Can Buddhist and Jain Logic be Seen as Forerunners of Modern Paraconsistent Logic?

Graham Priest

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Departments of Philosophy, CUNY Graduate Center, and the University of Melbourne

Abstract

In this paper, I will argue that, in a certain sense, Buddhist and Jain logic can be seen as forerunners of some paraconsistent logics. Specifically, the Buddhist *catuṣkoṭi* prefigures the logic of First Degree Entailment; and the Jain *saptabhaṇgī* prefigures a 3-valued plurivalient logic.

1 Introduction

The aim of this brief note is to answer the question of the title of the article. The answer, in both cases, is a qualified *yes*. First, the qualifications. 'Logic' can mean many different things. As modern Western logicians understand the notion, however, it is a subject which studies *what follows from what*; that is, what inferences are *valid*; that is, what inferences are such that their premises really do provide a ground for their conclusion (assuming them to obtain). The standard tools for answering these questions include the notions of a formal language, a proof theory, a model theory. And none of these things was on the agenda of Ancient Indian thinkers.

All systems of logic have, however, metaphysical presuppositions, concerning truth and reality, their natures, and the connections between them.[1]

[1]The claim is discussed and defended in Priest (2015).

And the metaphysical positions of at least some branches of Buddhism and Jainism can be thought of as underlying some modern logical theories, in particular, those of some paraconsistent logics.

There is a principle of inference now commonly called *Explosion*—its medieval name is *ex falso quodlibet* (*sequitur*). According to this, from contradictory premises, everything follows; that is, for any A and B:[2]

- $A, \neg A \vdash B$

Thus, from the premises that the sun is shining and not shining, it follows that Donald Trump is the President of India, that he is not the President of India, that Fermat's Last Theorem is true, that 2+2=17, that the cosmos is expanding, that it is contracting, and so on. A logic is *paraconsistent* if, according to it, Explosion is *not* valid. That is, contradictions do *not* entail everything.

It may surprise those with little knowledge of modern logic, that the standard contemporary view—that is, the one you will be taught if you take a first course in logic—is that Explosion *is* valid. The reason is that there can be no situation in which A and $\neg A$ are both true; hence there can be no situation in which A and $\neg A$ are both true *and* B is not true. That is, there can be no counter-example to Explosion; so it is valid. Sometimes logicians say that it is *vacuously* valid.

In the history of Western logic, the status of Explosion has been contentious, however. The earliest systems of logic, such as Aristotle's syllogistic, are paraconsistent; and there appear to be no advocates of the principle before early medieval logic. The standard logic of our day—so (inappropriately) called, classical logic—was invented at the end of the 19th Century by the German mathematician Gottlob Frege, and then polished by many of the great logicians in the first part of the 20th Century, such as David Hilbert and Alfred Tarski. The construction of modern paraconsistent logics began in the 1950s and 1960s, with pioneering work by the Polish logician Stalisław Jaśkowski, the Brazillian logician Newton da Costa, and the US logicians Alan Anderson and Nuel Belnap, amongst others. Since then, many systems of paraconsistent logic have been invented and investigated; their proof theories, model theories, and so on, are now generally well understood.[3]

In what follows we will see how some Buddhist and Jain metaphysical views can be thought of as appropriate metaphysical underpinnings for some

[2] $\neg$ is a logician's sign for negation. $\vdash$ is the sign for valid inference.

[3] For an account of paraconsistent logic and its history, see Priest (2007).

of these systems. Naturally, in an essay of this nature there is much that I cannot talk about, and there are many subtleties I must slide over. However, I hope to give the reader at least some sense of the connections between Buddhist and Jain thought and contemporary formal logic.

2 Buddhism and the Catuṣkoṭi

Let us start with Buddhism. There is a metaphysical principle in early Indian philosophy called the *catuṣkoṭi* (four points). According to this, given any putative answer to a question, there are four possibilities: that it is true, that it is false, that it is both, or that it is neither. These four possibilities are mutually exclusive and exhaustive.

The origins of the *catuṣkoṭi* are uncertain, but it is certainly in place by the time of Siddhārtha Gautama, the Buddha (c. 5th Century, BCE): we find it on display in some of the early sūtras. Take the following from the *Aggivacchagotta Sutta*:[4]

> "How is it, Master Gotama, does Master Gotama hold the view: 'After death a Tathāgata exists: only this is true, anything else is wrong'?"
>
> "Vaccha, I do not hold the view: 'After death a Tathāgata exists: only this is true, anything else is wrong.' "
>
> "How then, does Master Gotama hold the view: 'After death a Tathāgata does not exist: only this is true, anything else is wrong'?"
>
> "Vaccha, I do not hold the view: 'After death a Tathāgata does not exist: only this is true, anything else is wrong.' "
>
> "How is it, Master Gotama, does Master Gotama hold the view: 'After death a Tathāgata both exists and does not exist: only this is true, anything else is wrong.'?"
>
> "Vaccha, I do not hold the view: 'After death a Tathāgata both exists and does not exist: only this is true, anything else is wrong.' "

[4] Ñāṇamoli and Bodhi (1995), p. 591. A *Tathāgata*—literally, (*one*) *thus gone*—is someone who has achieved enlightenment.

