The Paradox of Instrumentalism[1]

David Papineau

University of Cambridge

1. The paradox

J.J.C. Smart says that instrumentalism makes it "surprising that the world should be such as to contain these odd and ontologically disconnected phenomena... . Is it not odd that the phenomena of the world should be such as to make a purely instrumental theory true? On the other hand, if we interpret the theory in a realist way, then we have no need for such a cosmic coincidence... . A lot of surprising facts no longer seem surprising... ." (Smart 1963, p. 39).

Intuitively Smart seems right. The instrumentalist, who believes the observational consequences of some theory, but eschews any commitment to the theory itself, ends up believing something far less plausible than the realist, who can account for those consequences in terms of the theory.

But how can this be? Schematize the situation as follows. The realist believes not just O, a set of general truths formulated in observational terms, but also T, a set of theoretical and mixed truths, which have O as a consequence, but go beyond O to talk about such things as molecules, electromagnetic fields, etc. How then can the realist's position be more credible? The realist believes T&O. The instrumentalist believes just O. T&O entails O but not vice versa. The probability of O, which the instrumentalist believes, must be at least as great as that of T&O, which the realist believes.

We seem to face a paradox. On the one hand our initial intuitions tell us that instrumentalism is less plausible than realism. But when we consider what instrumentalism says, it is difficult to see how it can be less plausible than realism.

Most philosophers think of general claims in science as "Humean" universal quantifications over events. In this paper I want to see how far the apparent paradox raised by instrumentalism can be resolved if we think instead of general claims as stating something stronger, namely, causal relationships, where a causal relationship implies the corresponding extensional generalization, but the converse implication does not hold. In the end, as we shall see, this reconstrual of the

---

content of scientific theories turns out to be only a part, and indeed a
dispensable part, of the solution to our paradox. But it will at least
help us to see more clearly what is at issue in the debate about
instrumentalism. (Dretske (1977), Tooley (1977), and Armstrong (1983)
all argue that laws of nature state necessitating relationships between
properties. This is roughly the idea I want to appeal to here.
However, as will become clear in the course of the discussion, I also
need the more specific idea, which is not developed by any of these
writers, that laws state <u>causal</u> relationships between properties.
Perhaps the way to think of causation is as necessary connection plus
<u>causal direction</u>. But, in any case, a precise analysis of causation
will not be needed here.)

2. The Suggested Solution

I shall use a simplified example to show how an anti-Humean view of
scientific generalizations suggests a rather different perspective on
the commitments of instrumentalism. Suppose our observation language
consists simply of terms to describe the readings on ten different kinds
of thermometer (mercury thermometers, alcohol thermometers, ... So
O_1, O_2, ... , O_{10}.) And suppose we have just one theoretical term, K,
to describe the temperatures of objects.

Traditionally the instrumentalist's O consists of the forty-five
extensional generalizations O_i-O_j, i, j=1, ... , 10, i≠j. The
realist's T&O consists of those forty-five, <u>plus</u> the ten generalizations
of the form K-O_i. And then of course we face the puzzle of how the
realist, who believes more, can have a more plausible view than the
instrumentalist, who believes less.

But if general claims state causal relationships between properties,
then the instrumentalist accepts not just forty-five O_i-O_j's as
extensional generalizations, but the additional claim that there are
forty-five pairwise causal relationships between the various O_i's.

That is, the instrumentalist believes not just
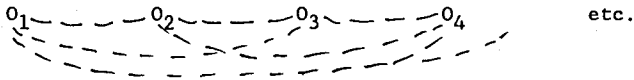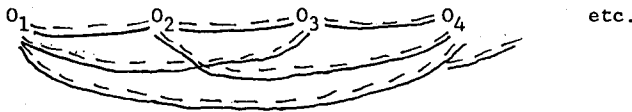

Fig. 1

but also

Fig. 2

where dotted lines indicate mere universal quantifications over events,

and solid lines indicate causal relationships.

