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Sociology

For My Next Trick...

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Simulations

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The basis of this sim is a simple “mind-reading” trick that can be used in a variety of different ways to liven-up the teaching of areas like research design or sociology and science. In this particular instance I’ve aimed the instructions at the former, looking specifically at **Popper’s Hypothetico-Deductive Model** (and the creation / testing of hypotheses). In this respect the simulation is designed to help students examine the “nuts and bolts” of this particular, very influential, model of research design and you can use it in a range of ways depending on your teaching preferences.

Background

There’s a couple of useful background areas we can outline: firstly, the idea of “scientific knowledge” and secondly a walk-through of **Popper’s** model.

1. Although there is a tendency to associate science with particular subjects, like chemistry or physics, science is not a body of knowledge, something unique to particular subjects. Rather, *science* is a way of producing a particular *kind* of knowledge which we can loosely characterise as factual rather than knowledge based on opinion, guesswork or faith. **Popper** (1934), for example, argues science is

"*A method that involves identifying a problem to study, collecting information about it and eventually offering an explanation for it. All this is done as systematically as possible*".

Science, therefore, is a methodology - a way of producing knowledge with two major qualities:

Firstly, it is *reliable*, something that refers to the *consistency* of the data collected in any research process. This is important because we can *check* the accuracy of research data by *repeating* (or replicating) it to see if we get the same, or very similar results. A very simple example might be a researcher *cross-checking* the reliability of a response by asking the same question in a different way, such as "How old are you?" and "When were you born?". If they get two different answers, the data is *unreliable* - and any conclusions we draw from it are going to have a limited value.

Secondly, it is *valid*; data is only useful if it actually *measures* or *describes* what it claims to measure or describe. If, for example, we wanted to measure the extent of crime we could use *crime statistics* published by the government. We would need to be aware, however, that the validity of these statistics may be limited if they only record crimes *reported* to the police - people may not report crime for many different reasons.

In this respect, a **scientific methodology** means certain rules have to be followed in order to "do science".

Scientific knowledge is created by following a set of *procedures*, agreed by the scientific community, that govern how data can be collected and analysed. **Popper's** H**ypothetico-deductive model** is a standard example of a scientific procedure we will outline in more detail later, but for now we can note that a scientific procedure generally begins with a hypothesis or research question that must be tested or answered in some way through the systematic collection, presentation and analysis of data. The crucial element here is the idea that any conclusions draw from scientific research have been tested against the available evidence and not been *disproven.* This procedure not only gives scientific knowledge greater *plausibility* than non-scientific knowledge, because it is based on tested facts rather than untested opinions, it also gives such knowledge a crucial quality; the ability to make predictive statements; scientific knowledge means we can say with *certainty* something *will or will not* happen in the future.

Scientific knowledge, therefore, is:
- factual
- objective
- evidence-based and
- testable,

Non-scientific knowledge is based on:
- opinion
- faith
- guesswork
- unsupported interpretations and
- untested assumptions.

positivism

Positivist research is based on the principle that reliable and valid knowledge is generated by developing and rigorously testing a hypothesis - something that provides both a focus for the research and a clearly defined objective for data collection. The researcher is locked-into a systematic design for identifying, collecting and processing data whose aim is an objective measurement of people's behaviour.

To test the hypothesis the researcher uses systematic observation to collect data, something that covers a range of quantitative methods - from questionnaires through interviews to direct observation itself. Once data has been collected the researcher must analyse it to test the hypothesis which, if confirmed, becomes part of a wider body of theory used to predict future behaviour. If the hypothesis is false the researcher has the option of rejecting it or revising it, in which case the research begins anew.

