Critical Reasoning
Lecture-Seminar 2
‘Induction and Falsification’

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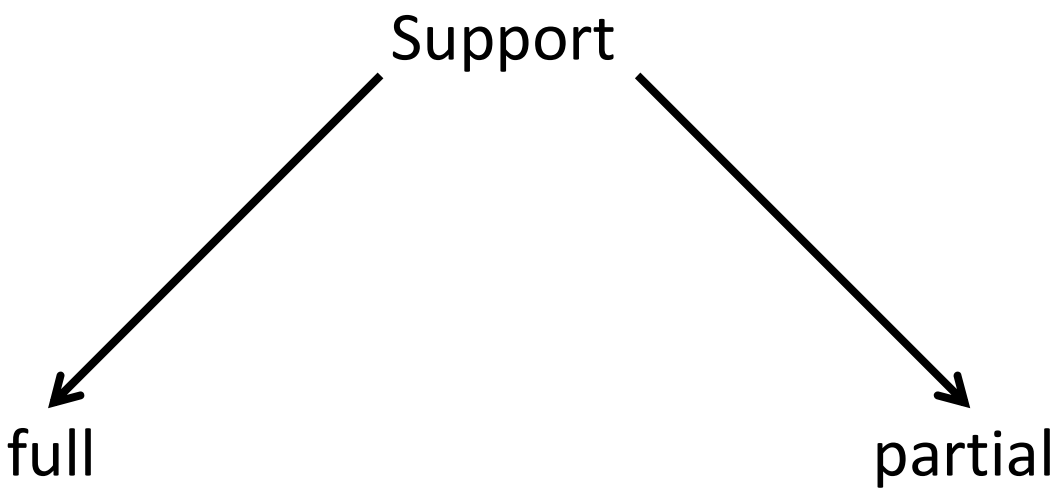
Introduction

Logic as a study of support

- Nola & Sankey:

  "Broadly speaking, we can say that logic is the study of the support that the premises of an argument give its conclusion" (2007, p. 108).



Deduction and induction revisited

- We only get *full* support with deductive logic:

  On the supposition that the premises are true, the truth of the conclusion is *guaranteed*.

- We get *partial* support with inductive logic:

  On the supposition that the premises are true, the truth of the conclusion is not guaranteed but *made probable*.

- Intuitively, and roughly, inductive inferences must lead us to the truth more often than not. More formally: $Pr(C \mid P) > 0.5$.

  where *P*: premises and *C*: conclusion.

Inductivism

- **Inductivism**: Hypotheses earn partial support through evidence, i.e. where the latter does not entail the former.

  NB: The idea goes back to Francis Bacon (1620) *Novum Organum*.

- That is, the premises in inductive arguments (evidence) lend some credence to their conclusions (hypotheses).

Premise 1 Premise 2	*Evidence*
Conclusion	*Hypothesis*

The Problem of Induction

The uniformity of nature and induction

- The principle of the uniformity of nature underlies all induction, according to David Hume (1748) *Enquiry*.

- Consider the following example of an inductive inference:

1. All hitherto observed ravens are black.

Therefore, all ravens are black.

The uniformity of nature and induction

- The principle of the uniformity of nature underlies all induction, according to David Hume (1748) *Enquiry*.

- Consider the following example of an inductive inference:

  1. All hitherto observed ravens are black.
  2. Ravens (particularly their colour) are uniform.
  Therefore, all ravens are black.

- That is, on the assumption that the properties of the said objects do not vary, we can conclude: all ravens are black.

Different versions of the principle

- There are various versions of the principle. Here's the most common one:

  The future resembles the past.

- Newton (*Principia*, Book 3) posits a more restricted version:

  "Rule 3: Those qualities of bodies that cannot be intended and remitted [i.e. that cannot be increased and decreased] and that belong to all bodies on which experiments can be made, should be taken as qualities of all bodies universally".

Doubting uniformity

- In the *Enquiry,* Hume claims that we project a psychological habit of uniformity onto the world.

- This is what underlies induction. In matter of fact, the future *need not* resemble the past.

- **Russell's chicken**:

  "We know that all these rather crude expectations of uniformity are liable to be misleading. The man who has fed the chicken every day throughout its life at last wrings its neck instead, showing that more refined views as to the uniformity of nature would have been useful to the chicken" (1912: p. 21).

The problem of induction

- It seems that we can provide **neither a deductive nor an inductive justification** for the uniformity of nature:

  "The question of justification is then the question of showing that nature is indeed uniform. This cannot be deduced from what we have observed, since the claim of uniformity itself incorporates a massive prediction [i.e. we have not and cannot make that many observations to guarantee the truth of the uniformity claim from them]. But the only other way to argue for uniformity is to use an inductive argument, which would rely on the principle of uniformity, leaving the question begged" (Lipton 1991: 416).

Try to formulate your own version of the principle of uniformity of nature.

Falsification(ism)

Popper's rejection of induction

- Popper ([1934]1959) argues that induction has no place in science. Rather science proceeds by:

  Conjectures (in the context of discovery) and

  Refutations (in the context of justification)

- No such thing as:

  (i) the construction of hypotheses through induction and

  (ii) the inductive support of hypotheses.

Refutation vs. corroboration

- A hypothesis is either refuted or is 'corroborated' - the latter means it has survived so far and is tentatively accepted.

corroboration does not equal confirmation

"The best we can say of a hypothesis is that up to now it has been able to show its worth, and that it has been more successful than other hypotheses although, in principle, it can never be justified, verified, or even shown to be probable. This appraisal of the hypothesis **relies solely upon deductive consequences** (predictions) which may be drawn from the hypothesis: There is no need even to mention 'induction'."(p. 315) [emphasis added].

