Strategy and Politics: Science and Models

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Notes

What is Science?

What do the following statements all have in common?

- Science is a collection of facts that tell us what we know about the world.
- A scientific theory is one that has been proven.
- "The sun revolves around the earth" is not a scientific statement.
- If my theory is correct, I should observe that rich countries are more likely to be democracies. I do observe that rich countries are more likely to be democracies. Therefore, my theory is correct.
- Politics cannot be studied in a scientific manner.

Notes

What is Science?

They are all wrong.

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They are all wrong.

- Science is NOT a collection of facts that tell us what we know about the world.
- A scientific theory is NOT one that has been proven.
- "The sun revolves around the earth" IS a scientific statement.
- If my theory is correct, I should observe that rich countries are more likely to be democracies. I do observe that rich countries are more likely to be democracies. IT DOES NOT FOLLOW that my theory is, therefore, correct.
- Politics CAN be studied in a scientific manner.

Notes

What is Science?

Is science a body of knowledge or a collection of facts?

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- No – if this were the case, then Newtonian physics would have to be called unscientific.
- No – if this were the case, then we could not make appeals to science in order to determine the veracity of that knowledge. We would be engaging in circular reasoning.

The body of knowledge that we call "scientific" may well be a product of science, but it is not science itself.

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What is Science?

Science is a method for *provisionally* understanding the world.

Science is a quest for knowledge.

But is science any quest for knowledge? Are meditation, religion, or introspection science?

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What is Science?

Science is a quest for knowledge that relies on criticism.

The thing that allows for criticism is the possibility that our theories or claims might be wrong.

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Falsifiability

Thus, the thing that distinguishes science from 'non-science' is that scientific statements must be falsifiable.

- There must be some imaginable observation that could falsify or refute our theory.
- All scientific statements must be potentially testable.
- This does not mean that our theories will ever be falsified, just that there is a possibility that they could be falsified.

Notes

Non-Falsifiable Statements

A tautology is a statement that is true by definition.

- "Strong states are able to implement policies" – unless we can think of a way of identifying a strong state without reference to its ability to implement policies, then this statement cannot be falsified and is, therefore, not scientific.

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This does **not** mean that non-science is nonsense or that these claims are necessarily false.

Notes

Falsifiability and Tests

They Might Be Giants and Scientific Tests, click here

Notes

Scientific Method

The scientific method describes the process by which scientists learn about the world.

Scientific method:

1. Question
2. Theory
3. Implications (Hypotheses)
4. Observe World (Test Hypotheses)
5. Evaluation

Notes

Question

"Why did that occur?"

Surprise implies a prior expectation or theory.

Without a pre-existing theory, there can be no surprises or puzzles.

Notes

Theory/Models

A theory is a set of logically consistent statements that helps us understand our observations or experiences.

- It is an abstraction that offers an explanation as to "why" something happens.
- An explanation identifies for us a "cause" or a causal process.

Theory is often referred to as a "model."

Notes

Theory/Models

A model is a simplification of the world.

- What a model needs to contain depends on the question.
- Models are useful or not useful, not right or wrong.

A model can be informal or formal.

- Though they do not have to be, informal models tend to be long and imprecise.

Notes

Theory Construction

When generating a theory it is useful to think of the starting puzzle as the end result of some previously unknown process.

We then speculate about what (hidden) process might have produced our starting puzzle.

In other words, we try to imagine a prior world that, if it existed, would produce this otherwise puzzling observation.

This becomes our model explaining the observation.

Notes

Deriving Implications

Once we have our model, we must deduce implications from our theory other than those we set out to explain in the first place.

"If the prior world we created to explain the phenomenon we originally found puzzling really did exist, what else ought we to observe?"

Good models are pregnant with many different implications.

Notes

Observe the World

The next step is to examine whether the implications of the model are consistent with observation.

We should conduct *difficult* tests and not seek to dogmatically confirm the implications.

A critical test allows us to use observation to distinguish between two or more competing explanations of the same phenomenon.

Notes

Evaluation

If we observe the implications deduced from our theory, then we say that our theory is corroborated. We do **not** say that our theory is proven. We then continue to look for evidence that would contradict our theory.

If we fail to observe the implications deduced from our theory, then our theory is probably wrong and so we return to theory construction.

