Abductive inference and the logic of discovery

**Recap**

Popper, Post Popperian and Critics

Popper has a strong view about the method of science and how it should look like: It starts from conjecture and refutation, and only IF the hypothesis resist verification then its good.

Inventing Hypotheses - **C. Hempel**

* Transition from data to theory requires imagination
* Hyphotheses and theories are not derived from observed facts but invented in order to account for them
* They constitute guesses at the connections that might obtain between phenomena
* “Happy Guesses” need to have great ingenuity above all if they involve a radical departure from current scientific thinking

*Free Imagination for C. Hempel*

* There is the possibility for scientist to be biased by questionable scientific knowledge
* Scientific objectivity is safeguarded by the fact that, even though theories and hypothesis can be made freely, they only can be accepted into the body of scientific knowledge only if they pass a critical scrutiny

*Discovery vs. Justification*

[Reichenbach]

* Once a result is obtained then we can order our thoughts in cogent way. This is a rational reconstruction of thinking that is controlled by logic and whose analysis reveals those rules which we call logical laws
* There is in fact a division between context of discovery and context of verification. The context of discovery is “left to psychological analysis, whereas the logic is concerned with the context of justification”. We have a method for the latter but there is no method for the former.
* Justification: *“We speak of justification when we possess a proof  which shows that we have good grounds to rely upon those results”*
* We have a good logical methods to choose which thoughts are good and which are not
* Reichenbach was more of an inductivist. Popperian had a different view. But the framework of thinking about the problem is the same

*The context of discovery [Hanson]*

Is there a logic of discovery? What logic would apply here?

**Hypothetical deductive model**

* From a conjecture
* Deductive

O….H —> (not)p —> (not) Hp

According to Popper, there is a great discontinuity between the first part and second part in the deduction, between the formulation of the hypothesis and the stage of the testing of the hypothesis (comprised all the observations used to test it).

* (1) O…H
* (2) H —> p —> H

This is because, according to Popper, the 2° stage is a perfectly logical stage (it follows falsification), while the first stage is alogical or pre-logical.

*Hypotheses precede observations*

We have no idea how these hypothesis come to our mind

“Observation is always selective”

* It requires to have a **P.O.V** to observe something (a position on an argument), a chosen **object** and a **problem**.
* Hypothesis > Presupposes Similarity and Classification > Interests, POVs and Problems

Which one comes first then? The observation (O) or the hypothesis (H)?

Popper says *“It is quite true that any particular hypothesis we choose will have been proceeded by observations (…) But these observations in their turn presupposed the adoption of a frame of reference”*

* And yet there is no way to account in logical terms, how we get this Hypothesis, or how we reach the stage of their formulation

Take Darwin for example: Darwin agrees with the model - *Darwin a Champion of HD?*

* *“How odd..service!” =* all observation must be for or against some view to be useful
* He means, of course that during he voyages he was not just recording things at random, but he was gathering a huge amount of data selecting only those which had some interest in. He had a framework for observing. But, as other remark, this does not mean that at that point he did have the hypothesis of his theory on his mind. A conjecture (answer to a problem) which we cannot claim he had already, he looked for observation without a clear idea in mind but with a method!
* His mind was not a tabula rasa, he knew many things, he had several scientific ideas. He a theoretical framework. So the HD people are right, **observation are never pure**. But that amounts to say that a scientist has in his mind all background info and not an answer to a problem or a theory. When we embark in some kind of enquiry we might have many info but we lack the answer.
* There is no well established logical reason that hypothesis cannot be derived from…
* Can we take a different direction?

*Objections*

* To have a theoretical framework is different from having a specific hypothesis in mind
* Not all/any hypothesis are tested

Normally there is more that one hypothesis to account for an observation, but a scientist must test them all indiscriminately.

**Probability and Plausibility**

H is probable

H —> P (1,2,3…)

P (1,2,3…)

————

H is more probable

When and hypothesis enter the hd scheme it should present itself being of some interest; we can say hypothesis enter hd inference with some degree of probability.

What we do when we have a theme, we processes it within the hd scheme and at the end we can tell if it is more probable.

Initial probability is plausibility, so we can say

If some h is plausible —> we might have a way to turning into a probable.

*How do we decide about plausibility?*

Without initial plausibility there is no real possibility it can be probable, so it is useless.

How do we decide about plausibility though? (We want to avoid the traps of the popperian “we don’t care”) In association with testing (so in the context of justification)? In some other context?

If I get to this answer I can have a good method to justify my hypothesis, not a method to prove how I got it. How can we account for the initial plausibility of an hypothesis so that we can test in a second moment?

How do we decide then? (Plausibility)

We need arguments to help us judge

We need to figure out where this judgement takes place

Should we think of a well demacarted context?

Should it just be part of the context of justification?

How do we make sense..?

**In favour of a logic of discovery**

In the popperian tradition, a number of post popperian address this question, they believe we should look for a logical discovery because we can find out what this logic is, and it is important because either we have a good idea where to take the hypothesis from or we cannot proceed.

**Hanson** was the first to address the problem.

Is there a logical discovery? What type of logic do we need..?

