

HPSC 1001/1901/2101/2901

***WHAT IS THIS THING CALLED SCIENCE?***

Semester 2, 2020

## **Lecture 23: Experiment, Scientific Realism**

## **Action and Experiment**

What is the relationship between observation and experiment?

Experimental observation seems more *active*; we intervene and manipulate things, to see what happens next. Rather than just taking in whatever we happen to see.

There seems to be a gradient or scale:

Wholly passive observation → Active observation without manipulating objects (eg., travel, timed observation at night) → Use of instruments such as a telescope → Some intervention: put chemicals together to see how they react, remove handle of a public water pump during an epidemic → Constructing large-scale apparatus: particle accelerators.

Why does it matter where you are on this scale, from more passive to more active and manipulative?

Two parts to my answer. One that we did not cover in detail here, though it's in T&R Ch 3 and 14, and it relates to how I handled the ravens problem in lectures.

Observations sometimes only become evidence because of the *procedures* that gave rise to them.

Procedures tend to take us some way along the scale. But we don't need to transform or manipulate the world -- pointing a telescope at the sky every night at midnight would count.

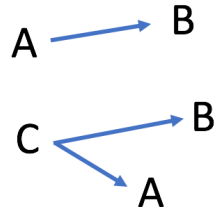
Instruments can also give you some access to objects that are very small or otherwise inaccessible. But any role for action in itself?

Another role: learning causes.

Suppose you are dealing with a system in which you know roughly what factors are present, and the question is what the causal relations are between them. You want to know whether  $A$  is a cause of  $B$ .

\* Strictly, " $A$ " should refer to not just one event, or one kind of event, but what can be called a *variable*. An example of a variable is *the weather*, which might be hot or cold on a particular day. It might also be a behavior, such as smoking or not smoking, or a disease, which might be present or absent. But I will speak more loosely today.

Two possible situations:



Suppose first that you just look at whether  $A$  and  $B$  are *associated*. They are. Whenever you  $A$ , you see  $B$  soon after. That is not enough to tell you which situation above holds.

But suppose you can reach in and affect the network. You bring about a case of  $A$ . Then see if  $B$  follows.

If yes, then you have made the second situation, where  $C$  is a cause of both, much less likely.

At least, you have shown (roughly speaking – supported the hypothesis...) that sometimes it is  $A$  that causes  $B$  (even if  $C$  might sometimes operate as well).

Why is that? Because when you intervene, choosing to act when you do and in the way that you do, you cut off many of the causal pathways by which some *other* factor could cause both  $A$  and  $B$ .

Example: John Snow and cholera in 1854. From the second week and ch 2 of T&R. He has the handle of a pump removed and stops a cholera outbreak.

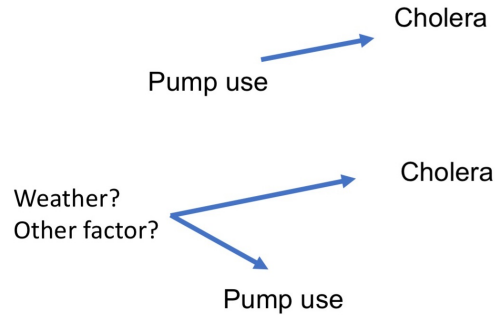
Suppose the case was like this: He observes lots of episodes where the pump stops working and cholera subsides.

Is it because something else (eg. cold weather) affects both?

Response: remove the pump handle to see what happens next.

How this relates to the diagram above:





This does not guarantee that he will learn the cause, but it makes a difference. When removes the handle, Snow cuts off a lot of the possible pathways by which some *other* factor might affect both the pump and the epidemic, because those other factors can no longer affect the state of the pump.

Especially if he does this a number of times in different conditions, he can work out that the network is one where the arrow goes *from* pump *to* cholera outbreak.

So observations are good in general, but experimental observations are often special, especially if we want to learn causes.

\* Via earlier discussion of HIV case. Three kinds of evidence:

(i) Associations (eg., hemophiliacs who get transfusions tend to get AIDS)

(ii) Interventions - hard to do with a deadly disease. But the tragic "natural experiments" (eg., Florida dentist, lab accidents) come close.

(iii) Mechanistic information - the pathway by which the virus does harm.

How different are these? For some empiricists, they are all just different aspects of the flow of experience. Does that fail to appreciate the important differences?

# Scientific Realism

"Scientific Realism": The standard discussion: does science tell us (sometimes, when things go well) about the hidden nature of the real world? A world that exists in a mind-independent way? Does it tell us (sometimes) how things really work?

Scientific realism: yes.

Opponents: no.

Why not? Perhaps theories can't "reach beyond" observables in what they say, *or* they can try to do this but we can't ever think they succeed, *or* it is not the business of science to do this, *or* the world itself does not exist mind-independently.

A family of views oppose the "realist" picture, very different from one another, but related in their denial of the view that (i) scientific theories can be interpreted as attempts to tell us what the world is really like, and (ii) sciences probably succeeds in this, at least a fair bit of the time.

I am mostly on the realist side. But the whole debate has become pretty confused. I will do the "standard" debate first and then rethink it a bit.

Standard debate: realism versus several opponents. In each case we need to understand some general philosophical ideas about "reality" and our contact with it, and also some ideas about science.

*Opponent 1: Empiricist anti-realism.*

Really a family of similar anti-realist views here, not one.

Via my first summary: **Perhaps theories can't "reach beyond" observables in what they say**, or they can try to do this but we can't ever think they succeed, *or* it is not the business of science to do this, *or* the world itself does not exist mind-independently.