What about the realist? Traditionally realists were taken to believe a "pyramid" of fifty-five universal quantifications (Fig. 3 below). But this doesn't mean we should now take them to believe in fifty-five different causal relationships. They need only be seen as accepting ten substantial causal relationships, namely those between K (the temperature) and the ten O_i's (thermometer readings). All the other universal quantifications they accept follow from these. While their old picture was
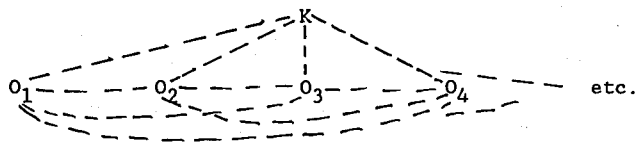

Fig. 3.
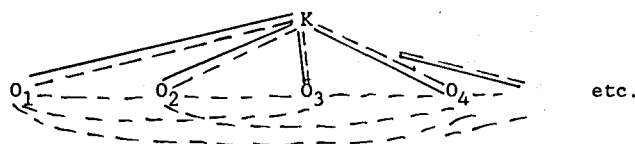
their new picture is simply

Fig. 4

So the realist actually seems to end up believing less than the instrumentalist. True, the realist will always have rather more dotted lines than the instrumentalist (in our example, fifty-five as opposed to forty-five). But there are a lot less solid causal relationships (ten versus forty-five), and the realist's advantage in this respect will quickly become enormous once we move from simple illustrations like the temperature example to more serious cases.

3. Causal Relationships versus Non-Accidents

There is an obvious objection to the above way of representing the choice between realism and instrumentalism. Clearly realists will only be better off in the way suggested if they can avoid ending up with all the solid horizontal lines I gave the instrumentalists in Fig. 2. But can they avoid this?

Solid lines are supposed to represent relationships between properties, as opposed to mere Humean generalizations. Yet don't the realists accept the horizontal lines as more than Humean generalizations? Certainly they accept the relevant counterfactuals, such as "If the mercury thermometer had read 35 degrees, then so would the alcohol thermometer." Surely then I ought to have given the realists all the instrumentalists' horizontal solid lines as well as their own?

This is where the idea of <u>causal</u> relationships between properties becomes significant. It is true that realists believe in the horizontal lines as more than Humean generalizations. But it doesn't therefore follow that they believe in them as causal relationships. They don't think that the mercury reading causes the alcohol reading, or vice versa: rather they believe that the two observables are the collateral effects of a common cause, the temperature. Whereas the instrumentalists, having no such common cause available, need to accept the existence of a direct causal connection between the two thermometer readings.

We need here to recognize a threefold distinction amongst general truths. First, Humean quantifications. Second, a class of general truths I shall refer to as "non-accidents". And thirdly, causal relationships. The higher truths, so to speak, imply the lower, but not vice versa. In particular, we can have a non-accident which fails to be a causal relationship, as in cases involving the collateral effects of a common cause.

The realist-instrumentalist contrast I am after lies in their differential commitment to causal relationships, not in their differential commitment to non-accidents. I concede that on non-accidents (as on Humean quantifications) the realist is no better (indeed worse) off than the instrumentalist. It is specifically with respect to <u>causal</u> relationships (which is how I intend the solid lines in Figs. 3 and 4 to be understood) that the realist can manage with less assumptions than the instrumentalist.

4. The Need for Causal Commitments

But now another query arises. Why should the instrumentalist be committed to <u>causal</u> relationships between the various O_i's, as opposed to merely non-accidental ones? Certainly, once we opt for an anti-Humean view of general claims in science, the instrumentalist will want to see the O_i's as related by something more than extensional quantifications. The instrumentalist doesn't think it's just an <u>accident</u> that different thermometers will give the same readings. But given that we have now allowed that a general truth can be non-accidental without being causal, why not think of the instrumentalists as believing in non-accidents <u>simpliciter</u>, without saddling them with an additional commitment to causal (solid) truths?