2. The basis of the **Hypothetico-Deductive Model** of scientific research can be broadly outlined in the following terms:

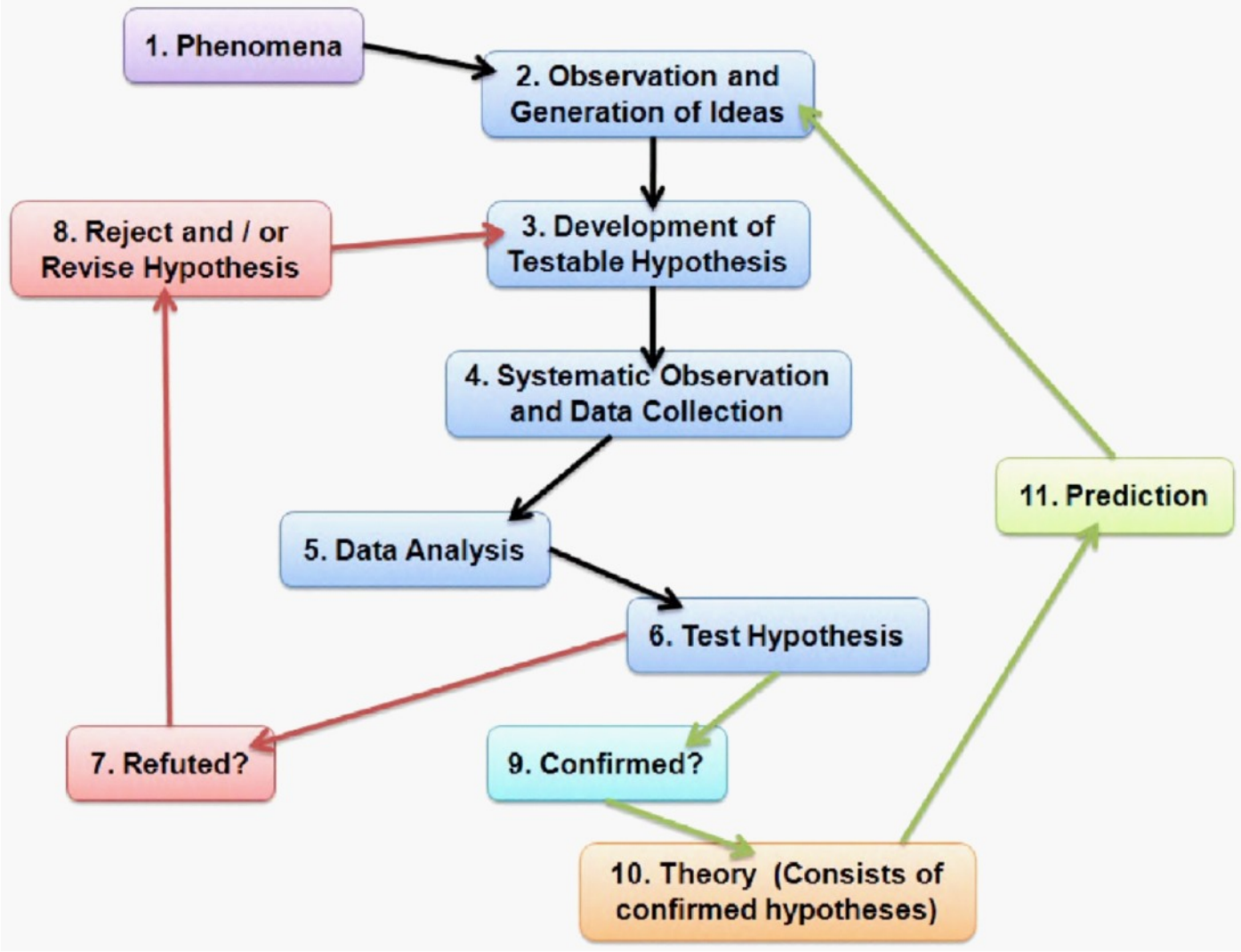
"**Hypothetico**" means "starting with a hypothesis" and for **Popper** the defining feature of a scientific research process is the ability to develop and clearly state **testable** hypotheses.

Deduction (or to give it its proper name, *deductive logic*) is a way of making authoritative statements (*proofs*) about what is *not known* by a thorough analysis of what *is known*. The ability to make *deductive statements* is a powerful tool because it's the basis for drawing logical conclusions about *specific events* from *general events*.

To simplify this idea, think about a fictional detective such as Inspector Morse. He solved crimes by *systematically* investigating a case, collecting and analysing facts and, on the basis of these facts, identifying the guilty party. This is an example of *deduction* because he proves something specific that was not initially known (the identity of a murderer) on the basis of general observations about things that were initially known (the facts of the case, the clues identified and so forth).

