

**EVEN IF
(Even if Popper solved the problem of induction, Popperians still
cannot be rational agents.)***

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Abstract. Popper claimed to have solved the problem of induction, but he reformulated the problem. According to Popper, the aim of science is searching for true theories. Instead of that, and because of practical reasons it is important to predict reliably or at least rationally. The problem of induction is primarily concerned with predicting the future, while falsificationism is able to provide only a rational reconstruction of past events. Falsificationism is therefore irrelevant for rational agents. If a Popperian objects that the rational agent does not need any knowledge, we can answer by using the manoeuvre “even if” which Popper himself employed.

1. Why do we need knowledge?

Why do we consider science valuable? Are we aiming at truth, or at usefulness?

The truth may indeed be useful. But one may claim that it is only a side-effect. The others, called pragmatists, declare that the truth can be reduced to usefulness. There may exist even more complicated relations (Reichenbach 1952:69). As far as we can describe the attitude towards knowledge by historical periods, then ancient and medieval philosophers considered knowledge as the aim in itself. This attitude changed in modern times, when science and technology started to develop rapidly. A man of modern times was both curious about nature and wanted to apply his knowledge in practical affairs¹. The sought knowledge was defined as knowledge that could be used.

It is usual to hold that modern epistemology attacked medieval views on the ground that knowledge must be checkable and checked. But there was also the demand of usefulness of knowledge in our temporal world, which in turn *requires* that knowledge should be formulated in empirical terms. The modern attack against

* I am thankful to Mr. Mark Notturmo for a fruitful discussion.

¹ David Hume was sometimes ambivalent concerning the motivation of our search for knowledge. He lets nature say for us: “Indulge your passion for science...but let your science be human and such as may have a direct reference to action and society.” (1996: §4).

medieval views is against *both* metaphysics and mysticism – against medieval definition and sources of knowledge.

In the 20th century this new attitude is exemplified in Popper's (1983) principle of falsifiability and his method of falsifications. Historically, this turn of mind was motivated by the demand for usefulness. We shall argue that Popper's philosophy fails to satisfy this practical demand. Or more precisely: it has not been proved that Popper's method satisfies the practical demand. In the present paper we accept inductive scepticism as Popper did.

One may object that even if modern epistemological aims were initially motivated by the demand of usefulness, they can still be regarded as aims in themselves. We think that only natural, but Popper's epistemology does not satisfy the practical demand. Even worse: this kind of philosophy is profiting from the fact that people believe that it does. Popper's philosophy, however, answers instead only the problems which were initially *motivated* by the practical demands. It does not seem to be an urgent task to answer these – initially practically motivated – questions, if we cannot answer them in a way which can satisfy our initial desires. A Popperian may object that we are "justificationists". It is, in fact, Popper who is a justificationist. He considers true theories as an aim *per se*, while trying to rehabilitate medieval views under the name of modern views.

There are *different possible epistemological aims*. Within pure epistemology, there are no reasons to prefer one to another. Motivation can emerge from outside epistemology. One good reason of preference would be usefulness. Popper prefers the epistemological aim (*true theories*), which was initially *motivated* by the demand of usefulness. But the aim that he reaches (*true reconstruction of past events*) is disconnected from usefulness. There is another epistemological aim (*true predictions*), neglected by Popper, but connected with usefulness, which would be historically more correctly related with the problem of induction.

2. The problem of induction and its consequences

Hume (1985, 1996) presupposed that we have a direct knowledge of present and past events, but not of future events. We have no *a priori* knowledge either. Knowledge about future events, if we indeed have any, must be an inferred knowledge. Hume considered only *inductive* inferences. But are these inferences rationally *justified*? This problem is called the "*problem of induction*". Hume's opinion was that there were no reasons to believe in the conclusions of inductive inferences. Therefore, *we do not know anything about future events*. We merely believe in the results of the inductive inferences, but this belief is not rationally justified. Hume's negative conclusion is called the "*inductive scepticism*".

Kant (1965, 1997) made a famous attempt to refute Hume's scepticism, but he changed the *presuppositions* of the problem. He assumed that we have *a priori* knowledge. He also took for granted that we know the natural laws – the main

issue for Hume. He also confused the presuppositions of the problem with its solution².

There have been attempts to *add* some assumptions to Hume's. The most obvious possibility is to assume *a priori* validity of the principle of induction¹³. Why should anyone actually believe in the truthfulness of additional assumptions? Trying to find reasons for that, the problem of an infinite regress emerges.

One can argue that the principle of induction is inductively justified and that this is *not* a vicious circle (Black, 1974). But inductive arguments are not the only ones that are "self-supporting". Besides, from Goodman's (1983) investigations it follows that inductive inferences are *relative* to the conceptual system. Inductive arguments are "self-supporting" in *any* conceptual system. Yet they yield to different predictions if made in different conceptual systems.

Talking about the "solution" to the "problem of induction", a derivative, *secondary* problem is often considered, and not the initial one. In the present paper we shall investigate such secondary problems. We shall *accept* Hume's presuppositions and his scepticism. We shall follow the *implications* of such an acceptance. We shall consider two questions:

1) *What is rationality?*

From inductive scepticism it follows that if rationality is possible, it cannot be identified with justification.

2) *What epistemological aims must be chosen?*

From inductive scepticism it follows that the seemingly coinciding epistemological aims are different, which in turn, according to the means-ends model of rationality, yields to different conceptions of rationality.

2.1. *The problem of rationality*

The problem whether inductive inferences from past to future are justified, can be called the *primary* problem of induction. It is reasonable to discern different aspects of this problem, like *epistemological*, *practical* and *ethical* aspects⁴. Inductive scepticism is a presupposition for a lot of problems. The problems relevant to the primary one and its aspects can be called the *secondary* problems of induction.

The most comprehensive secondary problem seems to be the problem of rationality. *What is rationality if Hume's sceptical result is true?* Again we can discern different aspects of the problem: 1) What method is *epistemologically rational* if inductive scepticism is true? 2) What epistemological method is *rational*

² My interpretation of Kant's epistemology and my arguments against it were fully presented in my manuscript: Eintalu, J. *Hume's Arguments*. Tallinn, 1999.

³ One can try to interpret Russell's (1996) attitude in such a way.

