Philosophica 86 (2012) pp. 83-99

RATIONALLY EVALUATING INCONSISTENT THEORIES[1]

Erik Weber & Maarten Van Dyck

ABSTRACT

What happens if one applies the "evaluation methodology" of Theo Kuipers to inconsistent theories? What happens if one applies the "problem solving methodology" of Larry Laudan to inconsistent theories? We argue that in both cases something unacceptable happens. We show that application of Kuipers' methodology to inconsistent theories leads to a methodological stalemate: inconsistent theories are incomparable to consistent ones. Then we show that according to Laudan's methodology inconsistent theories are always better than consistent ones. Finally, we offer partial solutions to these problems.

1. Introduction

This papers deals with two questions:

[1] A previous version of this paper was presented at the VlaPoLo8 workshop (Zielona Gora, 20-22/11/03). We thank the audience at LRR10, Bert Leuridan,Theo Kuipers and the two referees for their comments on previous versions of this paper.

(1) What happens if one applies the "evaluation methodology" of Theo Kuipers to inconsistent theories?

(2) What happens if one applies the "problem solving methodology" of Larry Laudan to inconsistent theories?

Both are "methodologies" in the sense of sets of rules for choosing between competing theories. We will argue that in both cases something unacceptable happens. More precisely we will show that application of Kuipers' methodology to inconsistent theories leads to a methodological stalemate: inconsistent theories are incomparable to consistent ones. And we will also show that according to Laudan's methodology inconsistent theories are always better than consistent ones.

The structure of this paper is as follows. In Section 2 we present the methodology of Kuipers. In Section 3 we show that there is a problem of incomparability. In Section 4 we present Laudan's proposal, followed by an explanation of its problem in Section 5. In Sections 6 and 7 we offer a partial solution for both problems.

2. The evaluation methodology of Theo Kuipers

Kuipers presents an "instrumentalist methodology" or "evaluation methodology", which he offers as a technical, albeit free, explication of Laudan's problem-solving methodology (Kuipers 2000, p. 115). A good starting point is Kuipers' definition of "more successful than":

> Theory Y is (at time *t*) more successful than theory X iff (at *t*):
> (i) the set of individual problems of Y forms a subset of that of X,

(ii) the set of general successes of X forms a subset of that of Y, and
(iii) in at least one case the relevant subset is a proper subset. (cfr. 2000, p. 112)

The set of individual problems of a theory are the empirically established counterexamples of any empirical law following from the theory, and the general successes are all empirically validated laws that are derivable from the theory.

The fact that Y is more successful than X at *t* is not a sufficient reason to prefer Y. But it suggests a stronger hypothesis (2000, p. 113):

CSH Y (is and) will remain more successful than X.

This *comparative success hypothesis* amounts to two components:

CSH-P All individual problems of Y are individual problems of X.
CSH-S All general successes of X are general successes of Y.

The hypothesis that Y is more successful than X thus can be falsified by finding a counterexample to Y that is not a counterexample to X, or an established empirical law which follows from X but is not derivable from Y. Unsuccessful attempts to falsify the subhypotheses increase the registered success difference and confirm CSH.

The last step is to formulate a rule of theory selection, called the *rule of success* (2000, p. 114):

RS When Y has so far proven to be more successful than X, i.e., when CSH has been 'sufficiently confirmed' to be accepted as true, eliminate X in favor of Y, at least for the time being.

The most important consequence of this instrumentalist methodology is that falsified theories need not be abandoned, as long as they are more successful than all competitors. The model's core notion is *evaluation*, not falsification. At a given time, theories known to be false can be the best we can get, but as long as successive theories are empirically *progressing* (having less counterexamples and/or more established empirical laws) it is rational to prefer them.

3. Application of Kuipers' methodology to inconsistent theories

It seems fair to assume that Kuipers has classical logic (CL) in mind when he talks about "derivations" and "derivability".[2] On this assumption, Kuipers' notion of general success can be expressed as follows:

> An established law L counts as a general success of theory T if and only if L is CL-derivable from T.

