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To prepare for the exam, do not only study from the slides: the readings are important for a great mark. She will appreciate personal skills, creativity and style in giving an original answer.

**MIXED REASONING**

**Popper** 🡪 in science we proceed by conjectures and refutations. (trial and error)

This means that it is important, vital to control and test the validity of our conjectures and that it is equally important to figure out how we set up our conjectures.

For him or people who share his vision, we can perfectly handle the first task but we have nothing to say about the second task. Or better, for him it does not really matter what we have to say about the second task because in any event we are in perfect control of the first task, so the formulation of our conjectures is not important because we have a powerful tool (logical derivation) that allows us to test rigorously the conjectures (falsification test) and then, as a consequence of this testing, we can decide if accept or not our conjectures.

Test 🡪 always an attempt to falsify

=

This amounts to the Hypothetical-deductive model:

1. We observe something (O)
2. We come up with hypothesis (H)
3. We deduce a consequence from that hypothesis (if H then p)
4. We check by means of observation (p?)
5. If the consequence is (not) true, then the hypothesis is also (not) true [(not) p, (not) H]

To describe how this model works and to see how it is not just a matter of deduction but a mixture of induction and deduction, **Hemple** makes a perfect illustration of this way of proceeding in science (scientific procedure).

The Semmelwise example, described by Hemple: a Hungarian doctor who worked at the general hospital in Vienna between 1844 and 1848, in the first maternity division. He grew distressed by noticing that a large proportion of pregnant women who delivered their babies in division 1, ended up contracting very serious illness (often fatal), which he called ‘puerperal fever’ or ‘childbed fever’.

In 1844, 260 women out of 3000 died of this disease 🡪 8% contracted it and died. Many more contracted it.

In 1846 this percentage went up 11.6% 🡪 it was a concern for the hospital and for the doctor in particular

Nothing of that sort happened in the second maternity division (same hospital). So, he worked on the case, trying to solve it: he gave a good explanation, writing a book about it.

Hemple was fascinated by it because he thought it was a very good illustration of scientific reasoning and how to use this hypothetical-deductive method.

🡪 How did the doctor discover what was going on? And on the basis of what logic?

He did not reason inductively: Hemple knows how inductive reasoning could not be of any help in this particular case, he was on the Popper side about the premises (an idea, a point of view) necessary to have a direction to scientific inquiry. He reminds us that there are no rules of this reasoning. We have to have some hypothesis in place that can give us some direction to start any scientific inquiry.

There are no general rules of induction!

HEMPLE: *The transition from data to theory requires creative imagination. Scientific hypotheses 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” of this kind require great ingenuity, especially if they involve a radical departure from current modes of scientific thinking (…)*

= [we need a great amount of imagination to give sense to what we see]

*Nevertheless, the ways in which fruitful scientific guesses are arrived at are very different from any process of systematic inference (…) In his endeavour to find a solution to his problem, the scientist may give free rein to his imagination, and the course of his creative thinking may be influenced even by scientifically questionable notions. Yet scientific objectivity is safeguarded by the principle that while hypotheses and theories may be freely invented and proposed in science, they can be accepted into the body of scientific knowledge only if they pass critical scrutiny.*

This happens in mathematics (we deal with proofs of our hypothesis but then we need to prove them by deduction) but nothing of this sort happens in science: here we test our hypothesis, we use experiments, and we use logic. But what type of logic?

= this is where the hypothetical-deductive model comes in

Semmelweiss started by considering different, alternative hypothesis: if H1 is true, then p would follow. We test *p*, and then decide on the fate of H.

He applies this type of reasoning on a type of alternative hypothesis.

Hypothesis: the fever was given to a disease spread in the streets of Vienna, so women were bringing it from the outside. But this was proved to be false. If H1 is true women would die no matter where they deliver their baby. The proof was that even in the women delivered the baby along the street they still contract the disease but at a much lower rate, and we know it because the women after having delivered the baby they would have gone to the hospital.