One form of empiricism sees our thoughts as "confined" to experience, as not able to reach beyond it.

*Phenomenalism*: all we can think about is patterns in sensations.

The Schlick quote I have discussed several times, from Logical Positivism, seems to assert something like this: "what every scientist seeks, and seeks alone, are ... the rules which govern the connection of experiences, and by which alone they can be predicted."

Log Positivists denied they were phenomenologists, but they seemed pushed towards it. This is because of their view of



language. The parts of language that refer to experiences, or at least to observable things, give meaning to all the other parts.

"Carbon atoms have 4 outer-shell electrons." What does that *mean*? How can that sentence be significant to a hearer? What do they really learn?

It seems that we need to explain its meaning in more basic terms. Something like: "If I put chemicals that look like this... and chemicals that look like this... together, I will see...."

In the 20th century phenomenalism became unpopular, but views that were similar to it hung around. These were views that doubted we can even make definite *claims* about the deeply unobservable parts of reality, as scientists often seem to. The theories of language that philosophers liked seemed to conflict with the ways language is actually used in science.

Another related view: Perhaps though we might be able to make hypotheses about things that are unobservable, we can never know if we are getting things right. So this is not a suitable goal for science. Science should try just to describe patterns in the part of the world we can observe. That is all science is, and should be, concerned with.

First summary again: Perhaps theories can't "reach beyond" observables in what they say, **or they can try to do this but we can't ever think they succeed, or [or so] it is not the business of science to do this, or** the world itself does not exist mind-independently.

Most of the workings of the world are off-limits to science. That is yet another kind of *empiricist anti-realism*. It is sometimes called *instrumentalism*.

Is a situation like this reflected in actual scientific behavior, and scientific change? No. The boundaries of the "observable"

are continually being moved as technology changes, and people are always trying to push into the next unknown layer.

Examples: Many in neuroscience. fMRI scans can tell us which parts of the brain are most active at a time, based on blood flow differences.

## *Opponent 2: Metaphysical Constructivism*

First summary again: Perhaps theories can't "reach beyond" observables in what they say, or they can try to do this but we can't ever think they succeed, *or* [/so] it is not the business of science to do this, ***or the world itself does not exist mind-independently.***

Terminology. "Metaphysics" refers to questions and claims that are about the most general nature of reality.

Metaphysical questions include: does the world exist independently of our thought about it? Does God exist? Etc.

"Constructivism" /construction, etc.... terms used in a great variety of ways.

Initial idea: our scientific ideas are not "given" to us by nature, stamped on us by data. Instead, we actively construct theories and concepts. We are creative in this process. We make choices rather than being compelled. (Very influential theme in the years after Kuhn.)

Fine - that is not yet in opposition to realism. It is opposed (maybe) to some kinds of empiricism.

But in some discussions: reality itself is constructed by us.

Does this just mean: our *ideas about* reality are constructed?  
That is not controversial and not a move away from realism.  
But that is not all that people meant.

The *world as we know it* is partly (entirely?) a human product or construction. The ways things are, or "the facts," are dependent on our beliefs, language, theories, and/or paradigms.

Construction of reality, as well as construction of our ideas about it:

Who? Kuhn (Chapter X), Latour (though he has recanted?)\*,  
Nelson Goodman (*Ways of Worldmaking*, 1978).

\* Latour: [http://www.sciencemag.org/news/2017/10/latour-qa?utm\\_campaign=news\\_daily\\_2017-10-10&et\\_rid=35137912&et\\_cid=1596541](http://www.sciencemag.org/news/2017/10/latour-qa?utm_campaign=news_daily_2017-10-10&et_rid=35137912&et_cid=1596541)



Kuhn's version, in *Structure*:

I have argued so far only that paradigms are constitutive of science. Now I wish to display a sense in which they are constitutive of nature as well.

After a revolution, “scientists work in a different world”

At the very least, as a result of discovering oxygen, Lavoisier saw nature differently. And in the absence of some recourse to that hypothetical fixed nature that he “saw differently,” the principle of economy will urge us to say that after discovering oxygen Lavoisier worked in a different world. (1996, 118)

Some influence of Immanuel Kant's philosophy here. Late C18. See T&R.

A line of argument I think has had even more importance: Attempt to *reject* a different family of views. But the rejection gets out of hand, and leads to a *reversal* of the view to be rejected.

That reversal does not really make much sense, but in some discussions, it is seen as important that the rejection of the alternative picture be as definite and forthright as possible.

Start from: the view that people think should be rejected:  
The world "stamps itself" on the mind of an observer or  
investigator.

Steven Shapin: reality acts on scientific belief with  
“unmediated compulsory force” (1982). A passive conception  
of scientific knowledge.

Especially after Kuhn, this was rejected, in increasingly  
emphatic ways. (Note a connection to the 'symmetry principle'  
of sociology of science.)

Woolgar (the person who wrote *Laboratory Life* with Latour), in his book *Science: The Very Idea* (1988):

The argument is not just that social networks mediate between the object and observational work done by participants. Rather, the social network constitutes the object (or lack of it).

The implication for our main argument is the **inversion of the presumed relationship** between representation and object; the representation gives rise to the object. (p. 65).

Part of the problem here: a false dichotomy.

Shapin and Schaffer, in *Leviathan*. Quoted in T&R:

“It is ourselves and not reality that is responsible for what we know” (1985, 344).

Roughly speaking, it is both.

You don't have to choose between two simplified, cartoon-like views – either the world stamps itself on us, or we stamp ourselves on the world.

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