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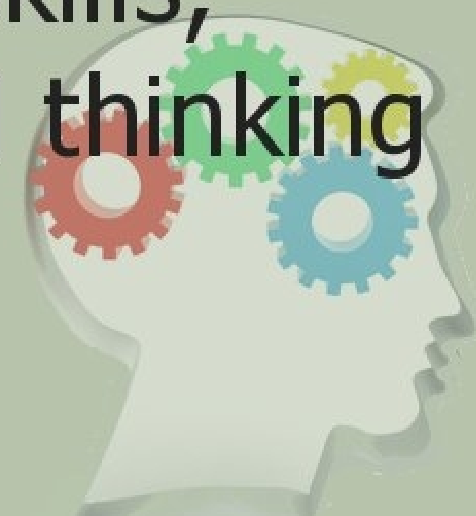
How to study psychology

A plain-English guide to study skills, accelerated learning and critical thinking



LEGAL INFORMATION

How to study psychology: A plain-English guide to study skills, accelerated learning, and critical thinking.

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Contents (*preview version – first 23 pages only)*

Introduction

I know you

Welcome to this study guide for psychology students by Warren Davies. I think I know you. At least, I know about you. Since you have bought this book, I'm fairly safe in assuming you're a psychology student (if not, you're almost certainly studying a science of some sort, and you perhaps feel a little tinge of anxiety about whether this book is applicable to your subject – it is). As a student, money is a little tight for you, and you're hoping this was a good investment. Having said that, perhaps you obtained this book through means other than direct monetary investment: shame on you! You should at least go to http://generallythinking.com and make a donation.

What else do I know about you? I might deduce that you're one of the people who actually cares about their course, and you want to get something out of it. You want a good grade, you have a career goal in psychology, or you're just the type of person who likes to do a good job in everything they do. You're probably already doing fairly well on the course, but you feel some motivation to do better. This is not the first study guide you've read, is it? Relax; I'm not the jealous type. You can read around.

Or maybe I've mistaken you for someone else. You're on the eve of a deadline, or your exams are looming. You bought this book to help you get through this ordeal alive! Left it all to the last minute again, didn't you? Don't worry; everyone does that. But, you've bought a study guide, so you're certainly not a slacker; you have ambition in you. Admit it, you secretly believe you're capable of doing really well on this course. Maybe sometimes when you're on the train or the bus, you even allow yourself to daydream about getting top marks. It's OK; your secret's safe with me. (By the way, de-clutter your desk; you'll feel better).

You feel pressured sometimes, though. There's a lot to do on this course, isn't there? Sometimes it feels like there's so much to remember, so much to do, and so little time! Sometimes it's hard to find a balance between studying and having a social life. Sometimes you have to make a choice between the two. Social life usually wins. But you wish you could have both. That's part of your motivation in buying this book – you want to do well academically without sacrificing your personal life – or vice-versa!

Have I described you? Maybe I haven't pinpointed you exactly, but you recognise bits of yourself here and there.

So as you sit there, hopefully having made the decision to put this book at the top of your 'To Read' list (which is the right decision, incidentally), let me thank you for your purchase, and express my hope that this book won't end up on your "Books to read later" list.

The philosophy behind this book

If you break a task down into it's constituent parts, then figure out better, quicker, or more efficient ways of doing those individual things, you can improve your performance on the overall task. The organisation of this book is based on my subjective breakdown of what is fundamentally involved in studying for a psychology degree, and a collection of different ways you can improve within each of these areas.

But, we're all different. Not everything in these virtual pages will appeal to you - or work for you - in your specific situation. If you're struggling with a particular class or aspect of studying in general, figure out where in the following areas the problem might lie, and try some of the suggestions to fix it. Customise: try things out, notice the results, and feel free to modify and adapt the ideas as you go. As Bruce Lee famously said: "Absorb what is useful, reject what is useless, and add what is specifically your own."

How the book is broken down

I have broken down the studying process in psychology into 7 main sections. These are:

FOUNDATION KNOWLEDGE

- ***Research Methods in Psychology***

- ***Statistics***

STUDY SKILLS

- ***Getting information in***
- ***Keeping information in***
- ***Understanding information***
- ***Getting information out***
- ***Organisation and productivity***

Most of these are self-explanatory. After getting an understanding of the foundations of the field (trust me: they're not as scary as you might think), we move on to actual study skills; how to find, not forget, and understand the information you need for your course. Getting information out gives you strategies and tips for your written assignments and exams, and the final section explains how you can make better use of your time.

