CHIP-3
Concepts and history in psychology

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CHIP-3 8 Oct 2013

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Lecture 3:

Experiments (cont.)

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Why experiment? (recap)

The triad only requires observation / data / empirical studies for its 3rd leg We might, perhaps, distinguish 4 stages for the "triad leg" of observation:

1. Collect and remember any cases you come across
2. Enhanced: you go out of your way to do more: collecting trips, measure properties (not just remember seeing them) e.g. rainfall measures.
3. Learn by exploration: fiddle with new and unexpected cases to reveal more of their properties. Dissection. Reassembly. [Henry Cavendish]
4. Full-on experiments to isolate causal factors.

Why do some people (especially in psychology) think experiments are strongly preferred for the role of observation?

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Step 1 of observation:
Cases you came across and remember

Anecdotes

The two people you happen to know with depression

Step 2 of observation
Active collection and measurement

Collecting butterflies

Bird watching

Recording rainfall daily

Pasteur observing incubation periods, scum on top of ferments, ...

Depression and sleep: asking a depressed person if they are sleeping all right.

Step 3 of observation
Active manipulation and invasive observation (and measurement)

Dissection. Taking something apart (and reassembling it)

Cavendish: not just making hydrogen, but burning it in air to re-make water.

Pasteur: what kills bacteria? how much heat? differences between species, differences with/out acid.

None of these explain the effects, but accumulate knowledge.

Step 4 of observation

Experiments

In reality experiments can be done for multiple reasons.

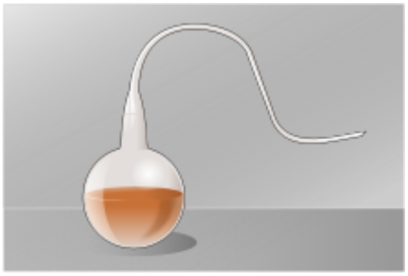
Pasteur seems to have lived and breathed experiments: it is what he wanted to do 16 hours a day, all his life.

We might call all of them experiments because they all used similar apparatus, were done in the lab when possible (but in the field when not).

But he commented on how they served three different purposes:

a. Giving him ideas, changing his understanding
b. Convincing other neutral scientists
c. Convincing (crushing) his opponents

Swan-necked flask (Pasteur)



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Why experiment? (1)

This is really (only) using experiment for Pasteur's 3rd goal: crushing opponents; compelling belief.

Expt. does 2 things:

A] Isolates one factor from all others

B] Establishes causal direction.

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Why experiment? (2)

A] Isolating one factor from all others

Expt. isolates one factor and varies it independently [the independent variable], and shows the links of that factor independently of others.

For these purposes, demonstrating causation is only useful as one means to the end.

If you have established what factors are independently active, then you can consider creating new combinations which haven't occurred naturally (at least in your samples).

We never know all the factors.

Does this work even if it is not you manipulating, but pre-selecting subsets of people? [Homework 2]

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Why experiment? (3)

B] Demonstrating causal direction

Correlation vs. experiment.
Fixes the direction of causation.

BUT:
Bertrand Russell: the most advanced science does NOT talk about causes but relationships.

Causation (apart from establishing the independence of factors) is for applied projects.

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Why experiment? (4)

How important is experiment? [ethology, spontaneous generation]

But: there are few experiments in astrophysics, or evolution, or epidemiology. So there is a lot of science that doesn't use expt.

Bertrand Russell: the most advanced science does NOT talk about causes but relationships. So arguably, causation is what engineers need to know, but isn't important in most pure science.

Homework: in what areas does psychology NOT use experiment? Is this OK?

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Causation (cont.)

2-way causation; 3 part relationships

Even if you are focussing on causation, it may not be 1-way

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Causation (cont.)

I pointed out that establishing causation and its direction was one of the special properties of experiments.

But I also raised the view that causation is NOT the central feature of science. It is in fact essential to applications, not to all theory.

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Multiple Causes

Even simple events always have multiple causes, even though ordinary conversation (and the blame game) almost always assigns a single cause. Why? because most of the time we are deciding what one thing to change.

A glass falls and shatters. Why?

Who thinks there is really one main cause for an event?

Multiple causes corresponds to studies with more than one independent variable
Brown & Harris. Multiple interacting causes.

3-part relationships where not one but 2 independent vars determine the person's behaviour e.g. in deep and surface learning.
=> So an experiment that demonstrates one cause may not tell the important story. (Effect size.)