A **model** is a small-scale *representation* of something that helps clarify the relationship between the various elements involved by describing them in simplified or idealised terms. In this case, **Popper's** model suggests the various steps to follow in order to "do scientific research" and, as such, helps us to design the actual process itself.

The Hypothetico-Deductive Model



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We can briefly explain each of the "steps in the research process" identified in the diagram in the following way:

1. Phenomena: The research starts with the choice of something to study and we can use "education" for illustrative purposes. However, in order to actually do research we have to narrow our initial ideas down to something more specific.

2. Observation and the generation of ideas: The researcher starts to focus their initial interest in "education" into something manageable. For example, they might find inspiration in previously published research (they might, for example, want to **replicate** it), their own particular academic interests or they may simply pick-up a government contract to do a certain type of research on a particular topic (such as rates of truancy in secondary schools).

3. Development of Testable Hypothesis: This provides both a *focus* for the research and a clearly defined *objective* for data collection - the researcher is now effectively locked-into a *systematic design* for identifying, collecting and processing data. Before they can actually start to collect data, however, the researcher needs to *operationalise* the various concepts in the hypothesis that require definition, testing or measurement.

For example, if our hypothesis was something like "Children who are bullied at school are more likely to truant than those who are not bullied" (not the world's greatest hypothesis, admittedly, but one that will serve for our current purpose) the researcher would need to define concepts like "truancy" and "bullying" and measure the concept of "more likely".

This, in a roundabout way, leads us to think about a problem faced by social scientists that is not generally faced by natural scientists, namely that many of the things we want to study and / or measure don't actually have a physical existence – we can't, for example, point to something called "bullying" and directly measure it (since it is simply a concept we use to label certain situations and actions – behaviour seen as "bullying" in one context may be seen differently in another). This problem can, however, be overcome by using *indicators* – things that *can* be measured. In this instance there may be a range of indicators of bullying we can define and subsequently measure.

A clearer example, perhaps, is provided by **Lindauer** (2005). In her review of research examining the educational properties of museums she noted that the question "Did the exhibition effectively communicate the main idea or message?" illustrates the idea of hypothesis testing within this type of research design. As she argues "The question…poses a *cause-and-effect relationship* - attending an exhibit will cause visitors to acquire particular knowledge or information" that can be measured and therefore tested (once the concept of "effectively communicate" has been operationalised and quantified).

4. Systematic Observation and Data Collection: The researcher starts to think about who they are going to research (their *sample*) and the research *method*(s) they will use.

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Just as the overall research design involves making choices at every stage in the process, so too do choices need to be made relating to samples and research methods (we've previously identified a range of research method choices – from questionnaires to covert participant observation. The idea of "systematic observation" is important because it clearly reflects the nature of this type of design –everything, in terms of researcher effort, is effectively channeled towards testing the hypothesis; anything that deflects the researcher from this goal is a distraction, of no importance to the research and is to be ignored.

5. Data Analysis: This may take a couple of forms:

a. Technical involves things like:

• Checking to ensure sufficient data have been collected.
• Ensuring the sample used has remained representative.

b. Interpretive involves making decisions about the *meaning* of data collected. This might, for example, involve discarding "irrelevant" data, as well as more straightforward data analysis – something that may be simplified if, as is highly-likely with this type of design, quantitative data has been collected.

6. Testing the Hypothesis: This involves deciding – on the basis of the data analysis - whether or not the tested hypothesis has either been:

7. Falsified: If the hypothesis is false a decision has to be made about whether it should be totally rejected (**8**) or whether it can be revised and **re-**tested (a return to step **3**).

9. Confirmed. If the hypothesis is confirmed it contributes to the final stage in the research process:

10. Theory Development: In everyday language, a *theory* normally means something that has *not* been tested ("It works in theory, but not in practice", for example). Sociologically, however, a theory consists of *confirmed hypotheses* that can then be used to predict (**11**) the behaviour originally observed (step 1).

In this instance, for example, our research might have shown that those who truant from school have a particular characteristic (or set of characteristics) that allow us to predict how children with those same characteristics will behave when they start secondary school.