> "How then, does Master Gotama hold the view: 'After death a Tathāgata neither exists nor does not exist: only this is true, anything else is wrong'?"
>
> "Vaccha, I do not hold the view: 'After death a Tathagata neither exists nor does not exist: only this is true, anything else is wrong.'"

The Buddha's interlocutor wants to know what happens to an enlightened person after death. The Buddha refuses to answer. There were, in fact, a number of metaphysical questions that the Buddha refused to answer, the *avyākṛta*. Why the Buddha refused to do so, is an interesting question: some sūtras suggest that such issues are just a waste of time; some hint that there is more to the matter than this. However, set this matter aside. The important thing to note here is that the Buddha's interlocutor is assuming the *catuṣkoṭi*. Neither does the Buddha do anything to problematise this framework. Thus, he does not say things like 'Look Vaccha, the third and fourth of your possibilities cannot arise', or 'Look Vaccha, there is a fifth possibility.

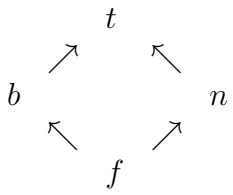
3 First Degree Entailment

Now, this metaphysical principle can be seen as underlying a modern logic called 'First Degree Entailment (*FDE*)'. (Don't ask about the name: the answer is of no import here.) One way of setting this up is as a many-valued logic. A many valued-logic is a logic in which claims can have more than one of the usual truth values. Thus, in standard logic, claims may be true (that is, true and just true) or false (that is, false and just false). These are the only two possibilities.

But in *FDE*, there are more possible values. Claims may be (just) true (t), (just) false (f), both (b), or neither (n).[5] In presentations of *FDE* it is common to display these values in the form of a diagram, sometimes called

[5]For a discussion of many-valued logics in general, and *FDE* in particular, see Priest (2008), chs. 7 and 8.

the d*iamond lattice*, thus:



The four points (corners) of the *catuṣkoṭi* literally appear before our eyes.

Given these values, how does negation behave? In a very standard way. Something is true just if its negation is false; and something is false just if its negation is true.[6] Hence:

- if something is t, true and not false, its negation is false and not true, f
- if something is f, false and not true, its negation is true and not false, t
- if something is b, true and false, its negation is false and true, so also b
- and if something is n, neither true and nor false, its negation is neither false and nor true, so also n.

Now, an inference is valid just if whenever the premises are true, so is the conclusion. In *FDE* there are two ways that something can be true: t and b. So an inference is valid just if, whenever the premises are t or b, so is the conclusion. That is, however we assign values to sentences, it cannot be the case that the premises receive one of these values, but the conclusion does not.

Many standard forms of inference come out as valid in *FDE*. One of these is the Law of Double Negation: according to this, 'it is raining' is logically equivalent to 'it is not the case that it isn't raining'. And in general, A is logically equivalent to $\neg\neg A$. Now, as a moment's thought suffices to show, in *FDE* the value assigned to A is always the same as the value assigned to

[6]The other connectives of *FDE* are conjunction and disjunction. How these behave is not relevant to this story. But for those who want to know, and to whom this means anything: conjunction acts as the greatest lower bound on the diamond lattice, and disjunction act as the least upper bound.

$\neg\neg A$. So one of these cannot take the value t or b without the other doing so. Hence $A \vdash \neg\neg A$ and $\neg\neg A \vdash A$.

However, Explosion is not valid. For give A the value b. Then $\neg A$ also has the value b. But now give B the value f. Then we have a counter-example to the inference $A, \neg A \vdash B$: both of the premises are true and the conclusion is not. *FDE* is, therefore, a paraconsistent logic.[7]

4 Jainism

Let us now turn to Jainism. Jain views would seem to find their origin in the thought of Mahāvīra, a rough contemporary of the Buddha. And Jain though has a very distinctive metaphysical picture of reality. Reality is multi-faceted, each facet being, in some sense, equally correct. This is the doctrine of *anekāntavāda* (non-one-sidedness). Hence, something (e.g., there is a self) can hold in one facet, but not another.

