МІНІСТЕРСТВО ОСВІТИ ТА НАУКИ УКРАЇНИ
СХІДНОУКРАЇНСЬКИЙ НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
імені ВОЛОДИМИРА ДАЛЯ

Юридичний факультет
Кафедра культурологічних та політологічних студій

НАВЧАЛЬНО-МЕТОДИЧНИЙ ПОСІБНИК
з дисципліни
«ФІЛОСОФСЬКІ ПРОБЛЕМИ НАУКОВОГО ПІЗНАННЯ»
(електронне видання)

(для здобувачів вищої освіти спеціальностей “Комп’ютерні науки”, “Комп’ютерна інженерія”, що навчаються за програмою підготовки магістра)

Укладачі: С.Л. Кузьміна, доц., д.філос.н.
С.О. Авдєєва

КИЇВ
2024

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Рецензент: О.І. Захожай, д.техн.наук, проф.

Навчально-методичний посібник з дисципліни «Філософські проблеми наукового пізнання» (для здобувачів вищої освіти спеціальностей “Комп’ютерні науки”, “Комп’ютерна інженерія”, що навчаються за програмою підготовки магістра) / Укл.: С.Л. Кузьміна, С.О. Авдєєва. - К.: СНУ ім. В. Даля, 2024. - 328 с.

Навчально-методичний посібник з навчальної дисципліни “Філософські проблеми наукового пізнання” складено на основі англомовних навчальних видань провідних університетів і є скороченим оглядом фундаментальних проблем філософії науки 20 - початку 21 ст. Мета видання - допомогти зорієнтуватись в основних категоріях і поняттях філософії науки, скласти базове уявлення про можливості й обмеження наукового пізнання. Воно складається з передмови з загальною інформацією про курс, опорних конспектів у вигляді презентацій з коментарями доповідача. У додатках розміщено глосарій і список рекомендованої літератури.

Навчально-методичний посібник складено відповідно до робочої програми навчальної дисципліни як базового освітнього компоненту освітньо-професійних програм “Комп’ютерні науки”, “Комп’ютерна інженерія”.

Видання призначено для здобувачів освіти другого (магістерського) рівня вищої освіти, аспірантів, а також може бути корисним для всіх, хто цікавиться проблемами філософії науки.

INTRODUCTION

This publication consists of lecture summaries on the academic discipline Philosophical Problems of Scientific Cognition.

This discipline is a foundational educational component of the educational and professional programs of the second level of higher education (Master's degree) in the specialties Computer Science and Computer Engineering, and is studied in the 2nd semester.

The total workload is 3 ECTS credits (90 hours), including 14 hours of lectures.

Forms of ongoing assessment: thematic testing, oral answers.

Form of final assessment: exam or defense of a research mini-project.

The language of instruction is English.

The purpose of studying the academic discipline is to master the basic principles and methods of scientific activity by students of higher education, the formation of knowledge, skills and abilities in the production and application of knowledge in various spheres of social life and professional activity. When studying the course Philosophical Problems of Scientific Knowledge, attention is focused on the theoretical importance of the discipline, which contributes to the formation of the foundations of scientific thinking. Knowledge is formed in the field of philosophy of science, study and analysis of modern scientific concepts and theories, study of methods for obtaining and further analysis of scientific knowledge, solving the problem of the scientific truth, acquaintance with the practical application of scientific and methodological knowledge in professional activity.

As a result of studying the course, Master's students should **know**:

- the main theoretical foundations of the philosophy of science, to have a concept of the subject, methods, tasks of the philosophy of science;

- the history of interaction between philosophy and science and the role of philosophy of science in modern life;

- modern theories of the development of scientific knowledge;

- characteristic features of scientific knowledge;

- general regularities of the development of science;

- what are the features of the methods of scientific cognition;

- differences between historical types of scientific rationality;

- concepts of scientific truth;

- key problems of the philosophy of computer science;

- fundamental principles of scientific ethics and academic integrity.

Also, they should **be able to**:

- reconstruct cognitive methods, categorical schemes; use modern methods of cognition;

- explain the regularities of the development of scientific knowledge;

- analyse the modern scientific worldview;

- distinguish scientific knowledge from non-scientific and pseudoscientific;

- characterise the factors affecting the development of science;

- characterise ecological, ethical and economic requirements for modern scientific research;

- use the categorical apparatus of the philosophy of science in determining the goals, methods and evaluation of the results of scientific research.

Prerequisites for studying:

Knowledge of philosophy and ethics within a bachelor's degree educational program. Lecture summaries are provided in the form of presentations with speaker's comments. Each lecture includes a topic, problematic questions, and key words, and at the end there is a list of recommended readings on which the summary was based. The appendices contain a glossary and a general list of recommended literature.

Philosophical problems of scientific cognition

Introduction. Important information

PROFESSOR

Svitlana Kuzmina,
dr. of philosophical sciences

Філософські проблеми наукового пізнання

Електронний університет СНУ ім. В. Даля

ЗАВДАННЯ
Sillabus 2024

Topic 1. Demarcation problem. 2024

ЗАВДАННЯ
Demarcation problem

Topic 2. Scientific method problem. 2024

ЗАВДАННЯ
Scientific method problem

Філософські проблеми наукового пізнання
Філософія та Богослов'я

Why is the course included in the curriculum of computer sciences?

Knowledge is formed in the field of philosophy of science, study and analysis of modern scientific concepts and theories, study of methods for obtaining and further analysis of scientific knowledge, solving the problem of the scientific truth, acquaintance with the practical application of scientific and methodological knowledge in professional activity.

https://docs.google.com/document/d/1wu-aMuMzgldrQSPKPfcbf6y1z9S9YhAooKQJasx1e5o/edit?usp=sharing

General information about the course

TIME

When?
2-nd semester

How much time is in curriculum?
3 credits ECTS
90 hours

How is the learning time divided?
14 hours - lectures
14 hours - practical classes
62 hours - independent learning

General information about the course

Form of final control

&

grade system

Form of final control: test

Student grading scale

Sum of points for all types of learning activities	ECTS grade
90-100	A
82-89	B
74-81	C
64-73	D
60-63	AND
35-59	FX
0-34	0-34

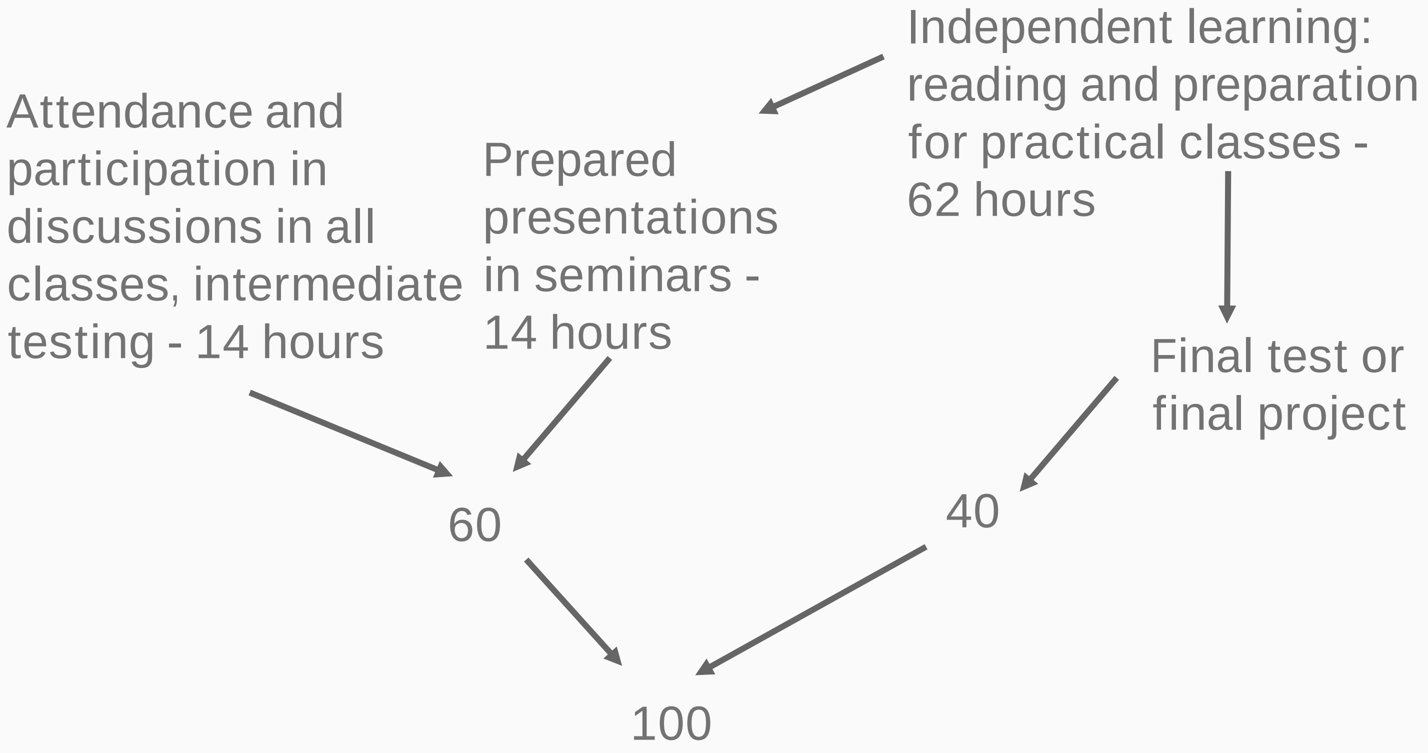
General information about the course

Course evaluation

For fully completed tasks, students can receive a certain number of points:

Tools and tasks	Number of points
Participation in the discussion	20
Tests	25
Individual and group projects	25
Final test	30
Total	**100**

General information about the course: evaluation



Where are the course materials?

ЗАВДАННЯ
Sillabus 2024

Topic 1. Demarcation problem. 2024

ЗАВДАННЯ
Demarcation problem

Topic 2. Scientific method problem. 2024

ЗАВДАННЯ
Scientific method problem

Філософські проблеми наукового пізнання

Recommended reading

Recommended reading:

Philosophy of Science for Scientists. Johansson Lars-Göran. – Springer, 2016, 257 p. – pdf

Methodological support:

Philosophy of Science. A Very Short Introduction. Okasha Samir. – Oxford University Press. – 2002, 144 p. – pdf

The Routledge Companion to Philosophy of Science. Edited by Stathis Psillos and Martin Curd. – Routledge, 2008, 619 p. – pdf

The Philosophy of Computer Science, Anguis Nicola, Primiero Giuseppe, Turner Raymond. – Stanford Encyclopedia of Philosophy, 2021. – https://plato.stanford.edu/entries/computer-science/

Where can you communicate about the course?

Operational communication:

https://t.me/+RlR1Jd7pRlg4MTUy

Філософські проблеми науки. 2024

1 member

LECTURE 1

Philosophical Problems of Scientific Cognition

course name

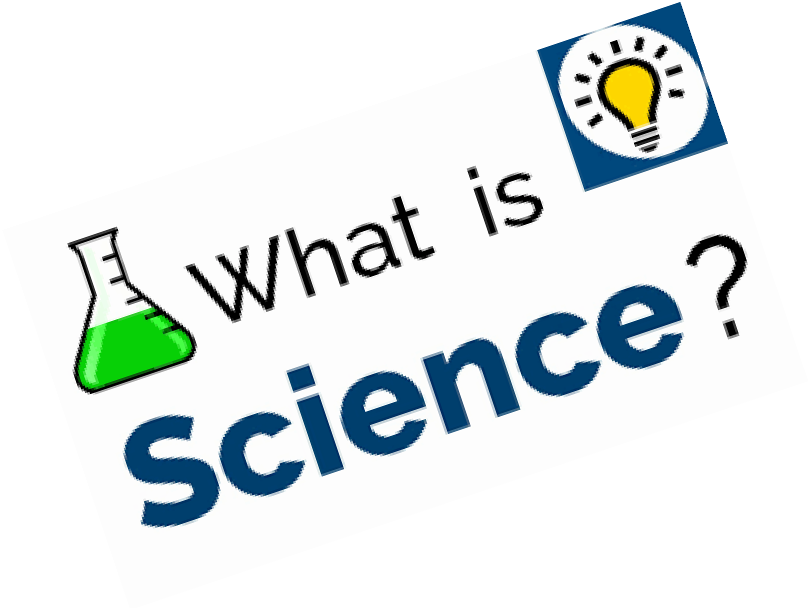
What will we talk about today?

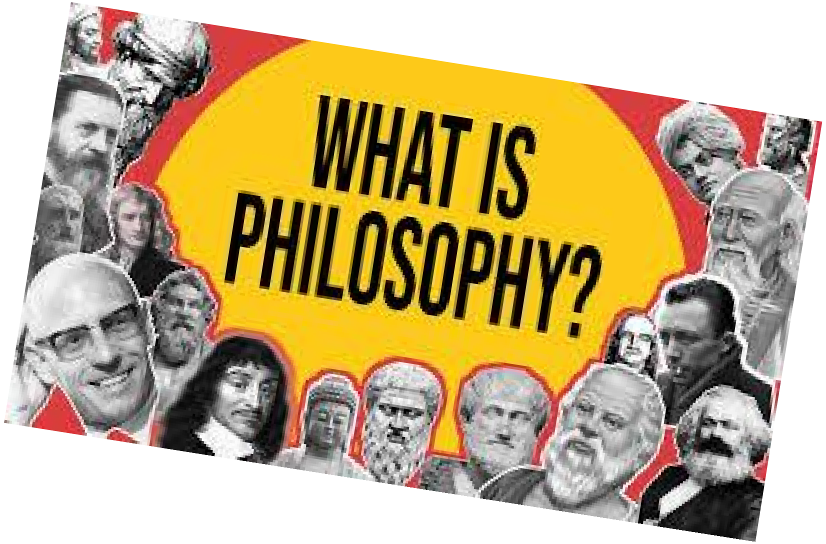
What is the difference between science and philosophy?

Can science work without philosophy?

How is it possible to distinguish true science from pseudoscience?

We should understand





We should understand

Before determining what the philosophical issues of science are, we need to deal with the fundamental question of what the difference is between science and philosophy. It is impossible to answer this one if we don’t define what science is and what philosophy is.

What does a scientist do?

OBSERVATION

GATHERING FACTS

IDENTIFICATION

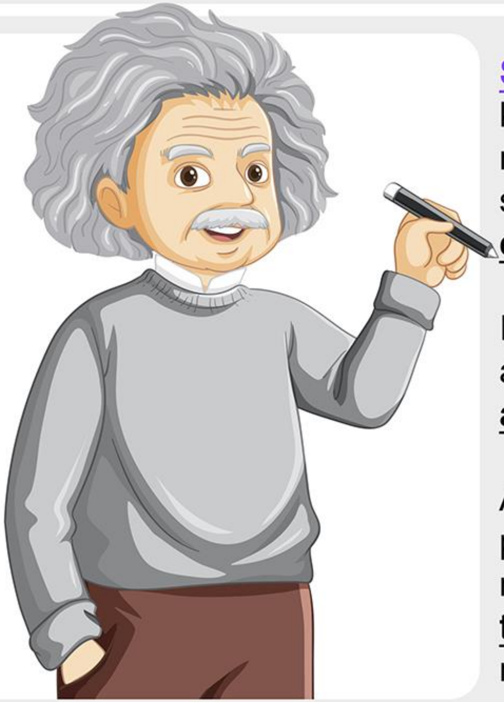
HYPOTHESIS

EXPERIMENTS

THEORY

SCIENCE is the study of the <u>empirical world</u> (world around us)

WHAT IS SCIENCE?



Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology **based on evidence**.

It is the **set of techniques**, methods, and laws that are used or were used to **achieve knowledge**.

Although the science is a set of propositions ordered and logically related to form a coherent system, **these propositions must be accurate**, not just ideas without foundation.

Glossary of terms | © www.WorksheetsPlanet.com

Worksheets PLANET

Please, write in our chat key words which defines what science is.

What does a philosopher do?

- QUESTIONS HOW THE WORLD IS ORGANIZED
- ASKS WHAT IS GOOD AND EVIL, LIFE AND DEATH
- TRIES TO UNDERSTAND AND EXPLAIN HOW PEOPLE THINKS
- TRIES TO EXPLAIN HOW SOCIETY WORKS

- QUESTION
- OBSERVATION
- IDEA
- CRITICAL THINKING
- THEORETICAL SYSTEM

Philosophy is thinking, inquiring about foundations of the world and human being, cognition, activity

WHAT IS PHILOSOPHY?

Philosophy is the **systematized study of general and fundamental questions**, such as those about existence, reason, knowledge, values, mind, and language.

There are 7 **branches of Philosophy**: **Metaphysics, Axiology, Logic, Aesthetics, Epistemology, Ethics** and **Political Philosophy.**

A **philosopher** is an **intellectual person who seeks wisdom or enlightenment.** They study about knowledge, truth and the nature and meaning of life.

Please, write in our chat key words which defines what philosophy is.

What is relationship between science and philosophy? Common

- ✓ doubt that already acquired knowledge is the truth
- ✓ ask questions of nature, human, society
- ✓ research
- ✓ explanation of causal relationships
- ✓ think according to logic laws
- ✓ develop theories
- ✓ cumulate and transfer knowledge
- ✓ support communication into societies of specialists
- ✓ willingness to change theories based on new facts and explanations
- ✓ progress

What is relationship between science and philosophy? Different

Science

- focuses on separate areas of knowledge and phenomena
- describes only observable world
- uses special methods of observations and measurement
- collects and checks empirical facts
- develops system of special proofs
- strives to make certain and irrefutable conclusions
- develops theories that predict course of events in special areas

Philosophy

- focuses on general understanding of the world and human
- describes general foundations of being
- uses and checks special methods of thinking
- collects and checks ideas
- develops abstract models and explanations
- reflexes ways of human cognition of the world

Can science or philosophy answer these questions?

- what the limits of science are?
- how does science work?
- how is science supposed to work?
- what are science’s methods?
- where are science’s methods applicable and where not?

Please, write in our chat your thought whether science or philosophy is capable to answer these questions.

Do scientists need philosophy?

Is it important for scientists to understand that what they are doing is truly scientific?

Richard Feynman: “philosophy is about as useful to science as ornithology is to birds”

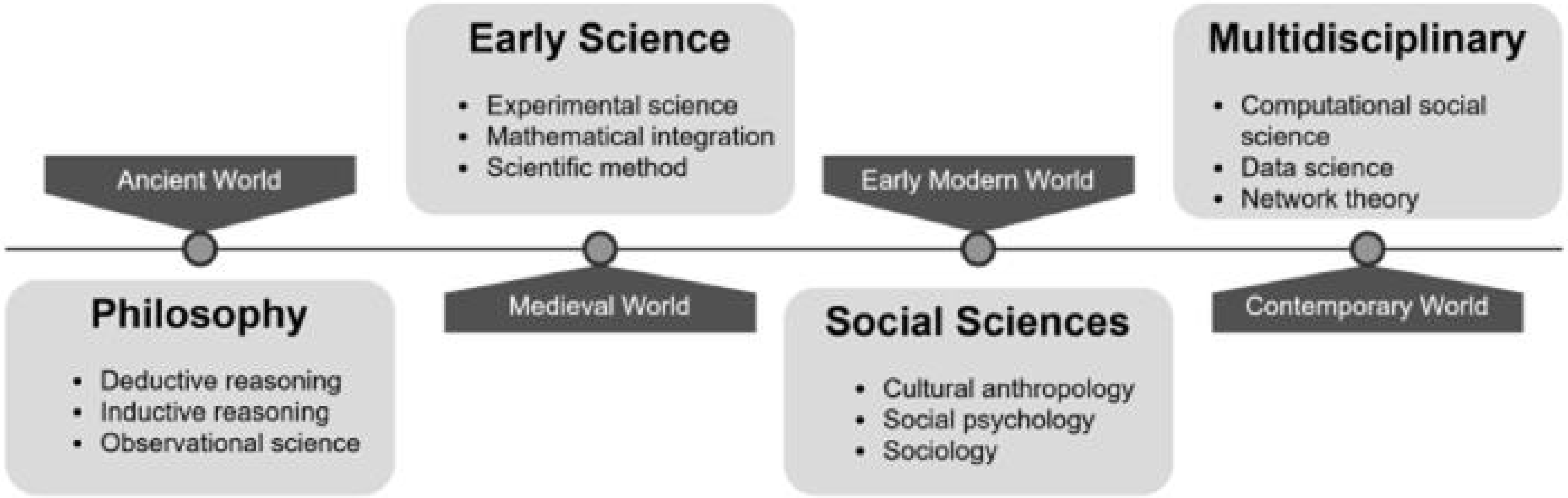
A lot of scientists neglect philosophy. They don’t suspect how they are depend on some philosophical ideas. In fact, it is impossible to answer the question whether a certain theory is truly scientific without help of philosophy.

DEMARCATION PROBLEM

What are the limits of science? What are the signs of science? What is the criterion of true science?

So, really significant problem for science is demarcation/distinguish science from other intellectual enterprises such as philosophy, art, policy, technology, religion so on. Nowadays pseudoscience doctrines become more and more popular. Hence, it is important to be able to separate these ones from truly science’s outputs. However let’s go in order.

The origin of science.
When did science arise?



Please, look attentively at this table and answer the question: from what intellectual enterprise were born sciences? You can tape your answer in our chat.

Can we point the exact date when science was separated from philosophy?

The process of shaping and separation science from philosophy was gradual. It began in middle ages, continued by scientific revolution in 17th century and ended in 19th century by critique of metaphysics. Let me remind you that Greece prefix ‘meta’ means ‘after’, namely metaphysics explains general foundations of nature and world being. Thus, when scientists wanted to refuse philosophy or metaphysics they had to know how to check whether a theory was free from philosophical ideas.

What is the difference between science and philosophy?

This question emerged historically the first because science arose from philosophy, and it was crucially important for scientists of Modern World to be free of philosophy

Logical positivism

Verification is a process when scientific statements are distinguished from philosophical statements

A scientific statement should be distinguished from a metaphysical statement. Hence, a scientific theory is a theory that contains only statements about empirical facts and does not contain philosophical statements

VIENNA CIRCLE

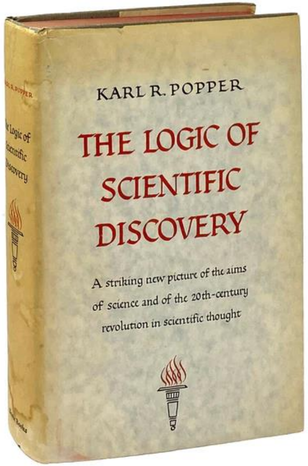
Solution of this problem was proposed by philosophers of Vienna Circle. Their doctrine has the name of logical positivism. In particular, they developed the special intellectual procedure called 'VERIFICATION'. This one means that every theoretical statement should be checked if it refers to facts obtained by observations or measurements. If it doesn't, this statement is philosophical and should be excluded from scientific explanations.

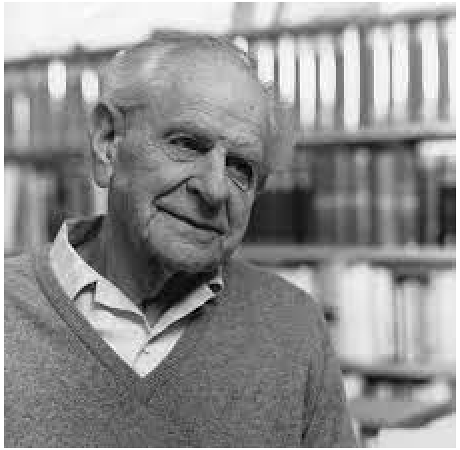
When is a scientific theory truly scientific?

Critical Rationalism

Falsification

"Statements or systems of statements, in order to be ranked as scientific, must be capable of conflicting with possible, or conceivable observations"





Numerous attempts to apply the verification procedure have shown that it is impossible to completely purify scientific theory from philosophical ideas. The philosophical circle from London which was called “critical rationalism’ tried to untie embarrassments of Logical Positivism. Famous philosopher from this circle Karl Popper offered the criterion of falsification for testing whether a theory is scientific. It was quite unexpected to suggest that it is a feature of a scientific theory whether there are facts from the relevant field of knowledge that the theory cannot explain.

And, on the contrary, if it is possible to explain any facts with the help of the theory, then this theory has no relation to science.

Look at the slide, please, and tell or write in the chat if there is something inappropriate on it. What are the white and black swans for? Who knows what does a very popular meme today “black swan’ mean?

The black swan theory or theory of black swan events is a metaphor that describes an event that comes as a surprise. The term is based on an ancient saying that presumed black swans did not exist, until they were discovered in Australia in 1697, and then it became reinterpreted to mean an unforeseen and consequential event. So, according to Popper's belief, a theory is scientific when it is falsifiable namely can be refuted on the basis of individual facts.

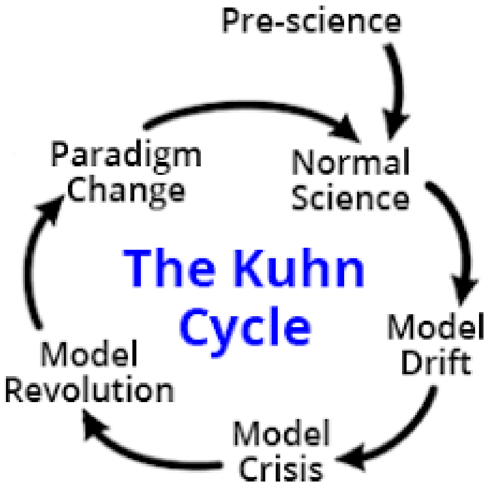
Bright examples of this are astrophysics and astrology. Astrophysics is unable to explain what is black matter and whether it exists in general. And they admit this fact. At the same time you’ll never hear from astrologist that it is impossible to know whether in your life something happened in this way but not another, and you will never be able to check their explanations.