= so *not p* therefore *not H1*

Another hypothesis he made was overcrowding: in division one there were a lot of women, therefore there was more of a chance of getting the disease. If that were the case (H2) then the same should apply also to the second division where the condition of overcrowding was even worse because women wanted to be admitted to the second division to avoid the risk of dying (p).

= Hence, not *p* and therefore not H.

He stumbles on a good hypothesis: one of his colleagues got stung on a finger from the scalpel of a student that had performed an autopsy: he died because of an infection with very similar characteristics to the ones of the women affected by the disease.

He put together these hypothesis: something (cadaveric matter) passed on from the scalpel of the student to the colleague. So, infection which cause the death of the women could be searched in the dirty of the doctors. It required a great deal of imagination since there was no knowledge of infections which could be transmitted.

The hypothesis then would be:

* If infection carried by dirty hands (H), then disinfecting hands will reduce infection (p).
* Tested on doctors: forced to wash their hands with a chlorinated solution after having done an autopsy. This order was implemented and doctors followed it-
* Mortality decreased to 1.27% in 1848, from 11,2%

But what about doctors in the other division? Actually, in the second division women were handled by mid-wives not by doctors, that did not go to the autopsy room.

Low mortality of those women who delivered their baby in the street: these women after entering the hospital very rarely were seen by a doctor. By not being handled by them less chances of being infected by their dirty hands.

In the situation where the doctor:

1. rejected the hypothesis 🡪 we are in the case of modus tollens, typical logic falsification;
2. accepts the hypothesis 🡪from the blood poisoning produced by cadaveric matter, we inferred that suitable antiseptic measures will reduce the disease in pregnant women. This seems the fallacy of ‘*affirming the consequent’*: weak type of reasoning.
3. But this is why he tested his prediction vis a vis to other hypothesis, so to have a wider range of unfavourable outcomes that lead us to the direction, in favour of his hypothesis. (H1 is true unlike H2, H3, etc). Each confirmation has the same logical problem, it is not a complete truth. It provides us some kind of credibility. It gives us confidence in our hypothesis. 🡪 testing the prediction on my hypothesis in respect to other ones.
4. Confirming H

He admits that induction may have a role in science, though not at the stage of inventing a hypothesis but only in the step of testing a hypothesis, which for him also means confirming it not just falsify.

**Hemple** 🡪 *even extensive testing with entirely favourable results does not establish a hypothesis conclusively but provides only more or less strong support for it. Hence, (…) it [scientific inquiry] may be said to be inductive in a wider sense, inasmuch as it involves the acceptance of hypotheses on the basis of data that afford no deductively conclusive evidence, but lend it more or less strong ‘inductive support’ or confirmation*

In other words, the inference from an H (hypothesis) to a p (prediction) is deductive, while an inference from the truth of p to the truth of H is inductive, in the sense of inductive support. This is the reason we are making MIXED REASONING in the hypothetical-deductive model.

Both bits of the inferences are needed to reach some results: this is what the story seems to tell us.

But this arises a series of problem:

1. In hypothetical deductive reasoning predictions are inferred from the hypothesis and then used to test the hypothesis: but this derivation is (in science at least) much less simple, straight-forward, conclusive, than logic would have it. It works in logic but it does not work well in the context of scientific inquiry.

To see why we have to go back to the story: the disease is caused by infection by cadaveric matter. The consequent (*washing hands in chlorinated solution)* does not follow deductively from the hypothesis alone: the derivation implies a further assumption (product to wash is the solving methods to the problem).

This further premise, not explicit in the argument, has been called **auxiliary assumption** (A):

*if H and A, then p.*

*BUT* this create a problem to logic of testing my hypothesis

*If H then p → not p → not H BUT If H and A, then p → not p → Either H or A is false*

= SO the test provides non-conclusive grounds for rejecting H.