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The Simulation

In the following we'll assume you're teaching research design / the Hypothetico-deductive model and you might want to preface the sim with a short introduction to "science and scientific thinking", how science is different to commonsense, faith, everyday thinking etc. Alternatively, just introduce **Popper's** model, a definition of an hypothesis or whatever.

preparation

At some point prior to the lesson you need to recruit a student in the class to be your **secret confederate**. Choose this student carefully because they have to be someone you can trust to play-along with the trick. If they fail to follow your instructions the trick will not work (assuming you can't really read the mind of each of your students…).

You need to agree with your confederate one of the following:

a. A single word (such as "mother")

b. Two related words (such as "mother and father")

c. A single sentence (such as "my father is an accountant")

If you choose a sentence to "mind read" this makes the trick more impressive. If you choose a single word, however, it increases the chances your students will offer the opinion that you were somehow able to guess the word they are going to write down on a piece of paper and put in an envelope as the basis of the sim. Alternatively they may suggest you were able to read their word as they wrote it etc. In other words, you need to tailor this preparation to your class because one of the objectives here is for them to construct testable hypotheses to explain your apparent ability to mind-read…

Cut a piece of A4 paper into *identical* small strips – enough for the students to write a single word / sentence. By using identical pieces of paper it's unlikely students will inadvertently recognise their piece when you do your mind-reading…

the practice

Casually inform class that you can read their minds. Tell them to write any word / two related words/ sentence on the piece of paper you give them and to place the paper into an envelope that should not be sealed (you should make a big play about not sealing the envelope, not because it has any effect on the outcome of the sim but because it will give the students another explanatory possibility for your mind-reading – that you were somehow able to look in the envelope to see what each had written). Tell them they should not fold the paper. This, again, will give them another chance to "explain" your ability.

Randomly collect the envelopes but make sure your student collaborator's envelope is at the **bottom**.

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Make a big play of examining the outside of the top envelope carefully, holding it to your forehead, holding it up to the light (another "hypothesis" opportunity for the students…) or whatever and then say the word / sentence you've agreed with your secret collaborator.

They should act surprised (another reason for choosing carefully) and say something like "That's mine" / "That's exactly what I wrote!".

Open the envelope to "check" you were right (without letting any of the students see the piece of paper) and silently read what another student actually wrote (i.e. what is in the envelope at the top of the pile you're holding). Confirm you were correct (again without letting the students see what's actually written on the paper) and quickly dispose of the paper / put it somewhere where it can't be seen (such as your pocket).

Take the next envelope from the top of the pile, repeat whatever mind-reading routine you've developed and recite the word / sentence from the *previous* envelope. When the student who wrote it recognises it (amazing!) open the envelope to "check" you were correct (of course you were…). Read what the next student has written and silently dispose of the strip of paper as before.

The trick here, so to speak, is to always stay one envelope ahead and after 4 or 5 "reads" you can stop the sim so that the real work can begin (and also avoid arriving at the final, confederate's, envelope). This can take a range of different forms, depending on what it is you want to get across to your students. For example:

● If you've introduced the Hypothetico-deductive model you might want to take them through it step-by-step, stopping along the way to invite possible explanations for your amazing feat of mind-reading that can be turned into **testable hypotheses** – and tested. If a student suggests you were somehow looking through the envelope (because you held it up to the light!) test this by just looking at the next envelope on the top of the pile and telling them the word / sentence you read from the *previous* envelope – hypothesis refuted!

Depending on how the above goes, your confederate could "suggest" / hypothesise about how the trick was actually done (without revealing themselves as the confederate). Students could then test this hypothesis.

● If you're looking at the idea of variables (dependent and independent) the students can suggest ways to control for different variables (as in the "holding the envelope up to the light" example).

● Examine the idea of "confounding" or "extraneous" variables in the research process (it's at this point your secret confederate can suggest – or reveal themselves as – your "confounding variable" in this process).

● Explore the ideas of replication and reliability – could the students suggest slightly different (more controlled!) conditions under which the same "mind-reading" experiment could be carried out? If so, what would they discover?

Source: Unknown (sorry!)

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