How to use this book

If you want to read this book cover to cover, you can. But it's not necessary to read it in that way. You *are* supposed to read it all, but the order is up to you. It's a reference book, the electronic equivalent of something you'd leave on your coffee table.

Skim through the book and the contents, and locate sections that you think are most pertinent to you. Start with those. If you're doing research for an essay, go to page 49, if you're having trouble understanding something, go to page 75 for the relevant information . On the left of every page there is a menu bar, which lists the main sections of the book. If you click any of those sections, you'll be taken to that part of the book. Once you're inside a particular section, that part of the menu bar will open up and you'll see all the sub-sections within it. This means that no section of this book is ever more than two clicks away – a nice advantage of an ebook that you don't get with a print one.

Ultimately, you're in control; feel free to jump around as you like, reading whatever part interests you at that particular time.

If you're reading this book linearly, we're going to start by looking at research methods and statistics. I know, I know, you hate them. But don't worry, we're not going into too much depth and there's no scary equations or anything like that. This stuff is the foundation of your subject, and it will be a huge advantage for you to – at the very least - get a broad understanding of *why* all this stuff needs to be a part of the study of the mind and behaviour. But I hope to give you a bit more than that.

Research methods in psychology

"Social science is an example of a science that is not a science. They follow the forms; you gather data, you do so and so [to it]… but they don't get any laws! They haven't got anywhere. Yet." - Richard Feynmann

If I was there at the time Feynmann said that, I might have debated the point with him. Since he was a Nobel Prize winning genius, I'd have lost, of course; but that's not the point. In my view, a field isn't classed as a science based on whether it has discovered any laws, but rather, on whether they "follow the forms." In other words, whether they use the scientific method to try to find out about the world.

Much to the dismay of many first year psych students, fresh with enthusiasm from the latest episode of *Profiler* or *Lie to Me*, psychology does use the scientific method. So if you want to understand the field, or do well in your course, the first step is to build an understanding of what science is, is not, and why. This feels like the donkeywork for most people, and maybe you'd rather get stuck into theories of behaviour than the philosophy of science. However, the scientific method is the foundation on which all that other stuff is built. If you don't get a handle on this, you will:

- Find every journal you read difficult to understand
- Be liable to make mistakes in your work and have a weaker grasp of the subject
- Get lower marks than your classmates who *do*

understand it

- Become more frustrated as time goes on

But if you **do** get a grasp of this, you will:

- Be able to understand journal papers more easily
- Be able to criticise studies and theories more easily - which is **essential** if you want to get a good grade
- Have a better grasp of the field as a whole
- Have the edge over your peers, most of whom do **not** have this knowledge (you do know you are graded relative to your classmates, don't you?)

If you've seen *The Matrix,* you'll remember the scene where Neo finally saw The Matrix for what it is; from that point on, everything changed for him. That's what you'll be like when you understand these foundations. Everything will just *make sense*. You're *the one*! And you don't need to be a Nobel Prize winner to get these benefits either. Just a basic grasp will be enough, and these sections will give you that. I'm not going to tell you how to do all the calculations and analyses: only how to understand journal papers. So don't worry; the technical terms might seem complicated at first, but you'll get used to them, and there's no maths or calculation to do (I promise!).

The truth of the matter

All scientists, including psychologists, are seeking 'the truth'. Like most people, they believe that there is an objective world 'out there' in which we all live, and that having accurate information about this world is 'a good thing'. These are pretty much the only assumptions scientists make.

So what's the best way to find out about the world? Well, we could make some observations, and jot them down. That could work. But what if you observe one thing, and I observe something else? Or what if we observe the same thing, but interpret it differently? We both have our own perceptions, biases, and perhaps even reasons to lie. How would a third person know, to the highest level of accuracy, which one of us was right? Would they make their own observation? Trust their gut? Ask their mother?

What is science?

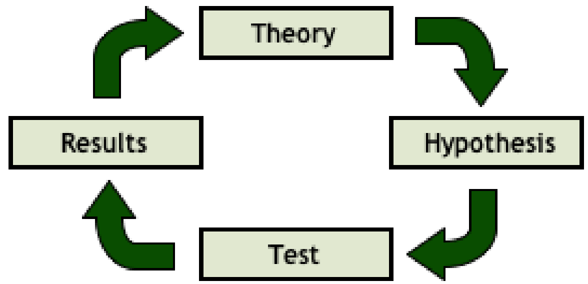
Science is simply a tool, a system that people use to get around problems like the ones above. Every rule and procedure of the scientific method exists because it is the best way we currently know of to get **objective** information about the world, and to get around problems like our own biases, propensity to lie, and inaccurate perceptions. What scientists are looking for, specifically, are **cause and effect** relationships between different things (the technical term for 'thing' being *variable*).

