



# **SCIENCE & EPISTEMOLOGY**

## SCIENCE & EPISTEMOLOGY

### GLOSSARY

**circular argument** Consists of premises offered in support of a conclusion, where the conclusion is not just one of the premises. Here is a famous example: Everything I clearly and distinctly perceive is true, I know this because God created me and He is no deceiver, and I know that because I clearly and distinctly perceive it, and everything I clearly and distinctly perceive is true.

**deduction** An inference from a general claim to a particular conclusion. For example: all snails eat lettuce, this thing is a snail, therefore this thing eats lettuce.

**dualism** A metaphysical viewpoint that holds that, ultimately, the Universe is made of just two types of stuff: physical stuff and mental stuff.

**epistemology** A branch of philosophy that is concerned with the study of human knowledge – its nature, its sources and its limitations.

**external world** The world of objects as they exist apart from our experience of them, as opposed to our inner worlds of thoughts, perceptions, feelings and the like.

**Gettier cases** Counter examples to the traditional view of knowledge as justified, true belief. A story is told in which someone has a justified, true belief which, perhaps because of luck, does not count as knowledge. They are named in honour of the person who first formulated them, Edmund Gettier.

**induction** An inference from many particular claims to a general claim, or to other particular claims. For example: this snail eats lettuce, this snail eats lettuce, this one too, etc, therefore, all snails eat lettuce. There is a problem with induction, however, made famous by David Hume, and a new riddle of induction, created by Nelson Goodman.

**inductive rule** A principle that legitimizes an inference from many particular claims to a general conclusion, usually thought to be the basis of inductive inferences. There are several candidates: the Universe is uniform, the future will be like the past, everything everywhere is regular, etc.

**inference** A mental movement from premises to a conclusion. Sometimes also used as a synonym for 'argument'.

**justification** Evidence or reasons that are presented in support of the truth of a belief or statement.

**paradigm** A collection of beliefs and agreements shared by scientists (partly implicitly), which guides their research, identifies problems and tells them what counts as a solution, a good experiment and much else.

**relativism** A collection of views that claim that one sort of thing (e.g. morality) depends on something else (e.g. cultural values), which varies. Since there's no set of standards that stand out (all cultural values are on a par), there's nothing to choose between various accounts of one sort of thing (hence, morality is relative).

**scepticism** The view that knowledge in some domains is not possible, perhaps because justifying our claims to knowledge claims is not possible. Scepticism can be local and directed at some of our alleged knowledge (e.g. scepticism about miraculous claims), or radical and directed at all of our alleged knowledge.

**thought experiment** An imagined case designed to put pressure on our intuitions, and perhaps clarify the way we think of something. For philosophers, thought experiments are like test tubes that separate a part of the mental world from everything else so that we can have a clear look at it.

**truth** According to the oldest conception of truth – made famous by Aristotle – to say of what is that it is, and to say of what is not that it is not, is to speak truly.

# I THINK, THEREFORE I AM

the 30-second philosophy

## 3-SECOND THRASH

You can doubt that there are other minds, that humans have bodies, even that philosophers are smart – but you can never doubt there is an ‘I’ doing the doubting.

## 3-MINUTE THOUGHT

The trouble with Descartes’ method of doubt is that the one indubitable truth, ‘I exist’, is not sufficient to retrieve knowledge of the world and mathematics. Descartes relied on God for this trick: he first proves that God exists and is not a deceiver. If God is no deceiver, then we are not systematically misled about those things we clearly and distinctly perceive, and which survive rational scrutiny. From here, it is fairly easy to retrieve certain of our beliefs about the world.

René Descartes, perhaps the first great modern philosopher, discovered that much of what he was taught by his Jesuit teachers was doubtful. So troubled by the fact that ‘there was no such learning in the world as I had been led to hope’, he set out to find the foundations upon which genuine, indubitable knowledge could be built. In *Meditations on First Philosophy*, he employed a technique of radical doubt, with the aim of identifying at least one belief he wouldn’t be able to doubt. His method was to examine each one of his beliefs, and then to abandon any of them that it was possible to doubt. In this way, he showed that it is easy enough to doubt the truth of all of our sensory experiences – we might be dreaming, and yet not be aware of it; and, most disconcertingly, that it is possible that we have been deceived about absolutely everything, even the simplest truths of mathematics, by an evil demon. Happily, this technique also establishes that in the very act of doubting we show there must be an ‘I’ which is doing the doubting. As Descartes put it, ‘Cogito ergo sum’ (‘I am thinking, therefore, I exist’).