Using deduction in search of refutations

- From Salmon et al. (1999, p. 45):

1. Boyle's law: At constant temperature, the pressure of a gas is inversely proportional to its volume.
2. The initial volume of the gas is 1 cubic ft.
3. The initial pressure is 1 atm.
4. The volume is decreased to 1/2 cubic ft.
5. The temperature remains constant.

∴ The pressure increases to 2 atm.

atm (standard atmosphere): a unit equivalent to the mean sea-level atmospheric pressure on our planet.

According to Popper, hypotheses can

at best be confirmed

be verified

at best be corroborated

be shown to be probable

The Demarcation Problem

Two distinctions

- **Science vs. Non-science**

  Distinguishing between science and other activities.

- **Science vs. Pseudoscience**

  Distinguishing between science and pretenders.

  NB: The latter distinction is not exhaustive.

Larger issues at stake

- Lakatos:

  "The Catholic Church excommunicated Copernicans, the Communist party persecuted Mendelians on the grounds that their doctrines were pseudoscientific. The demarcation between science and pseudoscience is not merely a problem of armchair philosophy: it is of vital social and political relevance" (1977, p. 20).

Creationism and the study of science

- More recently, there is conflict, especially in the United States, over the role of creationism in education.

- Scholars of science have been called to testify in courts.

  McLean vs. Arkansas: Act 590 'The Balanced Treatment for Creation-Science and Evolution-Science'.

  Michael Ruse:
  "Someone is needed to talk at a more theoretical level about the nature of science... it is my job to look at science, and to ask precisely those questions about defining characteristics" (1998: 38).

Back to Popper: Myth and conversion

- Pseudo-scientific theories have “more in common with primitive myths than with science” ([1963] 1998: p. 5).

- **Examples**:

  Marx’s theory of history
  Freud’s psychoanalysis
  Adler’s individual psychology

- Their admirers are like religious converts: “The study of any of [these theories] seemed to have the effect of an intellectual conversion or revelation, opening your eyes to a new truth hidden from those not yet initiated.” (ibid.).

Explaining (practically) everything

- "Once your eyes were thus opened you saw confirming instances everywhere... These theories appeared to be able to explain practically everything that happened within the fields to which they referred" (ibid.).

  Example: Drowning vs. saving a child.

- Using Adler's theory, one could argue that either case can be explained by the man's inferiority complex.

  * Drowning: Man proves he dares to commit such a crime.

  * Saving: Man proves that he dares to rescue the child.

Risk of refutation

- What appears like a strength is in fact a weakness, namely they seem to fit everything we throw at them.

- Compare this to a paradigmatically good scientific theory.

  Example:
  GTR predicts light deflection around massive objects.

- In other words, such theories make risky predictions.

- "If [the] observation [is false], then the theory is simply refuted. The theory is incompatible with certain possible results of observation" (p. 6) [emphasis added].

Falsifiability as a demarcation criterion

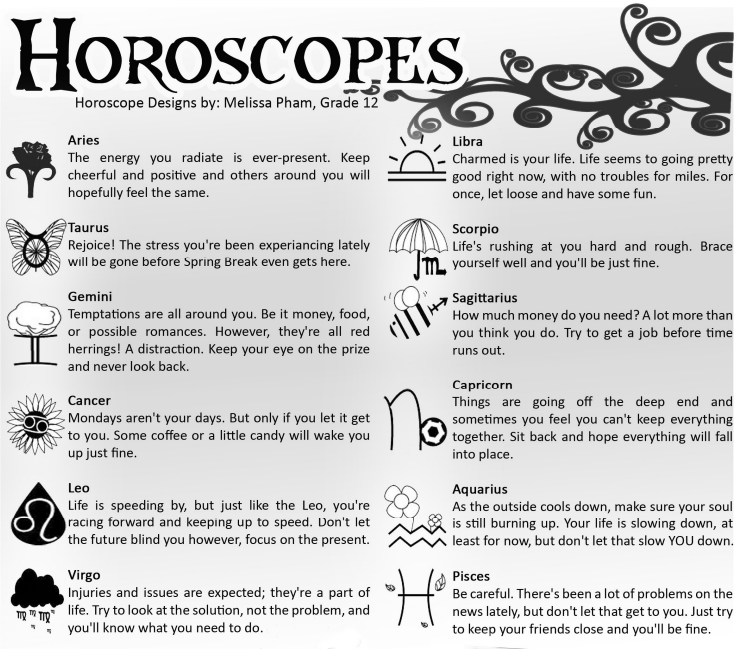
- **Falsifiability**:

  A theory earns its scientific status through risky predictions, i.e. "[it] must be capable of conflicting with possible, or conceivable, observations" (p. 9).

Example: Astrology revisited

- Is astrology excluded from the realm of the scientific when we utilise Popper's criterion?

- It seems not! For astrology also makes predictions.



A tempting reply

- Astrology's predictions almost always come out false.
- Suppose we turned such failures into a criterion. Wouldn't this disqualify astrology & other theories as non-scientific?
- No, various scientific theories make many false predictions!
- Recall that Popper dismisses observation, truth, etc., as good demarcation criteria for precisely such reasons.

Popper refined

- Theories must say not just something about the world but **something specific**. The more specific the better.

- Thornton: “Psychoanalytic theories by their nature are insufficiently precise to have negative implications, and so are immunised from experiential falsification” (2013, p. 4).

- This is at least true w.r.t. astrology and other theories. It is evident in the vagueness of horoscopes.

- **NB**: This approach turns falsifiability from an all-or-nothing criterion to one that gauges *degrees of scientificity*.

To be falsifiable means...

Reading

- Nola, R. and H. Sankey (2007) *Theories of Scientific Method*, Stocksfield: Acumen, Ch. 5: § 5.1-5.3.

The End