But the scientific method is not always followed so precisely. Even with all the rules and procedures that have been devised, it is not a perfect system. That's why you need to know the rules so you can see when they've been broken. Scientists are human and this does happen, particularly, you might argue, in psychology.

When these different rules are broken, it calls the results of a study ever-so-slightly into question. The bigger the rule that is broken, the more suspect are the results. You need to be able to recognise this.

You also need to know the rules so that you can weigh up the evidence of competing theories. Very often, there are two or more different theories claiming to explain the same thing. You might look at the research for these theories, and think "In these studies they did not select participants randomly, in this one they didn't use enough participants, here they used the wrong type of analysis." When you can work out the strength of the evidence, you're in a better position to know which of the theories is the strongest, the most likely to be correct. Don't worry; I'll tell you what to look out for in the pages ahead.

The Scientific Method



The following sections explain each step of the scientific method, and some of the issues involved with them. This is not a comprehensive coverage; I've cut it down to the minimum you need to know to get the largest benefit, and you should continue your study using the books I recommend throughout and the articles at http://generallythinking.com.

There are many technical terms and issues involved in science and in research methods, and unfortunately they all have intimidating names. When your lecturers throw terms at you like independent variable, statistical significance, and unfalsifiability, it can be quite intimidating. It was for me, anyway.

What I have done with the following sections is describe each of these terms at the most relevant part of the scientific process. I'll give a few examples along the way which I hope will be memorable.

Take a few minutes to skim through all the steps before returning here to go through again in more depth.

The Scientific Cycle

One way of picturing science is as a cycle (pictured opposite), where theories about the world are continuously refined through systematic testing.

This whole process relies on having questions to ask - wanting to know something about reality that we don't already know, or wanting to test something that we think we know, but might be wrong about. There are many ways we might come up with a question:

- By observing something in your life, and wondering how or why it is like that
- By having knowledge of existing theories, and identifying a direction for future research
- By noting that some previous experiments were of poor quality, and deciding to replicate them in a more thorough way

...and so on.

At any point in the cycle, a question can be devised. The cycle moves around, hypotheses are created, tested in experiments and the results of these tests are used to refine theories. Then a new hypothesis is created, tested, and the cycle repeats continually. We'll look at each of these steps individually.

Theory

Science doesn't prove anything.

Journalists, TV presenters, and advertisements often say that scientists have 'proven' something, but this is never true and only adds to a general misunderstanding of science. There is no such thing as a scientific fact. All science can do is report what happened in an experiment, under the **very specific conditions in which it was conducted**. Which, if you think about it logically, makes perfect sense. For example, right now, I am typing this with one hand (somewhat slowly), and in the other hand, I am holding your average office-variety pen. Science cannot say with 100% certainty what will happen when I drop this pen. Let's try.

OK, it fell to the desk, just as the theory of gravity would predict. They key word here though, is predict. No scientist has ever been in this room at this exact time and conducted this experiment, so, in a very technical sense, no one *fully* knew what would happen. All we can do is make a prediction based on our existing knowledge and experiences with dropping things. Illusionists and magicians use this to their advantage when performing; their tricks violate our expectations and seem to go against our existing knowledge of how the world works.

To put this another way, science is not able to verify claims, only falsify them (or fail to do so); and failure to falsify a claim is not sufficient as affirmative proof. As Albert Einstein famously said: "No amount of experimentation can ever prove me right; a single experiment can prove me wrong."

So how does a theory fit into all this? A theory is a more formal version of that existing knowledge. It is a higher-order idea, a description of some part of this objective world we all live in. We can use a theory to make predictions about the world, and we can test these predictions under very specific conditions.

Although it's impossible to test a theory in every possible situation, once we've tested a theory very thoroughly, we can be pretty sure we'll get the same results in future tests; as long as the conditions are not drastically different to the ones we've already tested. Although no one has dropped the same pen in the same place at the same time as I did just now, we all knew it would fall. Enough pens have been dropped that we knew what would happen.