⁴ *Epistemological* problem is purely about knowledge. *Practical* problem is about rational action. The problem of knowledge arises here in the context that we supposedly need knowledge when planning our actions. I discern also a *third*, the *normative* aspect, which arises mainly in connection with *ethics* (Eintalu & Notturmo 1999b:2368).

from the viewpoint of rational action, if inductive scepticism is true? It is not *a priori* evident that an *epistemologically* rational method should coincide with an epistemological method which is rational from the viewpoint of the rational agent.

In the 20th century the inductive scepticism has been accepted by Russell (1992a, 1996:634), Popper (1983, 1991:9) and Reichenbach (1952:342). In one or another version they posed the secondary problem of induction, “the problem of rationality”⁵.

Russell (1996:646) tackled the question of a possibility to discern between *sanity* and *insanity* if induction is not justified. He also posed the problem of *subjectivity* and *relativism* in connection with the problem of induction. His question was about whether rationality is reduced to the voice of majority (1996:646).

Popper reformulated the problem of induction (1991:3–4) as the problem of how one can empirically prefer one scientific theory to another (1991:8). He thought that science could be *rational* in spite of inductive scepticism (1991:5). The method of *conjectures and refutations* is rational, and it is also the solution to the problem of induction (1991:9). It is rational to propose hypotheses, to check them and to reject the refuted ones. Inductive inferences are of no importance here.

Reichenbach (1952:348–349) thought that it is possible to “justify” inductive inferences in spite of the fact that we cannot prove the validity of their conclusions. Even if we do not know the truth about the future, there can nevertheless be the “best” posit about the future. He thought that inductive inferences provide us with the “best” posit about the future and can be “justified” in *this* sense. He considered his “justification” as a solution to the problem of induction (1952:356). His “justification” was later called “*vindication*”⁶.

If inductive inferences could be justified, then it would be rational to use inductive inferences. It would also be rational to prefer the justified theory. While this inference is *valid*, it is not *correct*, if inductive scepticism is true. Still, one cannot yet infer that there can be no rationality, if inductive scepticism is true. It is not quite clear what we mean by the term “rationality”. Therefore one cannot say *a priori* that there can be no rationality. “Rational preference” is a logically weaker notion than “justification” and we have not yet fixed it. There is a difference between the problem of rational preference and the problem of justification⁷.

The implication from “unjustified” to “non-rational” can be only contingent, depending on the accepted notion of “rationality”. One can argue that many definitions of rationality are of that kind. However, one cannot argue inductively in the case of the problem of induction. While all proposals have been refuted, it is still impossible to demonstrate that there is no other and better definition of rationality.

⁵ Already W. Whewell proposed such a shift of problems (Wetterstern 1994:718; 723). Pascal’s Wager (Hacking 1993:63–72) can be considered (Musgrave 1993:519) as a precedent for Popper’s idea that a reason for believing something need not be a reason for what is believed.

⁶ H. Feigl used the term “vindication” (Putnam 1975:132; 146–147). The term “pragmatic justification of induction” has been also used (Salmon 1974:85–97).

⁷ H. Bohlin’s (1997:12) formulations are quite confusing.

I myself *believe* that there are only unreasonable definitions of rationality, where the secondary problem of induction can be “solved” – and there are reasonable definitions of rationality where it cannot be solved. I cannot *prove* it.

The heart of the problem lies in what should be regarded as a “relevant” and “close” problem following from inductive scepticism, and what is the “reasonable definition of rationality”. We do not want to regard *every* problem as the “problem of induction”. Not every question deserves an answer. Not every definition of “rationality” is reasonable. The real question is how we should *define* the sought rationality.

Popper (1995) argued that we must adopt his method because of irrational “faith in reason”. It sounds like an irrational faith in the principle of induction. While Popper denied it, he has not offered any other hints what his “reason” has to do with the problem of induction. Bartley (1962) argued that critical rationalism is rational according to its own standards (see also (Miller 1994:77–93). Musgrave (1993:524–525) objected that there are many principles that are “self-subsumptive”. But no-one has explained what the “faith in reason” or the internal coherence of an epistemological algorithm has to do with the solution to the problem of induction.

In the following, we shall measure the *relevance* of the proposed concepts of rationality against the problem of induction. We shall consider rationality relative to the posed *aims* and we shall estimate the relevance of the posed *aims* to the problem of induction.

2.2. Different epistemological aims

Let us consider a narrower conception of rationality – the rationality of *means to ends*⁸. It is irrational to use methods of which we know for certain that they do not help us achieve our aims. Therefore, our conception of rationality depends on the *choice* of our aims. It follows from inductive scepticism that the epistemological aims, which seemed to coincide, are actually different. It has not yet been sufficiently noted. That is why there are important equivocations concerning the notion of rationality. Our aims may be too far from the primary problem of induction and its aspects. Hence the ambiguities about what the “problem of induction” consists in and what should be a proper solution for it.

There are two important different formulations of epistemological aims: to reach *true theories* and to reach *true predictions*. The first was preferred by Popper (1991:8), the second by Reichenbach (1952:344).

A true theory provides us with a true description of the past, present and future events. Let us assume that we know the past and present events. It follows that if

⁸ A Popperian may object that the means-ends analysis gives a too narrow conception of rationality. Still, it is surprisingly illuminating in the case of the problem of induction. It helps us to clarify mistakes made by Popperians.

Forster (1995:351) follows “...Hempel’s admonishment that rationality only makes sense relative to a goal...” I do not argue that rationality makes sense *only* relative to a goal. I argue that the means-ends concept of rationality makes sense in the case of the problem of induction.

we reach one aim, we reach also another and *vice versa*: reaching the true theory is identical to reaching the true predictions. *Knowing* which theory is true is also equivalent to knowing which predictions are true:

$$K(T) = K(P). \quad (1)$$

We must not forget the *time perspective*. In the case of (1) “ $K(T)$ ” must be understood as ‘*knowing at some time moment “t” both the past, present and the future*’. Otherwise “knowing which predictions are true” – $K(P)$ – is reduced to “knowing which predictions were true”⁹.

From inductive scepticism it follows that we do not know the future:

$$\sim K(P). \quad (2)$$

It implies that we do not know which theories are true:

$$\sim K(T). \quad (3)$$

It must be read as “there is no time moment t when we know everything”.