But let us look more closely at the relationship between causal and non-accidental truths. As I pointed out in the last section, the example of two collateral effects (thermometer readings) of a common cause (the temperature) shows that there is a difference between a general truth being causal and its being non-accidental. Nevertheless, I think there is a close conceptual link between the two notions. I would argue (though this is scarcely the place here) that, as a matter of conceptual necessity, if properties A and B are non-accidentally related, then either (a) instances of A cause instances of B, or vice versa, or (b) they are collateral effects of a common cause. That is, I take it that a "non-accidental" relationship simply <u>means</u> a relationship that is due, either directly (case (a)) or indirectly (case (b)), to causal connections. Or, to put it slightly differently, I take it that

the only thing a non-accident <u>could</u> be, other than a direct causal relationship, is the co-occurrence of collateral effects.

And this is why I assumed that the instrumentalist would be committed to <u>causal</u> relationships amongst the O_i's, and not just to non-accidents. Given that the instrumentalist denies the possibility of appealing to common theoretical causes (like temperatures) to account for co-occurrences amongst observables (like thermometer readings), I would argue that the instrumentalist can preserve the non-accidentality of the relationships amongst the O_i's only by seeing them as causing each other.

This also explains why the instrumentalist needs so <u>many</u> relationships between properties - one for every pairwise combination of the O_i's - and can't get away with deducing the rest of the desired generalizations from some subset, such as, say, just $O_1=O_2$, $O_2=O_3$,. . ., $O_9=O_{10}$. Remember that O_i are observational <u>readings</u> on thermometers. Even if (a) mercury thermometers and alcohol thermometers, when used simultaneously, always read the same, and (b) alcohol thermometers and bimetallic strips, when used simultaneously, always read the same, it does not follow that (c) mercury thermometers and bimetallic strips will always read the same when used simultaneously. For (a) only tells us what happens when you've got both a mercury and an alcohol thermometer, and (b) only tells us what happens when you've got both an alcohol thermometer and a bimetallic strip. Yet (c) covers plenty of cases where neither of these conditions are satisfied - namely, those cases where no alcohol thermometer is present. The point here is that theoretical properties, being dispositional, are always present as common causes to ensure the co-occurrence of their joint effects. But observational properties, being manifest, cannot play this role, and so the instrumentalist needs to postulate such co-occurrences one by one as separate causal claims.

5. Atheism and Agnosticism

The argument of the last section assumed that the instrumentalist "denies the possibility of theoretical causes". But is this fair? Instrumentalists are people whose beliefs are restricted to the observational level. Shouldn't this mean that they simply have no beliefs about theoretical entities, as opposed to definite beliefs that there are no theoretical entities?

There is something of an ambiguity in the notion of instrumentalism. One can read instrumentalism as an "atheistic" doctrine, which positively denies the existence of any theoretical reality. This is a natural enough way to read those varieties of instrumentalism that stem from philosophical arguments which purport to show that unobservable entities <u>could</u> not exist. But it is also possible to be an "agnostic" instrumentalist, who simply refuses to have any views about the existence or non-existence of theoretical entities either way. (See van Fraassen (1980, p. 36); see also Armstrong (1983, pp. 108-109) for a similar distinction in a slightly different context.)

At the beginning of this paper I introduced the instrumentalist as somebody who believes just O, as opposed to the realist's T&O. Such a person is an <u>agnostic</u> instrumentalist. If we think of the realist as

believing T&O, then we should think of the <u>atheist</u> instrumentalist as
believing -T&O. The agnostic is then neutral between these two
positions, believing (T&O)v(-T&O) - which is to say, O.

   In the last section I argued that instrumentalists were committed to
the implausible Fig. 3 which had causal connections amongst all the
observables, on the grounds that this was the only alternative to
accounting for the connections amongst the observables in terms of some
common theoretical cause. But we now see that this argument only works
against the "atheist" instrumentalist. The atheist instrumentalist does
indeed have to accept Fig. 3. But the "agnostic" instrumentalist can
believe in the non-accidentality of the observational connections, and
allow that this requires either that the O_i's cause each other (Fig. 3,
-T&O), or that there is a common theoretical cause (Fig. 4, T&O), and
yet simply remain neutral from there on, refusing to decide between
Figs. 3 and 4.

