A methodological shift in favor of *some* paraconsistency in science

María del Rosario Martínez-Ordaz
martinezordazm@gmail.com

Federal University of Rio de Janeiro.

April 7, 2022
7th UNILOG, Crete, Greece.

Can science be *inconsistency tolerant*?

What would that tell us about paraconsistent logic?

METHODOLOGY

The way(s) in which we do (paraconsistent) logics

The way(s) in which we **justify** the (paraconsistent) logic that we do

Aim

I aim at addressing the question of under which circumstances cases of inconsistency toleration in the sciences could be evidence in favor of any kind of paraconsistency.

My response to this question is divided into two main parts:

1. Sometimes, the detection of inconsistency toleration practices in the sciences can play an evidential role in favor of *some* paraconsistency in the sciences;
2. but, in order to identify those cases in which it does, one should do some methodological changes in the way we approach the 'historical'/empirical evidence.

Plan

1. The problem (and its problems)
2. The solution
3. The Paraconsistent Alternative Approach

Preliminaries

- *Principle of Explosion* (PE) says that any (explosive) theory trivializes when containing a contradiction.
- A *contradiction* consists of a pair of propositions, where one is the negation of the other.
- A theory is *trivial* if it is possible to derive any proposition from it.

—— Any inconsistent (explosive) theory will be trivial.

Preliminaries

- A logical consequence relation is *paraconsistent* if it does not validate PE; and a formal theory is paraconsistent if, despite containing a contradiction, it is not trivial.

- *Inconsistency toleration* is the phenomenon of working with inconsistent information and avoiding triviality at the same time.

    - In the case of human reasoning, inconsistency toleration demands a previous identification of a contradiction in the reasoning reasoning, as well as the capability of the agent to reason sensibly with the inconsistent information.

How do science and paraconsistency relate?

Let me tell you a story...

> *Examples of inconsistent but non-trivial theories are easy to produce.An example can be derived from the history of science. (In fact, many examples can be given from this area.) Consider Bohr's theory of the atom. According to this, an electron orbits the nucleus of the atom without radiating energy. However, according to Maxwell's equations,which formed an integral part of the theory, an electron which is accelerating in orbit must radiate energy.Hence Bohr's account of the behaviour of the atom was inconsistent. Yet, patently, not everything concerning the behavior of electrons was inferred from it, nor should it have been. Hence, whatever inference mechanism it was that underlay it, this* **must have been paraconsistent**. *(Priest et al. 2015: 2.1. My emphasis)*

Call this the *abductive argument (in favor of paraconsistency)*.

[T]he simple story we are met with so often in the literature, of the early calculus as a set of inconsistent propositions plus a logic, is plain wrong. **Brown and Priest (2004) are typical of a subsection of the philosophy of science that assumes the early calculus can be reconstructed by making use of a paraconsistent logic. To motivate the application of a particular paraconsistent logic they dub 'chunk and permeate'** (. . .)Clearly this blurs the important distinctions between the algorithms of the calculus, the story one tells oneself whilst making a derivation, and the attempted justifications of the moves made within the algorithms (. . .) However, Brown and Priest are simply following a theme in philosophy of science which is completely entrenched. (Vickers, 2013: 186-90)

PARACONSISTENT LOGICAL PROGRAMS

Why would people do something like that?

Philosophical context

- *Exceptionalism* about logic is the view according to which the truths and the methodology of logic are significantly different from the ones of other scientific disciplines, making the study of logic an enterprise of a unique kind.

- In contrast, *anti-exceptionalism* is the view according to which logic is continuous with other sciences, in particular, with empirical disciplines (Cf. Quine and Ullian 1970; Quine 1986; Maddy 2002; Williamson 2007, 2013, 2015; Priest 2014).