After (2) and (3) we could still declare that our aim is to *know* true theories or true predictions. It is irrational, however, to posit a non-reachable aim. We can still declare that our aim is to *reach* true theories or true predictions, even without knowing them¹⁰. Then we should ask which are the rational means to ends.

Let us suppose that method M_1 is a rational method to achieve true *theories* and method M_2 is a rational method to achieve true *predictions*:

$$M_1(T) \ \& \ M_2(P). \quad (4)$$

The second method is also rational for the first end, but it does not yet follow that the first method is rational for the second end:

$$M_2(P) \rightarrow M_2(T) \quad (5)$$

$$\sim [M_1(T) \rightarrow M_1(P)]. \quad (6)$$

The aim of reaching true predictions is logically stronger than the aim of reaching true theories. It is analytically true that we predict the future *before* it comes. But one can aim at true theories independently of the *time perspective*. Popper dismissed this nuance.

Maybe there is a method M of rational preference between theories, or achieving “good” theories, which does not pretend to achieve true theories, but aims at a weaker end, which is still closely related to the notion of truth¹¹. There may also be a “rational predictive method” M , which does not pretend to be a rational method of achieving true predictions, but aims at some weaker end, which

⁹ Russell (1992a:151) discerns between “past futures” and “future futures”.

¹⁰ According to Popper (1983, 1991), our aim is to reach true theories and we cannot know whether we reached them.

¹¹ Any implication of the true theory may be such an aim. The aim of reaching the theories, which are true about *past* events, is such an aim. Maybe Popper’s notion of *verisimilitude* is also relevant.

is still closely related to the notion of true predictions¹². The rational method of predictions can then be irrational from the viewpoint of “good” theories:

$$\sim[M(P) \rightarrow M(T)]. \quad (7)$$

The rational method of choice between theories does not necessarily have to coincide with the rational method of choice between predictions:

$$M(T) \neq M(P). \quad (8)$$

It would be better to say that we have two *different* epistemological aims (and corresponding derivative ends): finding the preferred *theories* and the preferred *predictions*. There are two different aims: *to achieve good theories* and *to achieve good predictions* – in any sense of the word “good”. If one argues that these aims are coinciding, one must specify one’s definitions and conditions.

Methods M_1 and M_2 in (4) – (6) can coincide (i.e. the formula (6) can be false) if we formulate our first aim more precisely as the aim of reaching true theories *beforehand*. But if we do not require that the *time perspective* must be taken into consideration, then, without additional specifications and theorems, we have no idea whatsoever about why the rational method of achieving true theories should also be rational from the viewpoint of true predictions.

The aim of reaching true theories independently of the time perspective in falsificationism is reduced to the aim of reaching the theories, which are true about past events. A falsificationist’s aim is to actually reach the true description of the *history* of events, to get retrospective wisdom. According to the accepted inductive scepticism, there are no reasons at all to believe that the theory, that has not been refuted, shall give true predictions or that the refuted theory shall not give true predictions. It is easy to claim that one’s heart desires to jump to the heaven. Nevertheless, if one accepts that it is impossible to jump higher than 100 metres, one can as well say that one’s aim is to jump no more than 100 metres¹³.

While there are some possibilities to *try* to show that falsificationism is a rational method of predictions, Popper and his followers (except some rare and obscure exceptions) have dismissed all such attempts as “justificationist”.

Rational methods of describing¹⁴ the past do not necessarily have to coincide with the rational methods of predicting the future. The rational method $M(H)$ of achieving true theoretical description of the history H does not necessarily have to

¹² Reichenbach’s (1952:350) aim to achieve a good statistics of true predictions (instead of true predictions) is such an aim.

¹³ It is meaningless to declare that a rational method of driving a car is also a rational method of driving a car *and* of swimming. It is irrelevant whether it turns out that you can swim.

¹⁴ At first sight it seems as if Popper chose the aim of reaching true theories instead of the aim of reaching knowledge about which theories are true. It turns out, however, that he chose the aim of reaching knowledge about which theories are true about past events instead of the aim of reaching knowledge about which theories are true. In the case of future events he cannot provide either knowledge or the rational method of achieving the truth.

coincide with the rational method $M(P)$ of achieving true predictions P and *vice versa*:

$$M(H) \neq M(P). \quad (9)$$

It would be proper to say that there are two different epistemological aims: one concerned with the *past* and one concerned with the *future*. Popper's aim concerns the past.

Should we investigate the past or should we investigate the future? Within pure epistemology there are no criteria to decide between them. To consider one of them rather than the other as a "proper" aim and/or to connect it with the secondary problem of induction is an arbitrary decision.

The choice can be motivated by the demand that epistemological results must be applicable in practical affairs. We usually assume that knowledge about the consequences of our actions is needed *before* we are making our decisions. This was Reichenbach's motivation for posing the aim of true predictions (1952:315–316). But then Popper's choice to search for true theories independently of the time perspective is not motivated. It is also too far from the tradition, since the initial problem of induction, as it was formulated by Hume (1985:140, 1996: §29), was the problem about *predictions*. It was the problem of knowing the *future* and it was primarily motivated by the problem of *practical action* (1985:226, 1996: §110).

It is not proper to say that a solution to the problem about the future consists in the solution to the problem about the past. Even if Popper solved a problem, it is not etymologically correct to say that he solved the problem of *induction*. Also the question arises whether Popper's problem was actually worth solving. Referring to the truth as the obvious aim considers knowledge itself as a sufficient motivation, which needs no motivation from outside. In falsificationism, though, this aim is reduced to the aim of reaching the truth about the past. Inside pure epistemology there can be only one reason to prefer that aim. It is the claim that there are no rational methods for dealing with the future.

It has not been shown, however, and it cannot be shown that there are no rational methods of prediction. The only arguments which have been presented, are the justificationist ones. To explain how Popperians reject any attempts to search for a rational method of predictions, we must consider the heresy of *justificationism*.

How do Popperians pose their aim? Popperians hold that the classical notion of rationality coincides with the notion of justification. But after Hume it is clear that we cannot justify our theories. Still, philosophers (Notturmo 1985:1–8) often tacitly assume that we can justify our theories. Their conception of rationality is justified (or motivated) only in so far as we can justify our theories. So they are *justificationists*. We claim that falsificationism is not able to provide a rational method of predictions. Popperians have answered that our accusation originates from our tacit justificationist assumptions. But in classical epistemological theories the *truth* as an aim was motivated by the assumption that we can justify our theories. Truth is practically valuable, since if we know the truth then we can truly predict. After Hume it is clear that we cannot justify our theories. Philosophers (like Popper

and Notturmo) nevertheless often tacitly assume that we can justify our theories: they continue to hold that the truth is a valuable aim. So they are justificationists.