Notes

The Case of the Dumb Question

Suppose that the person next to you asks the professor a really dumb question.

If you believe that you need to be somewhat smart to get into college, it probably surprises you that someone would ask such a dumb question.

In other words, you find this observation – the dumb question – puzzling.

Can you think of a model – a process – that might produce such a puzzling observation?

Notes

The Case of the Dumb Question

Suppose that you know the person who asked the question is a rugby player.

This might lead you to the following simple explanation for the dumb question:

- Rugby players are dumb.

While this is an explanation, it is not a particularly good one.

Notes

The Case of the Dumb Question

One thing you might think to do in order to improve your explanation is to make it more general.

- Athletes are dumb.

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- Athletes are dumb.

But there are at least two problems with this model as things stand.

1. There is no sense of process
2. The model is essentially a tautology.

Notes

The Case of the Dumb Question

This might lead you to look for a new explanation or model that includes some sort of process that makes athletes appear dumb.

- Being a good athlete requires large amounts of practice time; being smart in class requires large amounts of study time. The amount of free time is so limited that you cannot both study and practice well.

Notes

The Case of the Dumb Question

An appealing feature of the model is that the logic of the argument not only applies to athletes but to any person involved in a time-consuming activity.

- **Limited Time Theory:** There is only a limited amount of time in the day. Anyone involved in time-consuming activities, such as athletics, will necessarily have less time to study. As a result, they will be more likely to say dumb things in class.

Notes

The Case of the Dumb Question

Can you think of any alternative explanations for why the rugby player asked a really dumb question?

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- **Excellence Theory:** Everyone wants to feel successful. Achieving recognition in any one area is enough to make most people content. Anyone who achieves success in non-academic areas, such as athletics, will feel less motivated to study for class and will be more likely to say dumb things.

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The Case of the Dumb Question

Can you think of any alternative explanations for why the rugby player asked a really dumb question?

- **Excellence Theory:** Everyone wants to feel successful. Achieving recognition in any one area is enough to make most people content. Anyone who achieves success in non-academic areas, such as athletics, will feel less motivated to study for class and will be more likely to say dumb things.
- **Jealousy Theory:** We tend to be jealous of success in others. When we are jealous of someone, such as an athlete, we attempt subconsciously to lower his apparent success in class by interpreting his questions as "dumb."

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The Case of the Dumb Question

But how can you evaluate which model is correct or best?

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But how can you evaluate which model is correct or best?

One way is to test some of the implications that can be derived from these theories. In particular, we would like to find some **new** question(s) to which the three models give different answers.

In other words, we would like to conduct a critical test that would allow us to choose among the alternative reasonable models.

Notes

The Case of the Dumb Question: Three Critical Tests

Question	Limited Time	Excellence	Jealousy
Will athletes ask dumb questions out of season	No	Yes	Yes
Will athletes ask dumb questions in schools that de-emphasize athletics?	Yes	No	No
Will athletes who do not look like athletes ask dumb questions?	Yes	Yes	No

Notes

Logic

One element of science involves constructing logically consistent theories or arguments.

There are two reasons why you should care about logic:

1. It tells us quite a lot about the way scientists should test their theories.
2. If you cannot distinguish between a valid and invalid argument, then it is easy for someone to manipulate you!

Notes

Valid and Invalid Arguments

An argument is a set of logically connected statements, typically in the form of a set of premises and a conclusion.

A premise is a statement that is presumed to be true within the context of an argument leading to a conclusion.

A conclusion in an argument is a claim that is thought to be supported by the premises.

Notes

Valid and Invalid Arguments

An argument is valid when accepting the premises compels us to accept its conclusion.

An argument is invalid if, when we accept the premises, we are free to accept or reject its conclusions.

Notes

Valid and Invalid Arguments

One way to represent an argument is in the form of a categorical syllogism that consists of a major premise, a minor premise, and a conclusion.

The major premise is typically a conditional statement such as "If P, then Q."

- The "If" part is called the antecedent.
- The "then" part is called the consequent.
- Example: "If a country is wealthy, then it will be a democracy."

The minor premise consists of a claim about either the antecedent or the consequent of the conditional statement.

The conclusion is a claim that is thought to be supported by the premises.