## RELATED PHILOSOPHIES

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THE BRAIN IN A VAT  
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## 3-SECOND BIOGRAPHY

RENÉ DESCARTES  
1596–1650

## 30-SECOND TEXT

Jeremy Stangroom

*René was sure he existed – but he wasn’t sure about those other two.*

# GETTIER'S COUNTER-EXAMPLE

the 30-second philosophy

## 3-SECOND THRASH

Why you can justifiably believe the right thing but not truly know it.

## 3-MINUTE THOUGHT

Later philosophers responded to Gettier by arguing that the things one has beliefs about and the belief itself must be connected in the right way in order for the belief to count as knowledge. But it's been hard to specify what this right way is. Must the link be reliable, rock-solid or perhaps causal? Some philosophers think we should give up the idea that there are precise criteria for concepts such as knowledge.

What is knowledge? Since Plato, many philosophers have thought it is a kind of justified, true belief. This so-called 'tripartite account' says knowledge has three conditions: (1) to know something you must believe it, (2) it must be true and (3) your belief that it is true must be justified. Then Edmund Gettier came along. Suppose, he argued, that Smith applies for a job and has a justified belief that Jones will get it. Smith is also justified in believing that Jones has ten coins in his pocket. Smith then applies basic logic and concludes, justifiably, that the person who gets the job will have ten coins in his pocket. In fact, Smith gets the job, and although he didn't realize it, he also had ten coins in his pocket. That means that Smith did indeed have a justified true belief that the person who got the job would have ten coins in his pocket. But surely he didn't know this. He didn't know he had ten coins in his pocket, and didn't even believe he would get the job. He had a justified true belief, but that was luck, not knowledge. There are numerous other such counter-examples to the tripartite account, known as 'Gettier cases'.

## 3-SECOND BIOGRAPHY

EDMUND GETTIER

1927–

## 30-SECOND TEXT

Julian Baggini

*The only thing Smith really knew was that it was lucky that he got the job – he didn't have much money left.*

# KARL POPPER

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Although Karl Popper is perhaps best remembered for his 'falsificationism', an idea that shaped the philosophy of science in the second half of the twentieth century, the scope of his interests was wide. He produced important work in areas ranging from political philosophy to the philosophy of mind. By the end of his life, his collected papers were voluminous enough to fill 450 cartons at the Popper Archive in the Hoover Institution at Stanford University, California.

Popper was born in Vienna in 1902, the youngest child of middle-class parents of Jewish descent. He was brought up a Lutheran, and educated at the University of Vienna, where he studied philosophy, mathematics, psychology and physics. Although he was attracted to Marxism in his youth and joined the Association of Socialist School Students, he quickly grew tired of the strictures of historical materialism and instead adopted the social liberalism that marked his life.

His first major work, *The Logic of Scientific Discovery*, was published in 1935 (although it wasn't translated into English until 1959). It was

in this book that he outlined his ideas about falsification that so influenced supporters and critics alike. In a remarkable ten-year period, he followed this with *The Poverty of Historicism*, a critique of the idea that history is governed by the operation of laws, and *The Open Society and its Enemies*, a two-volume defence of the principles of social liberalism in the face of the threat from authoritarianism and totalitarianism.

Undoubtedly Karl Popper's political ideas were influenced by personal experience. In 1937, fearful of the rise of Nazism, he left Austria, where he had been working as a schoolteacher, and took up a post as a lecturer in philosophy at Canterbury University College in New Zealand. After the end of World War Two, he joined the faculty at the London School of Economics, becoming Professor of Logic and Scientific Method in 1949, where he remained until his retirement from full-time teaching in 1969. Karl Popper died in 1994, with his reputation assured as one of the most important philosophers of the twentieth century.



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**1902**  
Born in Vienna,  
Austria-Hungary

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**1935**  
*Logik der Forschung*  
published

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**1937**  
Fled Austria for New  
Zealand, and took up  
a post at Canterbury  
University College

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**1945**  
*The Open Society and  
Its Enemies* published

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**1949**  
Became Professor of  
Logic and Scientific  
Method at the London  
School of Economics

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**1957**  
*The Poverty of  
Historicism* published

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**1959**  
*Logik der Forschung*  
finally appears in English  
as *The Logic of Scientific  
Discovery* translation

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**1969**  
Retires from full-time  
teaching

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**1994**  
Dies in London

# THE BRAIN IN A VAT

## the 30-second philosophy

### 3-SECOND THRASH

You think you're holding this book, reading this sentence, but actually you're a brain in a vat, being fed electrical impulses by a supercomputer located in Boston.