How do Popperians reject Reichenbach's aim? In the case (5)–(6) there are logical reasons to prefer the aim of true predictions. Inductive scepticism directly implies that *knowledge* about past *and* future is not reachable. Achieving the *truth* (even without knowing it) about past *and* future is a weaker end. It has not yet been shown that there are no rational methods of achieving such truth. It makes sense to ask which method is rational when aiming at such truth. This was Reichenbach's (1952) question. If *knowledge* about past *and* future is not reachable, then achieving knowledge about *only* past is *also* a weaker end. This was Popper's (1991) end. It is also weaker than Reichenbach's aim. If inductive scepticism implies that we must be satisfied with aiming at truth (even without knowing it), it still does not mean that it follows that we must be satisfied with aiming at truth *independently of the time perspective*. If we cannot justify our theories, we can still aim at true theories – this was Popper's formulation. It still seems as if Popper was a justificationist when stating that if we cannot justify our theories, then we can only aim at true descriptions of the past. Popper seems to assume that there can be no rational methods of aiming at true predictions. But this assumption can directly follow only from a justificationist presumption that rationality and justification are identical. After such a justificationist move one can infer that everyone who searches for a rational predictive method is a justificationist.

I *believe* that a rational method of predictions is impossible. Popper did not *show* that it was impossible, unless he was a justificationist. The belief *that* he showed originates from justificationist assumptions.

3. Sufficient and necessary means

Usually (see e.g. Von Wright 1980:46;73) the *practical syllogism* is formulated referring to the necessary means:

Agent *A* wants to achieve *E*.

Agent *A* thinks that it is *necessary* to do *M* to achieve *E*. (10)

Therefore: Agent *A* does *M*.

In *practical affairs* we often know which means to ends are the necessary ones, but we do not know whether they are sufficient. Our action can often be explained referring to the necessary steps we thought we must take to achieve our ends. Such steps can be regarded as compulsory, in a sense, to the rational agent (Von Wright 1980:29).

In *cognitive affairs* the same logic also works. Reichenbach (1952:349):

If we cannot realize the sufficient conditions of success, we shall at least realize the necessary conditions. If we were able to show that the inductive inference is a necessary condition of success, it would be justified; such a proof would satisfy any demands which may be raised about the justification of induction.

Reichenbach's aim was to achieve true predictions. He considered the necessary means to this aim as "justified" and, we may say, as rational. He identified this necessary means with inductive inferences. Popper's aim was to achieve true theories. It is necessary to abandon false theories, when aiming at true ones. While Popper did not say that his method is a necessary one, it still seems to be rational in Reichenbach's sense, relative to Popper's aim. And while Reichenbach declared that he is searching for a necessary method, he in fact searched for a conditionally sufficient method instead¹⁵.

We thus think that the main difference between Popper and Reichenbach's approaches consists not in the *methods* used, as is usually considered, but in the identification of the *aims* of science. In other respects their reasoning is analogous (see Table 1):

Table 1

Popper and Reichenbach's methods compared

	aim	necessary means	failure
Popper	true theories	to abandon refuted theories	chosen aim is irrelevant to rational agent's needs and to the problem of induction
Reichenbach	true predictions	induction (projecting the observed ratio of favourable cases to the possible ones)	fails to prove that induction is the necessary means

Following tradition, we connect the term "*justification*" with the term "*sufficient means*" and the term "*vindication*" with the term "*necessary means*". A cognitive method is vindicated if it has been *shown* that it is a necessary means to achieve the desired goal. Vindication is *relative* to chosen aims. One can try to vindicate Popper's method (falsificationism) relative to Reichenbach's aim (true predictions)¹⁶, or to vindicate Reichenbach's method (induction) relative to Popper's aim (true theories).

The idea of a necessary method was firstly systematically employed by Popper in his *The Logic of Scientific Discovery* (1934) (Popper 1983). Popper did not stress that his method is a necessary one. But his distinctions between universal and existential statements and between justification and refutation are corresponding to the distinction between sufficient and necessary means. One may think that Popper's method of refutations is vindicated relative to the aim of achieving the true

¹⁵ In another context Reichenbach still makes use of the necessary method. We mean Reichenbach's (1952:350–351) aim to achieve a good statistics of true predictions instead of true predictions.

¹⁶ I posed this idea in (Eintalu & Notturmo 1999b:2370). Maxwell (1993a:78) also argues that he has solved the problem of induction or, at least: "...all that I require...is that aim-oriented empiricism is *necessary* for a solution to the problem of induction, not that it is *sufficient*." He, like Popper, complains that other authors have not read his papers. Still he (like Popper) does not refer to Reichenbach.

theories¹⁷. In *this* sense Popper's method is rational. Its rationality, however, is *relative* to the goal preferred by Popper.

A few years later Reichenbach explicitly formulated the idea of vindication in his *Experience and Prediction* (1938) (Reichenbach 1952). Reichenbach's aim was to reach the true predictions. He thought that the method of inductive inferences could be vindicated relative to this aim.

Inductive scepticism implies that there can be no methods of which we *know* that they are *necessary* for true predictions. There is also an objection to the idea that Popper's method is vindicated relative to Popper's aim. Do we really know which theories are refuted? – No. We do not know the facts, we just *believe* them. To abandon the false theories is necessary to achieve the true ones. But to abandon the theories which we *believe* to be false is *not* necessary, because our beliefs about facts may be false.

Inductive inferences considered by Reichenbach (1952:351) (projecting the observed ratio of favourable cases to possible ones) are vindicated, relative to Popper's aim, *if* falsificationism is vindicated relative to Popper's aim. Concerning the past events, Reichenbach and Popper's methods coincide.