Correlation and causation

- A causes B
- B causes A
- A third factor C causes both A and B not necessarily at the same time (the electrical discharge of lightning causes both flash and boom, light and sound arriving at different times).
- A and B both increase (cause) the other, as in any positive feedback loop (vicious circle). Or each decreases the other (negative feedback loop cf. homeostasis). *(See next slide.)*
- A ≡ B. Tautology / identity. A and B have to occur together because they turn out to be the same by definition. E.g. miles and kilometres measure the same thing, and are always perfectly correlated. (Mass and weight.)

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Causation not 1-way

A and B both increase (cause) the other, (positive feedback loop)

- Two adjacent blocks of explosive: if one goes off, it will set off the other
- If person A annoys B, B is likely to retaliate
- If a student's motivation is high they are more likely to learn, but if they succeed at learning their motivation will rise (so motivation is often an effect, a symptom, not a prime mover)
- If A sees B as beautiful A is more likely to be attracted to B, but if A loves B then A is more likely to see B as beautiful.

Such 2-way causation is usual in human psychology. Arousal, .. group laughter, perceived attractiveness, ...

Negative feedback loop
Dieting: the forces of stability. Mood self-remediation. Student auto-compensation for bad lectures.

Why experiment? — recap

A] Isolates one factor from all others

B] Establishes causal direction.

A] is central to "pure" science
B] is central to applied science

Causation is NOT the central feature of science. It is in fact essential to applications, not to all theory.

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Part 4:

Kuhn, critical thinking, RMS

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Kuhn

Thomas Kuhn “The structure of scientific revolutions”
Buzzword “Paradigms”

In fact in real life scientists can be very slow to abandon disproved theories. Why?

- Personal vanity, inability to change ideas, …
- Science as sociology, anthropology [Read Bruno Latour] Kuhn was vastly more important to social scientists than to physicists

But perhaps there is a different angle on this: Critical thinking, "reason maintainence systems", ….

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“Reason maintainence systems”

A little considered everyday mental activity, which is also a version of critical thinking aimed at decision making under uncertainty, is “RMS”: maintaining provisional knowledge as a network of linked ideas. When contradiction is detected, this is adjusted by finding an assumption that can be abandoned to retain the maximum overall probability of the revised network.

We do it to understand everyday stories.
In CT we do it to give our best overall judgement on balance.
In science, it would lead to what Kuhn described: it takes more than one little data point usually to abandon a big network that explains a lot.

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Pure and applied science are different

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1) They have a different logic

The Newtonian triad applies to pure science; where the aim is to uncover universal laws that are true everywhere for all time, but may be negligibly small in their effects in some contexts. The approach is to isolate the one law you are interested in (“control” away all other causal effects). Truth over as many contexts as possible is the goal, not effect size.

Applied science is fundamentally different in its characteristic logic.
Its measure of success is benefit to real people in real contexts.

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1.2) Pure vs. applied

“Pure” focusses on a single cause and all its consequences

“Applied” on (achieving) a single effect and all its causes (necessary and sufficient conditions)

Applied success depends not on one law/factor, but on all the factors with significant effects in the context: just like running a business.

On the other hand, you can ignore true things if they are small:
Effect size not universal truth is what matters.

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1.3) Applied: how it works

The first step in any problem is to find out what the biggest factors are; or the biggest factors you could possibly influence.
(Why effect sizes are important in applied science.)

The measure of success is not discovering truth but helping people (patients cured, learners attaining more, bridges that carry traffic).

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2) They entail different research programmes

The different logics for conclusions entail different research programmes i.e. sequences of studies. This is important in conducting research, and in doing relevant critiques.

A programme for pure research will tend to go for identifying one single cause, learning how to control away all other causes, and then showing that (with appropriate controls and counter-balances) this factor is active in as wide a range of populations and contexts as possible.

A programme for applied research will tend to go for developing a procedure that is effective in real life contexts: e.g. a drug works on cells, then on rats, then on humans in the lab, then when given by a paramedic in remote rural village without safe water or electricity to keep it in a fridge. *[my first aid training]* 26

2.1) Shayer

Three stages for applied educational research:

1. Studying the primary effect
   (establishing that with the new method a gain is possible at all)

2. Replicating it without the original researcher.
   (Generalising to A.N.Other teacher, showing it can transfer.)

3. Generalising it = Teacher training
   (rolling it out to teachers who were not volunteers).

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