When is a scientific theory truly scientific?

Postpositivism

Puzzle-solving

True scientific theory solves definite puzzle



Thomas Kuhn who was a philosopher and historian of science believed that criterion of falsification could work only during specific periods in the history of certain science. You can see on the slide Kuhn’s conception of science’s development. The philosopher divides this one on periods of ‘normal science’ and ‘scientific revolution’. Accordingly to Kuhn, during scientific revolutions there were too many ‘black swans’, namely facts that couldn’t be explained.

Therefore scientists have to search for new explanations and theories. In return, there were periods of ‘normal science’ in the history. Then researchers is working on solving puzzles in the boundaries of existing fundamental theories or paradigm. Thus, the feature of true science is puzzle-solving on the frontier of known and unknown to science.

What is the sign of true science?

True science is constantly accumulating knowledge, and its research programs are changing

Progress

Research program is a set of ideas that provided a platform of common assumptions and ideas about of certain phenomena + professional network

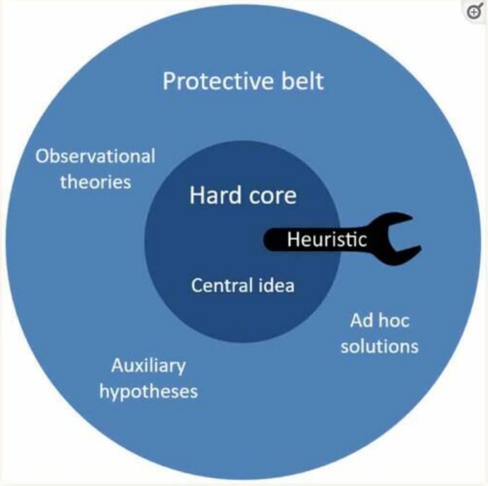


Figure 1

A research programme consists of a hard core of static beliefs, a heuristic, and a protective belt containing all other knowledge. The protective belt is dynamic and adapts in such a way that observations can be explained without affecting the hard core.

Famous philosopher of science Imre Lakatos criticized Popper’s idea of falsifying science theories as impractical. At the same time, he claimed that Kuhn’s conception of ‘normal science’ with its ‘monopolistic paradigm’ inhibits the development of science. So, Lakatos proposed the idea of research program to explain how true science works and develops. Every science has several research programs that compete with each other.

Research program has a set of ideas that allow to build assumptions about certain natural or social phenomena. They are the hard core of research program. This one is surrounded by protective belt which is consisted from heuristic suppositions such as observational theories, auxiliary hypothesis and special solutions. Heuristic is approach to problem-solving when people go by trial and error, rule of thumb (practical rules) or guess.

Concerning the sign of true science Lakatos believed that this is a progress of research program when emerge the new productive theories. These theories are able to make surprising predictions that are confirmed by more facts. If this is not the case then research program is pseudoscientific.

How can we recognize the true science?

We can distinguish science and pseudoscience by applying criteria which we have discussed already

MULTI-CRITERIA APPROACHES

True science:

- must be based on empirical facts and evidences which should be verified
- must not explain everything but define it's limitations clearly
- must solve it's very specific problems
- must have competitive research programs that constantly develop

Pseudoscience

FORMS OF PSEUDOSCIENCE

PSEUDO-THEORY PROMOTION

astrology
alchemy
alternative medicine
homeopathy
conspiracy theories
theory of spiral dynamics

SCIENCE DENIALISM

holocaust denial
climate change denial
vaccination denial
tobacco disease denial

intelligent design (creationism)
flat earth theory

Science  v. Pseudoscience 

mysportscience

Science	Pseudoscience
1 Findings are expressed through scientific journals that are peer-reviewed and maintain rigorous standards for honesty and accuracy	1 Literature is aimed at the public. No review, no standards, no demand for accuracy and precision
2 Reproducible results are demanded. Experiments must be precisely described	2 Results cannot be reproduced or verified. Studies are always vaguely described so no-one can figure out what was done or how it was done
3 Failures are searched for and studied closely	3 Failures are ignored, excused, hidden, lied about, discounted, explained away, forgotten etc.
4 As time goes on more and more is learned about the physical processes under study	4 No physical phenomena are ever found or studied. no progress is made, nothing concrete is learned
5 Convinces by appeal to the evidence	5 Convinces by appeal to faith and belief. Tries to convert not to convince.
6 Does not advocate or market unproven practices or products	6 Generally earns a living selling questionable products (books, courses, supplements or services)

Recommended reading

Philosophy of Science. A Very Short Introduction. Okasha Samir. – Oxford University Press. – 2002, pp.1-17. https://drive.google.com/file/d/1MFiKkg_Qbf8ra-mpVRDfVYw6N7izC7ES/view?usp=sharing

Science and Pseudo-Science. *Stanford Encyclopedia of Philosophy*, 2021. https://plato.stanford.edu/entries/pseudo-science/

Massimo Pigliucci and Maarten Boudry. Why the Demarcation Problem Matters. https://drive.google.com/file/d/1u-bvj4v3Ag2kJB_LGOrJwgI2e0R0-7Kx/view?usp=sharing

LECTURE 2

Scientific Method Problem

How do scientists reason?

What are we going to talk about today?

What is the problem of empirical facts?

Deduction and induction in scientific reasoning. Why are they always not enough?

Scientific explanation - what is it? Can science explain everything?

Key words

- empirical fact
- observation
- experiment
- hypothesis
- deduction
- induction
- explanation
- general law of nature
- causation

The Problem of Empirical Basis

Empirical fact
Observation
Hypothesis
Experiment

What is science based on? What is the ground of science?

Science studies natural and social world

We can learn what natural and social world is with the help of senses - sight, hearing, smell, touch.

All that we have learned through the senses is our experience. The Ancient Greeks invented a special name for this experience - empiria or empirical.

That is why philosophers call facts that we learn from senses empirical facts

The ground of science is empirical facts

How do scientists collect empirical facts?

They observe and experiment with nature or society

Scientific methods

observation

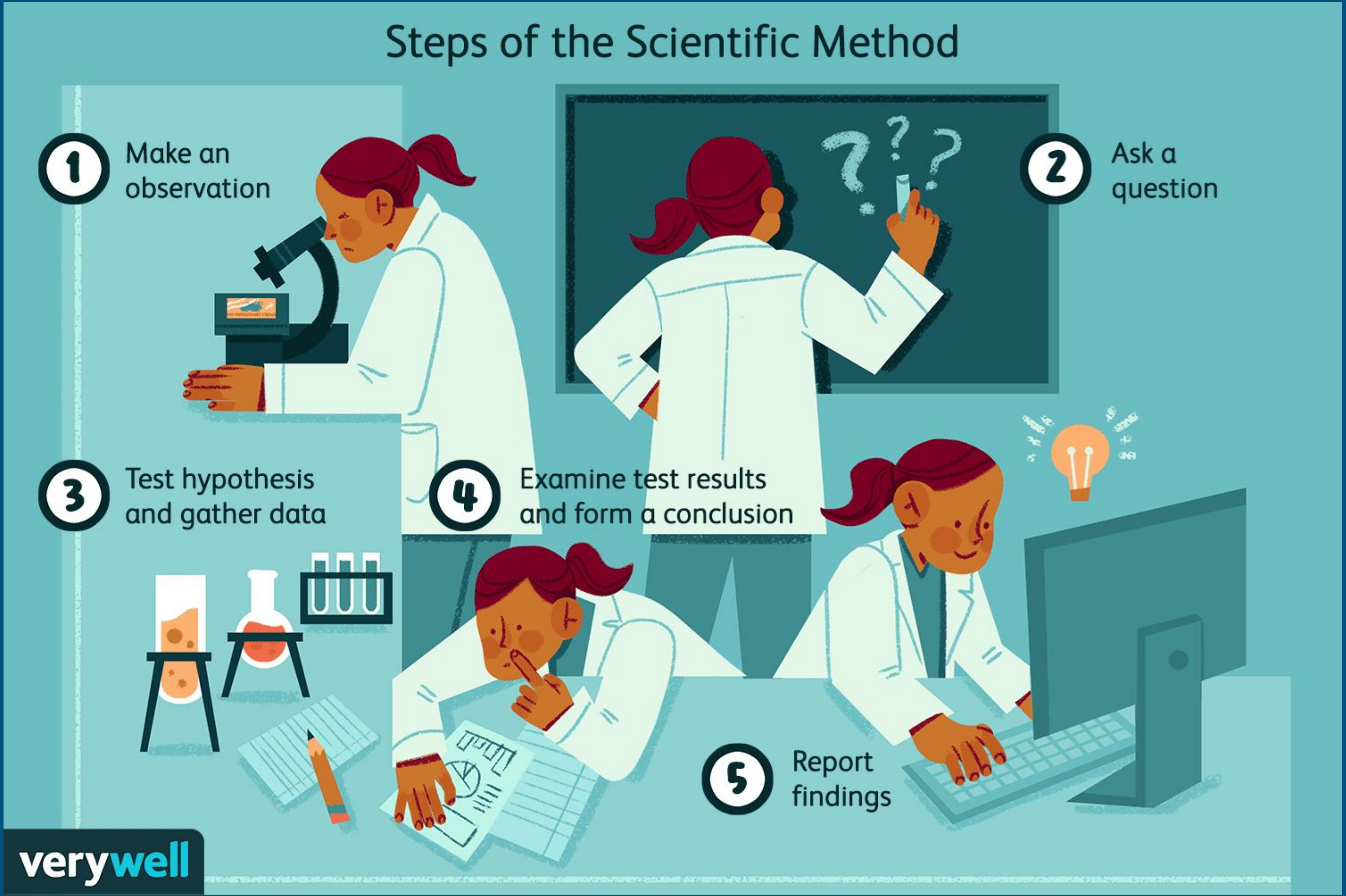
experiment

Method is a way of doing something

to observe - to watch carefully the way something happens

to experiment - to try (or check) some assumption (hypothesis) in order to discover what it is like or find out more about it

hypothesis=assumption


Steps of the Scientific Method
1 Make an observation
2 Ask a question
3 Test hypothesis and gather data
4 Examine test results and form a conclusion
5 Report findings
verywell

What is the problem of empirical facts?

certainty, credibility

1

Old and complicated philosophical problem:
Is everything we know through the senses true? Are our senses not deceiving us?

We cannot know

Immanuel Kant:
We can only learn the external world as our senses allow us to.

2

Specific question:
Are observations and experiments free from theoretical prejudgments?

NO

Observation and experiment must be aimed at a specific goal or assumption. The goal is determined by a certain previous idea.

Observation and experiment must be aimed at a specific goal, otherwise they will not bring results. The goal is determined by a certain previous idea, assumption. Therefore, observation and experiment cannot be completely free from pre-judgments. Scientists have to come to terms with it

Deduction and Induction Problem

What methods do scientists use to make sense of empirical facts?

Deduction - the process of reaching a decision or answer by thinking about the known facts

All the Chinese eat rice
Shanlin is the Chinese

Hence, Shanlin eats rice

CONCRETIZATION

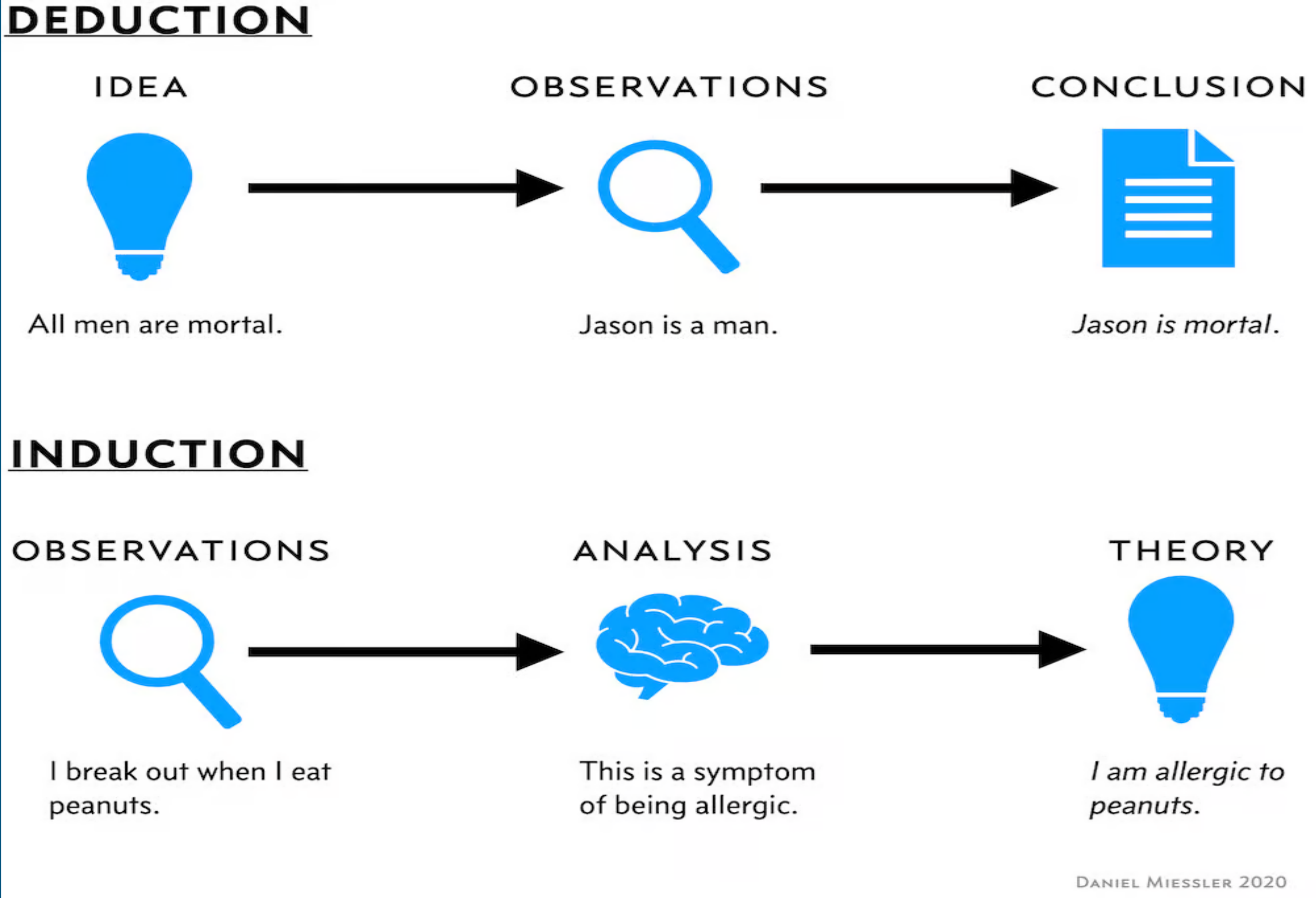
Induction - the process of discovering a general principle from a set of facts

Yan, Chao, Feng... eat rice.
Yan, Chao, Feng... are the Chinese

Hence, all the Chinese eat rice

GENERALIZATION

Basically, deduction is concretization when scientists flesh out substantial features of the subject of study. On the contrary, induction is generalization when scientists identify common features of the study subjects amount.


DEDUCTION
IDEA
OBSERVATIONS
CONCLUSION
All men are mortal.
Jason is a man.
Jason is mortal.
INDUCTION
OBSERVATIONS
ANALYSIS
THEORY
I break out when I eat peanuts.
This is a symptom of being allergic.
I am allergic to peanuts.
DANIEL MIESSLER 2020

What could be wrong with deduction?

All the Chinese eat rice.
Shanlin is the Chinese.

↓

Hence, Shanlin eats rice.

Premise ↓ Conclusion

True ↓ True

There are too few true premises

Premise is a basic idea or statement. Premise entails the conclusion. What is the condition of obtaining a true conclusion? True premise. In what form could this premise exist?

Firstly, it could be a set of irrefutable facts to which new ones cannot be added. Agree, this is hardly possible because scientists discover more and more new facts constantly.
Secondly, it could be a reliable theory which cannot be refuted. However, there are too few such theories.
Therefore, deduction is not the main method in science despite it is considered as the most reliable.

What could be wrong with induction?

Yan, Chao, Feng… eat rice.
Yan, Chao, Feng… are the Chines.

Hence, all Chinese eat rice.

Premise True???

Conclusion True???

Is it possible?

Li doesn't eat rice…
Li is Chinese.

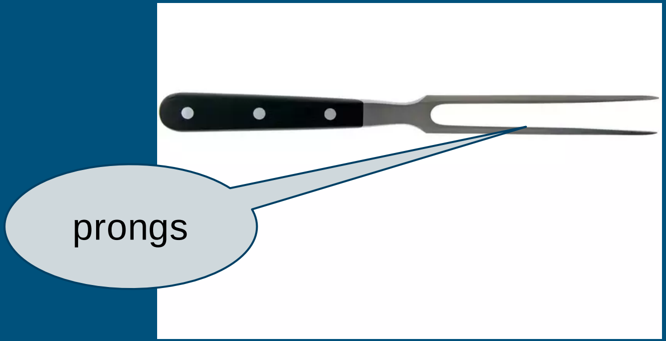
The induction method is basic in modern science for summarizing of empirical facts. There are more problems with induction method than with deduction. Let us analyze our example with the Chinese and rice. The problem of premise.

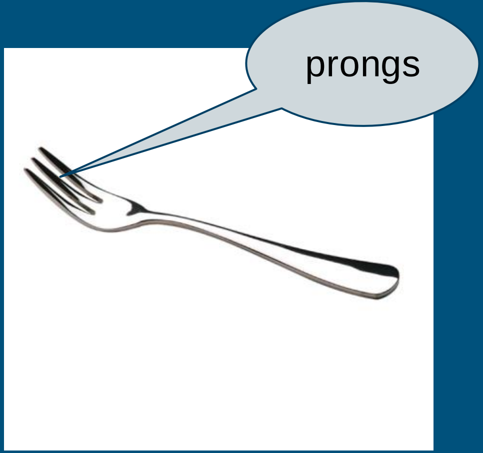
Is it possible when one of the Chinese does not eat rice? Yes, it is possible. Then the conclusion is not true. So, induction method cannot bring a reliable result on all 100 percent because it is impossible to collect all facts about certain phenomenon as in Rise-Chines case. There is always be exceptions or even denials.

Therefore when scientists use induction, and they almost always do, they are talking about probability in their conclusions.
In other words, scientists cannot afford to state something, what they have already discovered, categorically or directly. Instead, they can indicate a certain probability or say that it concerns only the set of facts which they have operated with. Only this kind of scientific conclusion will be correct.

David Hume

Custom is the great guide of life





It was David Hume who pointed out this drawback of induction. He noted that induction is a universal method of human and even animal thinking. We think according to events and things that we meet every day. This custom helps us to survive. At the same time, Hume proved that induction cannot be absolutely reliable for scientists. Philosophers call this proof ‘Hume’s Fork’. Let us see how many prongs (tips) does Hume’s Fork have? Two or three?

Premise

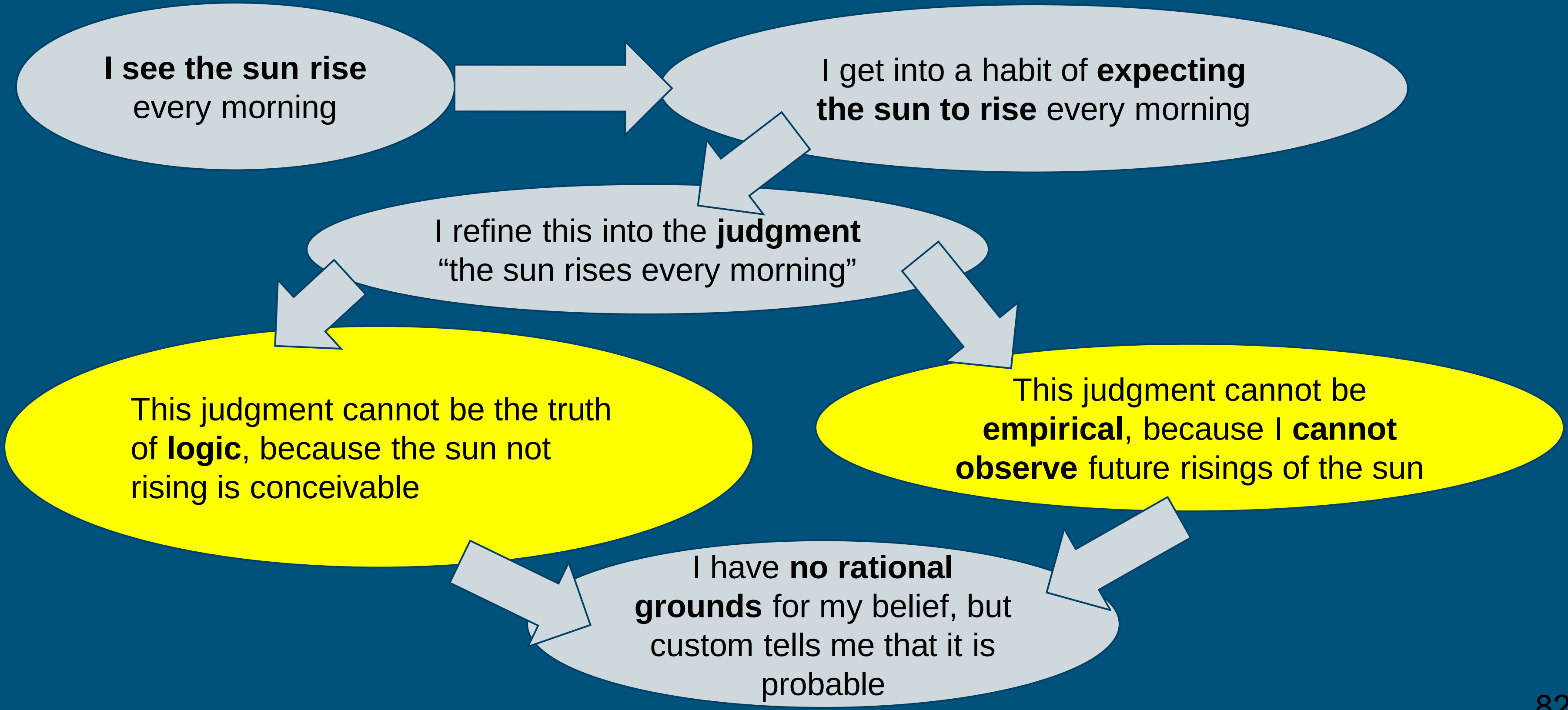
I have seen sunrising all my previous life. All humanity saw sunrising every previous day.

Conclusion

The sun rises every morning

Do you agree with the conclusion that sun rises every morning? This is the inductive reasoning that David Hume criticizes. He says that this statement can be refuted in two ways - logically and empirically. Let us trace how.

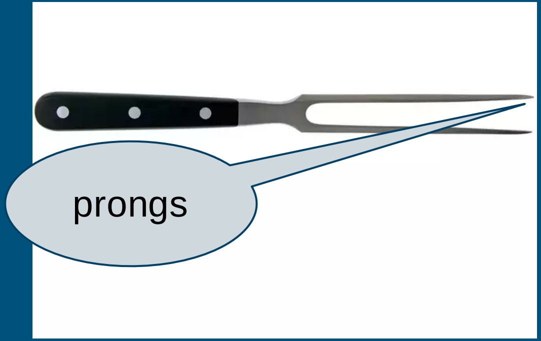
Hume’s fork

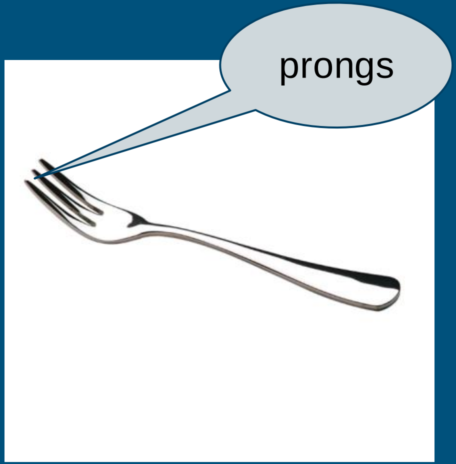

I see the sun rise every morning
I get into a habit of **expecting the sun to rise** every morning
I refine this into the **judgment** “the sun rises every morning”
This judgment cannot be the truth of **logic**, because the sun not rising is conceivable
This judgment cannot be **empirical**, because I **cannot observe** future risings of the sun
I have **no rational grounds** for my belief, but custom tells me that it is probable

Here we are. This is the way of Hume's reasoning. I start with the fact that I see sun rise every morning. Where did I get this fact? I have got it from my previous experience and I get into a habit of expecting the sun to rise every morning. On this ground I made the conclusion that sun rises every morning. However this conclusion could be refuted (disproved) logically.

Actually I am able to think that one day the sun will not rise. Also this conclusion could be disproved empirically because I cannot observe future sunrisings. So, Hume says, statement “the sun rises every morning” is based on our belief as a result of our experience. The statement is about probability not full certainty. Dear students, to summarize this part, answer in chat how many prongs (tips) Hume’s Fork has.

How many prongs does Hume’s fork have?





How scientific knowledge can be approved according to Hume?