Relative to the aim of reaching true *predictions*, Popper's method is irrelevant and is *not* the necessary method, because a false theory may give true predictions. But if we are aiming at theories, which are true about the past and which *also* provide us with true predictions, then Popper's method is not necessary enough. —

Even if there are some rational methods of predictions, it still does not follow that the rational method of achieving true predictions is rational from the viewpoint of the rational agent. We must be careful to distinguish between the cognitive aim in itself and the cognitive aim as an aimed means for the practical action. *Even the aim of true predictions can be a cognitive aim in itself without relevance to our practical concerns.* The same applies to the possible necessary methods of predictions.

“Necessary method of achieving true predictions in order to know necessary means to ends” does not sound too coherent. Suppose, counterfactually, that there *are* some necessary methods of achieving true predictions. If true predictions are necessary for the rational agent and if method *M* is necessary for achieving them, then using the results of *M* is necessary for the rational agent. We violated against inductive scepticism. But why then should the rational agent be satisfied with knowledge about *necessary* means? Maybe some knowledge is already attainable about *any* future events? And why is a *necessary* method of obtaining true predictions good enough for an agent who needs *sufficient knowledge about necessary means*?

What are we searching for when we try to solve the problem of induction? Let us consider the *hierarchy* of means. Let us investigate the *linear model*. We set aside the *disjunctive* necessary or sufficient means (e.g.: “it is necessary or sufficient to take a bus *or* a taxi”). If there is a sufficient method, then every necessary method is

¹⁷ Notturmo refused to acknowledge my point (Eintalu & Notturmo 1999b).

included in it. If there is a necessary method, then every sufficient method includes it. If there is a sufficient method, then it is better to use it instead of a method which is merely necessary. If there are two necessary methods M and M' so that M includes M' , then it is better to use M which is a *stronger* one. It is not rational to do more than is needed. The most rational thing to do is to use the *maximally necessary method* – the weakest method, containing all the necessary ones. It may itself be a necessary one: $M(\text{maxnec})$. Let us also define the *minimally sufficient method*, which is the strongest method included in every sufficient one. It may itself be a sufficient method: $M(\text{minsufl})$.

In relatively general circumstances, the minimally sufficient method coincides with the maximally necessary method:

$$M(\text{minsufl}) \text{ iff } M(\text{maxnec}). \quad (11)$$

Suppose again, counterfactually, that there are some necessary methods of predictions. Popper's method P is necessary to achieve the theories, which are true in the area of past events and also predict truly. Still, this method is irrelevant to the aim of achieving true predictions. If there is a necessary method for achieving true predictions, then this method together with Popper's method may compose the method M that is necessary for achieving the theories which give true descriptions of the past and also predict truly. M is a stronger necessary method than P , because M includes P . The theorem (11) implies that the maximally necessary method of achieving the theories giving true descriptions of the past and also predicting truly, is also the minimally sufficient method. This method should be an exact method J , which *justifies* our theories and does nothing excessive. But from Hume's scepticism it *directly* follows that no such method can be known. Still, it does not directly imply that there can be no weaker method M that is still necessary, but stronger than Popper's and which can be known:

$$P < M < J \quad (12)$$

Is there some method between falsification and justification?

Such a method may exist, e.g. the method sought by Reichenbach. We noted that in the case of inductive scepticism such a *mean method* is impossible, if rationality is understood to consist in the *necessity* of the method. Still, the idea of mean rationality is intriguing.

Can there be a "mean" method between the justification and the falsification in some other sense? This is the main problem. We have not fully solved the problem of induction if we have not found the mean method, or if we have not proved that there can be no such method. If we do not know the answer and we do not admit to our ignorance, we are deluding ourselves. If we admit that we do not know, we must also accept that we have not solved the problem of induction but, at best, only a part of it.

4. Conditionally sufficient means (CSM)

Instead of the necessary method, Reichenbach is searching for the *conditionally sufficient method (CSM)*. He provides an example of “the logical structure of our reasoning” (Reichenbach 1952:349):

A man may be suffering from a grave disease; the physician tells us: ‘I do not know whether an operation will save the man, but if there is any remedy, it is an operation.’ Of course, it would be better to know that the operation will save the man; but, if we do not know this, knowledge formulated in the statement of the physician is a sufficient justification. If we cannot realize the sufficient conditions of success, we shall at least realize the necessary conditions.

Reichenbach goes on to use that conception in the case of the problem of induction:

The world may be so disorderly that it is impossible for us to construct series with a limit. Let us introduce the term “predictable” for a world which is sufficiently ordered to enable us to construct series with a limit. (Reichenbach 1952:350–351)

In this sense the principle of induction is a necessary condition for the determination of a limit. (Reichenbach 1952:351)

...if there is any method which leads to the limit of the frequency, the inductive principle will do the same; if there is a limit of the frequency, the inductive principle is a sufficient condition to find it. (Reichenbach 1952:355)

Note that the concept of a conditionally sufficient means of true predictions does not in itself imply that this means must be an inductive inference. Again, the CSM concept of rationality can be used also when aiming at true theories. In any case, the question arises how to *define* the condition in which our method must be a sufficient one. In Reichenbach’s case we must specify the definition of the “ordered” or the “predictable” world.

In what sense is the CSM rational? Applying such a method is not a *necessary* condition of *success*, because there can be no such known conditions in the case of inductive scepticism. It is rather the necessary method of *rational aiming* at success. Reichenbach (1952:349) accepts that the reasoning of the physician presupposes inductive inferences. He nevertheless holds that in the case of the problem of induction we can use the same kind of reasoning:

The character of induction as a necessary condition of success must be demonstrated in a way, which does not presuppose induction. (Reichenbach 1952:349)

The “rationality” of any CSM method, however, only means that if we do not use such a method, then, if the defined condition happens to be satisfied, we have missed the best method in *this* case. Such “rationality” is in the danger of becoming purely verbal¹⁸. The ratio of possible cases when the world is “predictable”, to all

¹⁸ E.g., define this condition as follows: the searched apple is inside *this* pail. The CSM is to search the apple from *this* pail. Such a method is necessary only if the apple *is* in *this* pail. If you have no reasons to think that the apple must be in *this* pail, you may as well say that your method is purely arbitrary.

possible cases tends to be zero, regardless of the concrete definition of the “predictable world”. The only remaining possibility is to argue that some pre-fixed conditions are epistemically or rationally privileged.