So, the more of these 'very specific conditions' in which the theory has been tested, the more likely it is to accurately reflect the objective world 'out there'. It's kind of like having more legs (tests) to support a table top (theory).

When a theory is strong – that is, supported by the results of many tests - we are able to make accurate predictions from it. Newton proposed his theory of gravitation in 1687, which he used to explain the orbits of the planets. Something that was of great interest to later scientists was Uranus (the planet, that is. I know what you're thinking).

When the movements of *the planet* Uranus could not be accounted for using the movements of the other planets, Newton's theory predicted that there was another planet up there. Later, Neptune was discovered, which was obviously strong support for Newton's theory.

This is how science progresses. Theoretical models of the world 'out there' are made, and scientists ask themselves; if this theory is correct, what else might be true? Then they go out and see if that particular 'what else' really is true. The results might support the theory, or they might not, in which case the theory might have to be modified.

This is an important point. A theory is only useful if it can be put 'on the line', just like Newton's theory. Had Neptune not existed, Newton's theory would need to be looked at again in light of this new evidence. Some theories cannot be placed 'on the line' in this way. For example, the existence of a God. God is 'theorised' to be omnipotent, and omnipresent. It's impossible to formulate a test that could disprove the existence of a God, because you can always say "God made the experiment results turn out that way." You might mention religious texts which explain what God does and does not do. But again you have the same problem; how do you test this without assuming something to begin with? Another example is psychic powers. If a psychic fails to demonstrate his psychic abilities in a fair test, he can always say "The skeptical vibes around me interfered with my powers." I love the superhero character in the movie *Mystery Men*, who can turn invisible; but only when nobody is watching!

Maybe there is a God. Maybe there isn't. Maybe people are psychic. Maybe they aren't. The point is that these ideas cannot be tested; they are **unfalsifiable**. There is no conceivable way that they can be put on the line. In other words, it is impossible to find out whether the table top has legs. Science cannot be used to investigate topics that are unfalsifiable.

Special note on "It's just a theory!"

I was watching a debate on whether Creationism should be taught in science classes in public schools. There are only two TV shows that have actually made me throw my shoes at the TV screen, and this was one of them (the other was that abomination, *Big Brother*).

"Today's topic," the presenter says: "should Creationism be taught in science classes in public schools?"

Whack! Goes the first shoe…

One debater speaks up "Of course! Creationism is just as valid as any scientific theory!"

Smack! There goes the other one…

"You have to remember," he continues, "evolution is *just a theory!*"

The TV is lucky I only have two feet!

"*It's just a theory,*" is a common and nonsensical argument used against scientific theories by non-scientists (and they almost always start with "You have to remember", for some reason). The logic is that 'theory' must equal 'not fact', because this is how it is used in common vernacular: "This should work *in theory,*" "She doesn't really know, she's an armchair *theorist*." But in science, the word 'theory' is used whether the theory has 100 studies refuting it or 10,000 studies supporting it. Some theories are false, some are as close to being fact as science is able to give us. Don't get caught on the word 'theory'.

Hypothesis

Once a theory has been drawn up, scientists will go out and test the theory. To do this they create a *hypothesis*, which is a prediction about what might be true in the world, assuming the theory is correct, with the aim of testing these predictions against reality.

Suppose you have a theory proposing a number of physiological changes that occur through the practice of meditation. One of these is that some forms of meditation can increase body temperature. You wonder why this might be, since meditation is a relaxing state in which metabolism tends to lower? Your specific hypothesis, then, might be that this process works through vasodilation, rather than increased metabolism. If you tested this hypothesis, you might get results similar to Benson (1982), who recorded increased skin temperature during a form of 'heat' yoga, but not increased rectal temperature, as measured by a 10cm probe. The things people do for science.

The trick with hypotheses is to:

(a) make sure they really test the theory in question, and

(b) make them specific.

It's quite easy to come up with theories about the world, but it's a bit tougher to think up testable hypotheses that represent a real way of testing those theories.

So, the hypothesis is the thing that is being predicted. In science, there is *always* one or more specific hypotheses. A study is never conducted without making a prediction, just to "see what happens". This is because if you go out and collect a load of data, there are myriad ways you can cut it and slice it to make one point or another. Seriously; in any worthless data set you can probably find *some* fluke finding or other to report about. If we build theories on results like this, they would be flimsy and poor predictors of the real world 'out there'. Instead, we put our theories on the line – expose them to potential refutation. If they fail to be refuted over and over, we assume they are strong theories.