[2] This assumption can be justified in two ways. First, Kuipers speaks about "logical entailment" as if there is only one logic. People who do this usually have CL in mind. Second, he explicitly states that his system is based on the rules MP (*modus ponens*) and MT (*modus tollens*). Paraconsistent logics (the non-classical logics that were devised to handle inconsistencies) do not validate MT.

Since in CL inconsistent theories are trivial (A, ¬A ├ B for any B), this definition entails that any established law L is a success of an inconsistent theory. If Y is inconsistent and X consistent, we will always have that:

> All general successes of X are general successes of Y.

The reason is simple: every established law that follows from X also follows from Y.

The notion of individual problem can be rephrased as:

> A law that is CL-derivable from theory T counts as an individual problem for T if and only there is an empirically established counterexample to that law.

Now consider a law L that is an empirical problem for a consistent theory X. This law is also a problem for any inconsistent theory Y (because it is also derivable from Y and the counterexamples to L remain). This means that, if Y is inconsistent and X consistent, we will always have that:

> All individual problems of X are individual problems of Y.

Taking our two results together we have the following: if we compare a consistent theory with an inconsistent one, the inconsistent one will have more successes, but also more problems. CSH can never hold, because its two components pull in opposite directions. This methodological incomparability cannot be tolerated by Kuipers: though inconsistent theories can safely considered to be false (unless we assume that the world is inconsistent) they might be closer to the truth than consistent ones. So Kuipers' ideal of truth approximation implies that we should be able to compare consistent theories with inconsistent ones.

4. The problem solving methodology of Larry Laudan

The instrumentalist idea of success which we found in the proposal of Kuipers is also clearly present in Laudan's methodology:

> Given that the aim of science is problem solving .... progress can occur if and only if the succession of scientific theories in any domain shows an increasing degree of problem solving effectiveness. Localizing the notion of progress to specific situations rather than to large stretches of time, we can say that any time we modify a theory or replace it by another theory, that change is progressive if and only if the later version is a more effective problem solver (in the sense just defined) than its predecessor (1977, p. 68)

Problem solving effectiveness is defined as follows:

> [T]he overall problem solving effectiveness is determined by assessing the number and importance of the empirical problems which the theory solves and deducting therefrom the number and importance of the anomalies and conceptual problems which the theory generates. (1977, p. 68)

Laudan's definition of what it means for a theory to solve an empirical problem, is equivalent to Kuipers' definition of successes of a theory:

> Generally, any theory, T, can be regarded as having solved an empirical problem, if T functions (significantly) in any schema of inference whose conclusion is a statement of the problem. (1977, p. 25)

Anomalies are defined as follows:

> Whenever an empirical problem, *p*, has been solved by any theory, then *p* thereafter constitutes an anomaly for every theory in the relevant domain which does not solve *p*. (1977, p. 29)

This definition entails that inconsistencies with observational results are not the only form of anomalies:

> One of the most important species of anomaly arises when a theory, although not inconsistent with observational results, is nonetheless incapable of explaining or solving those results (which have been solved by a competitor theory). (1977, p. 29)

In the other direction, not all inconsistencies with observational results are anomalies:

> In stressing that a problem can only count as *anomalous* for one theory if it is *solved* by another, the analysis seems to run against the common view that one sort of anomaly, *the refuting instance, poses a direct cognitive threat to a theory*, even if it is unsolved by any competitor. (1977, p. 30)

Anomalies require a rival theory which solves the problem. As a consequence, a refuting instance is not automatically an anomaly. Therefore, anomalies should not be confused with Kuipers' individual problems (which are defined as refuting instances). The fact that Laudan uses anomalies instead of refuting instances is important for the way in which his methodology deals with inconsistent theories (see Section 5).