Notes

Valid and Invalid Arguments

Four types of conditional arguments can be represented by a syllogism:

1. Arguments that affirm the antecedent.
2. Arguments that deny the antecedent.
3. Arguments that affirm the consequent.
4. Arguments that deny the consequent.

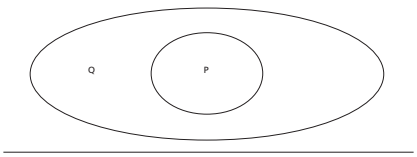
Which of these types of argument are valid?

Notes

TABLE 2.2 **Affirming the Antecedent: A Valid Argument**

	General form	Specific example
Major premise	If *P*, then *Q*	If a country is wealthy, then it will be a democracy.
Minor premise	*P*	The country is wealthy.
Conclusion	Therefore, *Q*.	Therefore, the country will be a democracy.

FIGURE 2.1 **Major Premise: If *P*, then *Q***



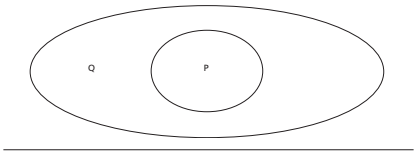
Affirming the antecedent is a valid argument.

Notes

Table 2.3 Denying the Antecedent: An Invalid Argument

	General form	Specific example
Major premise	If *P*, then *Q*	If a country is wealthy, then it will be a democracy.
Minor premise	Not *P*	The country is not wealthy.
Conclusion	Therefore, not *Q*.	Therefore, the country will not be a democracy.

Figure 2.1 Major Premise: If *P*, then *Q*



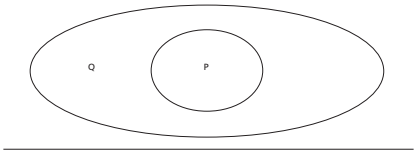
Denying the antecedent is an invalid argument.

Notes

Table 2.4 Affirming the Consequent: An Invalid Argument I

	General form	Specific example
Major premise	If *P*, then *Q*	If a country is wealthy, then it will be a democracy.
Minor premise	*Q*	The country is a democracy.
Conclusion	Therefore, *P*.	Therefore, the country is wealthy.

Figure 2.1 Major Premise: If *P*, then *Q*



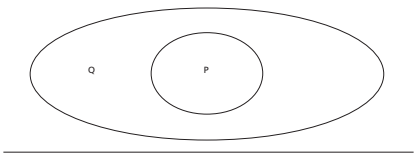
Affirming the consequent is an invalid argument.

Notes

Table 2.5 Denying the Consequent: A Valid Argument I

	General form	Specific example
Major premise	If *P*, then *Q*	If a country is wealthy, then it will be a democracy.
Minor premise	Not *Q*	The country is not a democracy.
Conclusion	Therefore, not *P*.	Therefore, the country is not wealthy.

Figure 2.1 Major Premise: If *P*, then *Q*



Denying the consequent is a valid argument.

Notes

Valid and Invalid Arguments

Table 2.6 **What Types of Conditional Arguments Are Valid?**

	Antecedent	Consequent
Affirm	Valid	Invalid
Deny	Invalid	Valid

Notes

Logic and Testing Theories

This brief foray into logic tells us something about how scientists test their theories.

Scientists typically evaluate their theories by examining the real world to see if the implications of their theories are true, based on the premise "If a theory is true, then its implications will be true."

Notes

Logic and Testing Theories

Puzzle: Rich countries are much more likely to be democracies than poor countries.

Theory:

- Living in a dictatorship is risky. Living in a democracy is less risky.
- Rich people are less likely to take risks than poor people because they have more to lose.
- Countries with lots of rich people are, therefore, more likely to be democracies than dictatorships.

Implication: Rich democracies live longer than poor democracies.

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Logic and Testing Theories

Say we went out into the real world and observed that wealthy democracies do in fact live longer than poor democracies.

Can we conclude from this that our theory is correct?

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Say we went out into the real world and observed that wealthy democracies do in fact live longer than poor democracies.

Can we conclude from this that our theory is correct?

The answer is **NO** because this would be affirming the consequent.