If the antiseptic measured is not followed by a declining immortality, H can still be true but we could have said something wrong about the antiseptic (it could be that chlorine is not the right tool). Even in the case where the auxiliary assumption can be used with confidence, this still does not assure us that this can never be disconfirmed in the future. 🡪 In science hypothesis never stand alone: they are always in a context, and they work because of the context, because of the auxiliary assumption.

This is referred to as the **Duhem-Quine problem**: the occurrence of an observation which refutes a prediction derived from the *conjunction* of a theory under test with *a number of necessary auxiliary assumptions* only shows:

* that at least *some* *one* member of that conjunction is false (either H or A)
* *not* that the false assumption is necessarily the *theory under test*; it could be the auxiliary assumption

this is a ‘holistic’ view: what is in fact tested by observational evidence are not individual theories, but rather kind of larger groupings, constellations of beliefs that include not only the hypothesis, but also the whole array of the auxiliary assumptions, even if they are not explicitly formulated. They are taken for granted.

(H&A) 🡪 p // not p // not (H&A)

*not (H&A)* is logically equivalent to not H or not A

BUT how do we know that it is H to be false rather than A?

Falsification of the conjunction btw H and A not necessarily of H

For Quine scientists can add a whole series of modification, ad hoc hypothesis, new assumptions so that any theory or any compound can be said from potential refutations. This happens all the time in science 🡪 use of ad hoc hypothesis. Redefinition of meaning.

It happens that theories cannot be conclusively refuted as much as they cannot be conclusively confirmed.

1. The **RAVEN PARADOX** is another problem.

Spread out by two ideas (assumptions) which can also be in contradiction.

**INSTANCE** **CONFIRMATION**: a universally quantified conditional, such that “All ravens are black’ is confirmed by an instance of it and disconfirmed by a non-instance.

It goes under the Nicod’s principle: *Consider the formula or the law: F entails G. How can a particular proposition, or more briefly, a fact affects its probability? If this fact consists of the presence of G in a case of F, it is favourable to the law […]; on the contrary, if it consists of the absence of G in a case of F, it is unfavourable to this law*

**EQUIVALENCE CONDITION**: in logic logically equivalent statements are confirmed by the same evidence. Some examples: All F are G, or, all non F are not G. The assumption here is: if A = B then whatever evidence confirms A will also confirm B.

Let’s make it with the ravens:

(1) All Ravens are black (x) (Rx → Bx)

equivalent to the statement:

(2) Everything that is not black is not a Raven.

since (1) and (2) are equivalent, collecting evidence supporting statement (2) is also an evidence that all ravens are black. And also the opposite, if you find evidence against 2 you find evidence also against 1.

Contradiction: whenever you see a black raven, it is a positive evidence for our assumption. As the number of evidence increase, we are more and more convinced about this.

Statement 1 and 2 are equivalent collecting evidence that support statement 2 is an evidence that also supports statement 1.

In the second case though, the evidence would be anything that is not a raven and neither is black: if I see a green chair or a red apple, I have evidence supporting B because they are neither black or a raven. Conclusion is paradoxical because we find confirmation of ‘the ravens are black’ by looking to anything else, something that is completely unrelated, irrelevant.

In fact, it is a **paradox about relevance.**

The paradox leads us to a counter-intuitive result: we have a rather intuitive expectation that the evidence of A to be a high number of cases in which I see black ravens.

**Hemple** kind of deconstruct this paradox in order to solve the paradox in a discussion with Nelson Goodman (another philosopher of science): assuming we know nothing about ravens and about their colour, we just focus on the statement. We do not know nothing about the background.

It says that everything is either a black raven, or it is not a raven.

So, we have *three categories*: non-black ravens (disconfirmation of our hypothesis),

black ravens (confirmation),

non-ravens (confirmation).

There is also a further class: the non-black-non-ravens, belonging to the third class, but this is supposed to be the class that confirms the statement. Paradox is that non-blacks-non-ravens confirm the statement.

If this seems implausible it is because we come to the question, to evaluating the statement with some background, we are not looking at the statement in isolation: we cannot ignore the context. Before considering the evidence, we know that there at least some black-ravens, and non-ravens which many of these latter are not black.