### 3-MINUTE THOUGHT

The philosopher Hilary Putnam rejects the sceptical implications of the brain in a vat thought experiment. He argues, roughly speaking, that the words that a person uses inside a virtual world refer to the constituent elements of that world, not to the things in a purported outside world. Therefore, whether I am sitting under a tree, for example, depends upon the state of affairs that exists in the particular world that I inhabit (virtual, or otherwise).

## The 'brain in a vat' thought

experiment, a version of which is the premise for *The Matrix* films, tends to be employed to tell us something about our knowledge of the world. It asks us to imagine that a brain has been detached from a person's body, placed into a vat of fluid and then connected to a device that entirely replicates the electrical impulses that normally come in from the outside world. The idea is that this will produce an experience of a virtual reality that is indistinguishable from the real world. This introduces the problem of radical scepticism. Specifically, it seems possible that we are living in a virtual world, but do not know it. This, in turn, would mean that all our beliefs about the world – for example, that I am currently typing this text on a word processor – are false. If we accept that this is possible, then seemingly we must concede that we cannot know that what we take to be true about the world is, in fact, true. In other words, if it is possible that something like the scenario portrayed in *The Matrix* is true, then we have to accept that there is no secure foundation for our knowledge of the world.

### RELATED PHILOSOPHIES

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### 3-SECOND BIOGRAPHY

HILARY PUTNAM  
1926–2016

### 30-SECOND TEXT

Jeremy Stangroom

**Surely you are more  
than a brain in a vat?  
Are you certain?  
Perhaps this is a  
picture of you.**



# HUME'S PROBLEM OF INDUCTION

the 30-second philosophy

## 3-SECOND THRASH

How do we know that the future will be like the past?

## 3-MINUTE THOUGHT

Peter Strawson claimed that the rule of induction requires no justification since part of what it means to be rational is to reason inductively. Max Black claimed that a particular inductive inference can be justified by the rule 'infer that the future will be like the past', and that this rule is justified since it has worked in the past. Hans Reichenbach tried to prove that if there is a reliable way to infer the future from the past, then induction will be reliable. None of these responses meet Hume's challenge head on, since they don't show that the rule of induction is reliable.

David Hume reflected on the fact that we often reason from what has been observed in the past to what will be observed in the future. For example, from the fact that all emeralds so far observed are green, we may infer that emeralds observed in the future will also be green. This reasoning is called 'an inductive inference'. Hume formulated this rule of induction: infer that regularities observed to hold in the past will be continued into the future. He then observed that inductive inferences following this rule are not deductively valid. It is logically possible for 'all observed emeralds are green' to be true although 'all emeralds are green' is false. Hume asked: 'If inductive inferences are not valid, then why should we think that they reliably lead us towards truths?' Perhaps all the emeralds observed so far are green, but starting tomorrow they will be blue. Hume argued that there cannot be a non-circular argument that shows his inductive rule does lead to truths, even if it generally does. Hume thought that although there is no justification of induction, it is part of our human nature to make inductive inferences. Many philosophers have taken his argument as a challenge to produce a non-circular demonstration that induction is reliable, but so far no one has succeeded and if Hume is right no one ever will.

## RELATED PHILOSOPHIES

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## 3-SECOND BIOGRAPHIES

DAVID HUME

1711-76

HANS REICHENBACH

1891-1953

MAX BLACK

1909-88

PETER STRAWSON

1919-2006

## 30-SECOND TEXT

Barry Loewer

*As soon as he found the blue emerald, he began to question everything: The Sun had risen every morning of his life so far – but will it come up tomorrow?*

# GOODMAN'S GRUESOME RIDDLE

the 30-second philosophy

## 3-SECOND THRASH

The rule 'infer that past regularities will be continued in the future' must be modified to apply only to projectible predicates.

## 3-MINUTE THOUGHT

Prior to Goodman propounding his riddle, Bertrand Russell had already remarked that reasoning that the future will be like the past can lead one astray. He imagined a chicken who observed the farmer having always in the past selected a chicken other than herself for his dinner. Thus the chicken concluded that in the future the farmer would always select a chicken other than herself for his dinner.