Notes

Logic and Testing Theories

TABLE 2.7 Affirming the Consequent: An Invalid Argument II

General form	Example	Specific example
If *P*, then *Q*	If our theory is correct *T*, then we should observe some implication *I*.	If our theory is correct, then we should observe that rich democracies live longer than poor democracies.
Q	We observe implication *I*.	Rich democracies live longer than poor democracies.
Therefore, *P*.	Therefore, our theory *T* is correct.	Therefore, our theory is correct.

Notes

Logic and Testing Theories

Now, say we went out into the real world and observed that wealthy democracies do NOT live longer than poor democracies.

Can we conclude from this that our theory is wrong?

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Logic and Testing Theories

Now, say we went out into the real world and observed that wealthy democracies do NOT live longer than poor democracies.

Can we conclude from this that our theory is wrong?

The answer is **YES** because this would be denying the consequent.

Notes

Logic and Testing Theories

TABLE 2.8 Denying the Consequent: A Valid Argument II

General form	Example	Specific example
If *P*, then *Q*	If our theory *T* is correct, then we should observe some implication *I*.	If our theory is correct, then we should observe that rich democracies live longer than poor democracies.
Not *Q*	We do not observe implication *I*.	Rich democracies do not live longer than poor democracies.
Therefore, not *P*.	Therefore, our theory *T* is incorrect.	Therefore, our theory is incorrect.

Notes

Logic and Testing Theories: Summary

There is an asymmetry in the logical claims that can be made on the basis of "confirming" and "disconfirming" cases.

- When an implication of our theory is confirmed, the most we can say is that the theory may be correct.
- When an implication of our theory is disconfirmed, we are compelled to conclude that our theory is wrong.

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Logic and Testing Theories: Summary

Think about what this means!

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Logic and Testing Theories: Summary

Think about what this means!

It means that:

- We are logically justified in having more confidence when we reject a theory than when we do not.
- All of our knowledge remains tentative and cannot ever be proven.

Notes

What is Science?

"The old scientific ideal of *episteme* – of absolutely certain, demonstrable knowledge – has proved to be an idol. The demand for scientific objectivity makes it inevitable that every scientific statement must remain *tentative* for ever . . . With the idol of certainty . . . there falls one of the defences of obscurantism which bar the way to scientific advance. For the worship of this idol hampers not only the boldness of our questions, but also the rigour and integrity of our tests. The wrong view of science betrays itself in the craving to be right; for it is not his *possession* of knowledge, of irrefutable truth, that makes the man of science, but his persistent and recklessly critical *quest* for truth" (Sir Karl Popper, [1959] 2003: 280-281).

Notes

What is Science?

If confirming observations do not prove that a theory is correct, does this mean that they are of no use whatsoever?

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No

Suppose we start with a set of implications derived from a theory.

If our observations are consistent with our theory, then we can have a greater measure of confidence in our theory *because it withstood the very real chance of being falsified*.

Notes

Falsificationism

Falsificationism is an approach to science in which scientists generate or "deduce" testable hypotheses from theories designed to explain phenomena of interest.

It emphasizes that scientific theories are constantly called into question and that their merit lies only in how well they stand up to rigorous testing.

Falsificationism takes a clear stance in the debate between deductive and inductive approaches to learning.

Notes

Deduction vs. Induction

The deductive approach to learning involves formulating an expectation about what we ought to observe in light of a particular theory about the world and then sets out to see if observation is consistent with theory.

- With deduction, theory precedes observation.

The inductive approach to learning starts with a set of observations and then tries to ascertain a pattern in the observations that can be used to generate an explanation for the observations.

- With induction, observation precedes theory.

Notes

Deduction vs. Induction

Induction is problematic because to be successful it must rest at some point on the fallacy of affirming the consequent.

The fact that observation precedes theory construction means that it is never exposed to potential falsification.

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Induction is problematic because to be successful it must rest at some point on the fallacy of affirming the consequent.

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Popper: Induction is not so much wrong, as impossible. We're all deductivists.

Notes

Why Science?

Science is just one way to explain things.

But science is tentative, objective, and public.

- Its tentative nature invites criticism and hence improvement.
- Its objective nature means that incorrect ideas cannot be protected based on the authority (or sheer power) of the person articulating the idea. This helps avoid conflict.
- Its public nature means that anyone can challenge and evaluate claims. This makes it faster to find errors.

Notes

What is Science?

In Our Time, BBC Radio 4, January 2012.

Discussion of the Scientific Method, click here

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