Now, what are the possibilities regarding a claim at a facet? Unlike the Buddhists, who took there to be four, the Jains held there to be only three: (just) true (t), just false (f), and a third possibility. Let us call this i. What is that? Sometimes it seems to be glossed as *both true and false*; sometimes it seems to be glossed *as neither true nor false* (maybe some kind of ineffability); and different commentators have interpreted i different ways.[8]

Whatever the truth of this matter, the multi-faceted nature of Jain metaphysics multiplies possibilities. A claim might be t in all facets; or f in all facets; or i in all facets; or t in some facets, f in some facets, and i in none; or t in some facets, f in some facets, and i in some facets; and ... . How many possibilities all together? Well, given our three choices, each may hold or fail in each facet. So there are $2^3 = 8$ possibilities. But given that there must be at least one facet, one of these can be ruled out, namely that none of them holds in any facet. Hence we arrive at 7 possibilities. This is the *saptabhaṇgī* (sevenfold division).

The matter is explained by Vādideva Sūri (c. 12th Century CE) as follows. Note that *syāt* is a Sanskrit word meaning something like 'it may be the case that'; but in Jain thought it has the more technical sense of *according*

[7]For further discussion of the *catuṣkoṭi* and *FDE*, see Priest (2010).

[8]Stcherbatsky (1962), p. 415, Bharucha and Kamat (1984), and Sarkar (1992) argue that i is most plausibly interpreted as *both true and false*. Ganeri (2001), 5.6, and (2002), sect. 1, favours *neither true nor false*.

to some facet:[9]

> The seven predicate theory consists in the use of seven claims about sentences, each preceded by 'arguably' or 'conditionally' (*syāt*) [all] concerning a single object and its particular properties, composed of assertions and denials, either simultaneously or successively, and without contradiction.[10] They are as follows:
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> (1) Arguably, it (i.e., some object) exists (*syād esty eva*). The first predicate pertains to an assertion.
>
> (2) Arguably, it does not exist (*syād nāsty eva*). The second predicate pertains to a denial.
>
> (3) Arguably, it exists; arguably it does not exist (*syād esty eva syād nāsty eva*). The third predicate pertains to successive assertion and denial.
>
> (4) Arguably, it is non-assertable (*syād avaktavyam eva*). The fourth predicate pertains to a simultaneous assertion and denial.
>
> (5) Arguably, it exists; arguably it is non-assertable (*syād esty eva syād avaktavyam eva*). The fifth predicate pertains to an assertion and a simultaneous assertion and denial.
>
> (6) Arguably, it does not exist; arguably it is non-assertable (*syād nāsty eva syād avaktavyam eva*). The sixth predicate pertains to a denial and a simultaneous assertion and denial.
>
> (7) Arguably, it exists; arguably it doesn't exist; arguably it is non-assertable (*syād esty eva syād nāsty eva syād avaktavyam eva*). The seventh predicate pertains to a successive assertion and denial and a simultaneous assertion and denial.

The first possibility (1) is that something is t (in all facets); the second (2) is that it is f (in all facets). The third (3) is that it is t is some facets, f in some facets, and i in none. And so on, for all the seven possibilities.

[9] *Pramāṅa-naya-tattvālokālaṁkāra*, ch. 4, vv. 15-21. Translation from Battacharya (1967). Note that, e.g., in clause (4) Vādideva Sūri (or his translator) glosses i, somewhat inconsistently, as both 'non-assertable', and as 'both assertable and deniable'.

[10] GP: Presumably, without contradiction, because each element of a compound possibility is qualified with *syāt*.

5 Plurivalent Logic

This metaphysical picture can be seen as underlying one of a family of modern logics called *plurivent logics*.[11] In such logics, there can be more than two values; but what is distinctive about them is that sentence may have *more* than one of these.

To see how this works in the present case, start with our three basic values, t, i, and f. These form a perfectly good 3-valued logic. What this is, depends on how i is interpreted. If it is interpreted as b, we just take the diamond lattice and remove n. This gives us the logic known as LP. If, on the other hand, we interpret it as n, we remove b from the diamond lattice. (So there is now only one way in which something can be true.) This gives us a logic known as K_3. LP is a paraconsistent logic. This is shown by the same argument that showed FDE to be paraconsistent. K_3 is not a paraconsistent logic. Explosion is vacuously valid, since A and $\neg A$ can never both take the value t.[12]

To obtain the plurivalent logic answering to the Jain semantics, we take our 3-valued logic, but now we allow claims to take any number of these values (any number greater than zero, that is). How does negation work? If a sentence relates to some values, its negation relates to the values obtained by negating them, according to the rules of the 3-valued logic. So, for example, if A has the values t and i, $\neg A$ has the values f and i. (If one negates i, one gets i, no matter whether one thinks of it as b or n.)[13]

How, now, do we define validity? If the underlying logic is LP, that is, we are playing the b side of the street, an inference is valid in the plurivalent logic just if whenever all the premises have either b or t as one of their values, so does the conclusion. If the underlying logic is K_3, that is, we are playing the n side of the street, an inference is valid in the plurivalent logic just if whenever all the premises have t as one of their values, so does the conclusion. (We no longer have b to play with.)