Because of this, pretty much all the statistical analyses that are done in science revolve around the fact that a hypothesis has been drawn up and is being tested. We'll come back to this point on page 29 when we talk about the null hypothesis.

Test

We've looked at a theory and drawn up a testable hypothesis. The next step in the scientific method is to design and carry out a study that will put our hypothesis to the test. As you'll see, this is not always as easy as it first seems.

First let's cover two broad types of study (methodologies) that scientists use.

Qualitative and Quantitative methodologies

Quantitative methodologies include anything that involves numbers (basically). How much? How many? Anything that is measured by being quantified, is quantitative. Pretty simple.

Qualitative methodologies include anything that involves words (basically). Labels, descriptions, narratives, diary entries. Anything that is written in words is qualitative.

Science is very heavily biased towards quantitative methods, and many students are relieved when they learn about qualitative methods, which might involve things like looking for themes and patterns in interviews. Typically, this involves going over the interview transcriptions, again and again, looking for the patterns. By the way, if you ever have to transcribe a number of interviews yourself, find a transcription service online – it could save you hours of time and some are very cheap.

Whether you do qualitative or quantitative research depends on what you're studying, and what work has already been done in the area. There are advantages and disadvantages to each.

Qual or Quant?

Qualitative is usually described as providing 'richer' data than quantitative. When you give a quantitative questionnaire to someone, you are forcing them to report on things in your specific way, and reducing their whole experience down to a number. This might be appropriate, it might not; but either way, you'll miss out on a lot of information about the participant's experience. On the other hand, qualitative data is harder to compare, and is more subjective than quantitative – different researchers might find different themes in the data, for instance. Quantitative is cheaper, quicker, and more objective. It allows you to measure and generalise data more accurately, and make better comparisons between groups of data.

Plus certain things only make sense quantitatively like height, weight, age, *etc*. Remember our meditators and the rectal thermometers? Imagine if that study was carried out qualitatively. What would you do, interview the participants and ask them if the temperature of their skin is higher then, *ahem*, elsewhere? It doesn't make sense to do that qualitatively. The results would not provide a solid leg for the table. On the other hand, imagine using quantitative data to collect information on how people cope with a terminal illness. You might ask, on a scale of 1 to 7, how often do you feel stressed, how much do you reach out to others for support, and so on. But by only giving the participant the option to tell you about certain things, you'll never capture the full story.

Usually in psychology, quantitative is used, and you'll rarely come across major qualitative papers unless you pursue an area of psychology that likes to use such methodology (such as social constructionism). One reason for this might be that there are so many more types of analysis that can be done on variables that are measured quantitatively. Reminder: a *variable* is just a 'thing' that you are measuring or manipulating. For example:

- age
- weight
- gender
- happiness
- extraversion
- attachment style

…are all variables.

When designing a study, scientists have to decide what variables they are going to measure. The most important two variables in a study are called the independent variable (IV) and the dependant variable (DV).

The IV and the DV

This tends to confuse people at first, as they are easy to get mixed up. The variables that the experimenter **manipulates** in the study are the Independent Variables, or IVs. The variables that are **measured** are the dependent variables or DVs. Here's an example.

I'm studying the effect of reality TV shows on the desire to throw shoes at the television screen. I might split my participants into two groups – one watches a reality TV show, the other watches something else, like a wildlife documentary, or perhaps just a blank screen (this second group is the **control** group). I put a few reasonably aerodynamic shoes near the participants, and measure how many were thrown over the course of the shows.

What is the IV in this case? what am I **manipulating**? I'm manipulating what people watch on the TV. One group watches reality TV, the other doesn't, so I'm manipulating the participants' viewing experience from one group compared to the next.

What is the DV? What am I **measuring**? It's the number of shoes thrown. This, I hypothesise, is **dependent** on what people watch on TV. Remember it like this: the dependent variable is *dependent on* the independent variable.

Control

In the above example, why do we need to include a control group? Can't we just sit people at the TV and count how many shoes they throw? Nope, and in fact, any experiment that does not use a suitable control group is flawed. I'll use a more realistic example to explain.