Philosophical context

(At least) for the anti-exceptionalist, the epistemic benefits linked to applicability are not restricted to the empirical disciplines, but can be extended to the logical realm.
The philosophical/methodological difference between any formal apparatus and a logic.[1]

For the case of paraconsistent logics, this independent evidence has come from two main sources: the study of paradoxes and the scrutiny of cases of inconsistent non-trivial human reasoning. In what follows, I focus only on the type of evidence that is expected to be obtained from the latter.

[1] Thanks to Moises Macias-Bustos for the pointers.

The critiques from logic

1. When looking at the historical record, a large majority of paraconsistent logicians have recognized different instances of inconsistency toleration in the sciences.

2. However, this 'evidence' in favor of paraconsistency is nothing but apparent, and it is obtained by a biased abductive argument that leads to interpret the relation between what the historical record has shown and the success of paraconsistent logics. "The idea here would be that there are interesting and productive inconsistent theories from which people do not infer random and unconnected conclusions; so, it might be thought, the logic they use does not licence such inferences" (Michael 2016: 3356).

Reading the argument

This argument goes from a particular case that illustrates (temporal or alleged) inconsistency toleration to, by abduction, inferring that the best explanation of this toleration is that either the reasoning of the scientists or the theory in question were closed under a paraconsistent logical consequence relation.

Once this conclusion is reached, it seems that the only remaining task is to determine which is the specific logic that allows the reasoning to be paraconsistent in the particular case.

There are two main methodological missteps that are followed in this argument:

- The presumption of logical explosion
- The presumption of logical closure

An even more severe methodological vice is revealed through the combination of these two unjustified presumptions...

The fallacious foundation

The abductive argument relies on one implicitly accepting that the results of a correct analysis of inconsistent scientific reasoning would necessarily privilege a particular (paraconsistent) logic. Yet, this methodological choice is not only unjustified but it is also the source of the later, also unjustified, requirements of human reasoning being closed under a logical consequence relation and the absence of logical triviality being the most telling outcome of the constraints of the reasoning carried out in inconsistent contexts. This can be characterized as a sort of methodological *petitio principii*.

The fallacious foundation

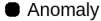
The main problem with the methodological missteps of the abductive argument is that, from the very beginning, the argument requires to overlook the salient features of inconsistent scientific reasoning.

- On the one hand, it neglects that the logical constraints of human reasoning, if any, would be of the shape of pragmatic and contextual reasoning strategies more than of logical principles (Cf. Harman 1984).

- On the other hand, the assumption of logical triviality (or lack thereof) being the most telling outcome of inconsistent reasoning fails at acknowledging the particularities of each case and their role in the handling of the corresponding contradictions –it also assumes that all cases of inconsistency toleration are, at least, structurally uniform, meaning that, the failure at handling a contradiction in one case would look the same as in any other case.

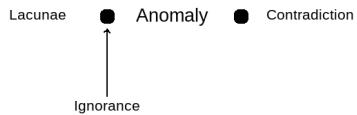
How could one do this better?

How do contradictions appear in science?


Anomaly

Anomalies

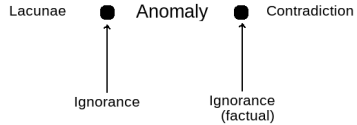
Anomalies consist of the presence of a statement (generally some kind of observational outcome), s, such that when combined with a particular theory, T, and with a *ceteris-paribus* clause the statement becomes a potential falsifying statement for the theory (see Lakatos, 1977: 40).


Lacunae
Anomaly
Contradiction
Ignorance

The *generic* explanation

1. When having two scientific statements that contradict each other, scientists tend to assume that, at least, one of them is false (Laudan, 1977: 56).
2. If scientists are able to distinguish which of the conflicting propositions should be regarded as false, then they would be able to explain how they could satisfactorily work on seemingly false information.
3. However, most of the time, when confronted with an inconsistent set of information, scientists ignore, at least, which of the mutually contradictory statements should be regarded as false (cf. Bueno, 1997, 2006; Brown, 1999; Priest, 2002).