Mathematics and logic bring “demonstrative” truths which cannot be denied.

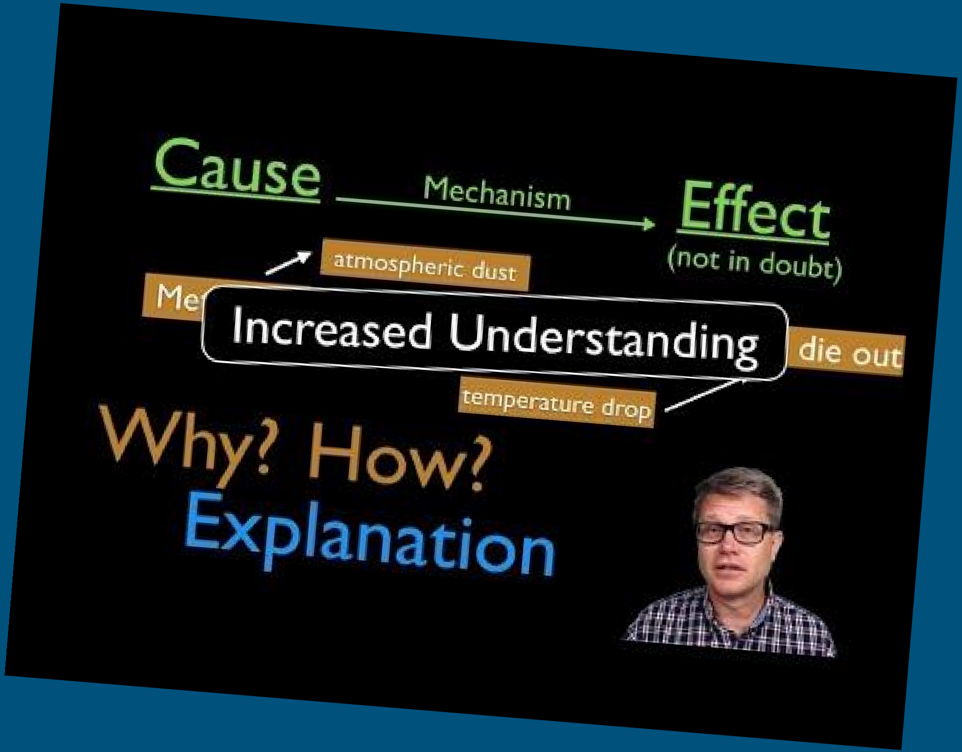
It seems that Hume's fork deconstructs the basis of science. Nevertheless, Hume indicates two points to support it. They are mathematics and logic.

The Problem of Explanation

Let us move on and discuss the explanation problem. Sometimes researchers call explanation ‘data interpretation’.

General Law of Nature

Causation



SCIENTIFIC EXPLANATIONS

CLAIM

Statement about the results of an investigation

- A one-sentence answer to the question you investigated.
- It answers, **what can you conclude?**
- It should not start with **yes** or **no.**
- It should describe the relationship between **dependent** and **independent** variables.

EVIDENCE

Scientific data used to support the claim

Evidence must be:

- **Sufficient** — Use enough evidence to support the claim.
- **Appropriate** — Use data that support your claim. Leave out information that doesn't support the claim.
- **Qualitative** — (Using the senses), or **Quantitative** (numerical), or a combination of both.

REASONING

Ties together the claim and the evidence

- Shows **how** or **why** the data count as evidence to support the claim.
- Provides the justification for why **this** evidence is important to **this** claim.
- Includes one or more **scientific principles** that are important to the claim and evidence.

Remember: Read what you've written to be sure it makes sense as a whole explanation.

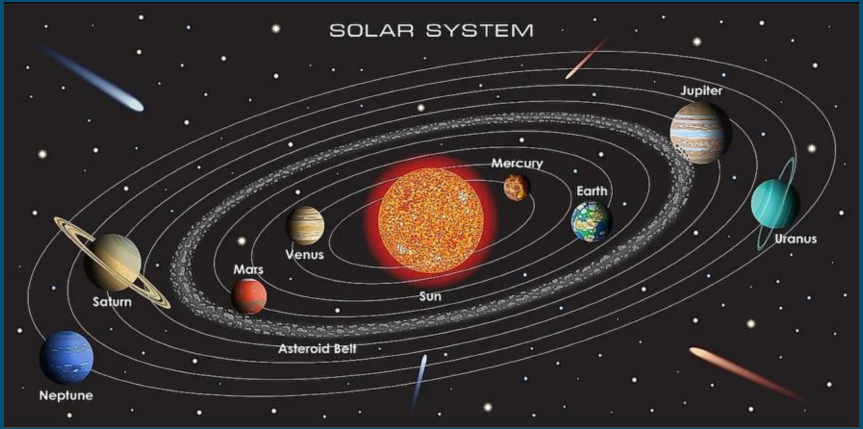
How does science explain some phenomenon?

Inductive inference (conclusion) from examined to unexamined instances

'explanation-seeking why questions'

explanatory considerations

Why is it going on in this way not another?



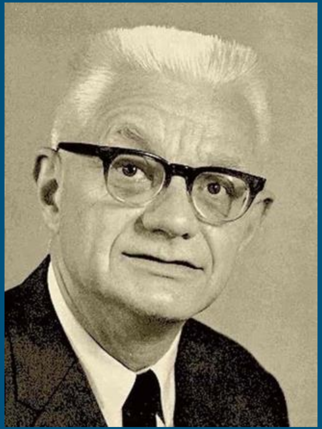
Why do the planets' orbits have the ellipse shape?

Why do women live longer than men?

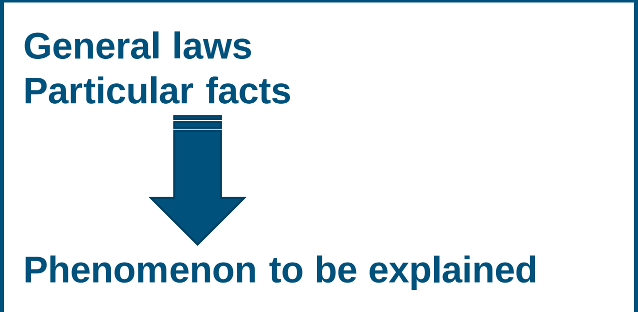
How can researchers explain the range of certain facts? They can use simple inductive inference or conclusion from examined to unexamined instances. At the same time much more common way is explanatory consideration. American philosopher Carl Hempel discovered the structure of one of this consideration. He called this one ‘explanation-seeking why questions’.

Covering law model of explanation

- premises should entail the conclusion, i.e. the argument should be a deductive one
- the premises should all be true;
- the premises should consist of at least one general law of nature



Carl Hempel



Carl Hempel claimed that to give a scientific explanation means to provide a satisfactory answer to an explanation-seeking why question. Hempel suggested that scientific explanations typically have the logical structure of an argument, i.e. a set of premises followed by a conclusion. The conclusion states that the phenomenon that needs explaining actually occurs, and the premises tell us why the conclusion is true.

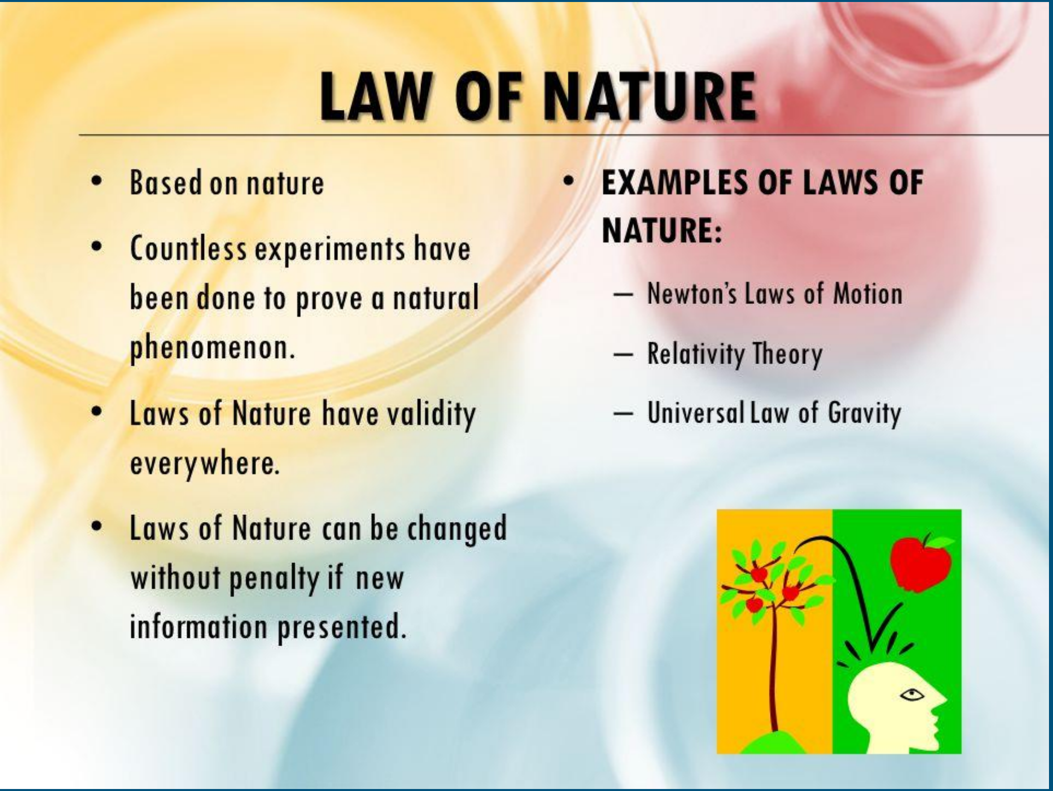
For according to the model, the essence of explanation is to show that the phenomenon to be explained is 'covered' by some general law of nature.

Hempel was aware that not all scientific explanations fit his model exactly.

Firstly, the premisses should entail the conclusion, i.e. the argument should be a deductive one. Secondly, the premises should all be true.

Thirdly, the premises should consist of at least one general law.

General Law of Nature



Law of nature is stated regularity in the relations or order of phenomena in the world that holds, under the stipulated sets of conditions, either universally or in a stated proportions of instances.

Britannica

This is a definition of the Encyclopedia Britannica. If we simplify it, we should say that general law of nature indicates constant connection between natural phenomena. As a typical instance we can remember law of classical mechanics.

Problems of ‘covering law explanation’

The Problem of symmetry

The law of universal gravitation explains why the planets revolve around the sun.

However, the fact that the planets revolve around the sun cannot explain the law of universal gravitation.

The problem of irrelevance

irrelevant explanation - not related to the subject of research

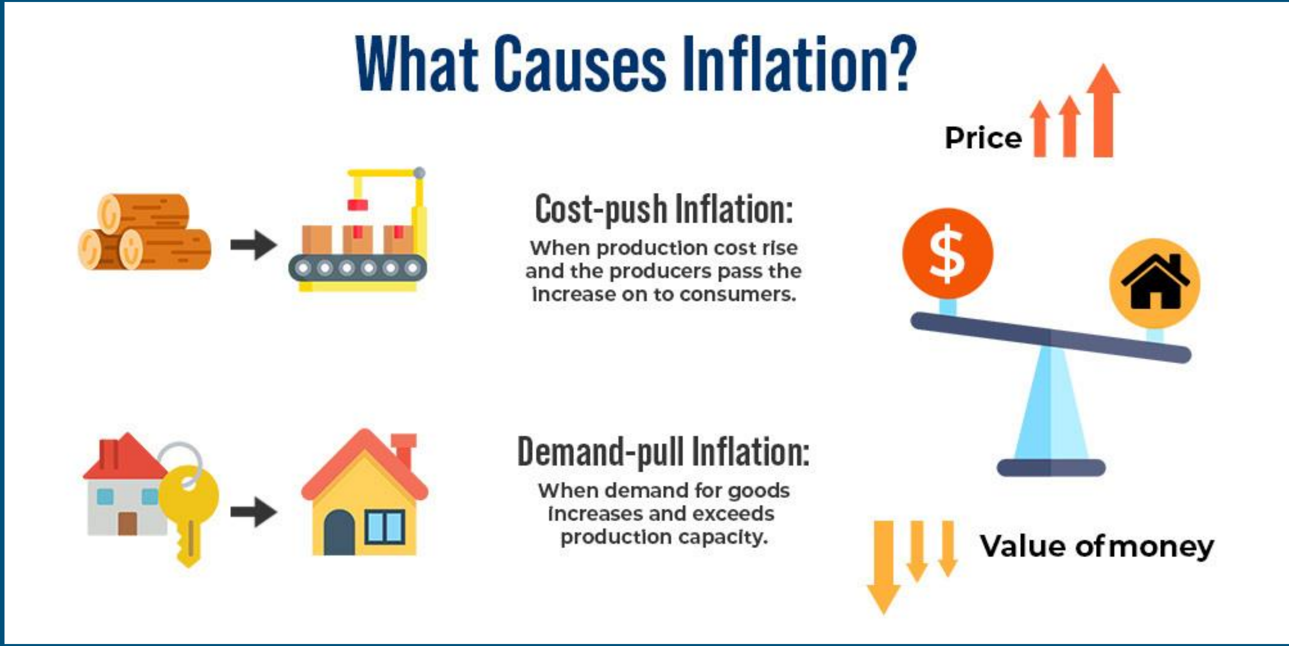
This is a topical problem in the area of Artificial Intellect

It is often when AI involves redundant facts, creates abstract hierarchies (which cannot exist), models non-existent physical devices so on.

Causation

indicates that one event is the result of the occurrence of the other event

What is the cause of the natural or social phenomenon?



Some philosophers believe that the key lies in the concept of causality. This is quite an attractive suggestion. For in many cases to explain a phenomenon is indeed to say what caused it.

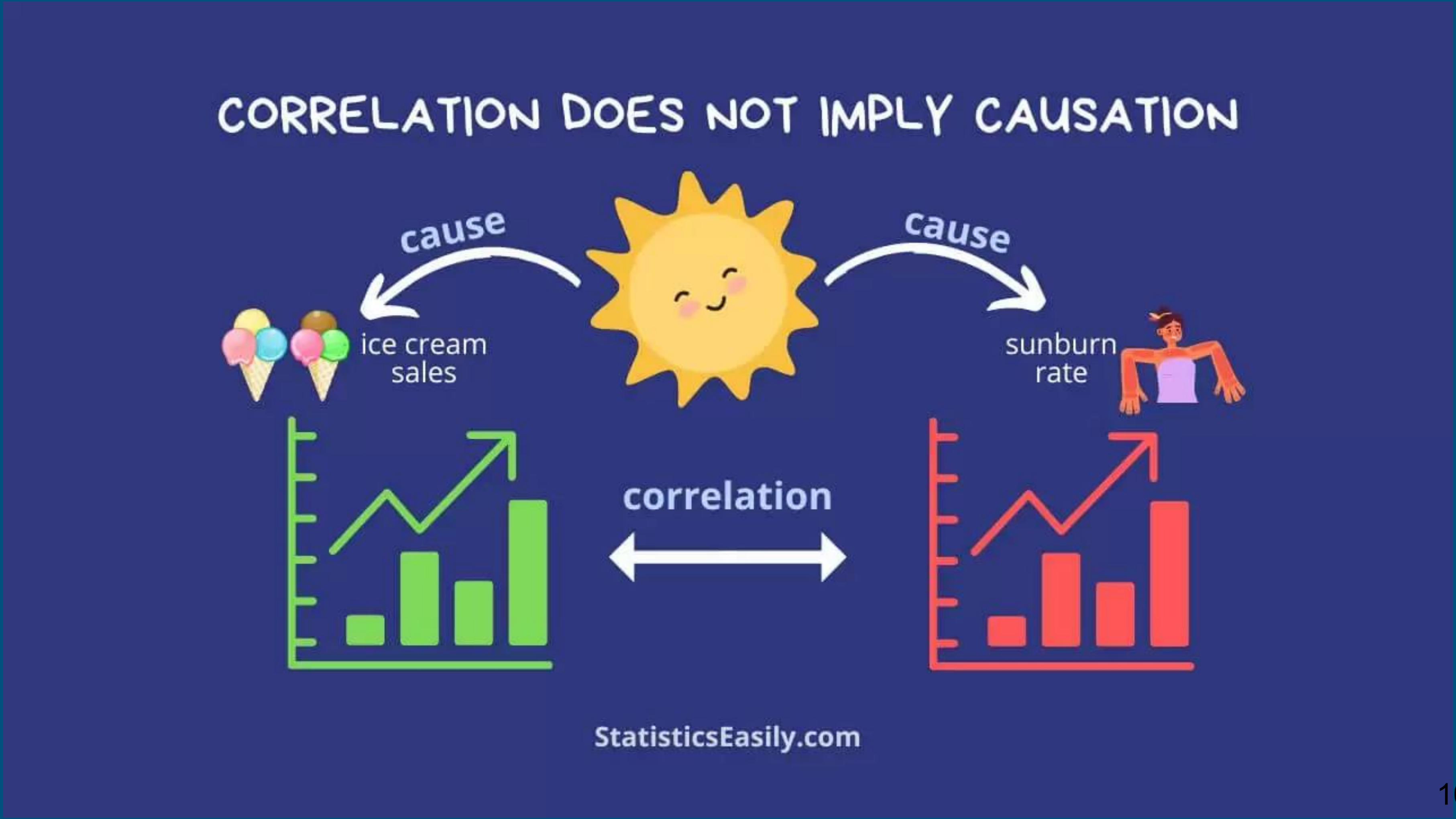
Concept of causality

Concept of Causality

A statement such as "*X* causes *Y*" will have the following meaning to an ordinary person and to a scientist.

Ordinary Meaning	Scientific Meaning
X is the only cause of *Y*.	*X* is only one of a number of possible causes of *Y*.
X must always lead to *Y* (*X* is a deterministic cause of *Y*).	The occurrence of *X* makes the occurrence of *Y* more probable (*X* is a probabilistic cause of *Y*).
It is possible to prove that *X* is a cause of *Y*.	We can never prove that *X* is a cause of *Y*. At best, we can infer that *X* is a cause of *Y*.

To explain a phenomenon is simply to say what caused it. In some cases, the difference between the covering law and causal accounts is not actually very great, for to deduce the occurrence of a phenomenon from a general law often just is to give its cause.


CORRELATION DOES NOT IMPLY CAUSATION
cause
cause
ice cream
sales
sunburn
rate
correlation
StatisticsEasily.com

Pay attention that people often confuse causation with correlation. You study this case during your homework.

What is the problem with scientific explanations?

Covering law model

Demands to be taken on faith certain general law of nature

Model of causation

The cause of the cause always remains without explanation

Both models of sci explanation are not final. ‘Covering law model’ demands to be taken for granted some general law of nature. ‘Concept of causality’ always remains without explanation the cause of the cause.

Can science explain everything?

To sum up:

You have learned what the following means:

- empirical fact
- observation
- experiment
- hypothesis
- deduction
- induction
- explanation
- general law of nature
- causation

You have understood what is:

- ➢ the basis of science
- ➢ what the methods of science research are
- ➢ why people cannot be confident in their empirical knowledge
- ➢ what methods of scientific reasoning are
- ➢ what drawbacks of deduction and induction are
- ➢ what models of scientific explanation are
- ➢ whether science can explain everything

Recommended reading

Philosophy of Science. A Very Short Introduction. Okasha Samir. – Oxford University Press. – 2002, pp.18-57. https://drive.google.com/file/d/1MFiKkg_Qbf8ra-mpVRDfVYw6N7izC7ES/view?usp=sharing

LECTURE 3

Scientific Truth Problem

What is accepted as truth in science?

Our topic today is Scientific Truth Problem. In other words, we will discuss which statements scientists do accept as truth.

What are we going to talk about today?

What do realists and anti-realists argue about?

Arguments for and against realism

What are the grounds for recognising a scientific theory as true?

Firstly, we will deal with what philosophers mean by the words REALISM&ANTI-REALISM and what the dispute between them is about. Secondly, we will consider arguments for and against REALISM. Thirdly, we will know about four theories of scientific truth. To crown it all we will define the grounds for recognising a scientific theory as true.

Key words

Theories of scientific truth:

- correspondence
- coherence
- pragmatic
- consensus

Realism & Anti-realism

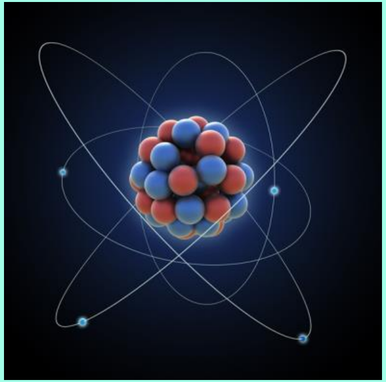
- observables & unobservables
- no-miracles argument
- distinction between observables & unobservables
- underdetermination
- pessimistic meta-induction

It is important to keep in mind that for better understanding we should clarify the meaning of keywords. Today they are connected with two points. The first is realism and anti-realism. Words which we will use: observables and unobservables, no-miracles argument, distinction between observables and unobservables, underdetermination, pessimistic meta-induction. The second one is scientific true theories: correspondence, coherence, pragmatic, consensus. So, go ahead!

Observables vs unobservables

Observables are the things or objects of the physical world which people are able to see by naked eyes or hear (sense of touch, smell) without any devices.

Unobservables are the objects of the physical world which people are not able to see by naked eyes or hear (sense of touch, smell) without any devices.

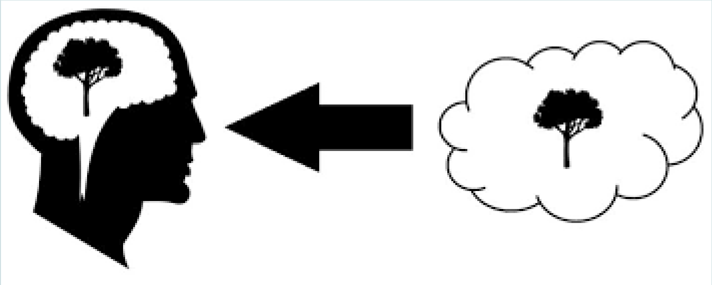


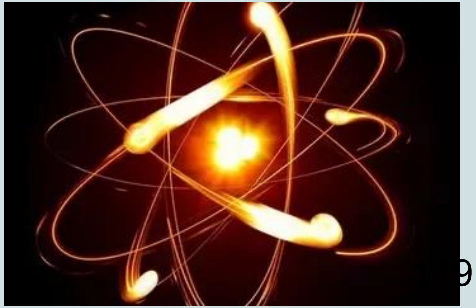
What is scientific realism?

Realism: beliefs that the physical world exists independently of human thought and perception

Scientific realism believes that:

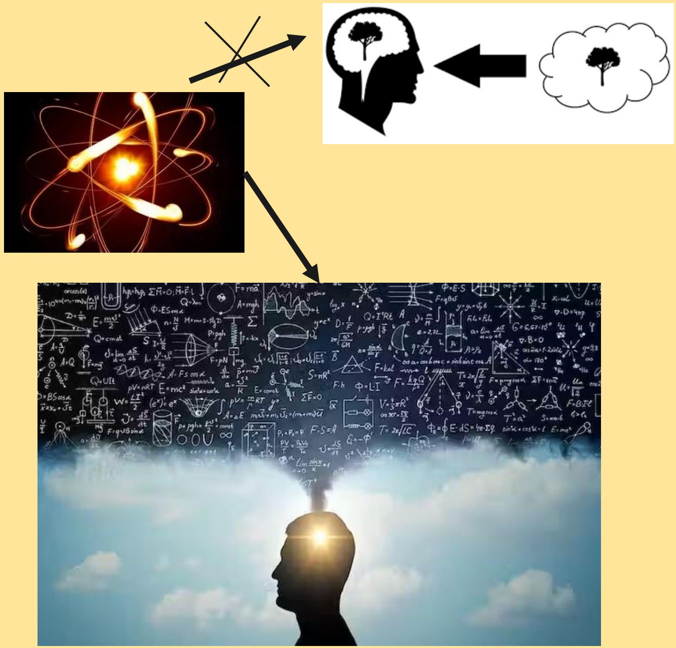
➔ unobservable entities exist as well as observable
➔ the aim of science is to provide a true description of the world
➔ the best scientific theories give true or approximately true descriptions of observable and unobservable aspects of a mind-independent world





Realism beliefs that physical world exists independently of human thought and perception. This one means that realists, i.e. people sharing the view are sure in existence of, relatively speaking, both objects that they are able to see by naked eyes and atoms or electrons. Furthermore, this people consider that the aim of science is to provide a true description of the real world. In addition, they agree that scientific theories gives us approximately a true picture of the world.

What is scientific anti-realism?



Anti-realism: doubts that physical world exists independently of human thought and perception

Scientific Anti-realism believes that:

- ➔ unobservable entities don’t exist unlike observable, they are convenient fictions which scientists use to explain and predict observable phenomena
- ➔ the aim of science is to provide a true description of a certain part of the world - the 'observable' part
- ➔ the best scientific theories give true or approximately true descriptions of observable world

I hope, you know that prefix anti- means negation. So, anti-realism says about fundamental doubts that the physical world is something accessible to human cognition. Anti-realists deny that unobservables particles exist because we are not able to see them by naked eyes. Anti-realists claim that rather scientists invented some images or fictions to describe what is happening on atom levels. Anti-realists believe that the aim of science is to deliver the picture of observable part of the world.