Say we're testing the effect of a new drug on symptoms of depression. Our problem as researchers is making sure that any results we collect are an effect of the medication, and nothing else – as closely as we can. This is difficult for us, because many things can improve depression besides our drug - spontaneous improvement, the placebo effect, the attention from the researchers when giving the pills out. So we need to do a **controlled trial**; we use two groups, that we try to match as closely as possible except for one thing – the IV; whether they get the drug or a sugar pill. Both groups are equally liable to the placebo and other effects, so if our drug group ends up with lower symptoms, we can have more confidence that the improvement is caused by the drug.

However, if you were an unscrupulous pharmaceutical company, and wanted to make your drug look good even though it isn't, you could manipulate this system to your advantage. You could take all the people who look like they're on the road to recovery, and put them in the treatment group, and put all the hopeless cases in your control group. This way, all you have to do is keep the study going long enough, and hey presto, a positive result you can use to sell your drug. Of course, this is highly unethical and bad scientific practice, so researchers will try to assign participants to groups randomly. A **randomised-controlled trial** is the best methodology we have to help us determine cause and effect. If a study has a control group, but not random assignment (or if the method of randomisation is flawed, or not mentioned), interpret the results with caution.

This is **experimental control**. In science you are usually trying to measure the effect of *one* thing, so you try to control as many other variables as you possibly can. But there are pros and cons to experimental control. If we control too many variables, our results might not reflect the real, complex world out there. Here's another example.

Why do we find ourselves getting hot under the collar for certain people, and turned off by others? An evolutionary theory to explain this is that we have systems in our brain that respond to people who might be good mates and provide us with healthy children. To this end, it is thought that women prefer indicators of status, and men are more attracted to physical characteristics. Gueguen (2007) tested this theory, investigating whether breast size had a role to play in male attraction. To do this he conducted a test in a few nightclubs, to see if women with larger breasts would be approached more often by men.

Let's fill in the blanks of this study design based on what we've covered so far. The **theory** is the idea that male mate selection is influenced by the physical characteristics of females. The researcher did a literature search and found that breast size may be associated with attraction in males. From this, his **hypothesis** was that males will make more approaches to women with larger breasts in nightclubs.

Think about how you might conduct this study. Would you take 5 women with different breast sizes, and put them in five different nightclubs and see how often they are approached? Well, you could do this, but how would you know whether it was their breasts, and not, say, their hair style, that attracted the man? Remember, nothing is assumed, and everything is tested.

Of course hair style is not the only thing that might contaminate the results. Other problematic variables might be the body shape of the woman, her height, what she was wearing, the atmosphere of each nightclub, the music that it plays, the clientele it attracts. All these annoying things that get in the way of knowing whether breast size is what is really attracting the males are called **extraneous variables**. Extraneous variables are nuisances. The more of them there are, and the stronger their presence is, the further our study moves from being a true test of our hypothesis. They prevent us from properly testing our theories, and hence, keep us from the truth.

So to get around these problems, the experimenter used the same woman, took her to 12 different nightclubs, and instructed her to wear the same clothes each time. The only difference was padding in her bra from the 'A' of her natural size to the 'B' and 'C' experimental conditions, that were chosen at random each night.

This is an example of how extraneous variables can be controlled. But it is impossible to control for everything. By conducting 12 tests, many variables like her mood, bodylanguage, or the confidence of men out each night might be averaged out. But maybe she felt more attractive or more confident when wearing the padded bra. It's conceivable that this was attracting the men, rather than the breast size itself. This is a special type of extraneous variable, called a **confounding variable** or **confounding factor -** it varies *with* the independent variable. It's hard to separate an effect caused by a change in the IV from an effect caused by a change in the confounding factor, because they change together – they correlate.

Given all the problems mentioned above, is it best to control for as many extraneous variables as we possibly can?

Controlling your way from reality

Maybe the woman's facial expressions were different each time. Maybe her posture was slightly different. What if the song that was playing made a difference to whether men approached her? So many extraneous variables! To totally control for all these things, what could we do? Put her in a white room and inject her with some drug to give her temporary paralysis? Or maybe we could take photographs of her and manipulate the IV with photoshop?

We could do this, and we'd certainly control for many variables. But the more of these variables we control for, the further our study gets from the real world in which we live. Distance from reality, in a sense, is an extraneous variable in itself. This is known as **ecological validity**. If you have made the conditions of your study so specific that people do not behave the same way when they are not in these conditions, there is little point to your experiment. Your theory refers to the real world, but your experiment was conducted somewhere else. So you can only provide minimal support for your theory – if any. This is **low ecological validity**.

