A theory is just a theory (notes)

Notes of [https://www.youtube.com/watch?v=co8adINPCns](https://www.youtube.com/watch?v=co8adINPCns&list=PLz0n_SjOttTenxXXdML7fOu1og3D9LaME&index=1)

Video 1: A Theory is Just a Theory (Underdetermination in Scientific Theory)

\*\* This is not looking at how the definition of a theory differs from scientific theories, but rather on how theories in science play a role in considering validity and so on. \*\*

Underdetermination:

* Fatou went to the market. She spent 13 dollars on artichokes and plantains. artichokes are 5 dollars and plantains are 3 dollars. How many of each did she buy? -

it must be the case that she bought 2 artichokes and 1 plantains:

a5+b3 = 13, a,b∈N (natural number set)

Thus: a = 2, b=1

* Sohna went to the market. She spent 28 dollars on artichokes and plantains. artichokes are 5 dollars and plantains are 3 dollars. How many id did she buy?

it is not specified:

a5+b3 = 28, a,b∈N (natural number set)

Thus: (a=5, b=1)v(a=2, b=6)v…

Thus: this problem is an underdetermination.

***Definition of underdetermination***: when the information we are given does not determine what conclusions can be drawn.

A more scientifically aligned example:

* Imagine that there is a correlation between playing video games and being antisocial. What conclusions can be drawn?

It is not specified:

P => playing video games leads to anti social behaviour

Q => anti social behaviour leads to playing video games

R => there exists an external factor that influences both e.g.

parental neglect

Thus: (PvQ)vR

A very important point in underdetermination is that correlation does not imply causation. This becomes very trivial when you think of some real life scenarios:

* Say that Bob is feeling sad on the family trip, and his sister, Lisa, is also feeling sad, and this tends to follow for whenever one is happy, the other is too, and whenever one is sad, the other is too. This does not imply that when Bob is happy, Lisa is happy, it could simply be the case that whenever their parents buy them candy, they are happy, so an external factor influences.

Thus:

A correlation underdetermines the conclusion of a causation

Underdeterminations come in two types:

* Holistic underdetermination: arises whenever our inability to test hypotheses in isolation leaves us underdetermined in our response to a failed prediction or some other piece of disconfirming evidence (when our predictions fail, we can’t validly conclude our hypothesis incorrect)
* Contrastive underdetermination: the quite different possibility that for any body of evidence confirming a theory, there might well be other theories that are also well confirmed by that same body of evidence (information can be modelled in many ways, prediction does not mean correctness)

Video 2: Are theories falsifiable? (Holistic Underdetermination)

Falsifiable: able to be shown or demonstrated to be false through experimentation. E.g. the claim that god exists is not falsifiable, so it is not a scientific theory

Carl popper and the demarcation problem: what distinguishes scientific theories to non scientific theories is their falsifiability, thus, this provides what I am going to call popper’s definition of science:

Science is the development of falsifiable theories

Is it possible to take any particular hypothesis and demonstrate that it is false? E.g. a physicist might take a theory’s prediction and compare it to an experiment, then, if the prediction is not obtained then the theory is false

But this gets a bit harder to deal with when you actually apply it:

Theory: given T, T => P (T= the theory is true, P= result)

Experiment: ~P

Thus: ~P=> ~T

Thus: ~T

Yet, there are problems with this.

A real life example: Newton’s celestial mechanics:

NCM is a theory on the motion of planets (T)

If NCM, then the orbits of planets will be correctly predicted (T=> P)

NCM did not predict the orbits of mercury (~P)

Two conclusions:

* NCM is false
* The experiments differed to the theory as we did not calculate the effects of another object, Vulcan.

^ the evidence underdetermines the conclusion, the very assumption of there being no Vulcan is another theory, and since we cannot test one without the other, we cannot tell which is incorrect. ^

Then, we may provide a counter argument:

Say that we searched for Vulcan, and we did not find it, thus, we should give up on NCM

Two conclusions:

* NCM is wrong
* Or Vulcan is made of some kind of matter we cannot perceive with light, and so on, but can be perceived in terms of orbits and effects on planets

The counter argument to popper:

Fx = x is falsifiable

Dxy = x depends on y

Ix = x is independent

1. (∀x)(Fx<=>~(∃y)(Dxy))
2. (∀x)(~Ix=>(∃y)(Dxy))
3. (∀x)(~Ix)
4. ~Iz (3, UI)
5. ~Iz=>(∃y)(Dzy) (2, UI)
6. (∃y)(Dzy) (4,5, MP)
7. Fz<=>~(∃y)(Dzy) (1, UI)
8. (Fz=>~(∃y)(Dzy))^(~(∃y)(Dzy)=>Fz) (7, Equiv)
9. Fz=>~(∃y)(Dzy) (8, Simp)
10. ~Fz (6, 9, MT)
11. (∀x)(~Fx) (10, UG)

This argument is valid, but let's try to see if it is sound (sound: if an argument follows from the premises and it’s premises are valid given the circumstances)

P1 soundness: a problem is self contradictory theories, but we can set aside that:

Cx= x is contradictory

1. (∀x)((Fx^Cx)<=>~(∃y)(Dxy))

P2 soundness: imagine that there exists some theory that cannot be tested in isolation, but depends on no other theories for it's falsification. Then, it must be tested using other theories, and yet no other theories can be used to test it

P3 soundness: any experiment that we design, or argument that we craft is dependent on our beliefs and previous theories: carneades decides to call ways to affirm and confirm P as theories/belief structures, thus, he says that T=>P requires a theory for finding P thus, proving not T: ~P=>~T requires the theories that make ~P be tested, thus, ~T requires that other theories that make ~P be tested exist, thus, in all cases of ~T, there exists other theories that are assumed to test for ~T, thus, ~T=>R, where R is a theory or a group of theories (those that form our “belief structure”), Thus, the falsifiability of T requires other theories, making it not falsifiable.

Thus: no theory is falsifiable

A popper quote: “In so far as a scientific statement speaks about reality, it must be falsifiable; and in so far as it is not falsifiable, it does not speak about reality.”

Video 3: Is science rational?

Irrational: a process or method is irrational if a step of it is not based on reason, rationality or logic (if through the same process and same premises, contradictory conclusions are reached, the process is irrational).

Quine: “the unit of empirical significance is the whole of science” (we can only test all of our hypothesis at once, if we find a problem, we cannot know where it is)

What Quine says is that there is no rational way to decide which theory to throw away.

Then, the only way for us to revise our beliefs is irrational. The SSK claims that this act is done to gain social/financial benefits. Thus, scientists are biased.

Larry Laudan (argument for the rationality of science): he says that there are two versions to the underdetermination thesis:

1. A stronger version, which has all of the consequences implied by the SSK, but is indefensible: “it is rationally defensible to retain any belief or theory come what may” it cannot be defended as: Laudan says principles of good reasoning may come in for us to ration through this, but this is changing our definition of rationality, since while deductive logic is very strict, this still allows for many problems:

The main being one posed by Quine:

Imagine a web of beliefs: it starts with deductive logical beliefs, then, it grows out to the scientific ampliative principles, things that humans have grown to find as fundamental in science (the narrator suggested that occam’s razor is a neat example of such), then, from these branches and so forth, grows the scientific theories that we currently hold.

The problem with this approach is that according to Laudan, when we have an experiment that disagrees with this belief structure, we are often underdetermined with which theory is the cause of the issue, but, the scientific ampliative principles should tell us what should be discarded, right? Well, the problem is that we might be underdetermined on whether we should throw out the very SAP themselves. A situation: we use an amplitude to decide to throw out belief X, but we are very psychologically inclined to believing X, so we throw the amplitude instead. Kyle stanford:

“...such further ampliative principles governing legitimate belief are, of course, themselves simply part of the web of our beliefs, and are therefore open to revision in response to recalcitrant experience - indeed, this is true even for the principles of deductive logic and the (consequent) demand for particular forms of logical consistency between parts of the web itself!”

Say that we are psychologically inclined to throw out the law of excluded middle, then, by definition, we are allowed to have contradictions in our belief structure.

So, “Laudan may be able to show that the SSK and others can't justify their larger claims about the deep biases of science. He is unable, however, to demonstrate the rationality of science as he underestimates the depth of Quine's criticism.”-*carneades or smt idk im not astro physics*

1. A weaker version that can be defended but lacks drastic consequences: “it is psychologically possible for a human to preserve any claim come what may”

Personal notes:

* I think a way to overcome this is to make independent groups, mapping to different theories being discarded and some not. More practically, say that all theories in use are of a set T, then, we would choose all possible ways to combine a set T of size n into two boxes, those that are discarded and those that aren’t, then, we would simply repeat the process over and over to find the ones that predict things right. (of course, now I notice that this makes no sense and still holds problems, but I’ll leave this in just for you to appreciate my stupidity (I don’t know I’m not an astrophysicist))