* Yes and not Induction nor Deduction, but it’s a bit of both…
* How do we convince a logician we can make sense in this area (formulation of conjecture)?

Hanson offers sympathetic theories to two people that weren’t really concern with it.

* Aristotle, Reduction (Apagoghé)
* Pierce (Pragmatic Philosopher), Abduction
* Hanson (re read to come up with his own view), Retroduction

What these philosopher have in common is to say that proposing an hypothesis is a reasonable affair:

* They all agree to some extent with deductivism
* We cannot think there is a logic of psychology of discovery (how ideas enter the mind). It is not a point of psychology.
* They all believe there is a need of an analysis of the context where they formulate.
* Context is not a psychological/ historical/ cultural influence, only rationality context.

*Why Aristotle?*

He distinguishes between a number of inferences, he did some work on this type of inference (Reduction). It is a type of syllogism where the major premise is certain, the c is somehow uncertain because the middle term is also uncertain/ probable.

How does Pierce interpret it?

According to Pierce, it is a “Funny type” of syllogism.

* The third type is abduction, it is constituted by a number (inference TO premises)
* Induction (inference from premises), From particular to general
* Deduction (inference from premises), From general to particular

*Abduction is an inference* ***to*** *premises.*

Start from like a puzzling fact, then we introduce something that if true, can explain a way

PF

If E, PF

———

(Probably) E

You infer to E to the plausibility of the conjecture

* “every inquiry…
* We try to see what’s puzzling about them,

*Format of abduction*

* The surprising fact C is observed
* But if A were true, C would be a matter of course
* Hence there is reason to suspect that a is true (If that’s the case)

*Description of Abduction.*

It is a vague terminology that can throw off people

* Enquiry can start with wonder about a certain phenomenon
* At lenght a conjecture arises that furnishes possible explanation
* I mean a syllogism exhibiting the surprising fact as necessarily consequent upon the circumstances of its occurrence together with the truth of the credible conjecture, as premises

So is it logic?

*How does a conjecture arise?*

* Hitting on the correct hypothesis
* The feeling is vague but the process is not at random (by chance). It is a process that must be able to rely on some reason or method
* An inference is not an inference to the truth of the hypothesis but its plausibility.

*Inferences to premises.*

* it is plausible, it makes sense and I can give you a reason why it might be a good candidate, then we put our hypothesis at a try. We have reasons why and we are able to say what are these reasons to test a hypothesis.

There is a strong reason to suggest but it might still sound vague, it spells out some of the criteria we might use so it looks like it is suggesting something.

*Putting forward a suggestion*

1. **H must explain the facts and have a criteria**
2. **We need to add knowledge to the fact in order to explain these facts** (they do not contain any knowledge in themselves). Deduction is not good because here we are importing things from the outside in order to put the hypothesis in place and it is ampliative (information from outside to address the problem)
3. **Additions are made by resemblance, but unlike induction resemblance here is created between different types of facts.**
4. **H must allow to acquire a new truth.**It must put us on the right track so at the end my conclusion is hhigly probable at least.

If we apply this general reason to the hypo. Then we are able to account for the formulation of hypothesis that are provisional and plausible (need to be tested), following the hd scheme we can then carry over the procedure till the very end

*Hanson against the Popperian View*

* All we care about is what happens after and not about the psychology of scientists

**Reasons for making H a plausible conjecture**

*Hanson and the logic of discovery.*

* Context of discovery has no logic, he is trying to destroy the asymmetry between justification and discovery.

*How did Kepler arrive at his first law?*

* He did not start with this hypothesis in the first place
* Observations —> Finding anomalies
* Struggle with many hypothesis until one seemed to fit the best

*Catching hypothesis*

* After catching hypothesis
* Studying only how hypothesis get accepted leaves out all the reasons that a lot of scientists had for thinking their hypotheses and preferring some rather than others.
* Kepler was not acting randomly
* Hanson is trying to explicit that hitting on the right hypothesis is the outcome of following a particular path. But how can we make this path accountable?

Hanson compares the hd scheme and retroduction. So he goes back to premises in the same way it appears by following Aristotle’s suggesiton.

*Logical Inference: formal ingredients - Same formal ingredients/ same logical route*

* Take two scientist that first starts from ABC (premises) plus H (hypothesis) to arrive to (conclusion) D and the other starting from D to ABC to get an H that would account for D.
* His response: We can think of the 1 route in terms of **premise unpacking** (from) and the second as **premise hunting** (towards). This does not affect the core question we are trying to figure out. That does not mean they are alike.

*Logical and actual order*

* If we have only one model of logic in mind, this is all we are dealing with. But if deduction is something that some one does, the results might be different, there might be more routes. There is a difference between the logical order and the actual order, when we use inferences to pursue particular tasks. In the second context we can think of variations of the logical order and still be inside the logical framework.

**HD from top to bottom vs RD form bottom, upwards - Same Logical Inference**

A, B, C & H D1, D2, D3

… HD … RD

D1, D2, D3 A, B, C & H

O H —> O

H —> O Abduction O Hypoth-Deduction

——— ———

H is plausible H is probable

Logically speaking we are talking about the same order, but real order is reverse.