Then again, the closer you get to reality, the less control you have, and, and therefore the more **extraneous variables** there are to get in the way of testing your hypothesis! What is the best way; more control, or higher ecological validity?

Both. Researchers conduct experiments under a variety of conditions, using different methodologies. They might do some studies under highly controlled conditions, some under more **naturalistic** settings (i.e., real world observations), and some that are in-between (like the nightclub experiment, for instance). Hopefully all of this evidence will point in the same direction, and support the theory. This is called **converging evidence**. A scientist's work is never done.

Types of test

It might be useful at this point to go over a few of the more common types of test that you will come across in your psychology degree. You should make it a goal to be able to recognise which of these categories any journal paper fits into.

True experiment

A true experiment is a test in which people were randomly assigned to the conditions (groups) of the study. This is not to be confused with random selection of participants from a population. Groups could be randomised using anything from coin toss to computer algorithm. The more random the better the test. With things like a coin toss or dice roll, there's always that little possibility of "Oh it landed on its side…better re-roll!"

A true experiment is the only study design that can make firm cause and effect conclusions. Typically, an experimental condition will be tested against a control group and while were on the topic, this is another thing to look out for in papers - many experiments lack proper control groups.

Quasi-experiment

A quasi-experiment is similar to a true experiment, except that group assignment is not random. So I might test a high income group against a low income group, or I may have already collected data for my treatment group, and then find a control group later. Quasi-experiments cannot tell us about cause and effect with full certainty, because we cannot fully separate an effect of the IV from an effect of our group assignment procedures.

Observational

Sometimes we just want to observe people and see what they do. Here we are the furthest away from making a cause-effect conclusion, because as we're not intervening in any way, we can't separate the variable we're observing from anything else. There are a two common study designs that fall into this category:

Longitudinal - A longitudinal design is one in which a group of participants are followed over time, typically many years. It is useful in cases where the variable of interest cannot be manipulated for ethical reasons. Although useful, we cannot determine cause and effect from this design, as we're not manipulating the independent variable.

Cross-sectional – This involves collecting data from each participant only once, and assessing the relationships within that data. This includes survey and questionnaire studies as well as literal observation studies.

Replication

Because science revolves around theory, a number of the customs and procedures of science are devised to find out if these very specific experiments really do support the theory. There might be a flaw in the methodology, or a problem with the analysis. However, even when the test has been carried out commendably, the experiment still needs to be repeated. This is called **replication**. Scientists replicate experiments for a number of reasons.

Firstly, even very well planned experiments still have the potential to throw up unusual results. Sometimes the results happen by fluke, and psychology is particularly susceptible to this because it deals with those unpredictable humans. In well-designed studies, the chances of this happening are small, plus you would take steps to prevent against this (using large sample sizes, randomly assigning participants to treatment or control groups, etc.); but it can happen and replication is a way of safeguarding this.

Secondly, maybe it's not the actual IV that's effective. Using the example of a drug trial, maybe the participants are excited to be trying out this cutting-edge treatment, which gives them optimism. And maybe it's this optimism that brings the benefit, not the treatment itself. You could also take steps against this; you could make the study **blind**, which means the participants do not know whether they are receiving the new treatment or a dummy treatment known to have no effect. In psychology, placebo exercises and activities are often used to the same effect as a sugar pill.

Thirdly, maybe you want your treatment to work so much that you *unconsciously* behave more kindly and optimistically to your treatment group. Again, there is a step you can take to prevent this; you can make the study **double-blind**. You would get a colleague who themselves does not know which is the treatment and which the dummy exercise to administer the interventions. In many cases however, particularly with mental health issues, you cannot get around this problem as it is unethical to allow someone who is not an expert to deliver such treatments - and an expert would be able to tell a real from a fake treatment. But it's extensively used in drug trials: a third party knows who is getting the real drug and who is getting the placebo, and tells the researchers at the end of the test. Another way of getting around this problem is to test an intervention that does not require one-to-one contact with the participant. The study might be conducted online using written instructions, taking care that they are phrased as closely as possible between groups.

The point of this, is that a single study is not enough to back up a theory – even when it's fantastically conducted. The study needs to be replicated numerous times, and carried out under different conditions and in different situations.

Results

The next step in the scientific method is the analysis and interpretation of the results. The previous steps exist to attempt to give us accurate results, and, as you have seen, this takes a lot of effort. Once the data has been collected, it will be analysed. There is a full section on the analysis of test results in the next section so I won't go into that here.