Video 4: Are Theories Verifiable? (Contrastive Underdetermination)

Verifiable: able to shown to be true via experiment, a particular theory is perfectly determined by a body of evidence (if it is verifiable it must be the only determined by a body of evidence)

Holistic: takes a set of beliefs and shows that responses to new evidence are underdetermined (we will not use this)

Contrastive underdetermination: takes a set of evidence and shows that more than one theory can be supported by it

e.g. graph:

If the body of evidence is a list of points P, then there might be many graphs that intersect all points in P, so we don’t yet know which graph to choose. It is simply a fact of mathematics that you will always be able to come up with infinitely many theories (functions) that fit n data points as long as n is finite, no matter how large. This for sure oversimplifies, but it gives the ideas. Evidence can support many theories at once. Theories that keep

EET: empirically equivalent theories: theories which make all and only the same empirical claims and predictions, and no evidence will ever allow us to choose one over another (when a theory simply is very similar or equal in terms of literal and practical experimental predictions, but both take different paths to the same answer, this may be a problem, because in no way are we to say that the universe takes literal 2 different paths to reach the same result, it might be the case that it only takes one).

E.g.

1. Newton’s gravitation and mechanics in conjunction with the claim that the universe is at rest.
2. Newton’s gravitation and mechanics in conjunction with the claim that the universe is moving at a constant velocity

^ Since a law of motion is that all laws of motion are the same for all frames moving at constant velocities, there is no way to tell, by this law of motion. ^

Note (don’t expect much from my dumdum brain): I think that that thing that someone said that what isn’t testable doesn’t matter will probably come up in the video

Laudan: comes to the rescue for this type of thing: our epistemic and empirical tools are constantly changing, but someday, we might be able to tell these sorts of things (my response: this is a great example of hope, and hope isn't that rational imo)

Kyle Stanford: so long as there is at least one other empirically equivalent theory the theory is underdetermined, and so far, since we have no way to show that there does not exist any empirically equivalent theory for all of our theories, there of course is a chance that all of our theories are underdetermined.

Earman: examples of theories that have EE:

1. “At least two genuine cosmological theories have serious non skeptical, and nonparasitic empirical equivalents: the first essentially replaces the gravitational field in Newtonian Mechanics with curvature in spacetime itself, while the second recognizes that EGTR (Einstein’s General Theory of Relativity) permits cosmological models exhibiting different global topological features which cannot be distinguished by any evidence inside the light cones of even idealized observers who live forever” (he basically says that inside the event horizon, no one can enter and we actually don’t know the topological structure of it, we assume it to curve into a singularity, but no one can test it. By “idealized observers who live forever” he meant, if we throw an immortal person inside and ask the person to tell whether or not the space curves inside of it in such and such a way, that, even that, cannot be distinguished. I don’t know why that is the case, I know gr basics but have no clue on that, but still, the argument is pretty convincing)

Kukla: for all theories, T, we can generate other empirically equivalent theories such as T’ (the observable consequences of T are true but T is false) or T’’ (when observed the world behaves according to T, but when not observed it behaves in some other way). < this argument seems pretty sensible for all theories <

Therefore any new data confirms empirically equivalent, yet contradictory theories. No one theory can be shown to be true or even likely to be true, only that it is one of a set of theories that is confirmed by the evidence.

Video 5: Are Our Theories Correct? (Transient Underdetermination)

Transient underdetermination: Theories that are currently right, and fit a dataset, but give different empirical results for scenarios previously unseen. These are not EETs.

All theories that have been previously considered correct, but were then shown not to fit new experimentation, are transient theories.

Kyle Stanford (on why all theories may likely be incorrect): “in the past we have repeatedly failed to exhaust the space of fundamentally distinct theoretical possibilities that were well confirmed by the existing evidence, and we have every reason to believe that we are probably failing to exhaust the space of such alternatives that are well confirmed by the evidence we have at present”

We have shown:

* No theory is falsifiable (V2)
* Science is irrational (V3)
* No theory is verifiable (V4)
* Theories can’t be shown to make correct predictions (V5)

So:

No theory can be proven false. No theory can be proven true. The methods to create theories are irrational. We cannot show that theories will continue to make correct predictions.

They might be useful:

But, a theory, is:

JUST A THEORY

So even though our theories might be correct, we cannot show.