Good, sound induction should be ampliative: if we did not know that ravens are black before getting to the question, maybe this would have told us something, but, given that we cannot erase the context, it does not give us any further info. We do not know if the ravens that we have not observed yet are black or not.

We do not know if the ‘non-black-ravens’ is empty or not: observing a black raven at least tells us that the observation is not a falsifying instance of what we knew. We don’t know if the member of the first class exists.

**Goodman:** The paradox emerges because there is a lot of tacit elements that are not expressed in our formulation, that disambiguate the way in which we analyse the statement: the important lesson of Goodman and Hemple is that inductive inference is sensitive to background info, to context. A good induction is the one performed not in isolation but within a certain background, that tells us a number of things.

From a logical point of view to infer from ‘A is a red apple’ to ‘all ravens are black’ may be sound logically, may be a genuine logical paradox, but it is uninformative, uninteresting.

= *the paradox of Ravens is a further possible objection to the use of induction in the context of the hypothetical deductive argument but there is a way to say there is a role to induction in other contexts*

Remember the beginning: in this context, of the hypothetical deductive argument, there is a whole grey area completely untouched. This area is the one of the invention/discovery of the hypothesis: there is no way to specify how we formulate a hypothesis.

**Popper** 🡪 *The initial stage, the act of conceiving or inventing a theory, seems to me neither to call for logical analysis nor to be susceptible of it. The question how it happens that a new idea occurs to a man…. may be of great interest to empirical psychology; but it is irrelevant to the logical analysis of scientific knowledge* (in the book ‘logic of scientific discovery’ which it sounds as a joke but this is the translation from German, the right one would be ‘logic of scientific inquiry’)

IN OTHER WORDS: Discovering a new idea is just an educated guess, something we stumble across by chance often. They can be of interest by anyone but no to the logicians and the philosophers of science. The hypothesis is expressed in the form of a universal statement but there is no account given to how H enters the model. H is there already and ready to be tested.

Not anyone agrees on that: there are philosopher for whom introducing new hypothesis is not just a guess but it is the result of a particular way of reasoning. For some this reasoning is inductive, because only induction is ampliative while deduction is not. Induction is the only bet for some, but for others induction is not that good, in fact, there is not only induction to alternative to deduction; there is another type of inference that might be of more use in this particular case.

The first who tried to find out this further type of inference is, was **Charles Peirce** (1839-1914). He is considered the father of pragmatism. He was interested in lot of things he was a very critic logician, a mathematician, he was interested in semiotic, scientists, an expert in geology. But logic was his vocation. He was a very prolific writer, and its writes were difficult to classify.

This third option is a bit odd because logically speaking is not well-defined as the other and also because it can be considered an inference itself. All the people against Popper argued in favour of a logic of discovery, somehow, they are all in debt to him.

There are not logical rules for inventing new hypothesis.

He claimed that inventing a hypothesis is the stage of discovery is well worth investigating by means of logical analysis: there are good reasons and bad ones to suggest a hypothesis. These reasons may well take us to make what he called *an inference to a hypothesis* which is different from *an inference from a hypothesis* (hypothetical deductive argument).

Induction is ampliative but is not satisfactory for a series of reasons, what we actually need to describe this stage is another type of inference which is partly inductive but it is more than this.

This third type is **ABDUCTION** or **retroduction**: how do we infer to a hypothesis. He defined it as an ampliative type of inference but it differs from induction.

*→ How does Peirce classifies the traditional types of logical inference?*

Different from the traditional way

Inference can be **explicative** (=use to when we follow deduction, or analytic type of reasoning) or **ampliative**. The latter, unlike traditional classifications, can come in two types: abduction and induction.

He put a lot of emphasis on the ampliative side of inferences because he complains that logicians normally are more interested on the explicative (deductive) one, because it gives certain results. Less interested in ampliative one because is much less secure and guaranteed. By putting it aside they leave the whole area of the productiveness of inference.