Nelson Goodman claimed that the inductive rule 'infer that past regularities will be continued in the future' cannot be right, since it leads to conflicting conclusions. To illustrate this he defined a predicate 'is grue' as follows: something is grue at time (t) if, and only if, it is green and t is before the first moment, of the year 2100, or it is blue and t is that moment or later. Suppose all emeralds so far observed are green. Then they are also grue, because they are green and have been observed before 2100. So, the rule of induction tells us to infer that emeralds after the year 2100 will be green, and also that they will be grue. But after the year 2100, grue emeralds are blue not green. Goodman concluded that the rule of induction must be modified to say that the future will be like the past, but only in certain respects that are 'projectible'. The problem is specifying which predicates are projectible, and which aren't. One idea is that 'grue' is not 'projectible' since it is defined in terms of 'green' and 'blue'. But 'green' and 'blue' are just as easily definable in terms of 'grue' and 'bleen'.

## RELATED PHILOSOPHIES

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## 3-SECOND BIOGRAPHY

NELSON GOODMAN  
1906-98

## 30-SECOND TEXT

Barry Loewer

*On the 25th of the month, the rooster realized that the induction had been wrong all along. He turned grue with fright.*

# POPPER'S CONJECTURES & REFUTATIONS

the 30-second philosophy

## 3-SECOND THRASH

Science grows by a process of conjecture and refutation.

## 3-MINUTE THOUGHT

The financier and philanthropist George Soros was Popper's student at the London School of Economics. He made billions of dollars with his investments and currency trading. Soros says that he used Popper's method of conjecture and refutation to help decide on investments, and credits it with his success.

Karl Popper rejected the view that science proceeds by the inductive inference of regularities from observations. To the contrary, he claimed that scientific knowledge grows by a process he called 'conjecture and refutation'. His mantra is: 'You can't prove a hypothesis true, or even have evidence that it is true by induction, but you can refute it if it is false'. Popper held that a good scientific hypothesis is one from which many surprising predictions deductively follow. His crucial point is that if an observation deductively follows from a theory, and if our experiments do not result in the predicted observation, then it follows that the theory itself is false. Popper's view is that scientists should put forward such hypotheses and try their hardest to refute them. If a prediction fails, we learn that the hypothesis is false. This process, he thinks, describes the growth of scientific knowledge from Aristotelian physics, to Newtonian physics, to Einstein's theories of relativity. Popper adds that what makes the claims of astrology, Freudian theory, and Marxism pseudo-scientific is that their practitioners don't even try to refute them, and argue away apparent refutations.

## RELATED PHILOSOPHIES

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## 3-SECOND BIOGRAPHIES

KARL POPPER  
1902-94

GEORGE SOROS  
1930-

## 30-SECOND TEXT

Barry Loewer

*Karl's brain grew so large that he realized that the only thing that he knew to be true was that he would never know what was true, only what was false.*

# KUHN'S SCIENTIFIC REVOLUTIONS

## the 30-second philosophy

### 3-SECOND THRASH

The work of scientific communities is driven by the demands of particular scientific paradigms, which rule the roost until better paradigms come along.

### 3-MINUTE THOUGHT

The major problem of Thomas Kuhn's approach is that it suggests a certain kind of relativism about truth. If the rules and criteria for assessing truth claims only work within paradigms, then it isn't possible to adjudicate between their competing claims. There is also no way to determine the overall merits of particular paradigms, since there is no view from the outside upon which to base such an assessment.

Thomas Kuhn argues, in his classic work, *The Structure of Scientific Revolutions*, that what he calls 'normal science' takes place within the context of particular paradigms, which provide the rules and standards for scientific practice within any particular scientific discipline. Paradigms allow scientists to develop avenues of inquiry, to create fruitful research strategies, to construct questions, to interpret results and to analyze their relevance and meaning. It is Kuhn's claim that the history of science is marked by periodic 'scientific revolutions', each of which sees the dominant paradigm in a particular field replaced by a new paradigm (as, for example, occurred when the Ptolemaic worldview was overthrown by the Copernican system). A scientific revolution is preceded by a period of crisis, during which it becomes clear that, under pressure from a growing number of puzzles and difficulties, an existing paradigm can no longer be maintained. A revolution occurs when the scientific community moves its allegiance to a new paradigm, signalling the end of the crisis and the resumption of normal science. Kuhn does not accept this pattern of continually changing paradigms means that science does not progress. He argues that modern scientific theories are better than earlier ones at solving puzzles that arise in many different conditions.

### RELATED PHILOSOPHIES

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### 3-SECOND BIOGRAPHY

THOMAS KUHN  
1922-96

### 30-SECOND TEXT

Jeremy Stangroom

*After a scientific revolution, or 'paradigm shift', many scientific theories turn out to be garbage.*