The researchers will then discuss whether the results support the hypothesis, and what the implications are for the theory from which the hypothesis was drawn. The results of the experiment, the discussion, and a full description of the test will be submitted to a peer-reviewed journal. The researchers' names will be taken off the paper, and it is sent to the reviewers of that particular journal, who will be other experts in that field. They will check the paper to ensure the test was conducted properly, that all relevant information has been included, and generally that it's not just a load of rubbish that someone sent in.

If the study was well conducted and controlled, and challenges the present theory, the theory will be modified in light of this new evidence – although usually not until after the results have been replicated. This is what stands science apart from other disciplines of knowledge – theories change in light of new evidence, as opposed to evidence being creatively interpreted to fit existing theories.

This does seem like a lot of work, doesn't it? The whole process from identifying a problem, designing and carrying out a study, and publishing the results, usually takes years. That's the major disadvantage of science – it is slow. However, speed is not the concern; accuracy is. People have the propensity get things wrong, and to lie to themselves (and others); that's why science needs all these complicated rules and procedures. If someone wants to use science to lie, it will be very difficult and costly for them to do, and it will be possible for other researchers to scrutinise the lie and expose it.

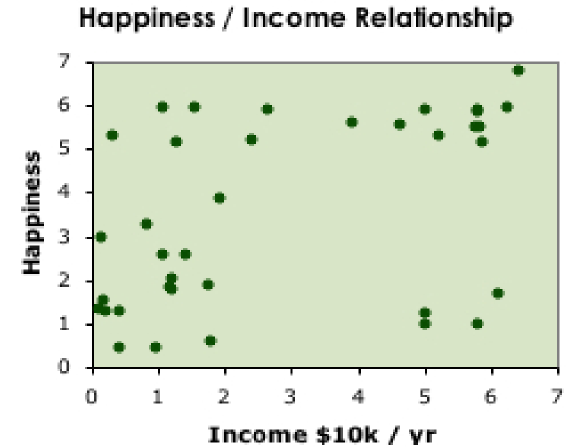
This is perhaps why the most common marketing method is not a properly conducted randomised controlled trial, but a testimonial from a happy customer. You've no doubt seen these in magazines, infomercials, billboards, and pretty much anywhere else you care to look. There'll be a quote from 'Bob' from Tennessee, who loves Acme facial scrub more than life itself. Related to testimonials are anecdotes; my personal favourite anecdote is the "*I know a person who…*" comment. "I know a person who smoked all their life and didn't get lung cancer, therefore it can't be true." "I know a person whose psoriasis was cured by homeopathy." "I know a person who…*whatever*."

Based on what you've read so far, what problems do you see with using testimonial and anecdote as evidence, in favour of scientific results? Let's look at a few:

- Selection bias – Testimonials are not randomly selected from the population, that's for sure. No matter what your product or claim is - whether it's some alternative remedy, special beauty cream, or psychic power - you can always find *some* people who swear that it works for them, that what you claim is correct.

- The placebo effect – If you tell enough people that a jar of coloured water will heal them, some will be healed through the power of their own belief.
- Belief bias – the human mind is programmed to give greater weight to arguments that agree with currently existing beliefs; we're not objective.
- They only look at one side of the story – how many people smoked all their life, but *did* develop lung cancer? What's the ratio?

Anecdote can be used to give the appearance of support for an idea, or the appearance of refutation of an existing example. In the former case, now that you've seen how careful scientists have to be about checking and double-checking every little fact, you can see how ridiculous it is to cherry-pick a few testimonials and call it evidence. It's not evidence. It's marketing. The latter case often means taking advantage of the probabilistic nature of the sciences - especially the ones involving people! For example, imagine this is the correlation between income and happiness (we'll discuss correlation in more detail on page 31):



There's a clear pattern; a correlation that seems to tail off at around $20k per year. But, there are still people outside of the main pack. These are called **outliers**. If you picked just those people and made a big show of it, you could probably convince people of something other than what the evidence really shows. And it doesn't matter how many testimonials you use, either, because they could *all* be cherry-picked. Remember this: "The plural of anecdote is not data."

The point of science is to arrive at results that we're as sure as we can be are accurate. These observations are then used to inform our theories. Unfortunately, despite all these safeguards, it is still possible for incorrect observations to slip through the net, either through error or design. Look into the track record of the pharmaceutical industry for some creative examples of this.

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