→ ‘uberty’ (=fruitfulness) of abduction: type of inference that is low in security but high in fruitfulness. It is evaluated in producing scientific hypothesis.

*Although it* [abduction] *is very little hampered by logical rules, nevertheless it is logical inference, asserting its conclusion only problematically or conjecturally, it is true, but nevertheless having a perfectly defined logical form.*

Retaining the ampliative results and trying to figure out a logical form of this type of uberty.



**Definition** 🡪 *Deduction proves that something must be; Induction shows that something actually is operative* (based on experience); *Abduction merely suggests that something may be*.

The first two are inference from premises.

The latter, inference to premises, is structured in this way: PF → If E, PF → (probably) E

Peirce explains it this way: *every inquiry whatsoever takes its rise in the observation (…) of some surprising phenomenon (…). The inquiry begins with pondering these phenomena in all their aspects, in the search of some point of view whence the wonder shall be resolved. At length a conjecture arises that furnishes a possible explanation, by which 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*.

There is a surprising fact (F) that we observe if E were to be true then our fact can be explained, therefore we have reason to suspect that our E is probably true.

It seems that the language Peirce uses, is a little vague; it seems that it has little to do with logic. Can we put it in the form of an inference?

*… think of what trillions and trillions of hypotheses might be made of which only one is true; and yet after two or three or at the very most a dozen guesses, a physicist hits pretty nearly on the correct hypothesis. By chance he would not have been likely to do so in the whole time has elapsed since the earth was solidified*

We don’t have to go through million of guesses in order to stumble on the most reasonable.

🗸 hitting on the right hypothesis is not a completely random process when there could exist millions, there must be some under-reason or reasons for we approach a specific hypothesis. There is a process, after all, that relies on some reasons that lend plausibility to the hypothesis we end up.

So, the inference, if indeed it is an inference, it is still not to the truth of our hypothesis but rather to the plausibility of our hypothesis. (what we are saying can be true)

Best thing to do after having made the hypothesis is to test it

From the way Peirce tries to make sense of what we’re doing here, we also see how abductions are a response to ignorance problems: we start from a puzzling fact that we cannot explain on the basis of what we know already. Abductions are attempt at overcoming our ignorance.

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(not to read the entire Lipton doc: consider just the first 10/11 pages, until a ‘scientific reading’)

RECALL: for Popper there is no question about confirming the hypothesis, testing is nothing but an attempt to falsify. For Hemple we may falsify as well trying to confirm.

Although, when we get into confirmation’s logic, we bump into a series of troubles: Duhem-Quine problem (never sure about confirmation, there is always the context/background to take into account, because hypothesis never come in isolation) and raven paradox (raise an issue of relevance: you might confirm a statement by quoting something that has nothing to do with it).

The Hypothetical-deductive model is a mixture of deduction and induction.

= One thing left out from this model is the hypothetical bit (in terms of logical description): we assume we have a hypothesis and we deal with it without justifying it. It is of no interest to figure out how we get to our hypothesis.

**Hemple** claimed that Hypothesis can come in many and various ways, like Popper did.

But not everybody agrees: for somebody else, **Peirce** starting, there is actually a logic behind hypothesis: not in the sense of being able to spell out a series of rules for discovery but there is a way to logically describe the various steps that allow us to conjecture something, to put our hypothesis together.

We are talking about an inference *to* premises, to a conjecture, not *from* it (as it happens with the H – D model).

PF → If E, PF → (probably) E

**Peirce** → the first who tried to clarify this type of inference; he settled the ground for later reflections.

It is customary to divide his work in two periods, an earlier and a more mature one: (1) treatment of three types of inference as different (deduction, induction, and abduction) and (2) stressing the interaction among the various types of inference.

1. With **induction** we basically classify a series of particulars as a general type or going from a sample to a whole. It is a *classificatory type to inference*.