And now, whichever is the underling 3-valued logic, the corresponding plurivalent logic is paraconsistent. For suppose that A has the values t and f. Then $\neg A$ has values f and t. So let B have just the value f. Then both A

[11] For plurivalent logics, see Priest (2014).

[12] For more on LP and K_3, see Priest (2008), ch. 7.

[13] For the record, conjunction and disjunction now function point-wise as well. That is, if A has some values, and B has to some values, the conjunction has any value one can obtain by conjoining one of A's values with one of B's. Disjunction works in a similar way.

and $\neg A$ have t as a value, but B doesn't. Hence, we have a counter-example to the inference $A, \neg A \vdash B$.[14]

6 Conclusion

Let me close with one final observation. When Western philosophers who know nothing of the contemporary developments in logic have looked at the *catuṣkoṭi* and the *saptabhaṇgī* they have struggled to make sense of them. Indeed, there really is no very good way of making sense of these things in Good Old Fashioned (Western) Logic. Skeptics about Indian philosophy have often been tempted to write off the metaphysical views in question because of this. As we have seen, though, it is not too difficult to make perfectly precise, formal, sense of these metaphysical pictures. That does not, of course, show that these pictures are correct. But it does show that they are not to be written off as logically incoherent.

Benefits also flow in the other direction. None of the formal logics we have looked at were developed with an eye on Indian metaphysics, about which Western logicians have traditionally known very little. Sometimes these logics have been challenged for what amounts to the want of an appropriate metaphysical foundation. The *catuṣkoṭi* and the *saptabhaṇgī* provide exactly that.

There is, of course, much more to be said on all of the above matters, both of the Indian metaphysical pictures involved, and the technical details of the formal logics we have met. These matters go beyond the scope of this essay, however. Its point was simply to show that both the Buddhist and Jain metaphysics we have looked at can be thought of as informing the corresponding formal logics we have met; and that has now been achieved.[15]

References

[1] Battacharya, H. S. (ed. and tr.) (1967), *Pramāṇa-naya-tattvālokālaṁkāra*, Bombay: Jain Sahitya Vikas Mandal.

[14]For more on the *saptabhaṇgī* and how it may be handled in modern logic, see Priest (2008).

[15]For much more on all the matters covered is this essay, see Priest (2018). This is a written up version of a talk given at the inaugural Pan-American Symposium on the History of Logic: Validity Throughout History, UCLA, May 2019.

[2] Ganeri, J. (2001), *Philosophy in Classical India*, London: Routledge.

[3] Ganeri, J. (2002), 'Jaina Logic and the Philosophical Basis of Pluralism', *History and Philosophy of Logic* 23: 267-81.

[4] Ñāṇamoli, Bikkhu, and Bodhi, Bikkhu (trs.) (1995), *The Middle Length Discourses of the Buddha*, Somerville, MA: Wisdom Publications.

[5] Priest, G. (2007), 'Paraconsistency and Dialetheism', pp. 129-204, Vol. 8, of D. Gabbay and J. Woods (eds), *Handbook of the History of Logic*, Amsterdam: North Holland.

[6] Priest, G. (2008), 'Jaina Logic: a Contemporary Perspective', *History and Philosophy of Logic* 29: 263-278.

[7] Priest, G. (2010), 'The Logic of the *Catuṣkoṭi*', *Comparative Philosophy* 1: 32-54.

[8] Priest, G. (2014), 'Plurivalent Logic', *Australasian Journal of Logic* 11, article 1, http://ojs.victoria.ac.nz/ajl/article/view/1830.

[9] Priest, G. (2015), 'Alethic Values', *Newsletter of the APA, Asian and Asian-American Philosophers and Philosophies* 14: 2-4.

[10] Priest G. (2018), *The Fifth Corner of Four*, Oxford: Oxford University Press.

[11] Sarkar, T. (1992), 'Some Reflections on Jaina *Anekāntavāda* and *Syādvada*', *Jadavpur Journal of Philosophy* 2: 13-38.

[12] Stcherbatsky, F. T. (1962), *Buddhist Logic*, New York, NY: Dover Publications.