4. Once this ignorance is acknowledged, if scientists have no better alternative to the inconsistent set of propositions, the **toleration** of the contradiction becomes the only option at hand -such a tolerant attitude towards contradictions is often seen by scientists as a temporary resource.


Lacunae
Anomaly
Contradiction
Ignorance
Ignorance
(factual)

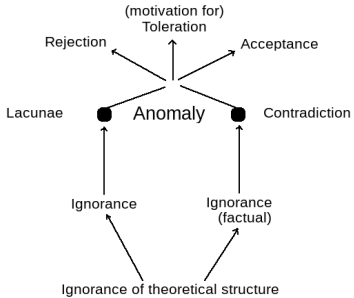
Which anomalies are of the interest of a logician?

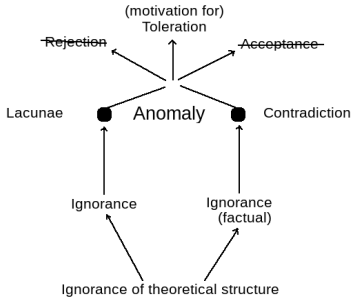
The resilient ones...

What causes the resilient character of the anomalies?

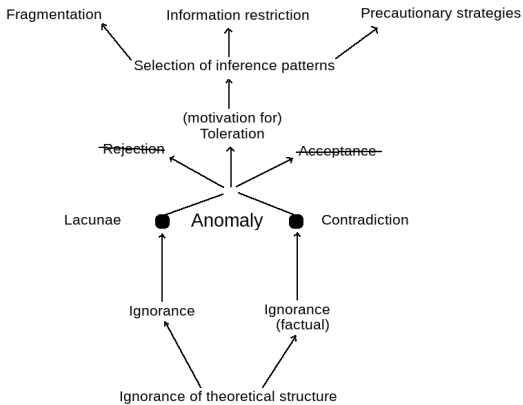
Ignorance of theoretical structure

Lacking knowledge of the (relevant) inference patterns that scientific theories allow for. When ignoring (the relevant parts of) the theoretical structure of a theory, scientists are not capable of grasping abstract causal connections between the propositions of their theory, they can neither identify the logical consequences of the propositions that they are working with nor can explain under which conditions the truth value of such propositions will be false.
(Martínez-Ordaz 2020: 12)


(motivation for)
Toleration
Rejection
Acceptance
Lacunae
Anomaly
Contradiction
Ignorance
Ignorance
(factual)
Ignorance of theoretical structure


(motivation for)
Toleration
Rejection
Acceptance
Lacunae
Anomaly
Contradiction
Ignorance
Ignorance
(factual)
Ignorance of theoretical structure

Partial overcoming of the ignorance of theoretical structure



Strategies

- Consistency-preserving strategies
- Inconsistency-tolerant strategies

Consistency-preserving strategies

Reject the acceptability of inconsistent scientific theories.

1. **Compartmentalization:** "classical logic is maintained, and the domains of inquiry, to which scientific theories that are inconsistent with one another apply, are compartmentalized so that there is no overlap among them. This generates a consistent disunity pluralist view, given that the various domains do not overlap and no attempt is made to unify them. Given the lack of overlap among the different domains, consistency emerges." (Bueno 2017: 240)

2. **Information restriction:** "classical logic is also maintained, and a single domain is kept throughout. In order to eliminate inconsistencies, conflicting pieces of information are (somehow) jettisoned and extracted. This yields a consistent monist view, given that a single domain is posited and consistency is maintained by the elimination of contradictory bits of information" (Bueno 2017: 2:40)

Inconsistency-tolerant strategies

- **Paraconsistent compartmentalization:** there are inconsistent but non-trivial scientific theories, given that a paraconsistent logic is assumed. Since a plurality of overlapping inconsistent domains is allowed for, this generates inconsistent disunity pluralism.

- **Dialetheism**: according to which *some* contradictions are true (Priest 2006a and 2006b). A paraconsistent logic is adopted, and all inconsistencies for which there is good evidence are taken to be part of a single scientific domain. This yields inconsistent monism.