Hanson is not denying the validity of hd scheme, and that the model he comes up excludes the other. He’s just saying it’s fine having another logically accountable model. He’s in away borrowing the elements of hd scheme and using them to see if it works in

* Different in the order of the premises
* Stame ingredients

He was criticized but some supporters from the logic

It is a desperate attempt, showing the same model applies on the logic of discovery. They think this model loses its specificity and resembles the hd frame/ format.

*Not only logical form*

What becomes interesting in reproduction is not only the logical ingredients but other factors, like

* **Principles** the regulate the choice of the hypothesis itself
* It does not simply happen in a logical context but also other types of **commitments** that constrain the choice of hypotheses in science

He formulates a pattern and tries to think whether things make sense within it.

*Two meanings of logic*

* Narrow meaning: the process of giving reasons for conclusions
* Broader Meaning: the process of giving reasons for conclusions has a rational structure that can be elucidated by epistemological analysis

*Rational context for H to appear*

* Logical discovery as complementary of logical justification.

*Why two contexts in the first place? Distinction: unwarranted and unilluminated.*

1. Unwarranted because to make a discovery is **to come to know something**, and of course it requires some justification.
2. Unilluminating, it might not be described properly how science works. It might not correspond to anything that happens in science.

*Continuum of reasons*

What we witness is the fact that scientist reason with a continuum of reason and argumentative reasoning. In that process it leads from the hypothesis all the way to the test.

I.e. Newton may not say how it came to his mind

- Discovering, pursuing and justifying a hypothesis is one context:

The context of research

- Reasoning happens from the start.

*Hypothesis as pattern formation:*

* seeing that something is the case
* Observing via theories

We might even end up taking abduction as a mixed type of reasoning. There is one type of inference. We can retroduce from these reasons to the formulation of this hypothesis.

**The thesis of “Theory-Ladeness” of observation -** Hanson

His hypotheses changed his ways of observing things all together. Hanson seems to share Popper’s point of view against inductivism. We never purely observe anything, there is always something of a theory before any observation. Even if he agrees, Hanson takes this claim to another direction.

What is it about? “There is more to seeing than meets the eyeball”.

In many cases to more observers, looking at the same object under the same physical circumstances, they do not see necessarily the same thing.

I.e. images in which you can see 2 different things.

**We can distinguish between two types of theses**

1. General thesis: Everything we see depends on what is inside our mind (knowledge, past experiences, expectations…) and what we believe
2. Specific Case of Science: A scientist sees something on the base of his theory (i.e: Kepler and Tycho, they do not see the same thing). Facts change with changing theories. There are devastating consequence for science, we change a theory, the very ontology changes equally.

We should adopt a relativistic view about science and what it can reveal to us.

**Since facts are Theory dependent, Total or partial dependence?**

* Totally dependent (from the more general) Every time a theory changes, fact changes (linguistic formulation, general background information). So the fact is totally dependent on a theory
* Partially dependent (to the more specific) To some extent the theory changes if the fact does too (explanation in the context of a scientific theory).

*Consequences*

* Which type of theory?

Hanson uses the word theory across a spectrum (general idea to specific), he refers to it

1. Generally
2. Specifically. It amounts to an explanation…This is what allows to apply a general thesis to the case of science.

**Meanings of theory:**

(Distinction should not be blurred) Hierarchy of meanings of Theory:

1. **Categorial.** I need a particular category in my mind, in order to see something. This is the very basic condition of our perceiving the world. Organisation of our perceptional field. Constitutive/ A Priori, without them we cannot organise the world in objects, which is by itself caotic, in an orderly manner.
2. **Interpretative**. Here we are one step ahead, we translate categories into the language that help us organise in the world we live.
3. **Explanatory.** We give further explanations

How do facts depend on these types of theories? - *Total dependence on explanatory theories*

* We can agree that facts are totally dependent on the 1 set of theories, and even might be a total dependence on the 2 set of theories.
* But we hesitate when we approach the 3 meaning. Can we agree with the total dependence on explanatory theories?
* Partial dependence is more involved, but there might be slipping to relativism.

***Hanson’s argument***

We are concluding that the two facts are different. Starting from  2 different scientists 2 different theories

2 different backgrounds

To see that = to believe that

K sees Sk because he believes that is his sun, T sees St. They are seeing their own version of things

**Sk ≠ St**

**Wrong Inference!!!**

Is it a right type of inference? Why cannot we make this conclusion on the basis of the assumption that ..?

* Believing something is not saying that something is true, we cannot infer a state of affair from what we believe about it. It is an inferential fallacy

Seeing and seeing that - Observation Level’s hierarchy

1. Level 1: seeing (perception) + object
2. Level 2: seeing that (proposition) + object

Things change. We seeing something about the object we are observing.

Facts are not totally dependent.

*Theory and observation*

* It is fault of naive inductivism (not acceptable). It sets facts completely apart from theories
* It is fault of radical relativism. It equates facts to theories

**Root of the problem**

What counts as a scientific theory