It has been usually held that Reichenbach fails to prove that inductive inferences are “vindicated” because of the problem of the *short sequence* (see e.g. (Kyburg 1978:193)). But Reichenbach’s approach can be refuted more generally and most easily by using the concept of *undecided games*¹⁹ (Eintalu 1994 & 1998) and Goodman’s (1983:72–83) predicates²⁰. Here we can only sketch our analysis.

The rationality of *any* conditionally sufficient method depends on the choice of the condition, which in turn depends on the used language. Any method may be tautologically “rational”, if the definition of the “predictable” world originates from this method itself²¹. If the definition originates from our common-sense beliefs, it is anthropo-centric²².

The problem of *relativism* is relevant to the problem of induction. Consider two languages L_1 and L_2 (e.g. the usual language of “green” and “blue” and Goodman’s (1983:72–83) language of “grue” and “bleen”). Universal generalisations of the form “All X -s are Y -s,” which are valid in one language, are invalid in the other. The definition of the “predictable world” is language-dependent. The considered conception of rationality is also language-dependent. We have two different methods: $CSM(L_1)$ and $CSM(L_2)$. As long as there is no way to prefer one language to another, the considered rationality is wholly relative to our *arbitrary choice of the language*. For a man of action it means that the results of epistemological methods give him nothing²³. CSM is reduced to retrospective wisdom. The agent never knows whether he has waited long enough and whether there was any regularity at all. The aim was formulated as concerning future events, but CSM only tells us how the world should look like *if* it is of the presupposed kind.

¹⁹ In the present context, the “undecided game” can be formulated as follows: for every time moment t the gambler A may declare that his opponent must *wait* till $T > t$ to see that A was right. Still, A ’s opponent B may declare that this is A who must *wait* to see that B was right. I made this remark in (Eintalu & Notturmo 1999b:2375). See also: (Maxwell 1993a:68).

²⁰ E.g., “grue(t)” is green till t , and blue after that; “bleen(t)” is blue till t and green after that. For every such strange predicate $P(t)$ there exists a time moment $T > t$ when one can possibly exclude it by observations. Still, it is an undecided game, because of for every time moment T one can define such a predicate $P(t)$, $t > T$, which cannot be possibly ruled out using the observations made till this moment. Putnam (1975) used Goodman’s predicates to defend a version of Reichenbach’s vindication. But Goodman’s predicates, together with the concept of undecided games, refute all such vindications.

²¹ E.g.: one can argue that Popper’s method is a conditionally sufficient method of achieving true predictions. Then one can add that the world is “predictable” in the case when the principle of induction is true.

²² There are no reasons to think that the language, which is easy for us, is “easy” to nature (Eintalu & Notturmo 1999a:2167). There is an obvious objection to any “anthropic principle predictions” (about such principle see, e.g. (Wilson 1994)). From the fact that we have stayed alive it follows, at the best, that the believed laws of nature have been held till the present moment. Nothing else follows.

²³ Except when one thinks that it is more important to do easily describable things than to do right things.

We shall now consider some combinatorial possibilities.

If the posed aim is to achieve true theories, Reichenbach's method coincides with Popper's. But is Popper's method conditionally sufficient, relative to the aim of achieving the true theories? One should first define the condition. *If* the true theory is inside the *finite pre-given class of theories*, then Popper's method is sufficient to reach it. However, we never know whether our initial list of theories includes the true one (Popper 1991:15). And we are searching for the true theory, not for the true theory that is *inside* this finite pre-given class. Still, Popper in fact tacitly presupposed that the true theory is included in the pre-given *infinite* class of theories. He considered only these theories which are of the universal form "All A-s are B-s", formulated in a regular language. He did not use Goodman's (1983) predicates and he prohibited the use of *ad hoc* manoeuvres. But it is logically possible that all ravens are black, except *this* one.

Is Popper's method conditionally sufficient to achieve true predictions? This question is relatively new²⁴. The "predictable world" may mean that the truly predicting theory must be included in the *initial list of theories*. Where, then, is the solution to the problem of induction? If this list is finite, why is it not equivalent to the principle of induction? If this list is infinite, then falsificationism can be in a sense "sufficient". But it has nothing to do with the solution to the problem of induction because of the logic of "undecided games" (Eintalu 1994 & 1998).

Maxwell (1993a, b, c) uses the version of Popper's critical method. In fact he argues that his method is a conditionally sufficient one (1993c:278). Maxwell does not refer to Reichenbach, nor does he use the term "conditional". So far, Maxwell's approach is the only one we know that tries to show that Popper's method is a rational method of *predictions*.

CSM still has to be shown to be rational in order to achieve knowledge about *necessary* means to ends. Also, if we are living in the "predictable" world, we have a sufficient method of obtaining *any* knowledge. Then why should we use knowledge about necessary means, if knowledge about sufficient means is attainable?

5. The *ad hoc* demand of avoiding *ad hoc* hypotheses

Popper seems to have valued the aim of reaching true predictions. *Ad hoc* manoeuvre does not look intelligent mainly because it provides only retrospective wisdom. Popper (1991:16): "They can be had for the asking..." Some Popperians have accepted that the problem of induction cannot be solved by solving only the problem of past events (Maxwell 1993a:71). The real problem concerning *ad hoc* manoeuvres is about "an aberrant theory" which gives different *predictions* (Maxwell 1993a:72).

What is an *ad hoc* move? A hypothesis is proposed that all ravens are black. Then a white raven is observed. Then a new hypothesis is proposed that all ravens

²⁴ I posed it in (Eintalu & Notturmo 1999b). Consider also (Putnam 1975).

are black, except *this* one. Popper's (1991:15–16) demand was to avoid such moves. Popper's explanations were confusing (Bamford 1993).

Note that the *ad hoc* manoeuvre is *not* the protection of the old *theory* against facts. In the strict sense of the word the *ad hoc* manoeuvre gives a *new* theory. But in the old, regular language this new theory cannot be formulated in the universal form "All A-s are B-s". It can be done using Goodman's (1983) predicates²⁵. The *ad hoc* manoeuvre protects our *predictions* from changing (Bamford 1993:350; Forster & Sober 1994:16–18; 27)²⁶. So the problem of *ad hoc* moves is related to the problem of induction, which in turn has not been solved by Popperians.