Arguments for Scientific Realism

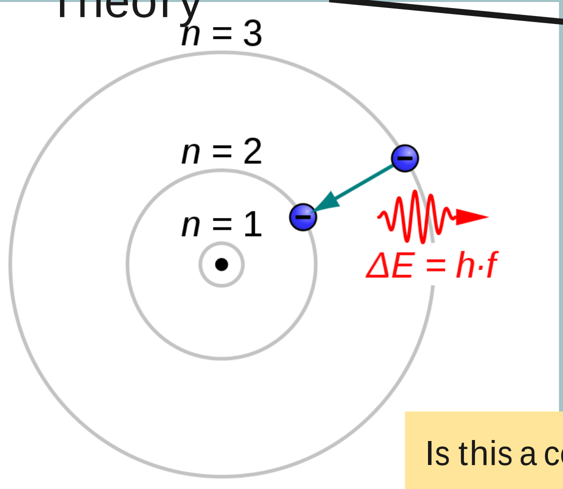
Let us take a look at the arguments for scientific realism.

No-miracles argument

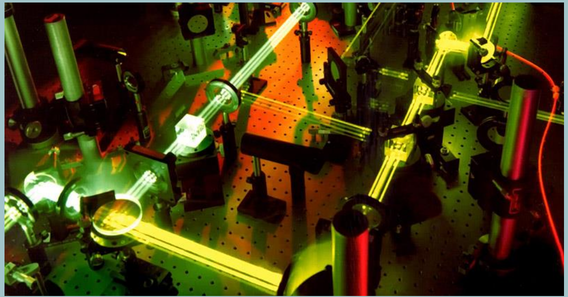
Many theories about unobservables:

- ➢ make successful predictions about observable events
- ➢ have important technological applications

Theory



Laser technologies



Is this a coincidence?

If you do not agree that elementary particles exist, you have to believe in a **miracle**

Theory of atomic electron transition

No miracles!

The first of it was called the no-miracles argument. It claims that many theories which posit unobservable entities are empirically successful - they make excellent predictions about the behaviour of objects in the observable world.

Furthermore, such theories often have important technological applications. For example, laser technology is based on a theory about what happens when electrons in an atom go from higher to lower energy-states: they radiate energy. And lasers work - they allow us to correct our vision, attack our enemies with guided missiles, and do much more besides.

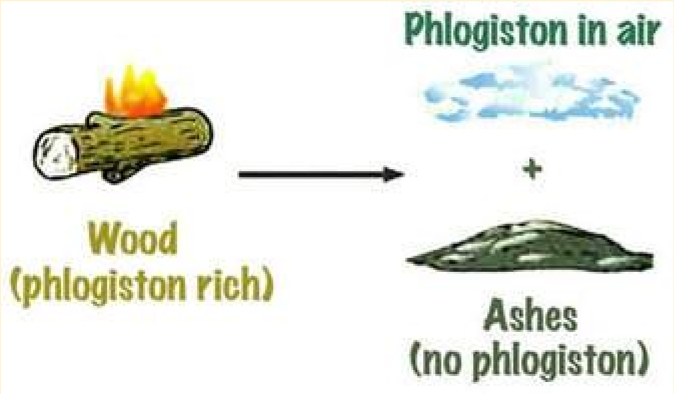
Why it became possible is explained by the theory of atomic electron transition. Anti-realists say that it could be other explanation of the things without appeal to unobservables. Realists answer that if you do not agree that elementary particles exist, you have to believe in a miracle.

The empirical success of theories that posit unobservable entities is the basis of one of the strongest arguments for scientific realism, called the 'no-miracles' argument. According to this argument, it would be an extraordinary coincidence if a theory that talks about electrons and atoms made accurate predictions about the observable world - unless electrons and atoms actually exist. If atoms and electrons are just 'convenient fictions', as anti-realists maintain, then why do lasers work?

On this view, being an anti-realist is akin to believing in miracles. Since it is obviously better not to believe in miracles if a non-miraculous alternative is available.

Denials of No-miracles argument

Historical:
There were false theories in the past that were empirically successful



Realists respond:

- ➢ the empirical success of a theory is evidence that what the theory says about the unobservable world is approximately true, rather than precisely true
- ➢ empirical success is not just a matter of fitting the known observational data, but rather allowing us to predict new observational phenomena that were previously unknown

Open question

Anti-realists deny no-miracles argument by historical illustrations. The phlogiston theory of combustion is one example. This theory, which was widely accepted until the end of the 18th century, held that when any object burns it releases a substance called 'phlogiston' into the atmosphere. Modern chemistry teaches us that this is false: there is no such substance as phlogiston. The history of science shows, highlight anti-realists, that empirically successful theories have often turned out to be false. So how do we know that the same fate will not befall today's theories? How do we know that the atomic theory of matter, for example, will not go the same way as the phlogiston theory?

Some realists have responded by modifying the argument slightly. According to the modified version, the empirical success of a theory is evidence that the theory’s assertion about the unobservable world is approximately true, rather than precisely true. Another way of modifying the argument is by refining the notion of empirical success. Some realists hold that empirical success is not just a matter of fitting the known observational data, but rather allowing us to predict new observational phenomena that were previously unknown. Whether the 'no miracles' argument is a good argument for scientific realism is therefore an open question.

Observable / unobservable distinction

Antirealism

Observables and unobservables can be easily distinguished

Realism

There is no clear line between observables and unobservables

How to distinguish observing from detecting?

Looking at something with a naked eye or through:

- ❑ a window
- ❑ a pair of strong glasses
- ❑ binoculars
- ❑ a low-powered microscope
- ❑ a high-powered microscope




Realists:

Which image should be accepted as observable and which as unobservable?

Antirealists:

Observables - vague concept

Central to the debate between realism and anti-realism is the distinction between things that are observable and things that are not. At first glance this distinction seems simple: tables and chairs are observable, atoms and electrons are not. But in fact the distinction is quite philosophically problematic whereas sciences are going forward.

Anti-realism thus presupposes that we can divide scientific claims into two sorts: those that are about observable entities and processes, and those that are not. They say that all description of unobservables are not observing but detecting. Then realists answer if something can only be seen with the help of sophisticated scientific instruments, does it count as observable or unobservable? How sophisticated can the instrumentation be, before we have a case rather detecting than observing?

Arguments against scientific realism

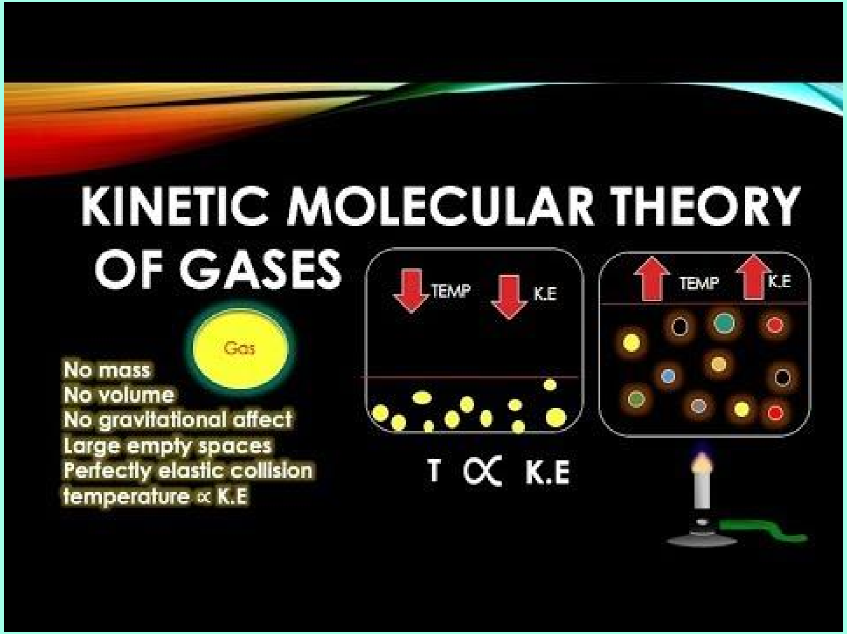
Let us know about arguments against scientific realism.

Underdetermination

There is not enough evidence

Antirealists:

Scientific theories are based on data collected from observation



It is possible there is another explanation of the phenomenon

Kinetic molecular theory of gas is not determined enough (underdetermined)

All scientific theories that involve unobservables are underdetermined

One argument against realism was called as underdetermination. This one centres on the relationship between scientists' observational data and their theoretical claims. In mathematics, a system of linear equations or a system of polynomial equations is considered underdetermined if there are fewer equations than unknowns. In the philosophy of science underdetermination is the idea that evidence available to us at a given time may be insufficient to determine what beliefs we should hold in response to it.

Anti-realists emphasize that the ultimate data to which scientific theories are responsible is always observational in character.
Kinetic theory of gases says that any sample of gas consists of molecules in motion. Since these molecules are unobservable, we obviously cannot test the theory by directly observing various samples of gas. Rather, we need to deduce from the theory some statement that can be directly tested, which will invariably be about observable entities. As we saw, the kinetic theory implies that a sample of gas will expand when heated, if the pressure remains constant.

This example illustrates a general truth: observational data constitute the ultimate evidence for claims about unobservable entities. Anti-realists then argue that the observational data 'underdetermine' the theories. It means that the data can in principle be explained by many different, mutually incompatible, theories.

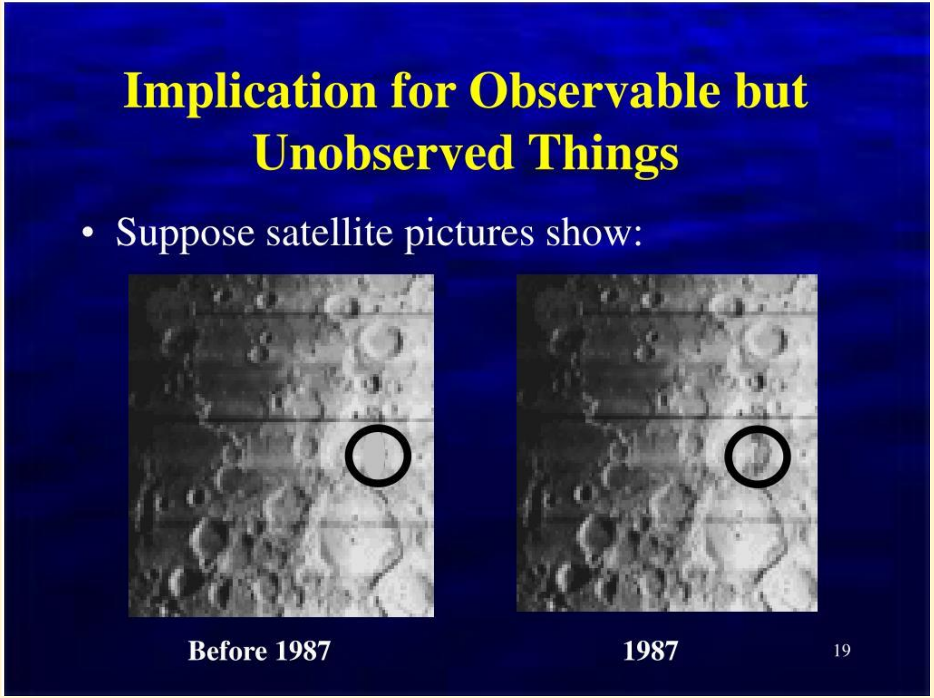
So according to anti-realists, scientific theories that posit unobservable entities are underdetermined by the observational data - there will always be a number of competing theories that can account for that data equally well.

Realists respond that it is reasonable to distinguish between theories. Not all the possible explanations of observational data as good as one another. We should admit as a criterion of ‘good’ theory its compatibility with observational data.

Underdetermination leads naturally to the anti-realist conclusion that agnosticism is the correct attitude to take towards claims about the unobservable region of reality. There are always multiple explanations of our data, we have no way of knowing which is true, so knowledge of unobservable reality cannot be had.

Additional reason to accept realism. If the observational data can always be explained equally well by many different theories, as anti-realists maintain, surely we should expect to find scientists in near perpetual disagreement with one another? But that is not what we find.

Against underdetermination argument



Realists:

Not all possible explanations of our observational data are as others

If we agree that additional criterion for theory choice should be compatibility with the observational data, the problem of underdetermination disappears

We can apply underdetermination argument both to unobservables theories but and to observables ones

Underdetermination argument is just a version of the problem of induction

Theories about unobserved objects and events are just as underdetermined by our data as are theories about observable ones. For example, suppose a scientist puts forward the hypothesis that a meteorite struck the moon in 1987. He cites various pieces of observational data to support this hypothesis, e.g. that satellite pictures of the moon show a large crater that wasn't there before 1987.

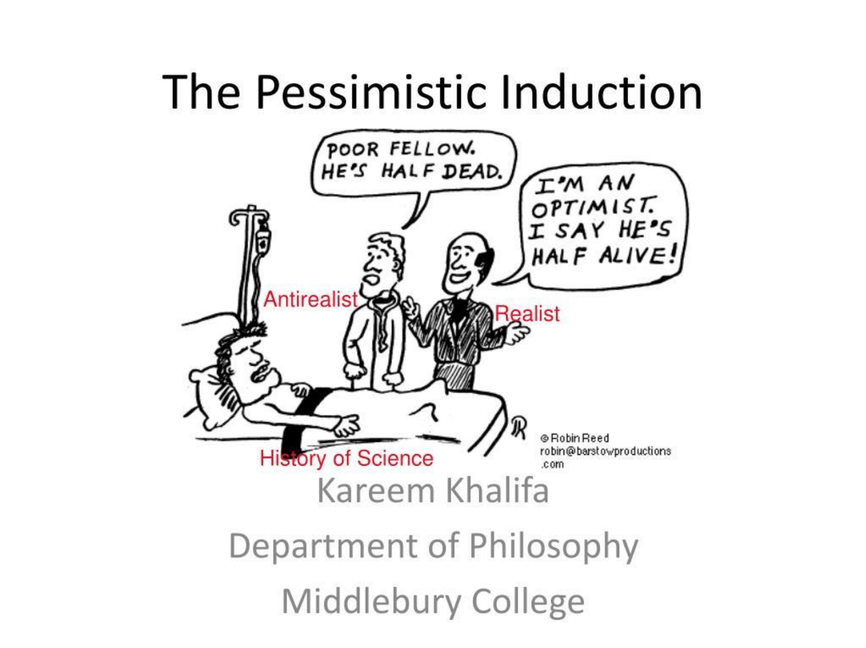
However, this data can in principle be explained by many alternative hypotheses - perhaps a volcanic eruption caused the crater, or an earthquake. Or perhaps the camera that took the satellite pictures was faulty, and there is no crater at all. So the scientist's hypothesis is underdetermined by the data, even though the hypothesis is about a perfectly observable event - a meteorite striking the moon. If we apply the underdetermination argument consistently, say realists, we are forced to conclude that we can only acquire knowledge of things that have actually been observed.

The pessimistic meta-induction

Antirealists:

The unobservables posited by past theories do not exist

Probably the unobservables posited by current theories do not exist

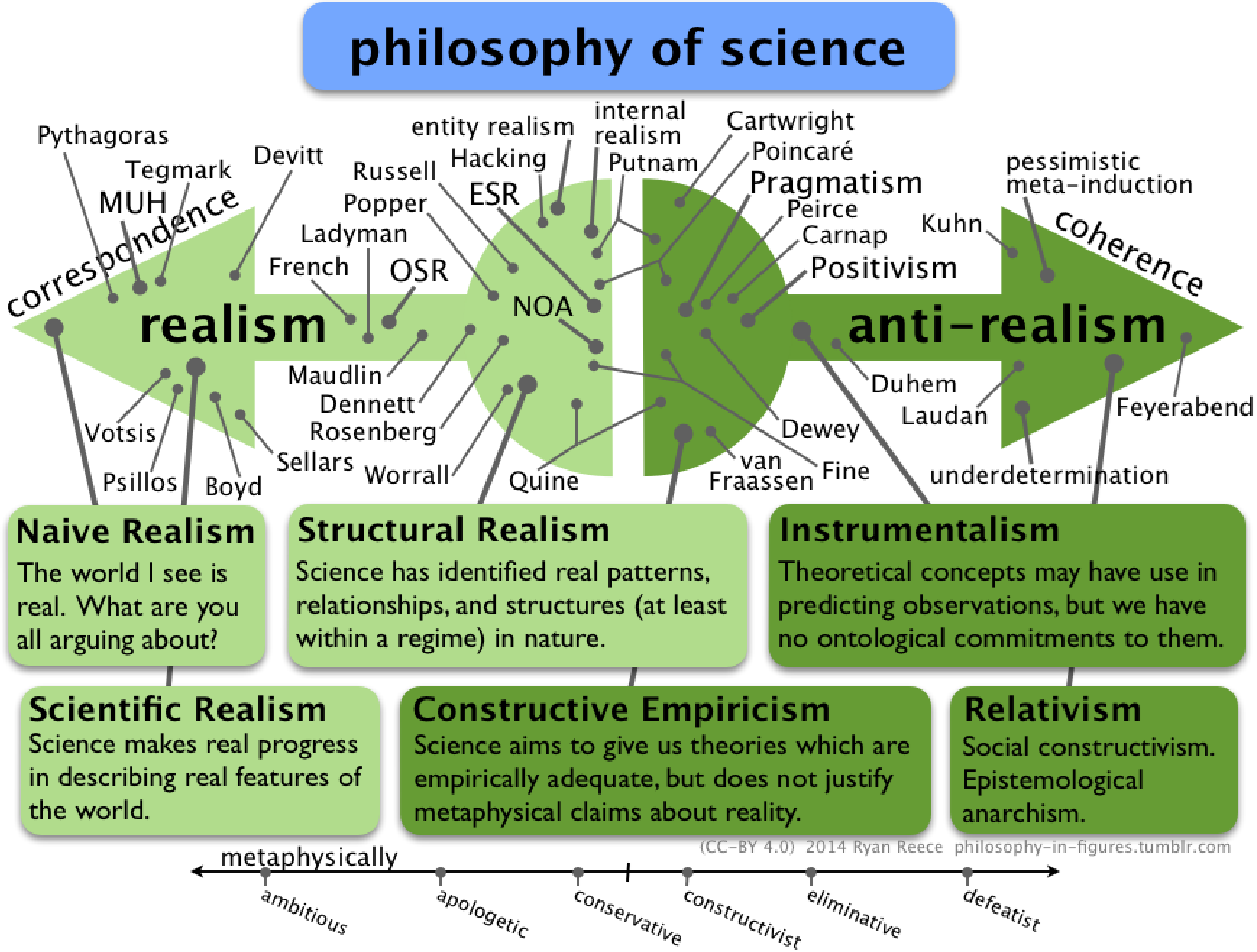


Realists:

Science is more or less right, but not totally so:

- some past theories are partly true
- some past theories are approximately true
- we are now much better at finding out about unobservables

The other argument against realism has the name of pessimistic meta-induction. It claims that if unobservables posited by past theories (such as phlogiston) do not exist then it is probable that unobservables posited by current theories also do not exist. Realists respond this^ some past theories are partly true; some - approximately true. Besides, we have an obvious progress in knowledge about unobservables.


philosophy of science
realism
anti-realism
correspondence
coherence
Pythagoras
Tegmark
MUH
Devitt
Russell
Popper
Ladyman
French
OSR
entity realism
Hacking
ESR
internal realism
Putnam
NOA
Cartwright
Poincaré
Pragmatism
Peirce
Carnap
Positivism
Kuhn
pessimistic meta-induction
Maudlin
Dennett
Rosenberg
Votsis
Psillos
Boyd
Sellars
Worrall
Quine
Duhem
Laudan
Dewey
van Fraassen
Fine
Feyerabend
underdetermination
Naive Realism
The world I see is real. What are you all arguing about?
Structural Realism
Science has identified real patterns, relationships, and structures (at least within a regime) in nature.
Instrumentalism
Theoretical concepts may have use in predicting observations, but we have no ontological commitments to them.
Scientific Realism
Science makes real progress in describing real features of the world.
Constructive Empiricism
Science aims to give us theories which are empirically adequate, but does not justify metaphysical claims about reality.
Relativism
Social constructivism. Epistemological anarchism.
(CC-BY 4.0) 2014 Ryan Reece philosophy-in-figures.tumblr.com
metaphysically
ambitious
apologetic
conservative
constructivist
eliminative
defeatist

Summing it up, I suggest that you study this table as your homework to comprehend how complicated is the discussion between realists and anti-realists and what consequences this discussion has. This discussion has a practical significance because it helps to develop scientific theories and realise the limits of scientific cognition.

Theories of Scientific Truth

As we could see, all in general sense of dispute between realists and anti-realists is whether scientific theories about unobservables are true or not. This question is connected with deeper philosophical issue about criteria of scientific truth. Which scientific theories should be accepted as true and which not? There are three basic theories of scientific truth in today’s philosophy of science.

Truth and Facts

3 Theories of Truth:

Pragmatic
Truth is what works, or serves our purposes

Coherence
Truth is what coheres with the rest of our knowledge

Correspondence
Truth is what corresponds to facts

They are correspondence, coherence, pragmatic. In a word, correspondence theory claims that theory is truth if it corresponds to empirical facts. Coherence theory offers to consider the theory true if it coheres or has logical consistency with existing knowledge. Pragmatic theory focuses on practical efficiency of the scientific theory. If it works and serves to our practical purposes, it is true. Further slides explain each of these theories in more detail.

Correspondence Theory

Correspondence Theory

- The dominant theory, especially popular with empiricists
- Correspondence Theory proposes that a proposition is true if it corresponds to the facts
  - Example: “The apple is sitting on the table” can be true only if the apple is in fact sitting on the table.
- Often traced back to Thomas Aquinas’ version: “A judgment is said to be true when it conforms to the external reality” (*Summa Theologiae,* Q. 16)
  - Also leaves room for the idea that “true” may be applied to people (a “true friend”) as well as to thoughts
- Two main versions of Correspondence Theory: object-based, and fact-based (currently prominent)

Correspondence Theory

- Strengths:
  1. Simplicity
  2. Appeal to common sense

- Weaknesses
  1. Difficulties pertaining to linguistics
  2. Falls prey to circular reasoning
  3. Awkwardness in application to mathematics
  4. Leads to skepticism about the external world

Coherence Theory

Coherence Theory

- Preferred by many idealists
  - For idealists, reality is like a collection of beliefs, which makes the coherence theory particularly attractive
- The coherence theory of truth states that if a proposition coheres with all the other propositions taken to be true, then it is true.
  - The truth of a belief can only consist in its coherence with other beliefs; truth comes in degrees
- Coherence theorists hold that truth consists in coherence with a **set of beliefs *or*** with a **set of propositions *held to be true,*** not just an arbitrary collection of propositions

Coherence Theory

- Strengths:
  1. Makes sense out of the idea of mathematical truths
     - **Ex:** (5+2=7) is true because: 7=7 ; 1+6=7 ; 21/3=(2x3)+1; are all true

- Weaknesses
  1. Like the Correspondence theory, the Coherence theory falls prey to circular reasoning
     - **Ex:** Proposition A is true because propositions B and C are true. But how do you know B is true? Because proposition A and C are true. But what external evidence is there to support the truth of any of these propositions?

Pragmatic theory

PRAGMATIC THEORY OF TRUTH

- Something is true if it is useful
- Whether or not it reflects reality is minor in importance
- Person A believes earning money is most important thing
- Their actions are guided by this belief
- Person B believes money is of minor importance
- They believe friends are the most useful thing
- This is truth for person B and it guides their actions

Pragmatic Theory

Truth and Facts

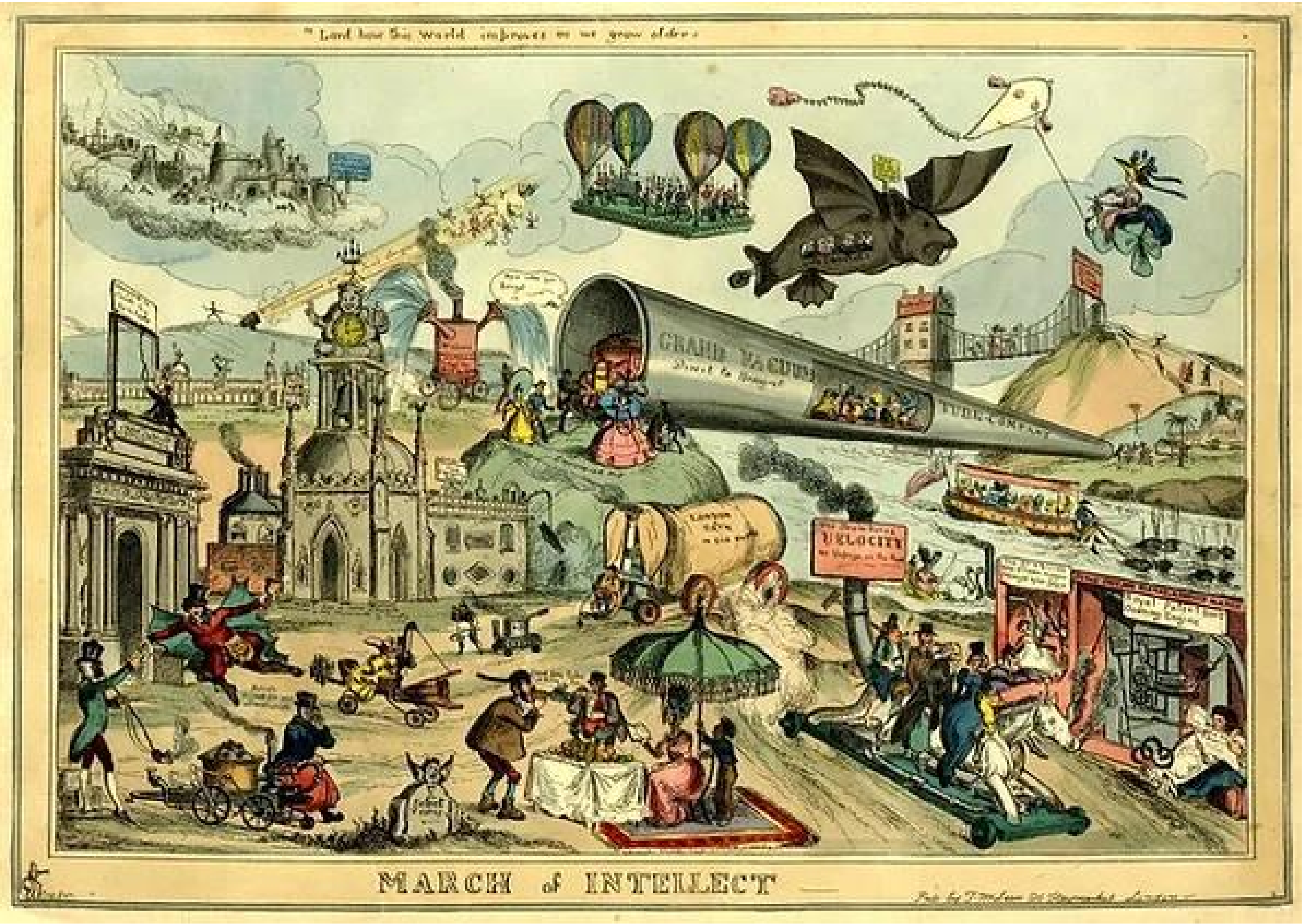
The Pragmatic Theory:

- seems compatible with many things we think are false
- belief in spirits or ghosts may work or serve the purposes of mediums and fortune tellers … we still want to say those beliefs are or may be false

Consensus Theory

Theory # 4

The **consensus theory** - knowledge is based on agreement or consensus of everybody, or that something is true if almost everyone confirms that it is true. Consensus is also used to determine the truth of scientific claims, where **experts** must agree on a certain phenomenon before it can be established as true.