Let us now look at conceptual problems. Laudan gives the following characterization:

> If empirical problems are first order questions about the substantive entities in some domain, conceptual problems are higher order questions about the well-foundedness of the conceptual structures (e.g., theories) which have been devised to answer the first order questions. (1977, p. 48)

Some of the examples he cites are the inconsistency of theories, their being rendered implausible by other accepted theories, and their incompatibility with prevailing worldviews. Laudan urges us to take serious the significance of conceptual problems for evaluating theories. Kuipers' instrumentalist methodology is clearly limited to empirical problems and successes. If there is room for conceptual problems in the evaluation of theories, this is only on a second-order level. As Kuipers' discussion of the importance of simplicity shows, such a criterion can only be rationally applied when choosing between theories *equally successful* at the empirical level.[3] Nevertheless, Kuipers also makes room for a more long-term dimension in evaluating theories, a dimension in which seemingly more conceptual factors come into play, as when he states that it is possible to evaluate vocabularies in which theories are stated. However, such an evaluation is still driven by the empirical successes and failures of the theories expressed in these vocabularies.

---

[3] Kuipers 2000, p. 120. Notice that in such a conception no disputable weighing between empirical and conceptual problems needs to be performed.

5. Application of Laudan's methodology to inconsistent theories

If we assume that Laudan has CL in mind (as he indicates himself - see the following quote), then his definition of problem solving amounts to:

> A theory T solves a problem L if and only if L is CL-derivable from it.

According to this definition, inconsistent theories solve all empirical problems. Laudan's solution is to put an a priori ban on inconsistent theories.

> Unless the proponents of such [i.e. inconsistent] theories are prepared to abandon the rules of logical inference (which provided the groundwork for recognizing the inconsistency), or can somehow "localize" the inconsistency, the only conceivable response to a conceptual problem of this kind is to refuse to accept the offending theory until the inconsistency is removed. (1977, p. 49)

This a priori ban on accepting inconsistent theories is at odds with Laudan's pragmatist perspective, since he explicitly refuses to ground acceptance in considerations of truth. An inconsistent theory is false (assuming that the world is consistent) but that does not entail that it cannot be a good problem solver. So there is no justification for this a priori ban. Moreover, if inconsistent theories were out of the acceptance-game, it becomes vacuous to claim, as Laudan does, that inconsistency counts as a conceptual problem (none of the theories considered will have this kind of conceptual problem). So the a priori ban is not a good solution. Laudan has to admit inconsistent theories as competitors, and once they are allowed they win automatically: they solve all empirical problems and they cannot have anomalies so they wipe out the rivalising consistent theories.

Before we offer solutions for the problems, it is useful to point out that the problem which Laudan faces is different than the problem for Kuipers because Laudan uses anomalies rather than refuting instances as elements that plead against a theory. Given that an inconsistent theory always has an infinite number of refuting instances, Kuipers' choice creates the incomparability problem explained in Section 3. And given that an inconsistent theory cannot have any anomalies (because it explains everything) Laudan's choice entails that inconsistent theories always win. Thus this choice determines how the methodologies deal with inconsistent theories and explains why they have different problems.

6. A solution for Kuipers

In the philosophy of science, the term *theory* is used to refer to intellectual products of very different size. Newtonian mechanics is often called a theory, but it is also very common to speak of the (Newtonian) theory of free falling bodies, the (Newtonian) theory of bodies falling in a fluid, the (Newtonian) theory of harmonic oscillators, the (Newtonian) theory of bodies on an inclined plane, etc. Likewise, we have Mendelian genetics (also often called a theory) versus the (Mendelian) theories of the height of pea plants, of the colour of the flowers of pea plants, of the colour of human eyes, of the human ABO blood group system, etc. One way out of this terminological confusion is to call only the big entities "theory" and find a different name (e.g. "theory-element") for the small ones. Another solution is to call the big entities "theory-complexes", and to reserve the term "theory" for the small ones. Kuipers chooses the first option. This is clear from a list of examples of theories, which he gives in his 2001 (pp. 40-41). His list contains a.o.: Newton's theory of gravitation, the kinetic theory of gases, Bohr's theory of the internal structure of the atom, Mendelian genetics and rational-choice theory. Kuipers uses the term "specific theory" for small theories. We will also take the first option but will use the term "theory-element" for denoting small theories.