Maxwell (1993a) claims to provide a (pre-)solution to the problem of induction. He sees the relevance of the problem of *ad hoc* moves. What is his solution? He first tried to use the CSM approach (1993c:278). He then also argues (1993a:76–78) that critical method is rational because it gives us hope for *improving* our knowledge. So it is a solution to the problem of induction. We must avoid *ad hoc* moves because otherwise we cannot learn from experience.

Here the problem is served as a solution of it. Popperians have not succeeded in showing that we can learn from experience. In fact they have *postulated* it. From inductive scepticism it follows that we do not know whether we can learn from experience.

There are difficulties even if we assume that we *must* somehow learn from our experience. Then we *must* postulate that *some* feedback mechanism is needed. But there is an infinite number of such algorithms. Hume (1996), for example, tacitly used the invalid argument from the algorithm to argue that *inductive inferences* are rational. Even the device "Do not change your predictions, whatever may happen" is an algorithm. We do not know *which* algorithm is the good one.

Maxwell (1993a, b, c), as many other Popperians, also seems to assume that critical method is rational *per se* and constitutes a solution to the problem of induction. The critical method is supported by the principle of induction, rather than being a solution to the problem of induction. From inductive scepticism it follows that we do not yet know why the critical method is a rational one, when we are concerned about future events. Popper's demand to avoid *ad hoc* moves is still an *ad hoc* demand²⁷.

There is a possibility to try to rationalise the demand of avoiding *ad hoc* moves. It is the statement that *projecting* the observed ratio of favourable cases to possible ones is a rational enterprise. It follows that it is irrational to suppose that the observed falsificator of the theory was the first and the last one (it does not mean that we *know* that there are no singular exceptions to the natural laws). But

²⁵ One must make two consequent Goodman's transformations for different time moments.

²⁶ All these authors are tacitly assuming the principle of induction. E.g., Forster and Sober consider only the polynomial functions. Compare with (De Vito 1997:394).

²⁷ Wetterstern (1994:725) names Brewster and Herschel's attempts to avoid induction as *ad hoc* attempts.

such a method pretends to be *vindicated* in Reichenbach's sense of the term "justification". We already noted that this programme must fail.

6. The pragmatic problem of induction

Popper and Popperians still have claimed the relevance of their method to the rational agent (Popper 1991:21–23; Miller 1994:20–24).

Popper (1991:21) formulates the pragmatic problem of induction. He is anxious to avoid the term "to rely". His answer is clear (1991:22):

...we should prefer as basis for action the best-tested theory.

...since we have to choose, it will be 'rational' to choose the best-tested theory.

What arguments does he have? Popper (1991:22):

This will be 'rational' in the most obvious sense of the word known to me: the best-tested theory is the one which, in the light of our critical discussion, appears to be the best so far, and I do not know of anything more 'rational' than a well-conducted critical discussion.

This argument is amazingly erroneous. The question is not about what *appears* to be the best posit for the future. It is not about what we actually *believe*. The question is about what we *should* believe, what is *rational* to believe, whether there is any justification or any reasons or any arguments for believing in what we actually believe (Hume 1985 & 1996). The question is about *rational preference*. It is only tautologically "rational" to prefer what you already prefer. The answer cannot be that you do not know anything better than to believe in what you already believe. Again, if something is the best *so far*, it does not follow that it is the best in the future. Popper *reiterates* the problem of induction. It appears now as the question: *Why should the critical method and the critical discussion be a rational enterprise when predicting the future events for practical reasons?* We are inductive sceptics. Therefore it needs an explanation what sense the critical method has.

One can as well think that the rational method consists of inductive inferences. One can then argue that one does not know anything better than the well-conducted inductive inferences. One can argue that the theory with the strongest confirmation is the one which appears to be the best so far and that nothing better is known than to use the best-confirmed theory.

Popper's argument seems to be justificationist. He seems to presuppose the principle of induction. Besides, if we presuppose the principle of induction, it is not evident that Popper's method must be preferred, e.g. to the method of inductive inferences. But if Popper's arguments are aprioristic, then everyone can argue that one does not know anything better than one's own favourite gambit.

Popper's argument rests on the equivocation of two different senses of the term "rational". The rationality of means is relative to the posed aims. The rationality of

Popper's method has been shown only relative to the *retrospective* aim. It does not follow that it is also rational relative to the practically needed *predictions*²⁸.

Miller (1994) presents the objections against Popper made by Feigl, Cohen, Salmon, Watkins²⁹ and Worrall. He declares (1994:23) that:

...rational action is possible without the smallest concession to inductivist magic.

He presents his falsificationist magic in the section 2.2.g: *The Pragmatic Problem of Induction* (Miller 1994:38–45). All his arguments originate from conceptual mistakes. Any mathematically (un)gifted person may produce an infinite number of such (un)professional arguments.

Miller reformulates Popper's old argument:

The hypothesis that has most successfully survived the critical debate is, we conjecture, our best source of information about the world, and if we wish to act appropriately, there is little sense in ignoring this information; or, worse still, acting as if it were not true. (Miller 1994:39)

This argument is completely nonsensical. If we *conjecture* something, then we already *do* this. But the question was about the *rational* procedure of proposing conjectures. Surely one can use the falsificationism to *propose* guesses, as well as the inductive inferences to *propose* guesses³⁰. Besides, the only "information" we have is about the *past* performances of the theory. It is certainly possible to *conjecture* that the information *extends* to future events also. But the question is whether it is *rational* to extend this information. Miller's argument demonstrates only his misunderstanding of the heart of the problem.

Miller also accuses his opponents of being *justificationists* (1994:39):

Popper rightly offers no direct answer to the justificationist question of why we should act in this way.

But if Miller holds that the question about rationality is in itself justificationist, then he is obviously a justificationist.

Many of Miller's arguments can still be distilled within some logical structure:

1) Arguments pretending to show that it is *rational* to use the corroborated theory when predicting the future in practical affairs (Miller 1994:39).

These arguments have been *invalid* or *justificationist*.

²⁸ Popper (1991:20): "But if we prefer *T* with respect to its claim to truth, then we have to prefer with it all its consequences, even though they can be less well tested separately." We strongly deny it. Popper prefers the theory only with respect to its truthfulness in the *past*. It does not follow that we should prefer also the *predictions* of such theory.

²⁹ Watkins (1995:613) is disappointed that Miller dismissed one of his main arguments. I agree. It concerns relativism.