"Lord how this world improves as we grow older"
GRAND VACUUM
Direct to Bengal
VELOCITY
MARCH of INTELLECT

Conclusions and Key Notions

What do realists and anti-realists argue about?

Can we know if there are things unobserved by ordinary human senses?

Arguments for and against realism

- no-miracles argument
- observable/unobservable distinction
- underdetermination
- pessimistic meta-induction

What are the grounds for recognising a scientific theory as true?

What theories of scientific truth do you know?

- ➢ empirical evidence
- ➢ predictive power
- ➢ falsifiability
- ➢ consistency with existing knowledge
- ➢ peer review and scientific consensus
- ➢ verification & reproducibility

Recommended reading

Philosophy of Science. A Very Short Introduction. Okasha Samir. – Oxford University Press. – 2002, pp. 58-76. https://drive.google.com/file/d/1MFiKkg_Qbf8ra-mpVRDfVYw6N7izC7ES/view?usp=sharing

Devitt M., Realism/Anti-Realism., *The Routledge Companion to Philosophy of Science*. Edited by Stathis Psillos and Martin Curd. – Routledge, 2008. – pp. 224-235. https://drive.google.com/file/d/19P7Q-pQgQkE1wAprpU_hZt82EQ0etXcF/view?usp=sharing

The Correspondence Theory of Truth. Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/truth-correspondence/

The Coherence Theory of Truth. Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/truth-coherence/

The Pragmatic Theory of Truth. Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/truth-pragmatic/

LECTURE 4

Scientific Rationality Problem

What affects scientific cognition?

Our topic this time is Scientific Rationality Problem. In other words we will discuss what affects scientific cognition.

What we are going to talk about today?

What is rationality?

Is scientific cognition based only on empirical facts and logic? Or does something else impact it?

Has scientific rationality changed over time?

Firstly, we should realise what is rationality. Secondly, we will look at the question if scientific cognition based only on empirical facts and logic? Or does something else impact on it? Thirdly, it would be interesting to figure out whether scientific rationality has changed over time.

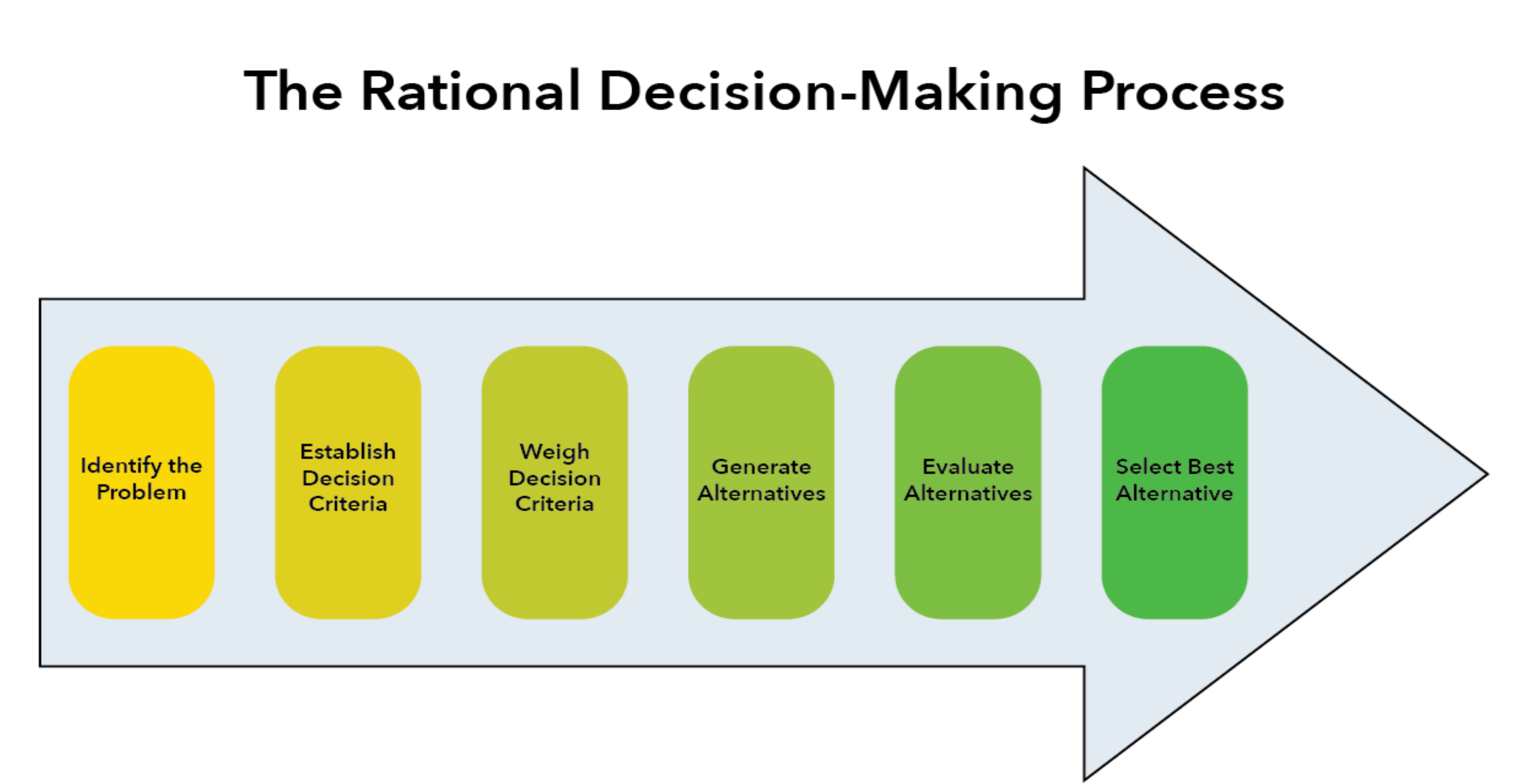
Key Words

Scientific Rationality

- rationality
- logical positivism
- linearity & cumulation
- critical rationalism
- discovery & justification
- scientific revolution
- paradigm
- cyclicity
- theory-ladenness of data
- types of scientific rationality

The main key word of this lecture is <u>scientific rationality</u>. It could seem to you that there too many new words here but everyone of them will be explained in the next slides.

What is rationality?



To understand what means the word ‘rationality’ let us look at the picture. This is the description of the rational decision-making process.

What is rationality?

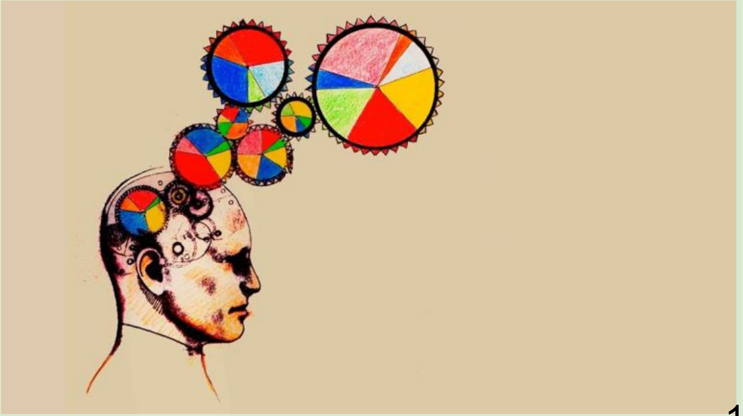
Making decision on clear thought and reason

What is the purpose of doing this?
Why am I going to do this?
How am I going to do this?

Signs of rationality:

people is **conscious** of needs and reasons of their activity

people **consciously** determines purposes and instruments for doing something

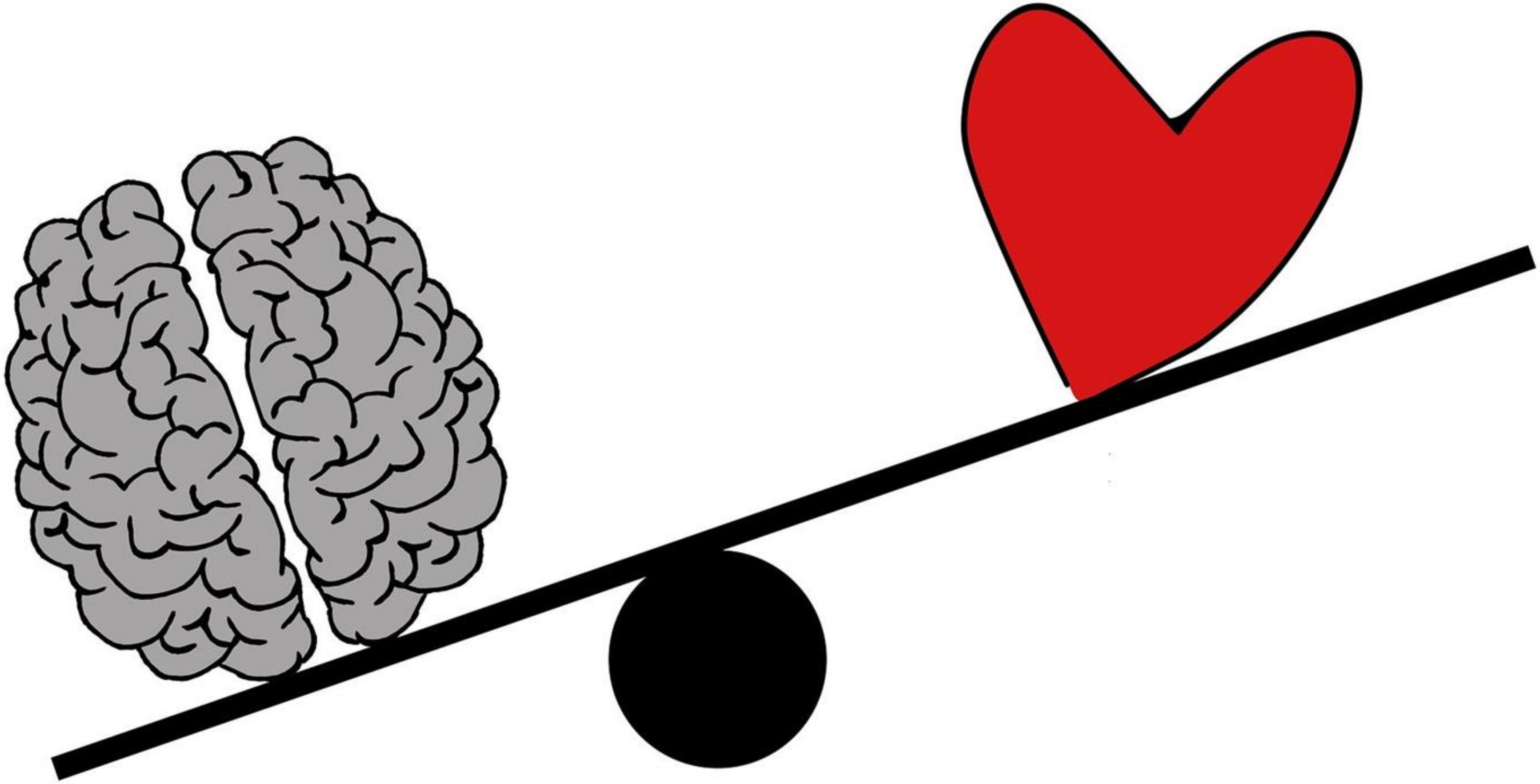


If people is able to answer these question, they act rationally.

What is rationality?

Rationality

An attraction to logical, objective and scientific methods; the endeavor to make decisions based on factual data and connections of cause and effect, and by taking into account objective feedback from others.



Traditionally, in philosophy rationality is contrasted with emotionality.

Logical positivism about the development of science

Logic: empirical facts+justification

Science develops:

linearly: theories change another one directly, in clear order

cumulatively: in a way that increases by one one addition after another

Justification: good reason or explanation of something.
Linearly: Gradually, step by step.
Cumulatively: accumulate, gather.

Science develops step by step and accumulate knowledge. What an iddlic picture!

Classical scientific rationality

Values and objectives of scientific cognition

Scientist

Problem

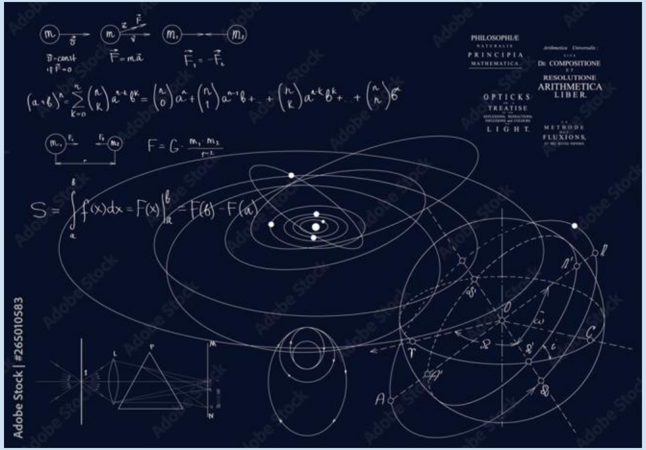
logic laws

Purpose

Collection of empirical data

Analyse and generalize of empirical data in a theory

logic laws

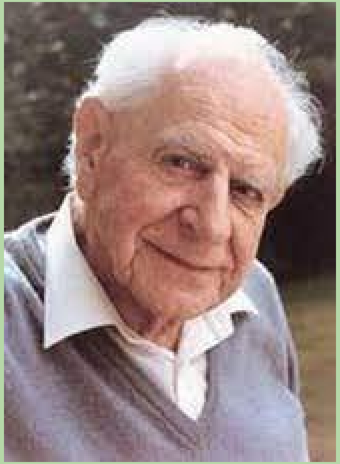


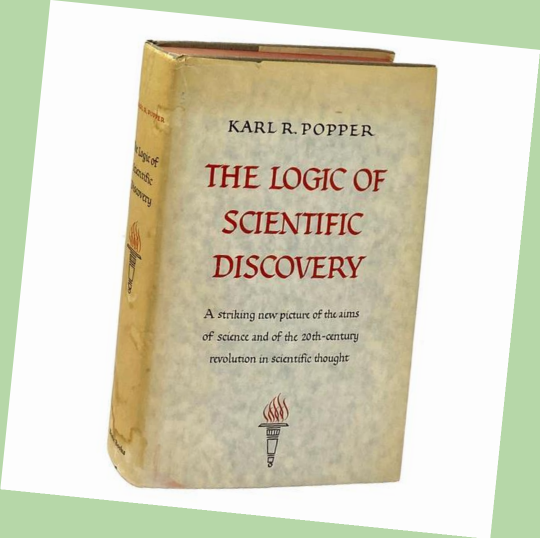
On this logical positivists' view formed vision of classical scientific rationality. This is an extremely simple scheme of scientific research. Scientist sees the problem, determine the purpose what he wants to know, collects empirical data, the way of analyzing and generalizing creates a theory. What makes an impact on the scientist from the outside? Logical positivists strongly believed that the process of scientific cognition is regulated only by logic laws. Logic laws help to organise and explain empirical data.

What did critical rationalism draw attention to?

history of science

Karl Popper





sequence!!!

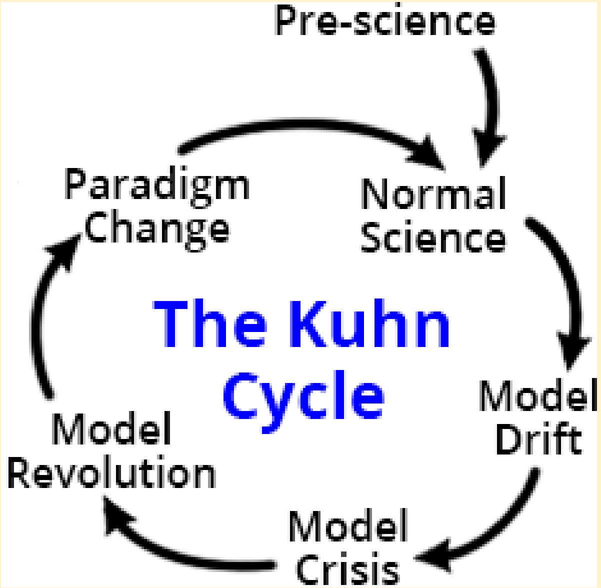
1. discovery

2. justification or explanation

Karl Popper criticized the view of logical positivists and offered the idea of critical rationalism. He paid attention to the history of science. He was interested in how scientists had made discoveries and noticed that scientists described the events as momentary illumination flash. Some of scientists first saw their discoveries in a night dream.

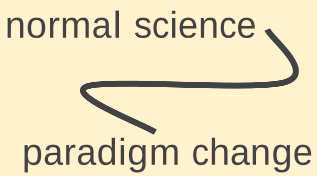
However, after that as discoveries had happened, scientists had to search for proofs and explanations to convince their colleagues. So, concluded Kuhn, certain sequence of scientific research exists and there is a some irrational part in this process. Discovery as it is is irrational. In return, justification and explanation are rational. In this regard, Kuhn wondered, what, besides logical laws, effects on scientific cognition and how science develops. In result, he put forward the theory of scientific revolutions.

Postpositivism
Theory of scientific revolutions



Development of science is not linear but **cyclic**, not cumulative but **competitive**.

The historical science cycle is divided into two key periods:



Analyzing the formal-logical structure of scientific theories, postpositivist Thomas Kuhn focused on the cases when some fundamental theory replaced another. For instance, when Ptolemaic system was changed by Copernican in astronomy. As you know, the first considers the Earth to be the center of Cosmos rotation whereas the second puts the Sun in the center of planets' rotation.

What did cause this change? There were too many mistakes and contradictions in explanations of planets' movement. Copernicus looking for a common explanation of all this phenomena and removing the center of planets' rotation on the Sun was the most suitable. This is one of the examples of a paradigm change. So, what is a paradigm?

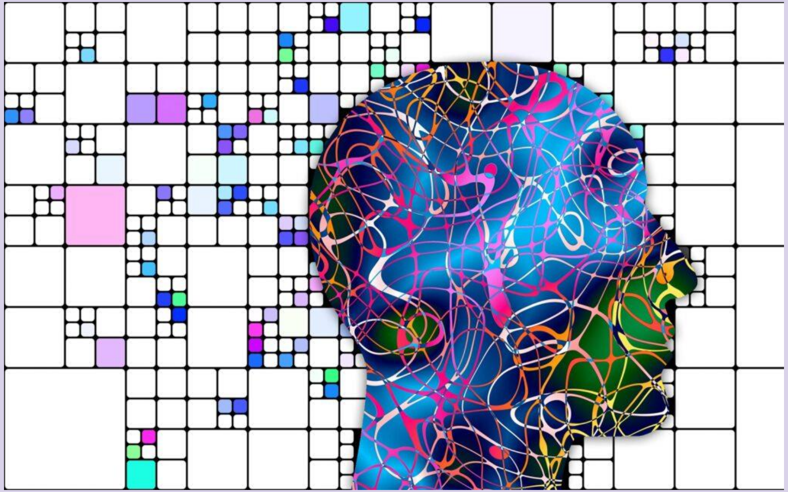
What is a paradigm?

a pattern or model

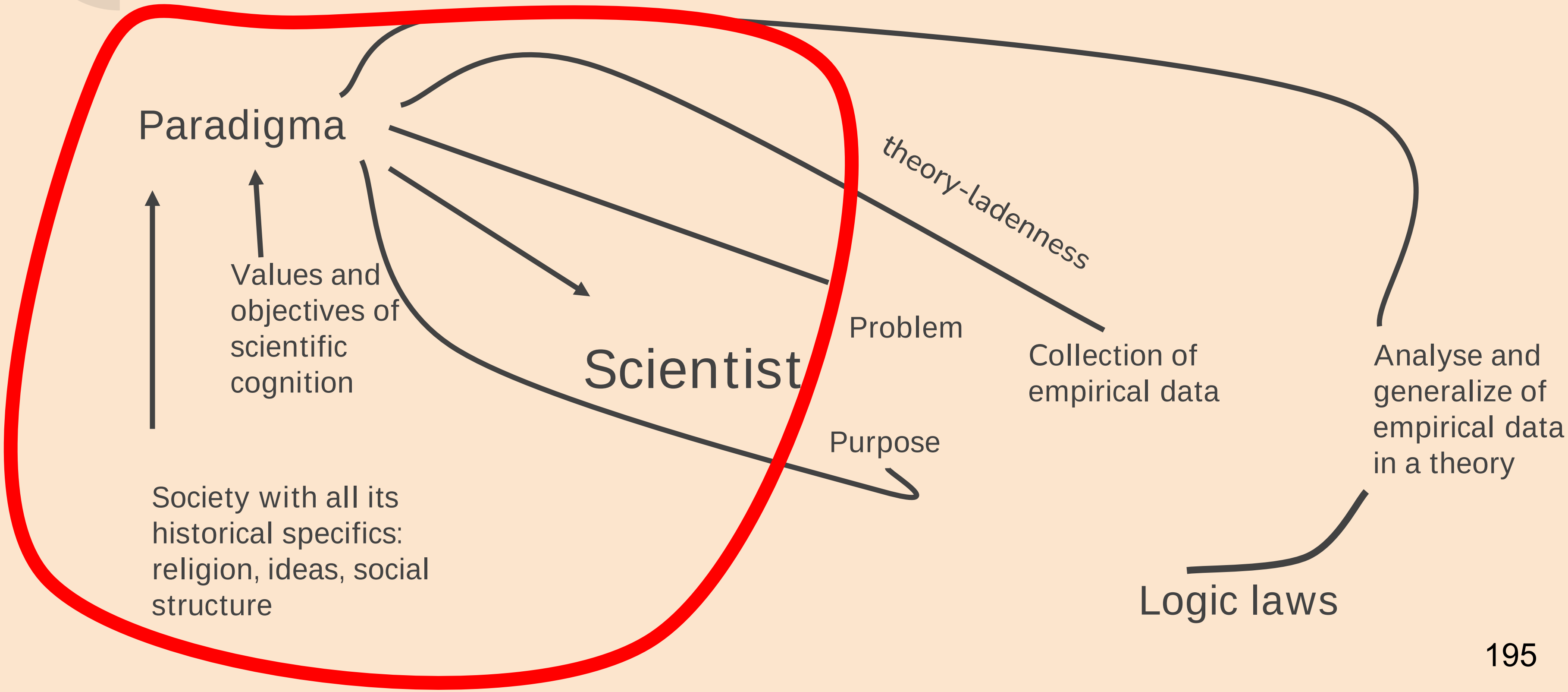
a framework containing the basic assumptions, ways of thinking, and methodology that are commonly accepted by members of a scientific community

A paradigm is **a standard, perspective, or set of ideas**. A paradigm is a way of looking at something

A framework, model, or pattern used to formulate generalizations and theories based on shared assumptions, concepts, questions, methods, practices, and values that structure inquiry



Non-classical scientific rationality



On the basis of critical rationalism and postpositivism, the vision of non-classical rationality was formed. This one includes the factor that impacts on scientists. This is a paradigm which consists of some socially and historically determined ideas, values and a concept how to pose and solve scientific problems.