**Abduction** instead is used to explain. We infer from observation a general principle that we’ll use to explain data.

Explanation is different from classification

1. More holistic view

We use abduction when we invent;

when we infer consequences from hypothesis that then will be tested, we use deduction;

and we use induction when we complete the testing.

**Abduction** is the first type of inference, because it has a feature of suggestions.

Also, in suggesting we make a hypothetical claim: this cannot be done in any way, there are restrictions. There are traits that hypothesis must possess in order to candidate itself as hypothesis:

1. H must explain the facts → we are not just classifying but we create a background, a pattern of explanation
2. H must add knowledge to the facts, in order to explain the facts. We use them to create knowledge out of them but are not the carrier of knowledge itself. 🡪 in Peirce there is not empiricism
3. H creates resemblance between different types of facts → the word resemblance is not in the inductivist sense (one thing similar to the other just because they appear this way), but more in the Popperian sense (we create similarities btw types of facts that might look heterogeneous but we make connections)
4. H must allow to acquire a new truth → it is an ampliative kind of reasoning (“*step out of ignorance*”)

At this point H is provisional but testable. Therefore, we see the inference TO a hypothesis.

Example: Kepler did not start with his hypothesis in mind of the elliptic orbit and then: he looked at the observations he already had and then he struggled back from these observations through a series of H until he formulated the most suitable one.

Struggle back to the hypothesis that is achieved by abductive reasoning.

ABDUCTION 🡪 inference TO hypothesis

CRITICISMS

1. Abduction cannot be a logical tool to enlarge knowledge because the **hypothesis is already included in the premises**.

It can offer a logical path for a preliminary evaluation or examination of the H. But it has already been discovered. It cannot be a logic of discovery because the hypothesis is already included (or supposed to be known) in the premises. Abduction can be placed btw original discoveries and final justifications, it doesn’t coincide with the original act of inventing.

**Peirce**: he never said he was offering this. We can figure out ways to how we can have hypothesis how they can put together, he never wanted to give any rule about H formation.

1. **Abduction is after all very permissive**, it is too loose. It does not seem to block any type of hypothesis, neither wild guesses as long as they explain the phenomena.

* from the mere fact that some H, if it were true, would explain the data, it does not follow that there is reason to believe that H is true.

**Peirce** made a variation to handle this criticism → we do not get to a true explanation, but we get to the best explanation. **Inference to the best explanation** is the contemporary take on Peirce’s view of abduction.

[digression: Peirce was aware of this possible criticism/limitation of his way of dealing with abduction. He introduced the idea that human mind has an innate power of what he defines *‘intelligent guessing’* a sort of instinct that guides us in formulating our conjectures. But this arises other problems: We do not have proof + this seems a psychological feature, not a logical device so abduction would depend on something not logical. This seems to running contrary to modern scientific inquiry where a lot of theories seems to be very counter intuitive. He answered claiming that his instinct is not enough: abduction must be paired with tests to confirm or to reject the hypothesis. The method for producing correct inferences are not separate from practicing all those methods of data collection, evaluation, confirmation, etc. In fact, in his mature period he was concerned with the interrelations of the various types of inferences]

This was first defined by **Harman** in a seminar article back in 1965. Idea of better and best start to come to the fore: *“In making this inference one infers, from the fact that a certain hypothesis would explain the evidence, to the truth of that hypothesis* (classical abduction)*. In general, there will be several hypotheses which might explain the evidence, so one must be able to reject all such alternative hypotheses before one is warranted in making the inference. Thus, one infers, from the premise that a given hypothesis would provide a "better" explanation for the evidence than would any other hypothesis, to the conclusion that the given hypothesis is true”. →* Inference to the better explanation, hypothesis: way to handle the excessive permissiveness of abduction.

The process to get the truth is important: compare different hypothesis to pick the best one 🡪 better explanation

Example: cheese has disappeared. I remember the night before I heard some scratching noises. I think ‘maybe a mouse ate the cheese’. Here I have not reason deductively: my premises do not entail the conclusion. And the cheese indeed could have been disappeared from another reason. And the noise I heard could be due to some malfunctioning in the boiler. Dishonest maid may have eaten the cheese, noises may be some malfunctioning of the boiler (all ‘wild guesses’).