The problem that Kuipers faces can be solved by introducing the idea of a theory-element in his definitions. Before we can do this, a second terminological distinction must be made. Kuipers says:

> Recall, finally, that the principles of a theory, whether ontologically and/or epistemologically stratified or not, can frequently be distinguished in main or generic principles, claimed to be true for the whole domain concerned, and special principles, only claimed to be true for a certain subdomain. (2001, p. 317)

We will call the set of generic principles the *core* of theory. A theory-element contains the core of the theory and some special principles.[4]

We can now formulate the following definition, as a possible solution to Kuipers' problem:

> A law L_x counts as a general success for a theory T if and only if there is a consistent theory-element T_x from which L_x is CL-derivable.

[4] The distinctions that we and Kuipers make are inspired by the structuralist approach to theories (Balzer, Moulines & Sneed, 1987).

T_x contains the core of T and some special principles. This definition does not solve the problem: it only excludes theories with an inconsistent core. If the inconsistency results from contradictory special principles (i.e. if the special principles of one element contradict those of another element) this definition makes no difference.

A second possible definition using the new terminology is:

> A law L_x counts as a general success of a theory T if and only if:
> (i) there is a consistent theory-element T_x from which L_x is CL-derivable, and
> (ii) T as whole is also consistent.

This definition entails that inconsistent theories are worthless, which is also unacceptable: it turns inconsistency into an all-overriding epistemological drawback.

A third possible definition is:

> A law L_x counts as a general success of a theory T if and only if:
> (i) there is a consistent theory-element T_x from which L_x is CL-derivable, and
> (ii) T_x is compatible with every single other theory-element of T.

This last definition is the most appropriate one. We will show this by means of a formal example. The empirically validated laws we consider are:

$(\forall x)(Cx \rightarrow Ex)$

$(\forall x)((\neg Cx \wedge Dx) \rightarrow Ex)$

$(\forall x)((\neg Cx \wedge \neg Dx) \rightarrow \neg Ex)$

We consider theories with a simple core:

$$(\forall x)(Ax \leftrightarrow Bx)$$

We first consider a theory with two theory-elements:

Theory-element 1

$(\forall x)(Ax \leftrightarrow Bx)$ $(\forall x)(Cx \rightarrow Ax)$ $(\forall x)(Bx \rightarrow Ex)$

Theory-element 2

$(\forall x)(Ax \leftrightarrow Bx)$ $(\forall x)((\neg Cx \wedge Dx) \rightarrow Ax)$ $(\forall x)(Bx \rightarrow Ex)$

The theory consisting of these two elements has two successes (the first two empirical laws) and no problems (according to all three definitions above). Next, we consider two ways to extend this theory. The first is to add a third theory-element which preserves consistency of the theory as a whole:

Theory-element 3

$(\forall x)(Ax \leftrightarrow Bx)$ $(\forall x)((\neg Cx \wedge \neg Dx) \rightarrow \neg Ax)$

$(\forall x)(\neg Bx \rightarrow \neg Ex)$

The resulting theory has three successes (again, according to all three definitions above).

Our second extension is one that makes the theory as a whole inconsistent (if we assume that $(\exists x)(\neg Cx \wedge Dx)$):

Theory-element 3'

$(\forall x)(Ax \leftrightarrow Bx)$ $(\forall x)(\neg Cx \rightarrow \neg Ax)$ $(\forall x)(\neg Bx \rightarrow \neg Ex)$

According to the first definition the resulting theory is as good as the first extension: three successes, no problems. This shows that the first definition does not adequately handle inconsistencies. Inconsistencies are an epistemic drawback which should lead us to prefer the first extension above the second one. The first definition does not imply such a preference. According to the second definition, the second (inconsistent) extension is completely worthless. The third definition results in a verdict somewhere in between because it separates the problematic from the unproblematic theory-elements. According to this definition the inconsistent theory has one success (the first empirical law: theory-element 1 is consistent with the two other theory-elements taken separately). The two other laws do not count as successes, because the relevant theory-elements are mutually inconsistent (the second empirical law does not count as a success because theory-element 2 is incompatible with theory-element 3'; analogously for the third empirical law). In other words: the second extension results in a less good theory, but this theory is not completely worthless.