Post-non-classical scientific rationality

Paradigm

society
global problems
ecology
interdisciplinarity
gender
feminist discourse

Some basic philosophical questions about scientific rationality

1. Is an account of rationality something **discovered** rather than humanly **constructed**?
2. Is a theory of rationality something that can be fixed *a priori*, or can it (must it?) be naturalized, in whole or in part, i.e., shaped by a broadly empirical mode of inquiry?
3. Is there just one, unique, **correct conception or theory of rationality**, of universal applicability?
4. Can (should) our concept of rationality be relativized to specifically human capabilities and to specific kinds of decision-action situations, or could it turn out, by some **universal standard**, perhaps realized by future artificial intelligence or by (other) aliens, that we are all terribly non-rational, scientists included?

Endless challenges

Rationality has more to do with appropriate response to change than with sticking rigidly to one's initial standpoint. This challenge strikes at the heart of traditional accounts of context of justification, hence at the heart of traditional philosophy of science.

Conclusions

What is scientific rationality?

Conscious choice of the reasons, problems, purposes and methods of scientific research

What affects scientific cognition?

historical and cultural conditions

previous scientific theories

paradigm

Has scientific rationality changed over time?

Historical types of scientific rationality

- classical
- non-classical
- post-non-classical

Recommended reading

Philosophy of Science. A Very Short Introduction. Okasha Samir. – Oxford University Press. – 2002, pp. 77-94. https://drive.google.com/file/d/1MFiKkg_Qbf8ra-mpVRDfVYw6N7izC7ES/view?usp=sharing

Worrall J., Theory-Change in Science, *The Routledge Companion to Philosophy of Science*. Edited by Stathis Psillos and Martin Curd. – Routledge, 2008. – pp. 281-291. https://drive.google.com/file/d/19P7Q-pQgQkE1wAprpU_hZt82EQ0etXcF/view?usp=sharing

Historicist Theory of Scientific Rationality https://plato.stanford.edu/entries/rationality-historicist/

LECTURE 5

Issues of Ethics in Science

Rules of activity and conduct of a scientist

What are we going to talk about today?

What is the ethics of science?

Are there ethical rules that always apply to all scientific disciplines in all societies?

What are the grounds for ethical norms in science?

Fundamental ethical norms in science

AI and research ethics

- meta-ethics
- normative ethics
- applied ethics
- theory-based approach
- casuist approach
- principle-based approach
- ethical norms

KEYWORDS

What is the ethics of science?

Scientific ethics is the standards of conduct for scientists in their professional endeavours

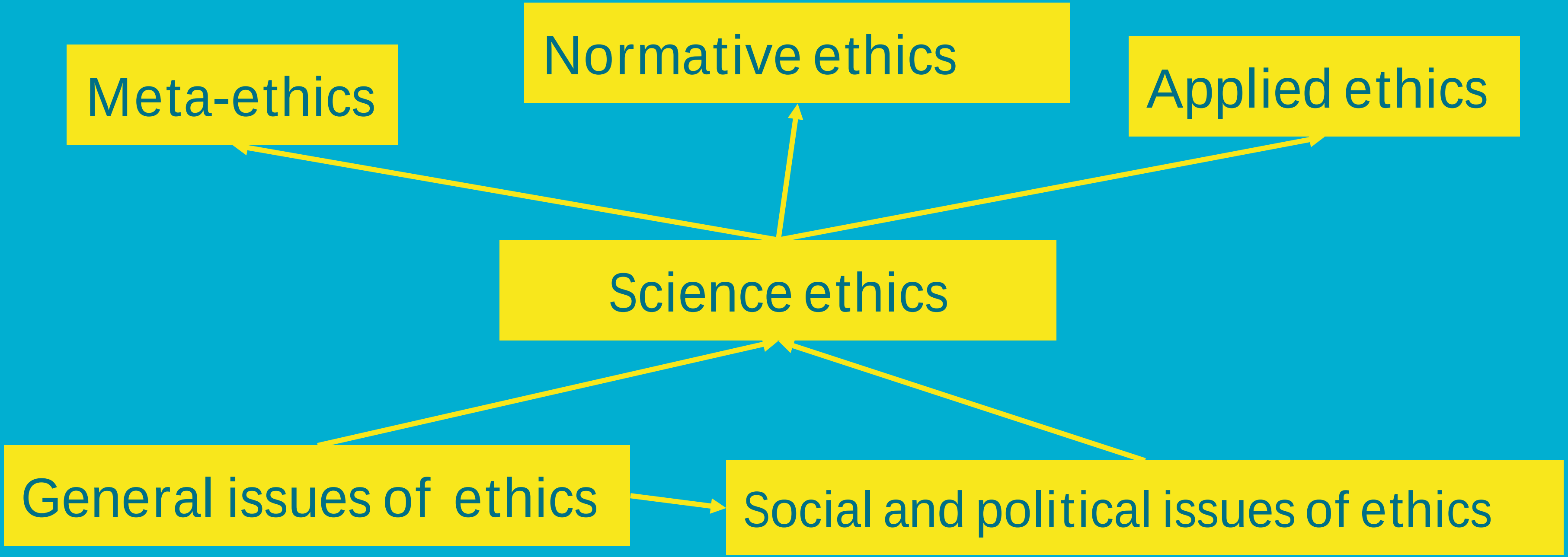
Which list describes the ethical behavior of a scientist, and which is unethical?

- falsification: the misrepresentation of results
- fabrication: reporting on work never performed
- plagiarism: taking the writings or ideas of others and representing them as your own

- valid scientific experimentation
- education
- peer review
- communication of results to the public

Scientific ethics is the standards of conduct for scientists in their professional endeavours.

How are ethical standards of science formed?



Scientific ethics is the standards of conduct for scientists in their professional endeavours. How are ethical standards of science formed? The ethical questions and issues that arise in scientific inquiry correspond to the traditional branches of ethics: meta-ethics; normative ethics; and applied ethics. Thus, the meta-ethics of science considers the meaning and justification of ethical norms in science;

the normative ethics of science addresses the theories, concepts, and principles that guide conduct in the sciences; and applied ethics of science examines specific ethical problems and dilemmas that arise in science, such as the allocation of credit, sharing data, and so on. The ethics of science also encompasses social and political issues, such as the funding of research and the intellectual property system.

The Meta-Ethics of Science

Justification - a good reason or explanation for ethical norms:

- ❖ Why is it reasonable for scientists to be honest, objective, considerable, critical-thinking self-critical, open-minded etc.?

Universality - the quality or state to be existing everywhere, or involving everyone

Are there ethical rules that always apply to all scientific disciplines in all societies?

Core (definicial) norms: honesty and objectivity; openness and freedom of inquiry etc.

Meta-ethics deals with questions concerning the foundations of ethics. Two of the central meta-ethical problems are the justification of ethical norms and the universality of ethical norms. These questions arise also in the ethics of science. Science’s ethical norms are part of the social epistemology of science and can be justified insofar as they are necessary for achieving the goals of scientific communities. These goals include seeking truth, avoiding error, explaining phenomena, and controlling nature.

Some ethical norms, such as openness, fair credit allocation, respect for colleagues, and respect for intellectual property, help to promote trust among scientists, which is vital to achieving the community's goals. Most scientists conduct research in groups ranging in size from several to hundreds to even thousands of researchers. Scientists share information, methods, tools, and resources; publish data and results; review and criticize each other's work; and educate and train future researchers.

All of these social activities require a high degree of cooperation and trust. Finally, ethical norms also promote the goals of science by helping to secure the public’s support for science.

Since scientific communities exist in larger societies, scientific norms must also answer to broader social and moral norms and rules. For example, ethical rules and guidelines pertaining to the use of human subjects in research are based on moral norms, such as beneficence, justice, and respect for persons. Dishonesty in science is unethical because it prevents scientists from achieving their goals and because it is a form of lying, which is morally wrong.

Misappropriating intellectual property is unethical in science because such conduct destroys cooperation and trust among scientists and because it is a form of theft, which is immoral. In addition to possibly violating moral norms, unethical conduct in science may also be illegal, since there are many different laws and regulations governing scientific research, including rules concerning the use of human or animal subjects, intellectual property, laboratory safety, fraud, sexual harassment, and so on.

Questions concerning the universality of science's ethical norms rehash, in some ways, traditional debates in philosophy about moral relativism. The basic problem is: are there ethical rules that apply to all scientific disciplines at all times in all societies? Questions about the universality of ethical norms in science have arisen in controversies about authorship, plagiarism, treatment of data, intellectual property, human research, and animal research.

In the middle ages, for instance, scientists knew nothing about authorship. In countries that place less weight on individual contributions, such as China and India, scientists pay less attention to accurate authorship attribution and citation.

While it seems reasonable to hold that there should be some cultural, disciplinary, and historical variation in the ethical norms in science, it does not seem reasonable to hold that that there are no ethical norms that transcend different cultures, disciplines, and historical periods. There must be some core norms (or values) common to all of the different practices that we regard as “scientific.” They are, again, honesty and objectivity; openness and freedom of inquiry so on.

Normative ethics

- theory-based approach
- casuist approach
- principle-based approach

The normative ethics of science focuses on the general norms (standards, values, or principles) that should guide scientific conduct. There are several different approaches to the normative ethics of science, which correspond to different approaches to normative ethics. According to the top–down (or theory-based) approach, general ethical theories, such as utilitarianism, Kantianism, natural rights, or virtue ethics, should guide scientific conduct.

According to the bottom–up (or casuist) approach, precedents set by different cases should guide scientific conduct. According to the mid-level (or principle-based) approach, ethical values, such as honesty, social responsibility, and the like, should guide scientific conduct. In our case the principle-based approach offers the best account of the normative ethics of science.

Scientific norms should provide researchers with guidance concerning particular decisions and actions. Theories are not well-suited to that task. Scientific norms should provide researchers with a consistent, coherent framework that they can use in accounting for their conduct. Casuistry is not well-suited to this task, because it does not develop general rules or principles. A list of ethical norms that should guide scientific reasoning and conduct is included in the following slides.

Honesty

Scientists should practice honesty in research and publication, and in their interactions with peers, research sponsors, oversight agencies and the public

As noted earlier, this norm helps to promote the goals of science and is supported by broader moral norms. Dishonesty in science may also violate laws or regulations. Legal prohibitions against data fabrication and falsification are based on the scientific commitment to honesty.

Scientists should strive for objectivity in research and publication, and in their interactions with peers, research sponsors, oversight agencies, and the public

Objectivity*

*Objectivity - the fact of being based on facts and not influenced by personal beliefs or feelings

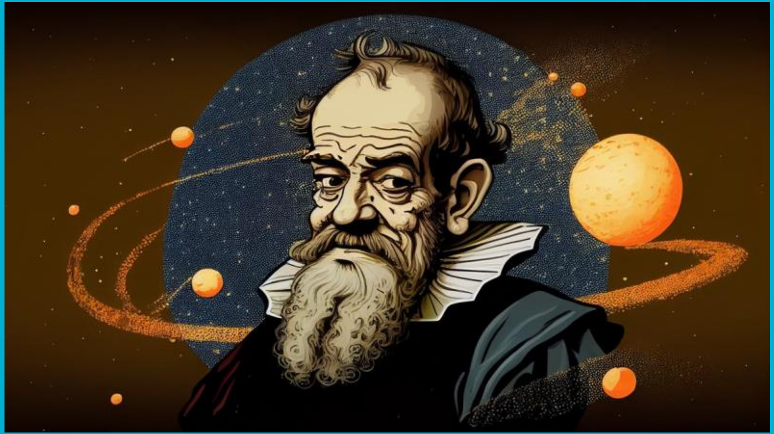
If one assumes that truth and knowledge are objective, then this norm also helps to promote science's epistemic goals of truthfulness and error-avoidance. Strategies and methods designed to minimize bias and error in research, such as good record-keeping practices, the peer review system, replication of results, and conflict of interest rules, are based on a commitment to objectivity. Scientists also have an obligation to strive for objectivity when giving expert testimony in court, or when serving on government panels and committees.

Openness

Scientists should share data, results, ideas, methods, tools, techniques and resources.

As noted earlier, science is a social activity that involves cooperation and trust. It is important, therefore, for scientists to share with one another. To paraphrase Isaac Newton, all scientists stand on the shoulders of giants. Openness is vital to publication, peer review, replication, and other strategies and methods that promote objectivity. Even though openness is a very important norm in scientific research, it sometimes conflicts with legitimate demands for secrecy and confidentiality.

For example, researchers are justified in not sharing unpublished data and results in order to protect their claims to priority or intellectual property and their work from premature dissemination. Secrecy is also justified in peer review, personnel decisions, research on human subjects, and in research sponsored by the military or private industry.



Freedom

Scientists should be free to conduct research without political or religious intimidation, coercion, or censorship

Limits:

- ❑ a right to free inquiry is not a right to receive funding
- ❑ a right to free inquiry is not a right to violate laws

This norm applies to institutions and organizations that support and oversee science, as well as the political systems in the countries where science is conducted. Freedom is vital to innovation, discovery, and criticism in science, since scientists need to be free to develop or pursue new ideas and to question old ones.

For hundreds of years, scientists have had to defend their intellectual freedom against opponents. In the seventeenth century, the Inquisition put Galileo Galilei under house arrest for disobeying the Roman Catholic Church’s demand that he recant his contention that the earth is not the center of the universe.

In the seventeenth century, the Inquisition put Galileo Galilei under house arrest for disobeying the Roman Catholic Church’s demand that he recant his contention that the earth is not the center of the universe. In the twentieth century, the Soviet Union punished, intimidated, suppressed, and exiled biologists who did not agree with Lysenkoism, a biological theory endorsed by the communist regime. Although freedom of inquiry is crucial to science, there are some limits to the extent of such freedom.

First, a right to free inquiry is not a right to receive funding. Research sponsors, such as private corporations and governments, can decide how best to invest their research and development (R&D) budgets. In making R&D funding decisions, corporations have an obligation to earn profits for the company and its shareholders; and in deciding how to allocate R&D funds, government agencies have an obligation to promote the public good.

Second, a right to free inquiry is not a right to violate laws, rules, or regulations designed to protect human or animal research subjects, intellectual property, the public health, national security, or other important social goods.

Fair credit* allocation

Scientists should give credit, but only where credit is due

*credit - praise, approval, or honor

This principle is important in promoting scientific collaboration and cooperation, since people who work together on a project or publication deserve to receive credit for their contributions. People who publish their research also want to be cited properly when others use their findings. Prohibitions against plagiarism, and rules pertaining to scientific authorship reflect science’s commitment to fair credit allocation.

Although disputes about credit allocation do not seem to have as much moral significance as debates about respecting human or animal subjects, they mean a great deal to scientists. Publication, priority, and citation are the coinage of science. Indeed, there is evidence that a large percentage of the ethical disputes in science involve controversies about credit allocation.

Respect for colleagues

Scientists should treat their peers, subordinates, students, and supervisors with respect.

This norm is important for building and maintaining cooperation and trust among scientists, and is supported by the moral requirement to respect persons. It implies ethical duties to refrain from engaging in practices that show disrespect for colleagues, such as sexual and non-sexual harassment, discrimination, abuse, and exploitation.

Respect for property

Scientists should respect physical and intellectual property belonging to individuals, institutions, and organizations

This norm is also important in building and maintaining cooperation and trust in scientific research, and promotes collaboration among researchers and among institutions and organizations that support research. People are less likely to share their property when they believe that it may be damaged, destroyed, or stolen. Physical properties in research include such items as cell and tissue samples, reagents, organisms, scientific instruments, and computer technology. Intellectual properties include data, patented inventions, and copyrighted original works.

Respect for laws

Scientists should comply with the laws, regulations, policies, and guidelines that pertain to their work

There are many different laws that govern scientific research, including government rules and regulations, institutional and organizational policies, and professional guidelines and codes. Compliance with those rules is important in securing public support for science and in promoting trust among scientists and research institutions and organizations.

Additionally, scientists have a moral obligation to obey laws because laws protect people from harm and promote social stability. Laws and other rules govern many areas of research, such as experimentation on human or animal subjects, laboratory practices, radiation safety, conflict of interest, harassment, discrimination, controlled substances, restricted biological agents, technology transfer, record-keeping, management of funds, fraud, and intellectual property.

Even though scientists have an obligation to adhere to laws and other rules that govern their work, they have a right to protest or deliberately violate laws they believe to be immoral, unjust, or antithetical to scientific progress. Conscientious objection sometimes has a place in scientific research.

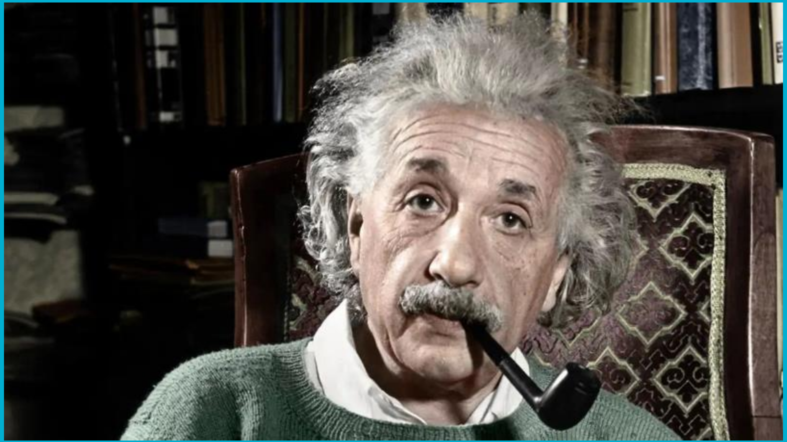
For example, during the sixteenth century, it was illegal in many European countries to dissect the human body, but Andreas Vesalius disobeyed such laws in order to advance the study of human anatomy. One might argue that Vesalius was justified in violating the law because it placed unethical restrictions on human freedom and stifled progress in research on human anatomy.

Stewardship of research resources

Scientists should take appropriate care of physical, human, technological, and financial resources used in research

Scientists make use of many resources in conducting research, including equipment and tools; money and investments; laboratories, rooms, and buildings; samples and specimens; geographical sites and regions; and human communities. Stewardship of resources is important to help advance the goals of science and to promote public support for scientific endeavor.

For example, in studying the remains of an ancient city, it is important for archeologists to avoid damaging the site, so that other researchers may also study it. If scientists mismanage or waste DAVID B. RESNIK 156 public funds, then the public will be less inclined to trust them with public money in the future.



Social responsibility

Scientists engage in activities that enhance or promote social goods, such as human health, public safety, education, agriculture, transportation, and scientists therefore should strive to avoid harm to individuals and society.

There are many different ways that scientists can fulfill their social responsibilities, such as: testifying in legal proceedings or government hearings; educating the public about science; promoting science education in elementary, high school, and college education; warning government agencies and the public about dangerous substances, activities, or conditions; and conducting research which benefits the public.

Some of the most significant events in the history of modern science have involved researchers exercising what they regarded as their responsibilities to society. For instance, during the Second World War, Albert Einstein wrote to President Franklin Roosevelt urging him to develop the atomic bomb before Nazi Germany would be able to develop the weapon.

After the war, many scientists who were involved in the effort to develop atomic weapons turned their attention to preventing the spread of nuclear weapons and promoting peaceful uses of nuclear power.

First, like other people in society, scientists have a moral duty to benefit others and avoid doing harm. Second, since scientists receive a great deal of public support through their careers, they have an obligation to repay society for its investment in their education and research. Third, socially responsible science helps to promote public support: people will be less inclined to fund science if they regard researchers as socially irresponsible, “mad scientists.”

Human treatment of animal subject

Principles of the animal treatment in science:

- ➢ reduction
- ➢ replacement
- ➢ refinement

Scientists should protect and promote the welfare of animals used in research

Although many people have voiced moral objections to using animals in research, there is little doubt that animals make important contributions to our understanding of biology and human health. There are three principles pertaining to the humane treatment of animals in research: reduction (whenever feasible, one should reduce the total number of animals used in research); replacement (whenever feasible, one should replace animal subjects with, for example, animal tissues or cells); and refinement (one should refine experimental techniques to minimize pain and distress in animals).

Respect for human subjects

Scientists should respect the rights of human subjects and protect them from harm and exploitation

Ethical principles relate to respect for human subjects in research:

- ❖ informed consent
- ❖ beneficence
- ❖ privacy
- ❖ justice
- ❖ scientific validity

There are many different ways that scientists can fulfill their social responsibilities, such as: testifying in legal proceedings or government hearings; educating the public about science; promoting science education in elementary, high school, and college education; warning government agencies and the public about dangerous substances, activities, or conditions;

and conducting research which benefits the Human subjects participate in many types of research, ranging from psychological studies of human cognition, emotion, and behavior, to social and anthropological studies of human societies, to biomedical studies of treatments for human diseases.

The reasons for treating human subjects with respect are familiar and obvious. First, scientists, like in the rest of society, have obligations to refrain from violating the rights of other people or harming or exploiting them. Second, respect for human subjects helps to promote public support for science, since most people will disapprove of research that violates human rights or harms or exploits people.

A range of ethical principles related to respect ~~for~~ human subjects in research:

- informed consent (human subjects should not be used in research without their informed consent or the consent of their legal representatives);

- beneficence (researchers should promote the welfare of human subjects and implement procedures designed to minimize harm to human subjects);

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A range of ethical principles related to respect ~~for~~ human subjects in research:

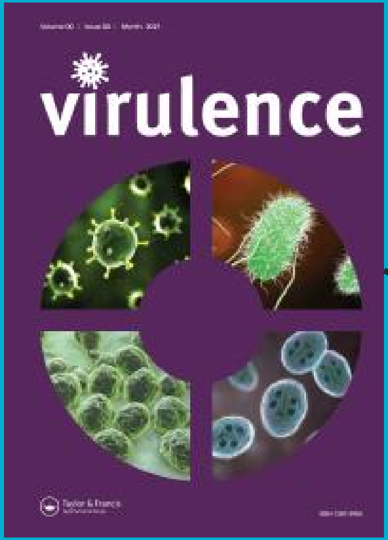
- justice (researchers distribute the benefits and burdens of research fairly and should select subjects equitably);

- scientific validity (researchers should not enroll human subjects in experiments that are poorly designed and are unlikely to yield scientifically useful results).

Ethical contradictions in scientific activity

The norms may sometimes conflict with each other or with various regulations, laws, or policies

Openness?



Social responsibility?

terrorists

The norms should be understood as entailing prima facie obligations. The "prima facie" circumstance is directly related to placing the burden of proof from the side of the plaintiff to the side of the defendant. The norms (or principles) are rules of thumb, rather than exceptionless rules. The norms may sometimes conflict with each other or with various regulations, laws, or policies. When conflicts arise, scientists must decide which norm, regulation, law, or policy to follow.

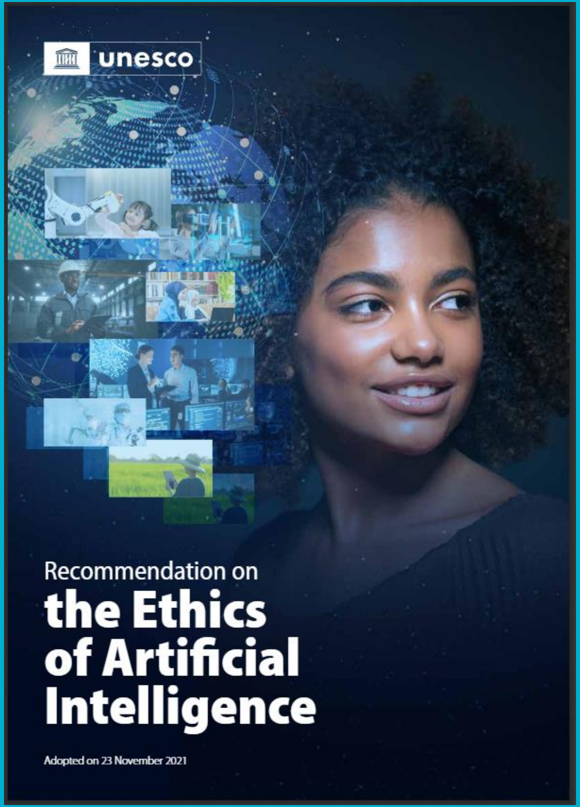
For example, openness may conflict with social responsibility if sharing information can cause significant harms to society. Thus, if a researcher develops a method for modifying a common virus to make it increase its virulence, he or she might decide against publishing the research out of concern that the information could be used by terrorists to make a bioweapon.

If a scientist has signed a contract with a company that requires her to not divulge the company’s confidential information, and she discovers that the company is keeping important information from the scientific community concerning the hazards of a drug manufactured by the company, then she must decide whether to adhere to the requirements of the contract or to fulfill her social responsibilities by disclosing that confidential information.

To decide on the best course of action to take when conflicts arise, scientists must carefully weigh and balance different norms, rules, and policies in light of the relevant facts.

Ethical Issues Related to Artificial Intelligence

UNESCO recommends:



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POLICY AREA 8: EDUCATION AND RESEARCH

101. Member States should work with international organizations, educational institutions and private and non-governmental entities to provide adequate AI literacy education to the public on all levels in all countries in order to empower people and reduce the digital divides and digital access inequalities resulting from the wide adoption of AI systems.

102. Member States should promote the acquisition of "prerequisite skills" for AI education, such as basic literacy, numeracy, coding and digital skills, and media and information literacy, as well as critical and creative thinking, teamwork, communication, socio-emotional and AI ethics skills, especially in countries and in regions or areas within countries where there are notable gaps in the education of these skills.

103. Member States should promote general awareness programmes about AI developments, including on data and the opportunities and challenges brought about by AI technologies, the impact of AI systems on human rights and their implications, including children's rights. These programmes should be accessible to non-technical as well as technical groups.