³⁰ Notturmo holds that we can use inductive *procedures* to *propose* the hypotheses, but that there are no inductive *arguments* and that inductive methods cannot *justify* our hypotheses (Eintalu & Notturmo 1999a:2164–2165). I stress that, concerning the future events, exactly the same is the case with the falsificationist procedures. It follows that there are yet no reasons to prefer the falsificationist proposal to the inductivist proposal.

2) Arguments pretending to show that it is *not irrational* to use the corroborated theory when predicting the future in practical affairs (Miller 1994:39; 42).

These arguments are invalid or are not able to give any preference to falsificationist proposals – they meet the problem of *relativism*.

3) Arguments pretending to postulate the *third* between science and practice, e.g. engineering (Miller 1994:39–40).

These arguments are *reiterating* the problem of induction and they cannot show that *science* makes any rational sense for a man of action.

4) Argument from the coherence of the epistemological method (Miller 1994:41).

This argument meets the problem of relativism.

Miller also uses an argument which in Notturmo's formulation (Eintalu & Notturmo 1999b:2377) sounds: "There is a lot of truth around." Miller (1994:42):

...the lack of any reason to believe in its success does not mean that the proposal will not be successful.

But *any* proposal *may* be successful. Besides, there is a lot of falseness around.

There is one more possibility Miller did not use. One can argue that in the case of inductive scepticism, *we do not know whether we need any knowledge of future events*. We accused Popper since we are justificationists. Indeed, Popper himself was a justificationist. We have yet not realised all the consequences of the thesis that we do not know the future. Maybe rationality is redundant.

7. Even if

A sceptical argument about the non-knowledge of *any* future events tries to undermine the common-sense view that we know some future happenings *better* than other ones. This common-sense view, and not the doctrine that we know everything equally well, is needed to save our common-sense views about action, rationality and obligations. But it has not yet been proved that we cannot prefer without justification³¹.

I shall use Popper's own argument, but in another context. *If* we can use Popper's argument, then it implies that we are able to discern between better and worse known things, despite the fact that we do not know anything. Popper employed this argument in epistemological matters. I shall employ it in the theory of rational action. My reasoning remains conditional: *if* such argument has a power in one place, then why does it not have a power in another place. I shall not analyse when and why such an argument is correct. Popperians also do not like to analyse this.

³¹ This was one of my ideas in (Eintalu & Notturmo 1999a). I discussed these topics with Mr. M. A. Notturmo also in our second e-mail conversation in November-December 1998.

Hume assumed that we know (only) present and past events. But do we really know that this presupposition of the problem of induction is true? Must we justify our belief in it? Hume (1985, 1996) argued inductively that his presupposition is true. It is senseless because of his inductive scepticism. Popper (1991:17) recognised that the test statements can be criticised. Still he argued that it is of no importance to the solution of the problem of induction (1991:7).

Popper's line of argumentation, as I interpret it, is the following. We do not know the facts. If we know the facts, then we cannot justify our theories. If we know the facts, then we can falsify our theories (Popper 1991:7; 12). In short:

*Even if we know the facts, we still do not know whether our theory (which is in accordance with these facts) is true, but then we can at least eliminate these theories, which are contradicting these facts*³².

The logic of "even if" has not yet been seriously investigated. In contrast, the logic of "if...then..." has received considerable attention, but it has still remained controversial (see e.g. *Conditionals* 1991 or Lewis 1986)³³.

But why cannot we argue as follows?

"Even if we know the necessary means to ends, we still do not know the sufficient means to ends, but then we can at least avoid the biggest mistakes."

Compare:

1) *Even if* I know the facts, I still cannot justify my theories.

But then I can at least refute them.

It is irrational to use the refuted theory.

2) *Even if* Columbus knows that he must take fresh water on board,

he still does not know that he reaches America instead of India.

But at least he knows that it is irrational and unethical not to take fresh water on board.

He knows that he cannot justify his actions, but he knows that he can be blamed for some of his actions.

If a Popperian argues that I cannot use such a manoeuvre in the logic of actions, then I ask why can a Popperian use such a manoeuvre in the logic of epistemological actions? In both cases this manoeuvre is meant to make a distinction between better and worse known things. In both cases this move is meant to discern between the necessary and sufficient means. In both cases it is argued that indeed we do not know anything. In both cases it is in a sense compulsory to prefer what is known better.

From inductive scepticism it seems to follow that there can be no such distinctions between bad and good means in the theory of action. The badness and goodness of means are related to future events, while in epistemology the past is "good" and the future is equally "bad". But one can object that because ethics is possible, there can be no too sharp distinction between the past and the future. We

³² In different context, Popper explicitly used the term "even if" (Popper 1991:22–23).

³³ Some philosophers have argued that the natural laws are not *regularities* of events, but are *counterfactual* instead, which is important when considering the problem of induction (Armstrong 1993).

already admitted to having difficulties with binding the practical syllogism of epistemology with the practical syllogism of practical action.

Even if we do not know anything, still we know some things better than the other ones. If we know the past much better than the future, then we know necessary and sufficient means equally unsatisfactorily. If we know the necessary means much better than the sufficient ones, then we know the past and the future equally unsatisfactorily.

Obviously, the argument from “even if” is not sufficient. One must give reasons *why* we should believe in the presuppositions of the problem of induction. But the need for such explanations is denied by Popperians.

8. Conclusion

In the present work I argued that a falsificationist is not able to be the rational agent. The main line of argumentation was that rationality is relative to posed aims and that the aim of falsificationists is reduced to the rational reconstruction of the history of past events, while the rational agent needs the rational method of predictions.

I would like to point out that the arguments of the present paper are presupposing inductive scepticism that has been accepted by Popperians. If we assume that the principle of induction is true, then a falsificationist can be the rational agent. But in this case he has not shown the superiority of his method over other methods, e.g. inductive inferences or Bayesianism, nor can he claim that he has solved the problem of induction. If we assume that some theories about nature are known to be true, then again falsificationism is a rational method – both in epistemology and in practical matters. Then again, this method does not pretend to be a solution to the problem of induction, nor has it demonstrated its superiority over probabilistic etc. methods.

In the present paper I have not argued that there are some better methods than falsificationism or that the problem of induction can or cannot be solved. I argued that the claims that falsificationism is better than other methods and that it gives a solution to the problem of induction, are unjustified.

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