Then I compare two hypotheses: after all my mouse hypothesis sounds plausible, more plausible than the others. It seems a better explanation, or actually the best one. It is not certain to be truth.

This is how we reason accordingly to the INFERENCE TO THE BEST EXPLANATION

I reason abductively but where I end up is not necessarily a true explanation, but the best out of all possible alternative.

Am I reasoning inductively? There is a relation btw IBE and induction, but the inference to the best explanation is more fundamental than induction because IBE is implied any time we reason inductively. The explanation is fundamental for induction: induction depends on explanation.

Then we can argue that IBE is implied when we reason inductively, it is parasitic of induction.

Induction is dependent on IBE, IBE is more fundamental.

Example of the cheese again: why the mouse hypothesis better than the others? We knew a few things about the others, and the mouse seems more likely. But we are actually saying that we base our knowledge on past experience. Hence, we are reasonably inductively. Though it seems that IBE is dependent on induction. So, this means we need induction to perform abduction

So, part of the problem is due to the fact that we have to be clear of what we mean by ‘best’ here. What criteria we use to claim that an explanation is ‘best’? and how do we explain the difference ‘best’ ≠ ‘true’?

We reach our best explanation by comparing different hypothesis until we think one is actually the best. We are making comparisons, which is quite crucial in choosing the best hypothesis. But this is not a criterion, comparing is based itself on some criteria.

Peirce gave us a series of criteria to decide when an hypothesis seems plausible, but this does not help because once we tell ourselves that hypothesis or some conjectures are good enough to be considered, we still don’t know why our judgement of best/better is still hanging.

Example of the cheese again: the mouse-H explains both causes I have (noise and missing cheese). When it comes to the maid-H: I have to add the connotation to ‘dishonest’ and the boiler-H must be taken into account. The first one is simpler and more parsimonious.

**Simplicity** has been a driving criterion in science and in construction of theories (btw two theories go for the simpler one!). But you realize that a simple explanation might not be necessary be the true one despite being appealing, or it might be a **lovely** explanation and yet not be a **likely** one.

[**Terminology of Peter Lipton**, IBE scholar] → *Does it mean the most probable (“likely”) explanation, or rather the explanation that would, if correct, provide the greatest degree of understanding (“lovely”)?*

The first one is not obvious as it seems: again Lipton, *to say that scientists infer the likeliest explanations is perilously similar to saying that great chefs prepare the tastiest meals: true perhaps, but not very informative if one wants to know the secrets of their success*.

What about loveliness? Can scientist privilege this? Maybe they take it as a guide to likeliness. Also this arises challenges, one above all: how do we know/how do we show that loveliness and likeliness go hand in hand? How do we know that the loveliest explanations tend also to be those that are judged the likeliest to be correct?

→ Favouring simple is no guarantee of getting likely theories. And also simplicity is bit of controversial, contextual, subjective.

It is difficult to claim that all these types of reasoning we have seen are self-contained. Even more so when we are dealing with processes like empirical enquiry, more than one single pattern of reasoning seems to be at work. There is always a mixing-reasoning.

READING OF NORDBY CH.7 – COMMENTS

How did they get to explanation 🡪 they reason by seeing past events: an inductive reasoning. On the basis of what they know

1) Why did they accused betty?

1. Precedent crimes or attempted crime + precedent aggression to Carlo himself, also using a gun
2. She survived the fight
3. Alone in the house according to the neighbour witness: she heard the fight btw the two, until a final scream of Carlo
4. Drunk a lot
5. She was a pugilist

Given the premises, we must infer she is the guilt one: we are using induction.

Induction is not always good here.

The doctor has a different point of view.

BUT The doctor came into the scene and see a particular that puts the mystery in the case: her feet. If she was the murdered she would have cuts on her feet because there was glass all over the floor where Carlo was found dead.