104. Member States should encourage research initiatives on the responsible and ethical use of AI technologies in teaching, teacher training and e-learning, among other issues, to enhance opportunities and mitigate the challenges and risks involved in this area. The initiatives should be accompanied by an adequate assessment of the quality of education and impact on students and teachers of the use of AI technologies. Member States should also ensure that AI technologies empower students and teachers and enhance their experience, bearing in mind that relational and social aspects and the value of traditional forms of education are vital in teacher-student and student-student relationships and should be considered when discussing the adoption of AI technologies in education. AI systems used in learning should be subject to strict requirements when it comes to the monitoring, assessment of abilities, or prediction of the learners' behaviours. AI should support the learning process without reducing cognitive abilities and without extracting sensitive information, in compliance with relevant personal data protection standards. The data handed over to acquire knowledge collected during the learner's interactions with the AI system must not be subject to misuse, misappropriation or criminal exploitation, including for commercial purposes.

105. Member States should promote the participation and leadership of girls and women, diverse ethnicities and cultures, persons with disabilities, marginalized and vulnerable people or people in vulnerable situations, minorities and all persons not enjoying the full benefits of digital inclusion, in AI education programmes at all levels, as well as the monitoring and sharing of best practices in this regard with other Member States.

106. Member States should develop, in accordance with their national education programmes and traditions, AI ethics curricula for all levels, and promote cross-collaboration between AI technical skills education and humanistic, ethical and social aspects of AI education. Online courses and digital resources of AI ethics education should be developed in local languages, including indigenous languages, and take into account the diversity of environments, especially ensuring accessibility of formats for persons with disabilities.

107. Member States should promote and support AI research, notably AI ethics research, including for example through investing in such research or by creating incentives for the public and private sectors to invest in this area, recognizing that research contributes significantly to the further development and improvement of AI technologies with a view to promoting international law and the values and principles set forth in this Recommendation. Member States should also publicly promote the best practices of, and cooperation with, researchers and companies who develop AI in an ethical manner.

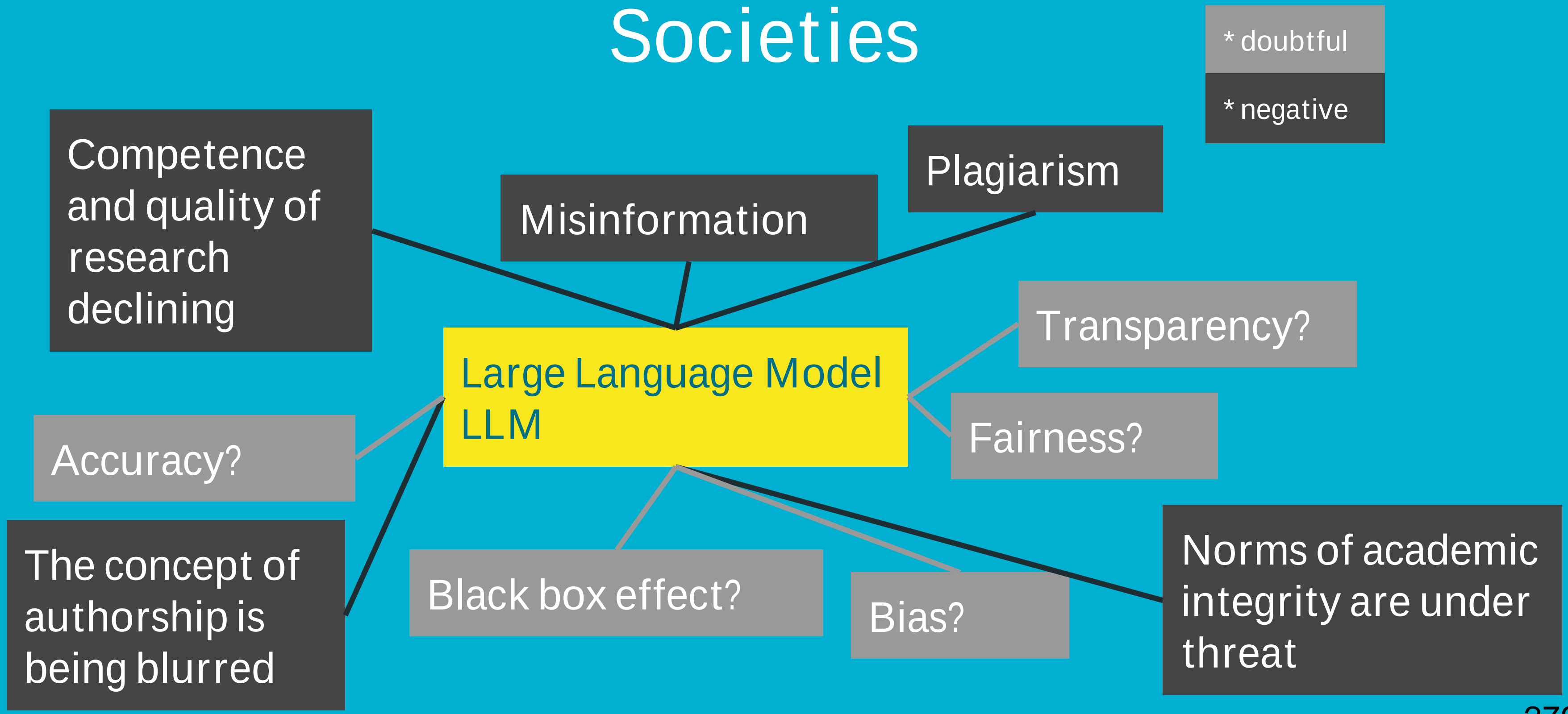
108. Member States should ensure that AI researchers are trained in research ethics and require them to include ethical considerations in their designs, products and publications, especially in the analyses of the datasets they use, how they are annotated, and the quality and scope of the results with possible applications.

109. Member States should encourage private sector companies to facilitate the access of the scientific community to their data for research, especially in LMICs, in particular LDCs, LLDCs and SIDS. This access should conform to relevant privacy and data protection standards.

110. To ensure a critical evaluation of AI research and proper monitoring of potential misuses or adverse effects, Member States should ensure that any future developments with regards to AI technologies should be based on rigorous and independent scientific research, and promote interdisciplinary AI research by including disciplines other than science, technology, engineering and mathematics (STEM), such as cultural studies, education, ethics, international relations, law, linguistics, philosophy, political science, sociology and psychology.

111. Recognizing that AI technologies present great opportunities to help advance scientific knowledge and practice, especially in traditionally model-driven disciplines, Member States should encourage scientific communities to be aware of the benefits, limits and risks of their use; this includes attempting to ensure that conclusions drawn from data-driven approaches, models and treatments are robust and sound. Furthermore, Member States should welcome and support the role of the scientific community in contributing to policy and in cultivating awareness of the strengths and weaknesses of AI technologies.

Challenges of AI for Academic and Research Societies



https://blog.mdpi.com/2024/02/01/ethical-considerations-artificial-intelligence/

Conclusions

What have we learned about scientific ethics?

- Scientific ethics is the standards of conduct for scientists in their professional endeavours
- There are three levels of justifying of ethical norms: meta-ethics, normative ethics, applied ethics
- There are some core (universal) ethical norms in science: honesty, objectivity, openness, and freedom
- Conflict is possible between ethical norms in science
- AI brings threats for quality of education and research

Recommended reading

Resnic D.B., Ethics of Science, *The Routledge Companion to Philosophy of Science*. Edited by Stathis Psillos and Martin Curd. – Routledge, 2008. – pp. 149-159. https://drive.google.com/file/d/19P7Q-pQgQkE1wAprpU_hZt82EQ0etXcF/view?usp=sharing

Kelly N., Artificial Intelligence: Ethical Considerations In Academia, https://blog.mdpi.com/2024/02/01/ethical-considerations-artificial-intelligence/

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LECTURE 6

RESEARCH ETHICS' ISSUES RELATED TO ARTIFICIAL INTELLIGENCE

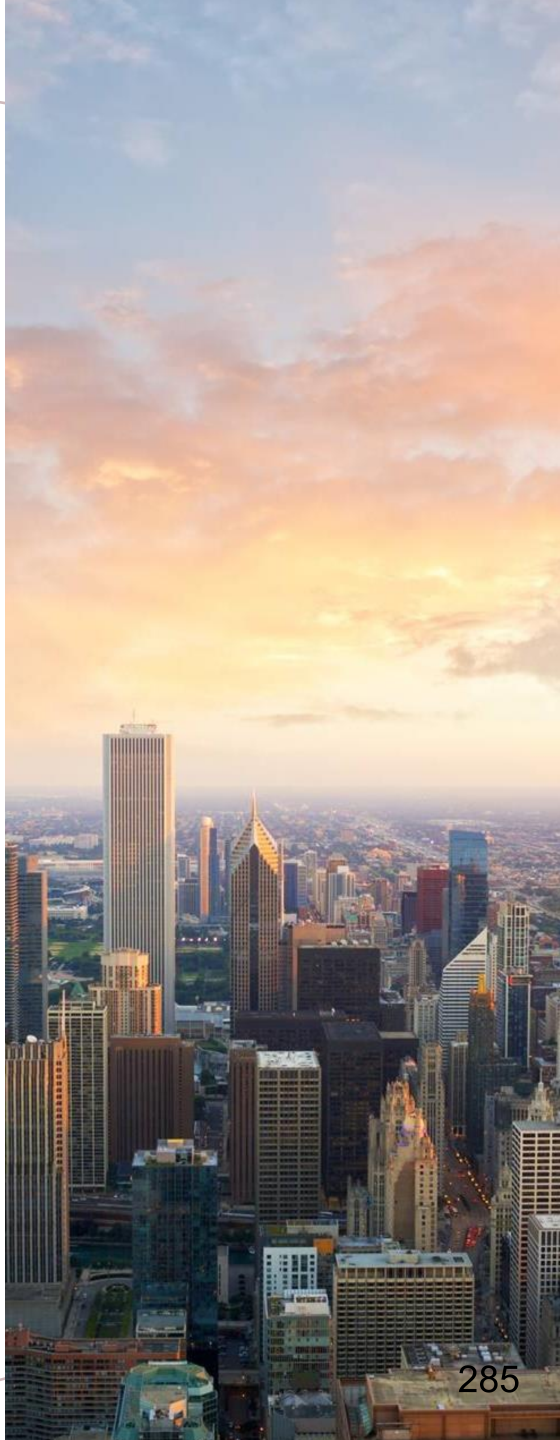
Treatment of human subject in research

Ethical contradictions in scientific activity

Challenges of AI for academic and research societies

UNESCO's recommendations on the ethics of AI

Conclusions



WHAT NORMS OF RESEARCH AND ACADEMIC ETHICS ARE PROBLEMATIZED BY AI?

RESEARCH ETHICS' BASE NORMS

- Honesty
- Objectivity
- Transparency
- Freedom
- Social & personal responsibility
- Fair credit allocation
- Respect for laws
- Respect for human subjects

RECOMMENDED READING

Resnic D.B., Ethics of Science, *The Routledge Companion to Philosophy of Science*. Edited by Stathis Psillos and Martin Curd. – Routledge, 2008. – pp. 149-159. https://drive.google.com/file/d/19P7Q-pQgQkE1wAprpU_hZt82EQ0etXcF/view?usp=sharing

Bouhouita-Guermech S, Gogognon P and Bélisle-Pipon J-C (2023) Specific challenges posed by artificial intelligence in research ethics. Front. Artif. Intell. 6:1149082. doi: 10.3389/frai.2023.1149082

Kelly N., Artificial Intelligence: Ethical Considerations In Academia, https://blog.mdpi.com/2024/02/01/ethical-considerations-artificial-intelligence/

UNESCO. Recommendations on the Ethics of Artificial Intelligence. Adopted on 23 November 2021, p. 33-35, unesdoc.unesco.org/in/rest/annotationSVC/DownloadWatermarkedAttachment/attach_import_e86c4b5d-5af9-4e15-be60-82f1a09956fd?_=381137eng.pdf&to=44&from=1

SPECIFIC WORDS

Black-box effect

Explainability

Validity

Responsibility

Biased algorithms

Risk of error

Informed consent

Risk-benefit ratio

Privacy

Scientific validity

Research ethics board

Moral agent

Rights

Ethical contradiction

Power hierarchy

Research ethic board

It reviews all research that involves humans (including living individuals, human biological materials and information from or about humans) to ensure that it meets the highest ethical standards, and that the greatest protection is provided to research participants.

TREATMENT OF HUMAN SUBJECT IN RESEARCH

Respect for human subjects

Scientists should respect the rights of human subjects and protect them from harm and exploitation

Ethical principles relate to respect for human subjects in research:

- *informed consent*
- *beneficence (risk-benefit ratio)*
- *privacy*
- *justice*
- *scientific validity*

Human subjects participate in many types of research, ranging from psychological studies of human cognition, emotion, and behavior, to social and anthropological studies of human societies, to biomedical studies of treatments for human diseases. The reasons for treating human subjects with respect are familiar and obvious. First, scientists, like in the rest of society, have obligations to refrain from violating the rights of other people or harming or exploiting them. Second, respect for human subjects helps to promote public support for science, since most people will disapprove of research that violates human rights or harms or exploits people. A range of ethical principles related to respect for human subjects in research:

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- justice (researchers distribute the benefits and burdens of research fairly and should select subjects equitably);
- scientific validity (researchers should not enroll human subjects in experiments that are poorly designed and are unlikely to yield scientifically useful results).

INFORMED CONSENT

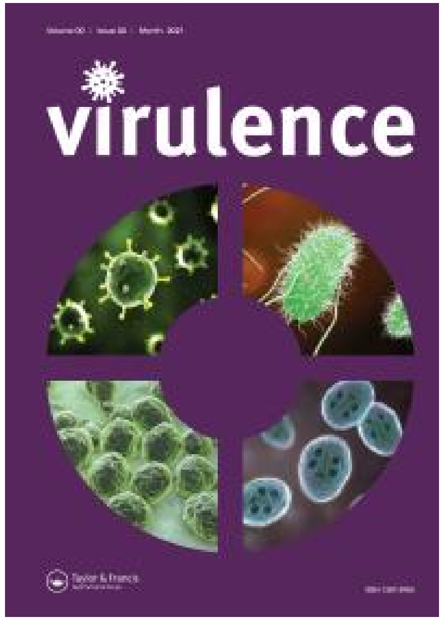
- Information disclosure
- Comprehension
- Voluntariness
- Capacity
- Ensured validity of research

Research ethics board

ETHICAL CONTRADICTIONS IN SCIENTIFIC ACTIVITY

The norms may sometimes conflict with each other or with various regulations, laws, or policies

Transparency? →



← Social responsibility?

↓

terrorists

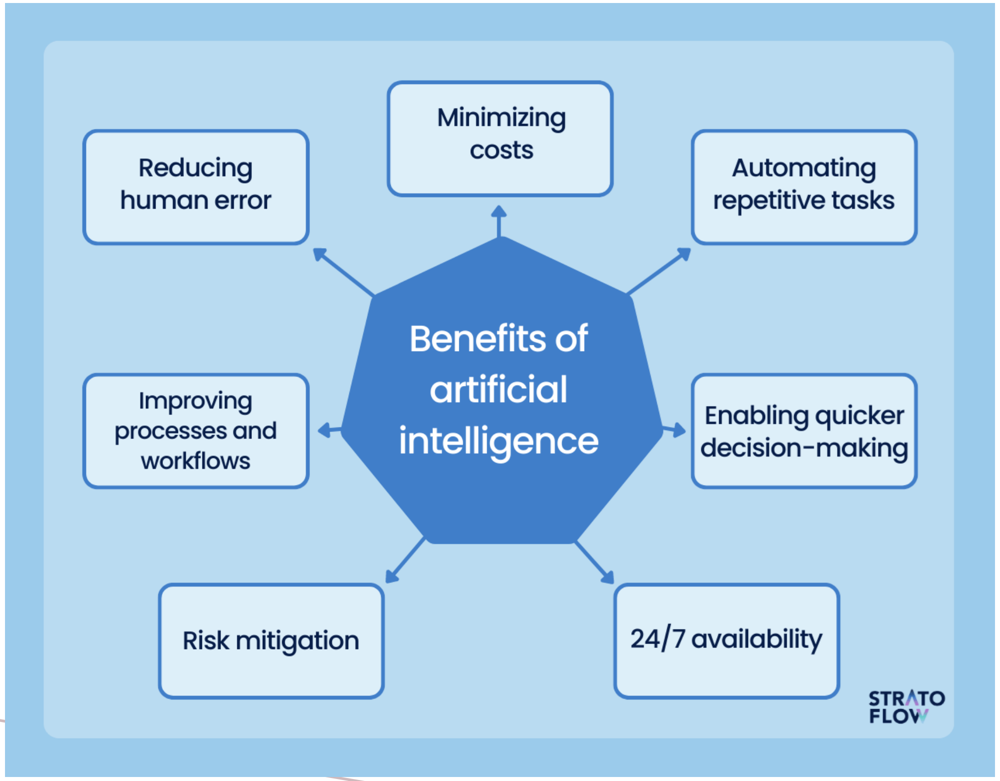
The norms should be understood as entailing prima facie obligations. The **"prima facie" circumstance** is directly related to placing the burden of proof from the side of the plaintiff to the side of the defendant. The norms (or principles) are rules of thumb, rather than exceptionless rules. The norms may sometimes conflict with each other or with various regulations, laws, or policies. When conflicts arise, scientists must decide which norm, regulation, law, or policy to follow. For example, openness may conflict with social responsibility if sharing information can cause significant harms to society.

Thus, if a researcher develops a method for modifying a common virus to make it increase its virulence, he or she might decide against publishing the research out of concern that the information could be used by terrorists to make a bioweapon. If a scientist has signed a contract with a company that requires her to not divulge the company’s confidential information, and she discovers that the company is keeping important information from the scientific community concerning the hazards of a drug manufactured by the company, then she must decide whether to adhere to the requirements of the contract or to fulfill her social responsibilities by disclosing that confidential information. To decide on the best course of action to take when conflicts arise, scientists must carefully weigh and balance different norms, rules, and policies in the light of the relevant facts.

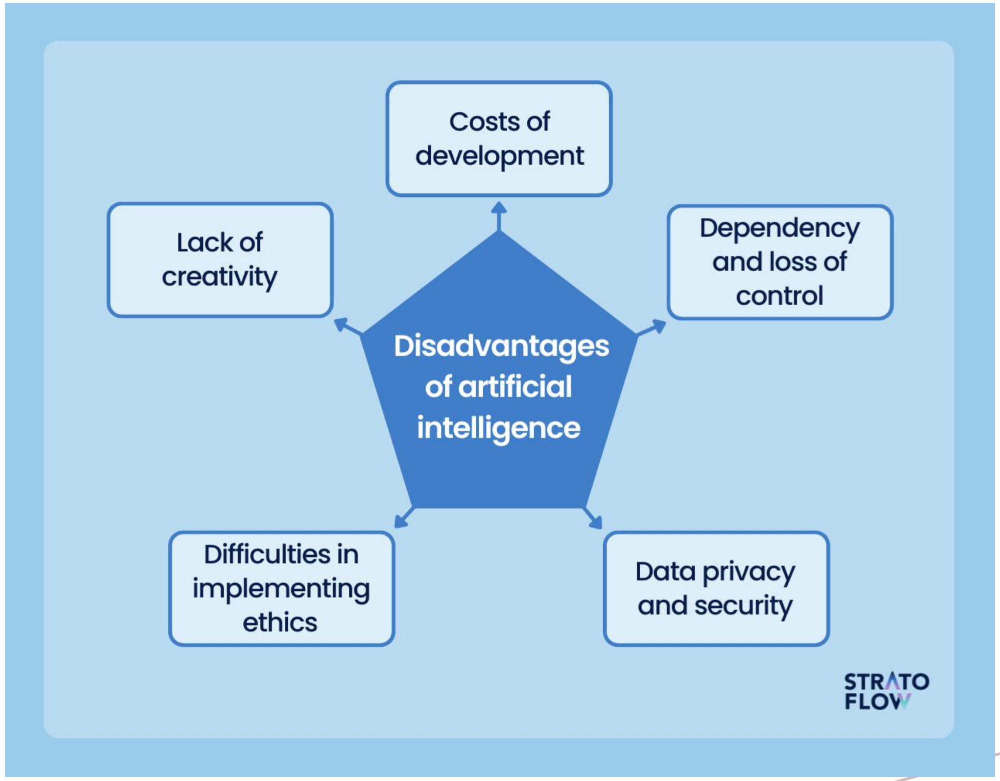
CHALLENGES OF ARTIFICIAL INTELLIGENCE FOR RESEARCH AND ACADEMIC SOCIETIES

PROS & CONS OF AI IN GENERAL

BENEFITS OF AI



BACKWARDS OF AI



Data bias, the black-box effect

GENERAL ETHICAL ISSUES OF AI

- Responsibility
- Data bias
- The black-box effect
- Privacy at risk

RESEARCH ETHICS AND AI: FUNDAMENTAL PROBLEMS

- Responsibility - AI’s moral status and rights?
- Data bias – honesty, objectivity?
- The black-box effect – transparency, explainability and validity?
- The black-box effect - informed consent, privacy?

AI'S MORAL STATUS & RIGHTS

AI is not capable of:

- Solving problems ethically: to distinguish good and evil
- Delivering explanation of generated results
- Making choices & being responsible

AI & robots don't have a moral agency

However:

Research ethics attributes rights to animals as sentient living organisms & unique tangible goods

Questions:

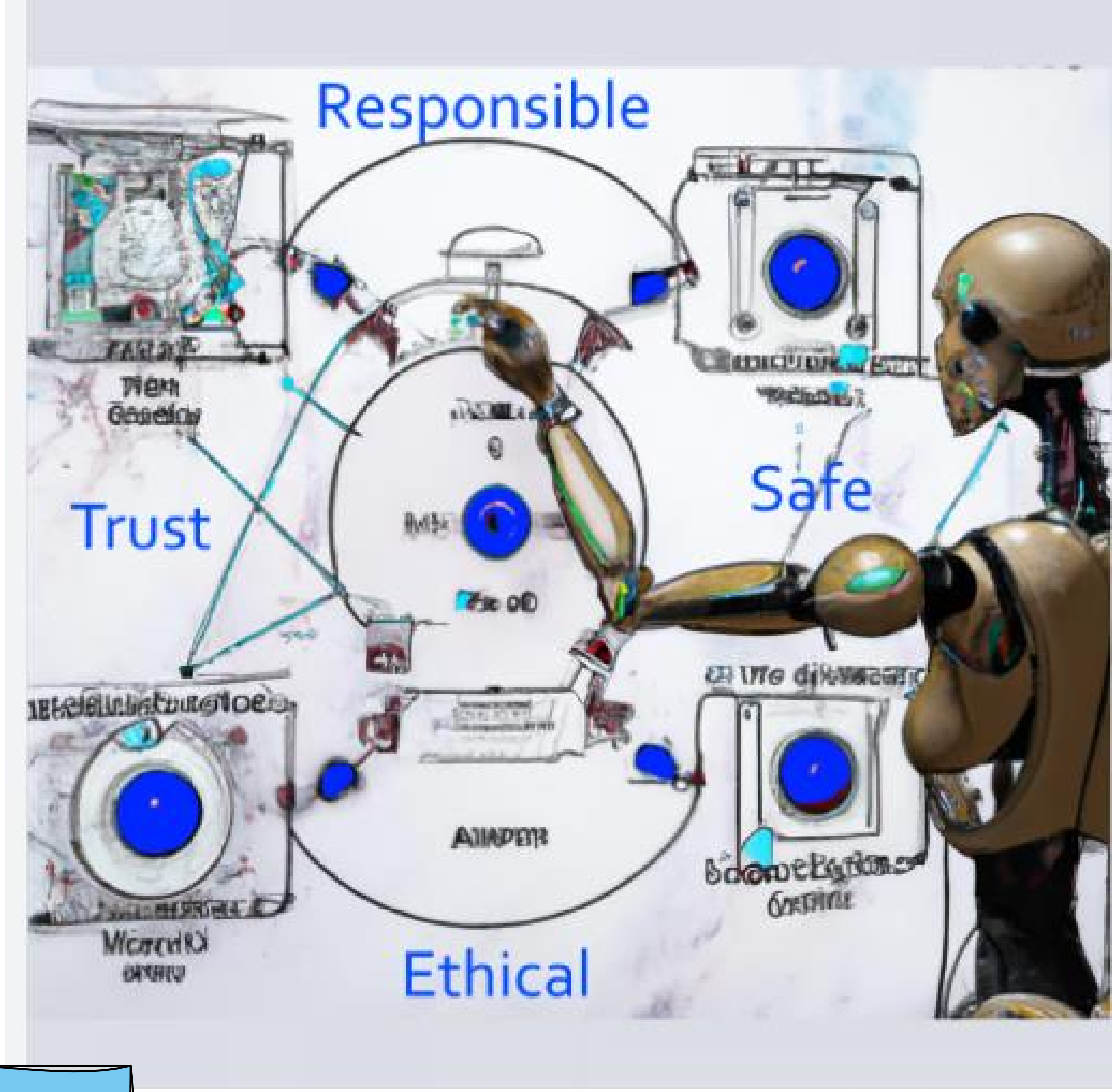
What rights does AI have on human-machine relationships?

What should be the power hierarchy of human-machine relationships?

Research ethics boards needs certainty

WHOSE RESPONSIBILITY?