Paraconsistency Alternative Approac (PAA)

Paraconsistent reasoning strategies: General formal tools that do "not focus on identifying or proposing alternative logics that might lurk in the background of scientific reasoning. Instead it focuses on a more directly observable feature of reasoning, viz., how and where different premises are invoked in the course of arguments" (Brown and Priest 2015: 299). The result is a type of analysis of inconsistency in (scientific) reasoning through the use of some reasoning strategies

PAA

- Considering that the PAA view makes no assumptions about which is the underlying logic of scientific reasoning, it is considered to be 'minimal' (Brown, 2017) when used to model specific cases from the history of sciences.

- The PAA consists of a set of strategies or general procedures that are explanatory of the way in which it is possible to handle contradictions in order to avoid explosion. Such strategies are paraconsistent in the sense that they allow scientists to avoid logical explosion in an optimal way –recognizing that what is 'optimal' would depend on the own constrains of each of the cases that are being studied.

PAA

- Paraconsistent strategies do not necessarily focus on the structure of the scientific inconsistent theory (or model) itself, but they pay special attention to both, the information that epistemic agents often employ to identify the contradiction and the ways in which agents use such information in scientific problem solving and still avoid triviality.

But... what about the logcis?

PAA

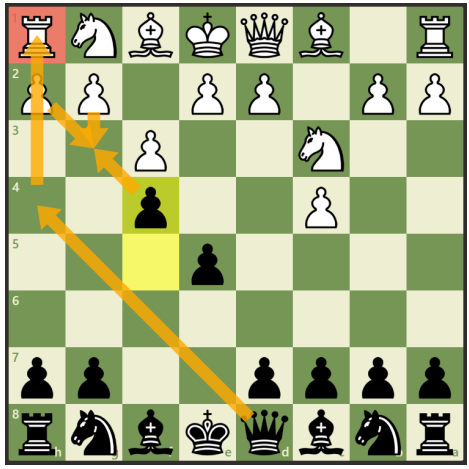
Because the PAA-strategies set the grounds for constructing logics −regardless whether they are paraconsistent or not−, the analyses that result from applaying PAAs to particular cases, (can) end up being about the logical consequence relation that was built in each case. Yet, **the way through which this is obtained is methodologically much more virtuous than the paths that are followed when using those of the logical programs**.

PAA

While these strategies guide very general procedures of information management, such as to separate the information in maximally consistent sets, or to distrust certain type of results, they are also compatible with different non arbitrary types of logical consequence relations; and there is where the secret of their explanatory and descriptive power lies. As a matter of fact, the PAA is in the large majority of cases accurate because it allows for a unique openness regarding the procedures and the corresponding interpretations of human reasoning.

Sketching the view

1. The value of applicability in favor of paraconsistent logics.
2. Logical programs vs historical programs about inconsistency in science.
3. How to get it done: the importance of inferential patterns and general strategies.
4. Paraconsistent Alternative Approach: paraconsistent reasoning strategies.



Thanks

A methodological shift in favor of *some* paraconsistency in science

María del Rosario Martínez-Ordaz
martinezordazm@gmail.com

Federal University of Rio de Janeiro.

April 7, 2022
7th UNILOG, Crete, Greece.

for instance...

> *Chapter 9 attempts to clarify the close connections between paraconsistency and philosophy of science: in a nutshell, there are so many cases of contradictions, even if temporary, arising between scientific theories, as well as between facts and theories, that a paraconsistent approach to the foundations of science seem to be almost inevitable. (...) The last section, Sect. 9.5, succinctly wraps up one of the chief points behind LFIs(...) explains the adequacy of LFIs for wider accounts in the philosophy of science, and also their applicability in the fields of linguistics, theoretical computer science, inferential probability, and confirmation theory.*

Carnielli and Coniglio (2016): *Paraconsistent Logic: Consistency, Contradiction and Negation*, Logic, Epistemology, and the Unity of Science, Springer.