He reasoned through modus tollens: deduction. (if Betty shot Carlo, she would have injured feet. She has not injured feet; therefore, she did not shoot Carlo).

Is gradually building falsification of the first scenario, but this is not the end of the story.

The doctor proposed an alternative hypothesis, a new reading of the scene, where Carlo shot himself accidently. This is abduction: he uses what it’s not the case + a new reading from the scene +results from autopsy and puts it all together putting them together abductively 🡪 from facts available (positive or negative) he infers to the hypothesis. + he applied Hanson’s idea of the relation of facts and preventive theories.

Transition from falsification into confirmation by abduction and by reinterpret the signs that are available at the time.

Detective story is not a mystery story whereas the one of the doctor is a mystery story.

DETECTIVE: FROM past history TO murder as likely explanation. 🡪 no mystery history. They reasoned inductively and the apply a type of modus ponens

While for the doctor FROM reading the signs at the crime scene, he rejects the wrong interpretations of the other story, he interprets and creates relevant patterns among the various signs (he put the signs in context by looking them in a different way abductively), he incorporates result of the autopsy TO a coherent explanation (abduction) of accidental death. For him the better explanation 🡪 the doctor’s history has mystery because he cannot jump to this conclusion because “if Carlo shoot himself accidently, then Betty did not shoot him. Betty is innocent (so she did not shoot him) therefore Carlo shoot himself” = FALLACY

If a, b, etc. are inconsistent with the claim “Betty shot Carlo” then Betty is innocent. The question now is: what happened to Carlo. If a, b, etc. is consistent with him shooting himself accidently then Betty is innocent. But if we already know that she’s innocent, then do we have reasons to believe that Carlo shot himself accidently?

This ay be too quick 🡪 Fallacy: affirming the consequent

From the fact that she did not shot him we cannot infer that Carlo killed himself, we need more to support this explanation. That’s why the doctor is looking at instances of confirmation of that hypothesis.

To go from bad explanation to a better one and from a better one to the best explanation.

Various steps and different types of reasoning are actually entailed. All types of reasoning help each other to find the solution 🡪 mixed type of reasoning.

We use deduction, we do a little of induction, we need observation and imagination because we create connections.

**TOULMIN**

One of the problem of logical inference is that we look at it as a piece of pure reasoning, a-contextual, a-temporal reasoning.

Toulmin: to justify an inference we try to extract it from everything else and look at it in isolation from everything. And this is a limit for him.

*“The science of logic has throughout its history tended to develop in a direction leading away (….) from practical questions about the manner in which we have occasion to handle and criticize arguments in different fields, and towards a condition of complete autonomy, in which logic becomes a theoretical study on its own, as free from all immediate practical concerns as is some branch of pure mathematics.” [The Uses of Arguments, p.2]*

But we are interest in seeing logic at work, once we move from pure to actual logic we can develop a different look about the uses we can make of logic, it becomes also different the way we look at arguments. We are not just looking for justification or validity, we are looking for other features that make an argument qualified for being good.

Toulmin thinks that a better model for logic, of this more applied type of logic, rather than mathematics is actually jurisprudence.

*“Logic is generalized jurisprudence. Arguments can be compared with law-suits, and the claim we make and argue for in extra-legal contexts with claims made in the courts, while the cases we present in making good each kind of claim can be compared with each other.”*

We see argument at work, and people discuss by means of argumentation 🡪 in the occasion they end up with a good argumentation.

*“A sound argument, a well-grounded or firmly-backed claim, is one which will stand up to critic, one for which a case can be presented coming up to the standards required if it is to deserve a favorable verdict.’*

What the doctor did 🡪 compare his argument whit the one of the detective and then defending his own point of view.

There must be general standards that, however, have to judged in context of the practice we are referring to.

Logic in term of formal logic give some tools but then there is another type which is applied logic in which we have formal tool + a whole series of informal tools the come to the picture and contextualize the formal tool.