- **Digital mental health apps** and other institutions will now be attributed responsibilities that have usually been acclaimed to professionals or researchers using the technology
- Scientists and AI developers must not throw caution to the wind regarding **the possibility that biased algorithms** could be fed to AI models
- Clinicians will have to tactfully manage to inform patients of the results **generated by machine learning (ML) models** while considering their risk of error and bias



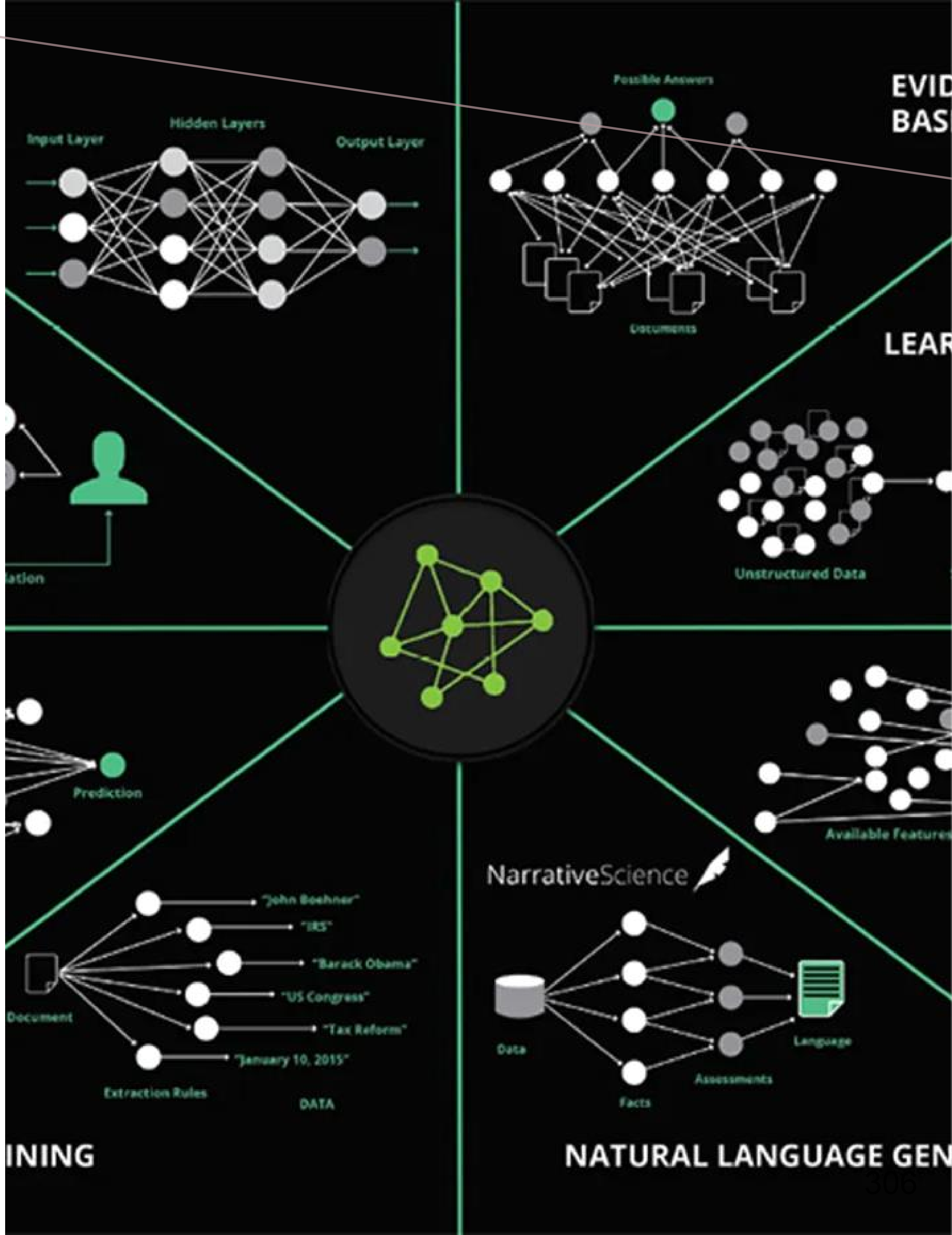
Focuses of responsibility are shifting

EXPLAINABILITY & VALIDITY

The black-box effect

Machine learning and deep learning with **more extensive algorithms** that encloses data with a broader array of interpretations. **This makes it harder to explain how a particular conclusion was reached**. This poses transparency issues that are challenging to participants. Since AI is known for its ‘black-box' aspect, where results are difficult to justify, **it is difficult to fully validate** a model with certainty

The problems of explainability & validity are becoming rather difficult



TRANSPARENCY & INFORMED CONSENT

AI models produce a great deal of data that does not always come from consenting users → Sometimes it is impossible to obtain informed consent from all targeted audience

The lack of explainability of AI-generated results might not allow participants to have enough information to give out their informed consent → It is necessary to create consent forms easily comprehensible for the targeted audience

Required authorization for all data might effect in data bias and a decrease in data quality because it only entices a specific group to give out consent which leaves a significant part of the population out → The requirement to obtain informed consent for all data from AI databases may lead to a loss of credibility of the obtained research results

Informed consent & AI: impossible? Adverse?

PRIVACY

Data are attractive commodities

Risk increases with data increase

Researchers are responsible for keeping participants unidentifiable while using their data

Data protection

Dichotomy between safeguarding participants' data and making scientific advancements

Gooding, P., and Kariotis, T. (2021). Ethics and law in research on algorithmic and data-driven technology in mental health care: scoping review. JMIR Ment. Health 8, e24668. doi: 10.2196/24668

CHALLENGES OF AI FOR ACADEMIC COMMUNITIES

DOUBTFUL

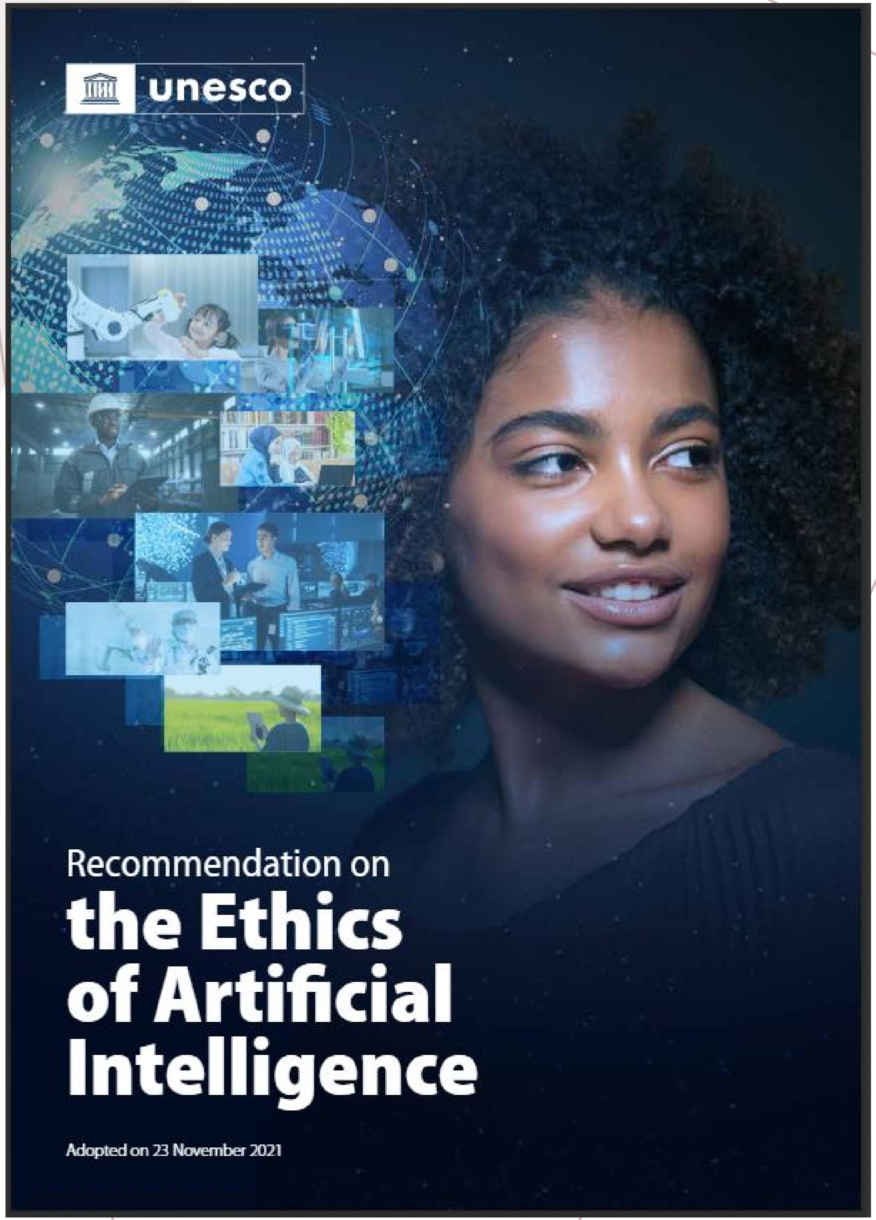
- Accuracy
- Transparency and black box effect
- Fairness
- Bias

LARGE LANGUAGE MODEL LLM

NEGATIVE

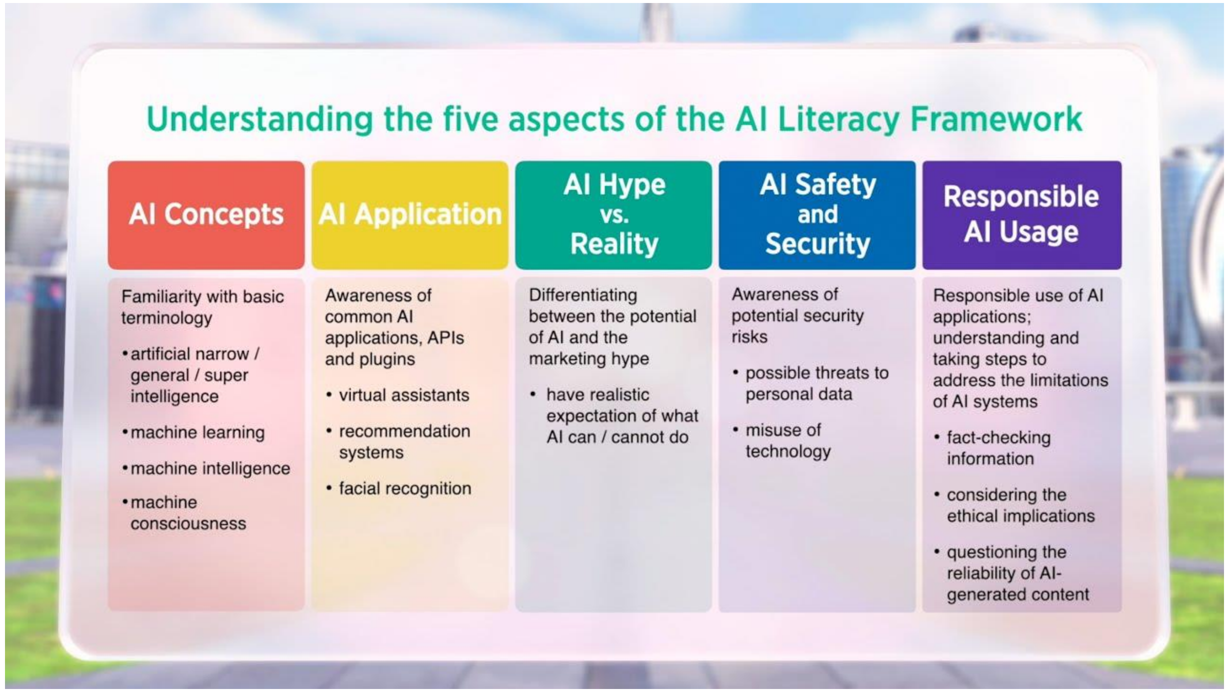
- The concept of authorship is being blurred
- Plagiarism
- Misinformation
- Competence and quality of research decline
- Norms of academic integrity are under threat

UNESCO RECOMMENDS



POLICY AREA 8: EDUCATION AND RESEARCH

101. Member States should work with international organizations, educational institutions and private and non-governmental entities to provide adequate AI literacy education to the public on all levels in all countries in order to empower people and reduce the digital divides and digital access inequalities resulting from the wide adoption of AI systems



AI literacy on all levels without limitations

Providing prerequisite skills for AI education

102. Member States should promote the acquisition of "prerequisite skills" for AI education, such as basic literacy, numeracy, coding and digital skills, and media and information literacy, as well as critical and creative thinking, teamwork, communication, socio-emotional and AI ethics skills, especially in countries and in regions or areas within countries where there are notable gaps in the education of these skills.

103. Member States should promote general awareness programmes about AI developments, including on data and the opportunities and challenges brought about by AI technologies, the impact of AI systems on human rights and their implications, including children's rights. These programs should be accessible to non-technical as well as technical groups.

Promotion of general awareness of AI programs

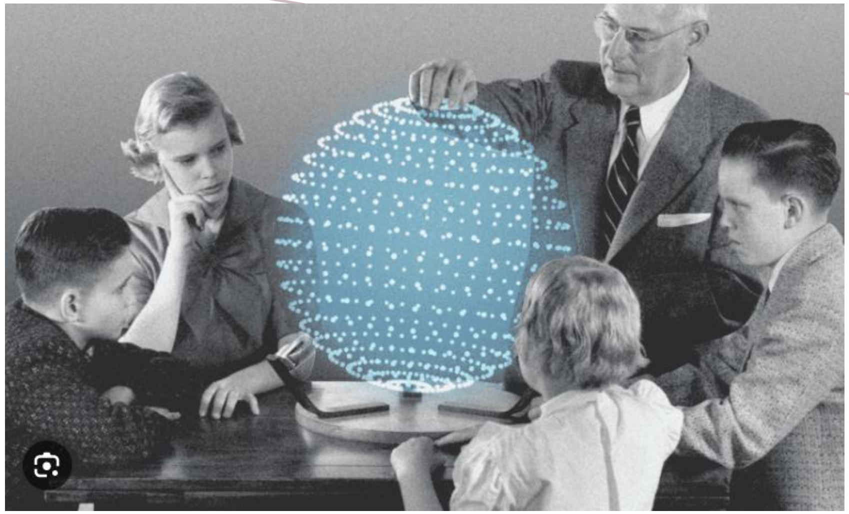
104. Member States should encourage research initiatives on the responsible and ethical use of AI technologies in teaching, teacher training and e-learning, among other issues, to enhance opportunities and mitigate the challenges and risks involved in this area. The initiatives should be accompanied by an adequate assessment of the quality of education and impact on students and teachers of the use of AI technologies. Member States should also ensure that AI technologies empower students and teachers and enhance their experience, bearing in mind that relational and social aspects and the value of traditional forms of education are vital in teacher-student and student-student relationships and should be considered when discussing the adoption of AI technologies in education. AI systems used in learning should be subject to strict requirements when it comes to the monitoring, assessment of abilities, or prediction of the learners' behaviours. AI should support the learning process without reducing cognitive abilities and without extracting sensitive information, in compliance with relevant personal data protection standards. The data handed over to acquire knowledge collected during the learner's interactions with the AI system must not be subject to misuse, misappropriation or criminal exploitation, including for commercial purposes

Encouragement of research on the responsible and ethical use of AI **in teaching** without reducing cognitive abilities and extracting sensitive information, in compliance with relevant personal data protection

Gender balance

105. Member States should promote the participation and leadership of girls and women, diverse ethnicities and cultures, persons with disabilities, marginalized and vulnerable people or people in vulnerable situations, minorities and all persons not enjoying the full benefits of digital inclusion, in AI education programs at all levels, as well as the monitoring and sharing of best practices in this regard with other Member States.

106. Member States should develop, in accordance with their national education programs and traditions, AI ethics curricula for all levels, and promote cross-collaboration between AI technical skills education and humanistic, ethical and social aspects of AI education. Online courses and digital resources of AI ethics education should be developed in local languages, including indigenous languages, and take into account the diversity of environments, especially ensuring accessibility of formats for persons with disabilities.



Including AI ethics into the curricula for all educational levels. Promotion of cross collaboration between AI technical skills education and humanistic, ethical and social aspects of AI education

107. Member States should promote and support AI research, notably AI ethics research, including for example through investing in such research or by creating incentives for the public and private sectors to invest in this area, recognizing that research contributes significantly to the further development and improvement of AI technologies with a view to promoting international law and the values and principles set forth in this Recommendation. Member States should also publicly promote the best practices of, and cooperation with, researchers and companies who develop AI in an ethical manner.

Investments in AI ethics research. Promotion of the best ethical practices in AI

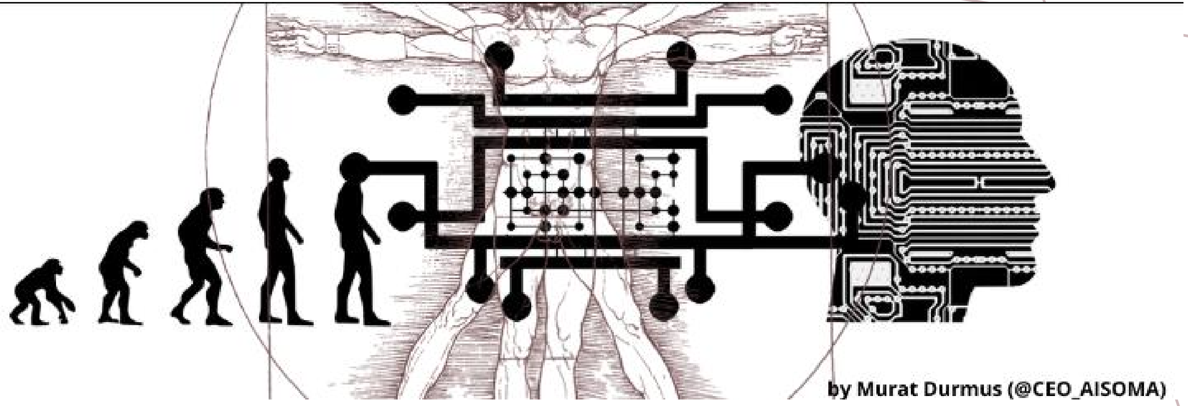
Requirement to include ethical considerations in research designs, products and publications

108. Member States should ensure that AI researchers are trained in research ethics and require them to include ethical considerations in their designs, products and publications, especially in the analyses of the datasets they use, how they are annotated, and the quality and scope of the results with possible applications.

109. Member States should encourage private sector companies to facilitate the access of the scientific community to their data for research, especially in LMICs, in particular LDCs, LLDCs and SIDS. This access should conform to relevant privacy and data protection standards

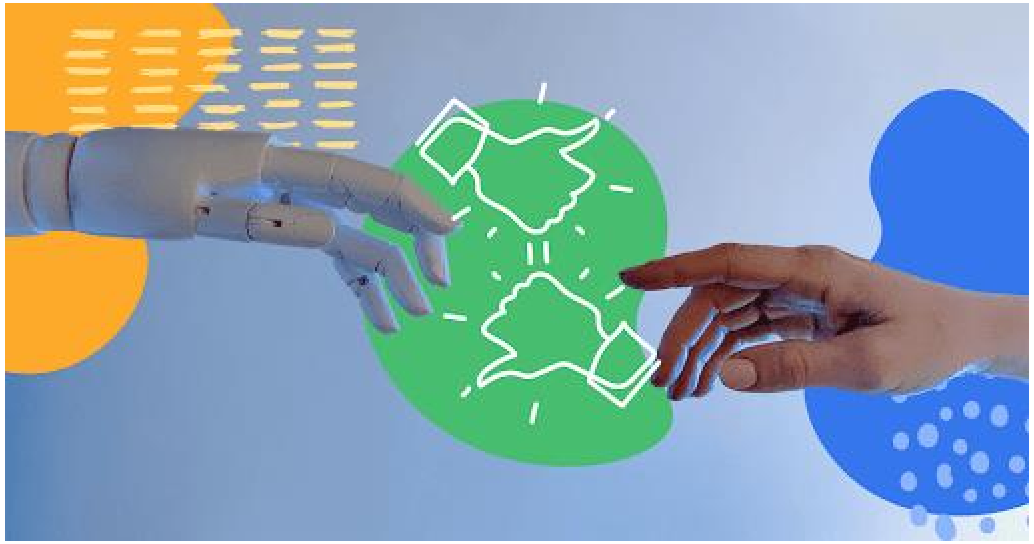
Encouragement of private sector companies to facilitate the access of the scientific community to their data for research

110. To ensure a critical evaluation of AI research and proper monitoring of potential misuses or adverse effects, Member States should ensure that any future developments with regards to AI technologies should be based on rigorous and independent scientific research, and promote interdisciplinary AI research by including disciplines other than science, technology, engineering and mathematics (STEM), such as cultural studies, education, ethics, international relations, law, linguistics, philosophy, political science, sociology and psychology.



Critical evaluation of AI research. Not only STEM but also humanity and social sciences

More expertise of AI benefits, limits and risks



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CONCLUSIONS

RESEARCH ETHICS NORMS

- Honesty
- Objectivity
- Transparency
- Freedom
- Social & personal responsibility
- Respect for human subjects
- Fair credit allocation
- Respect for laws

ETHICAL CHALLENGES OF AI

- AI's moral status & rights
- Probability of biased algorithms
- Immoral decision-making
- The black-box effect
- Impossibility of informed consent for all personal data
- Impossibility to protect personal data
- Dichotomy between increase of protected data & necessity to advance research

RECOMMENDED READING

Resnic D.B., Ethics of Science, *The Routledge Companion to Philosophy of Science*. Edited by Stathis Psillos and Martin Curd. – Routledge, 2008. – pp. 149-159. https://drive.google.com/file/d/19P7Q-pQgQkE1wAprpU_hZt82EQ0etXcF/view?usp=sharing

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Glossary of Terms

Anti-realism doubts that the physical world exists independently of human thought and perception, and considers unobservables to be abstractions that scientists use to build models to explain natural phenomena.

Black Swan Theory (**theory of black swan events)** is a metaphor that describes an event that comes as a surprise.

Coherence Theory states that if a proposed explanatory model fits with all the previous ones taken to be true, then it is true.

Consensus Theory – knowledge is based on agreement or consensus of everybody, or that something is true if the majority of the expert community confirms that it is true.

Correspondence Theory proposes that a proposition is true if it corresponds to the facts.

Cumulatively- collect or gather something in a way that increases by one addition after another**.**

Deduction - the process of reaching a decision or answer by thinking about the known facts.

Empirical facts are facts that we learn from senses.

Induction - the process of discovering a general principle from a set of facts.

Justification is a good reason or explanation of something.

Linearly progress in a way that involves events or thoughts following another one directly, in a clear order.

Meta-ethics deals with questions concerning the foundations of ethics.

Method is a way of doing something.

No-miracles argument claims that many theories which posit unobservable entities are empirically successful - they make excellent rational predictions about the behaviour of objects in the observable world without appeal to miracle or God's will. It contends the truth of our best scientific theories is the only hypothesis that does not make the predictive and explanatory success of science a mystery.

Objectivity - the fact of being based on facts and not influenced by personal beliefs or feelings

Observables are the things or objects of the physical world which people are able to see by naked eyes or hear (touch, smell) without any devices.

Paradigm is a framework containing the basic assumptions, ways of thinking, and methodology that are commonly accepted by members of a scientific community

Paradigm is a framework, model, or pattern used to formulate generalisations and theories based on shared assumptions, concepts, questions, methods, practices, and values that structure inquiry.

Philosopher is an intellectual person who seeks wisdom or enlightenment.

Philosophy is the systematic study of general and fundamental questions, such as those about being, existence, reason, knowledge, values, mind, and language.

Philosophy is thinking, inquiring about foundations of the world and human being, cognition, activity

Pragmatic Theory considers statements as truth if they are useful to believe, are the result of inquiry, that have withstood ongoing examination, that meet a standard of warranted assertibility.

Premise is a basic idea or statement, or a logical judgement.

"Prima facie" - the "prima facie" circumstance is directly related to placing the burden of proof from the side of the plaintiff to the side of the defendant.

Rationality is an attraction to logical, objective and scientific methods; the endeavour to make decisions based on factual data and connections of cause and effect, and by taking into account objective feedback from others.

Realism believes that the physical world exists independently of human thought and perception, and that people unobservables are available for study.

Science is the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence.

Scientific ethics is the standards of conduct for scientists in their professional endeavours.

Scientific rationality is a conscious choice of the reasons, problems, purposes and methods of scientific research.

Sentient living organisms

Sentience is the ability to experience sensations, i.e. to feel a range of emotions and feelings, such as pleasure, pain, joy, and fear. Researchers argue that all living organisms are **sentient.** Some animals even experience complex emotions, such as grief and empathy. Animals are **sentient beings**, and this means that their feelings matter.

Tangible goods means products that are of a physical nature, such as clothing or household items.

to experiment - to try (or check) some assumption (**hypothesis**) in order to discover what it is like or find out more about it.

to observe - to watch purposefully and carefully the way something happens, and to record the results.

Universality - the quality or state to be existing everywhere, or involving everyone.

Unobservables are the objects of the physical world which people are not able to see by naked eyes or hear (touch, smell) without any devices.

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з дисципліни
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(електронне видання)

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Укладачі:
Кузьміна Світлана Леонідівна
Авдєєва Світлана Олегівна

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Адреса видавництва: вул. Іоанна Павла II, 17
Тел.+38(050)218 04 78, факс (06452) 4 03 42
e-mail: vidavnictvoSNU.ua@gmail.com