated by (non-bold) T, hence T = **T**, assuming such a characterization exists, which I will do throughout in this paper. T will be called 'the (explicit) truth', for reasons that will become clear.

In a nomic context attempts to characterize **T** in V-terms are primarily done by theories that exclude certain conceptual possibilities as nomic possibilities. Let theory $\underline{X}$, or simply $\underline{X}$, indicate a subset X of U, defined in V-terms, with the (exclusion) claim "$\mathbf{T} \subseteq X$", or equivalently "$cX \subseteq c\mathbf{T}$", i.e., all non-members of X are *excluded* as nomic possibilities.

It is now plausible to define that $\underline{X}$ is *true* iff its claim is true, i.e. iff $cX \subseteq c\mathbf{T}$, that is, iff $cX - c\mathbf{T} = \varnothing$, *false* otherwise. It is easy to see that there is at most one strongest true theory, called *the true theory* or *the (explicit) truth*, viz. the characterization of **T** in V-terms, *if it exists*, as before indicated by T, with non-bold 'T', i.e. the target of research!

It is also plausible to define:

the *truth content* of $\underline{X}$, $TC(\underline{X})$: the largest subset of cX which is also a subset of c**T:** $cX \cap c\mathbf{T}$, that is, the subset of those members of cX for which the claim $cX \subseteq c\mathbf{T}$ is true,
the *falsity content* of $\underline{X}$, $FC(\underline{X})$: the largest subset of cX which is also a subset of **T**: $cX \cap \mathbf{T} = cX - c\mathbf{T}$, that is, the subset of those members of cX for which the claim $cX \subseteq c\mathbf{T}$ is false.

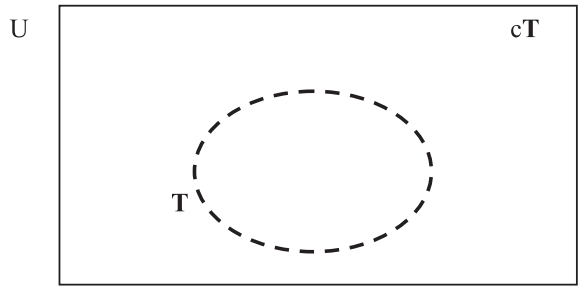

Fig. 1. The set of conceptual possibilities U and the (unknown) subset of nomic possibilities **T**.

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