HPSC 1001/1901/2101/2901

WHAT IS THIS THING CALLED SCIENCE?

Semester 2, 2020

Lecture 22: Consensus 2, Experiment

"The important thing is to not stop questioning."
Albert Einstein
Echoed by Peter Duesberg.

Consensus: the ending of debate. In principle, it might happen to quickly or too slowly. If science was purely about questioning, debating, trying out ideas, then an absence of consensus would be no problem at all. But that's not all there is to it. When scientific ideas have to be put into practice, guiding policy decisions, then consensus is a good thing (as long as the theory agreed on is a good one...).
A *spontaneous* consensus will usually look like a good thing. But spontaneous consensus can be slow to come, and people

(or businesses) might also have an interest in delaying it or making it appear weaker than it is. A *curated* consensus is one that has been "managed" to some extent, perhaps in relation to a problem of that kind. Natural to feel a bit uneasy about them. But sometimes necessary?

HIV/AIDS case

Early 1980s: AIDS pandemic and discovery of HIV.
Some qualified denials (Duesberg).
US Nat. Academy of Sciences tried to assert a consensus: evidence HIV causes AIDS is "conclusive."
Looks early? Gaps closed fairly quickly. And South Africa 2000-2003 shows costs of denialism.

(See also R. Shilts' book *And the Band Plays On* – history of AIDS written very early, published 1987.)

This is a case where it seems that.... "The important thing is to not stop questioning"... is not very helpful?

Or: you *can* keep questioning, but often you also have to act. In some contexts, especially in a democractic society, action that is expensive and has costs will require a consensus.
If there is a consensus of the spontaneous kind (no one wants to ask more questions), then there is no problem. In the HIV case, the situation was close to that, but not quite there.

Scope also existed for a *circumventing* of the usual effects of the near-consensus (of spontaneous kind) that existed. The SA govt distrusted Euro-American medicine and especially the drug companies. They were motivated to listen to the few qualified dissenters.

It would fine to keep questioning, if you could let policy be guided by the weight of expert opinion (the 'center of gravity' in the community, a spontaneous consensus or an approximation to one) without being circumvented. This is becoming more and more difficult.

That is how I ended this discussion in 2019 class. Do things look different in 2020?

Covid-19

About the basic biology: spontaneous consensus as far as I know. Not like the AIDS case, with qualified dissenters about the role of the virus itself.

More controversy about epidemiological models of the virus' patterns of spread, and its health consequences. The UK Imperial College model changed policy in the UK almost completely.

"Special report: The simulations driving the world's response to COVID-19" by David Adam. *Nature*, April 2010. https://www.nature.com/articles/d41586-020-01003-6

> When updated data in the Imperial team's model indicated that the United Kingdom's health service would soon be overwhelmed with severe cases of COVID-19, and might face more than 500,000 deaths if the government took no action, Prime Minister Boris Johnson almost immediately announced stringent new restrictions on people's movements.

Some analogy between controveries over these models and controversies over climate change models. But these models had much greater effects on policy.

The models of the disease's spread are (like all models of this kind) very simplified. Will discuss this next week if we have time. . . .

Models of this kind can be seen as giving us a lot of "if A, then B" statements (conditionals). The "A" in such a model tends to be simplified, but it might be usefully *close* to reality, and then we might be able to make predictions using the model.

(See my "Models, Fictions, and Conditionals," in *The Scientific Imagination* and on my website).

A place where much more controversy is found: how should we respond, in our policies, to the basic biology (where there is consensus) and the models (moderate controversy)?

How severe should restrictions on everyday behavior and business activity be, from "Let it rip" (no restrictions) to "Lockdown" (as seen in Victoria over recent months, France and UK now in milder forms). This is not itself a scientific question, but a policy question in which science plus other information is used. It includes value judgments about the different outcomes.
"Listen to the science" has acquired a rhetorical role in the policy debate.

Jay Bhattacharya (Stanford U prof of medicine, but a controversial figure in the policy debates):

> I think part of the problem is that there are two very different norms of discourse in public health and in science. In public health, there needs to be some degree of unified messaging, with the level of confidence conveyed consonant with the science. Disagreement in those cases is viewed as dangerous. By contrast, censorship and suppression of disagreement kills science. We're in a situation where the science of COVID is still emerging, and yet the norms [of] unified public health messaging are being applied. Science cannot work under these circumstances.
>
> https://old.reddit.com/r/LockdownSkepticism/comments/jcxsb1/ask_me_anything_dr_jay_bhattacharya/g94d4by/?context=3

See also https://www.sfgate.com/science/article/Stanford-prof-s-anti-lockdown-movement-faces-15644375.php

Overall:

There is spontaneous consensus about the basic biology (unlike early HIV debate)

Some controversy about models (related to climate science controversies, as all models of this kind make simplifications).

Much controversy about policy.

Where does science end and policy start? At least with value judgments about costs and benefits of different kinds.

Action and Experiment

A topic covered quickly, that relates to all these issues and more.

Remember the 'web of belief' view (Quine). All our beliefs, thoughts, theories (etc.) form one big mental apparatus that we use to predict experience. Quine said this applies to just about everything in our minds. If our predictions are going well, there is no need to change anything. When they are not going well, we can change whatever we like, in order to get our predictions back on track.

Something missing?

Action, behavior, *doing things*.

Two roles here:
(i) The pursuit of goals. The overall situation looks like this: we use prediction to test beliefs, and then use beliefs to guide our actions.
And (ii) We also use action to shape and enrich experience.

In the POS context, (ii) brings us back to questions about experiment. Remember Feynman from early in the course:

> The principle of science, the definition, almost, is the following: *The test of all knowledge is experiment*. Experiment is the *sole judge* of scientific “truth.”

Passive observation is worthless? What if you can't do experiments?

What *is* the relationship between observation and experiment? And why does the distinction matter?

Some thoughts on this.
There seems to be a gradient or scale:

First: passive observation.
Ancient argument that the Earth is round: how ships disappear over horizon.

Next: more active, deliberate observation, but without changing the things you are looking at.
Astronomy. Use of telescopes: Galileo, from around 1609.
1705 Edmund Halley used Newton's theory along with past records to predict that a comet would return in 1758. It did.

From there: preparing samples for microscopes, bringing about chemical reactions to see what will happen.

And then: constructing large-scale apparatus (particle accelerators, etc).

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.

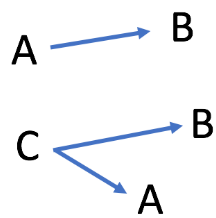
Procedures tend to take us some way along the scale. But we don't need to transform or manipulate the world -- pointing a telescope at the sky every night at midnight would count.

A second 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:

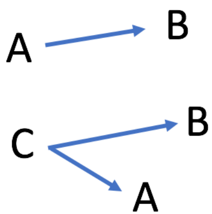


Suppose first that you just look at whether *A* and *B* are associated. Whenever you *A*, you see *B* soon after. That is not enough to tell you which situation holds.

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).

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.

How this relates to the diagram above:



Suppose 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.

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 discussion yesterday. In the 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?