In order to make the solution complete we also need a new definition of the notion of individual problem:

> A law counts as an individual problem for T if and only there is an empirically established counterexample to that law and T contains a consistent theory-element from which L is CL-derivable.

This definition does not show up in our example because we assumed that the laws are true. In general, we need it to prevent inconsistent theories from always having more problems than consistent ones.

7. A solution for Laudan's problem

With the aid of the terminology introduced in the previous section, we can formulate the following definition:

> A theory T solves a problem L_x if and only if there is a consistent theory-element T_x from which L_x is CL-derivable.

This definition fails for similar reasons as the analogous definition in Section 6: it only excludes theories with inconsistent cores.

A second possible definition is:

> A theory T solves a problem L_x if and only if:
> (i) there is a consistent theory-element T_x from which L_x is CL-derivable, and
> (ii) T is consistent.

This definition deprives inconsistent theories from any problem solving power. As we have argued in Section 5, this is not acceptable given Laudan's general ideas.

A third possible definition is:

> A theory T solves a problem L_x if and only if:
> (i) there is a consistent theory-element T_x from which L_x is CL-derivable, and
> (ii) T_x is compatible with every single other theory-element of T.

We can again use the example of Section 6 to discuss the adequacy of these definitions. According to the first definition, the second extension is as good as the first one, at least if we look at the capacity to solve empirical problems: three empirical problems solved, no anomalies. At first sight this definition cannot adequately handle inconsistencies. But it does what Laudan suggests in the quote above: it “localizes” inconsistencies. By introducing the concept of theory-element and requiring that theory-elements are consistent, the inconsistencies become clearly identifiable problems: mutual inconsistencies between the special principles of different theory-elements. If we adopt this definition, we can count these localised inconsistencies among the conceptual problems to be weighed and summed with all other problems. The result of this will be that (ceteris paribus) the first extension will be preferred because it has less internal conceptual problems.

According to the second definition, the second extension is completely worthless. So it is not adequate. According to the third definition, the inconsistent extension solves one problem and has two anomalies. The first extension is better: three solved problems, no anomalies. If we compare it with the two extensions, the original theory has two solved problems and anomaly. So it is better than the inconsistent extension.5 The third definition handles inconsistencies in a different way than the first definition: the presence of inconsistencies reduces the capacity of theory to solve empirical problems. The advantage of this is that the problem of weighing conceptual and empirical problems is partially eliminated, because inconsistencies are no conceptual problems anymore. They influence our judgment about the value of a theory in a different way.

---

[5] If we disregard the first extension and compare the original theory with the inconsistent extension, the verdict is that this extension is not progressive: the original theory then has two solved problems and no anomalies. The inconsistent extension has one solved problem and one anomaly.

8. Conclusion

We have argued that Kuipers' evaluation methodology and Laudan's problem-solving methodology run into problems if applied to inconsistent theories. The solutions we have offered are based on the distinction between (large, overarching) theories and theory-elements. Once we have introduced this distinction, it becomes possible to reformulate the core concepts of Laudan and Kuipers in such a way that the problems are solved.

We have to insist, however, that our solutions are partial: they can only be applied when the core of the theory is consistent, because otherwise the theory-elements cannot be consistent. For theories with inconsistent cores presumably paraconsistent logics will have to be invoked.

Ghent University
Email: Erik.Weber@Ugent.be
Maarten.VanDyck@Ugent.be

REFERENCES

Balzer, W., Moulines, C. U., and Sneed J. 1987. *An Architectonic of Science*. Dordrecht: Kluwer.

Kuipers, T. 2000. *From Instrumentalism to Constructive Realism.* Dordrecht: Kluwer.

Kuipers, T. 2001. *Structures in Science.* Dordrecht: Kluwer.

Laudan, L. 1977. *Progress and its Problems.* London: Routledge.