   Note how this distinction between atheistic and agnostic
instrumentalism is relevant to the general issue of this paper. I
started by asking how instrumentalism could be simultaneously more
implausible than realism, and yet logically weaker. We now see that it
is specifically atheistic instrumentalism that is committed to the
implausible view that there are coincidental (in the sense of
theoretically unexplainable) connections amongst the observables (O,
even though not-T). But since the atheist definitely denies T,
atheistic instrumentalism is not <u>per se</u> logically weaker than realism.
Agnostic instrumentalism is indeed logically weaker than realism. But
once we have taken care to distinguish it from atheistic
instrumentalism, we can see that it is not really less plausible than
realism. It is true that there is a sense in which there is something
implausible "in" the agnostic view: the agnostic, believing (T&O)v
(-T&O), does not rule out the implausible -T&O, whereas the realist
does. But this is not to say that the agnostic's view is as such less
plausible than the realist's. (The objection to agnostic
instrumentalism is not that it commits you to an implausible
coincidence, but simply that it is excessively cautious, refusing to
take a view on a matter where a reasoned judgment is possible.)

   What this means is that the adoption of an anti-Humean view of
general claims in science is not <u>essential</u> to the solution of my
original puzzle. The argument of the last paragraph is as available to
Humeans as to non-Humeans. Humeans will have a different view about the
effect of adding T to O (it gives us the purely dotted Fig. 3 rather
than the mixed Fig. 4). But this doesn't stop them resolving the
original "paradox" by observing that the agnostic O isn't <u>per se</u> less
plausible T&O (it's just unreasonably cautious), while the atheistic -
T&O isn't necessarily weaker than the realist T&O, and so could well be
less plausible. True, my explanation of <u>why</u> atheism is less plausible
than realism did appeal to a non-Humean account of laws. I represented
the choice between -T&O and T&O as the choice between the overburdened
Fig. 2 and the economical Fig. 4, and I took the contrast between these
figures to show why atheism is less plausible than realism. But,
although Humeans are of course precluded from representing the choice
between atheism and realism in this way, there's no reason why they
shouldn't give some other account of why -T&O is less plausible than
T&O. In particular, there is nothing to stop a Humean simply

maintaining that an atheistic commitment to observational generalizations as true but unexplainable is _a priori_ less probable than the realist view which conjoins those observational generalizations with a theoretical explanation.

Even so, I think that the non-Humean response to atheistic instrumentalism I have developed in this paper is preferable to the Humean response. For one thing, the notion of explanation that the Humean is likely to appeal to here is undesirably anthropocentric: why should the ability to give explanatory satisfaction to humans be a guide to truth? And, more generally, the appeal to _a priori_ probabilities is dialectically double-edged: it invites the blunt instrumentalist response that -T&O is in fact more probable than T&O. Neither of these difficulties arises if we approach instrumentalism armed with a non-Humean view of laws.

Note

[1]I would like to thank D.M. Armstrong, Jeremy Butterfield, David Lewis, and D.H. Mellor for helpful comments on predecessors of this paper. In particular, I would like to thank David Lewis for curing me of my confusions about the atheist-agnostic distinction: the representation of atheism as -T&O, realism as T&O, and agnosticism as the disjunction between them was suggested by Lewis.

References

Armstrong, D.M. (1983). *What is a Law of Nature*? Cambridge: Cambridge University Press.

Dretske, Fred. I. (1977). "Laws of Nature." *Philosophy of Science* 44: 248-268.

Salmon, W. (1984). *Scientific Explanation and the Causal Structure of the World*. Princeton: Princeton University Press.

Smart, J.J.C. (1963). *Philosophy and Scientific Realism*. New York: Humanities Press.

Tooley, M. (1977). "The Nature of Laws." *Canadian Journal of Philosophy* 7: 667-698.

van Fraassen, B. (1980). *The Scientific Image*. Oxford: Clarendon Press.