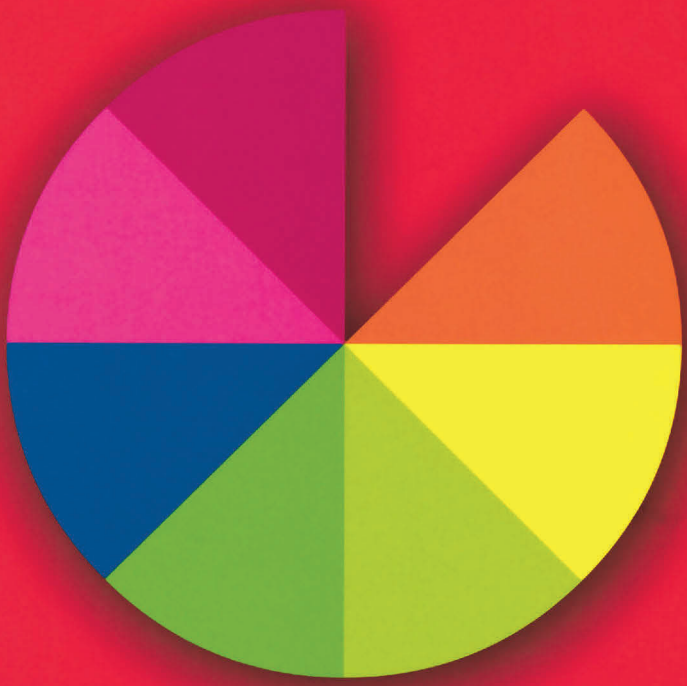
Introducing Research and Data in Psychology

A guide to methods and analysis

Ann Searle



PERSPECTIVES AND RESEARCH

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Introducing research and data in psychology

Perhaps the primary motivation for the study of psychology is simply the desire to understand behaviour. However, as Ann Searle reminds us in her introduction, if psychology is going to progress beyond 'common sense' argument, research must be conducted within a well-designed structure, results analysed and recorded carefully, and the findings presented clearly.

The aim of *Introducing research and data in psychology* is to help introductory-level students develop these abilities and, at the same time, to demonstrate that research design and data analysis are interesting and useful skills.

It introduces both experimental and non-experimental methods of research, and the analysis of data using both descriptive and inferential statistics. The uses, interpretation and calculation of common two-sample statistical tests are explained.

Ann Searle is a Principal Moderator for A-level and AS-level coursework.

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Introduction

When you decided to study psychology you may well not have expected to have to study methodology and statistics. This may have been an unpleasant surprise to some of you and rather a shock to the system.

I am not going to attempt to justify here the emphasis that exam boards place on this area but rather to try to help you get over the shock. I well remember an experience in my own student career when a statistician came in and spoke what appeared to me to be complete gibberish for an hour. After a little gentle therapy, however, I actually came to quite enjoy the subject.

If you are thinking that psychology should be about understanding behaviour and experience you are quite correct. Don't ever forget this point. Some people do seem to get so wrapped up in measuring variables and number crunching that they seem to have lost touch with what presumably interested them in psychology in the first place – understanding behaviour. However, if psychology is going to progress beyond 'common sense' argument we must conduct well-designed research, record and analyse our results carefully, and present the findings in a form which is clear to everyone.

The aim of this book is to help you to do this, and also to show you

that research design and data analysis are interesting and useful skills. Indeed, it can be argued that the ability to assess the quality of the research studies we may read or hear about via the media is a skill that all adults should possess.

A few practical points:

- Words highlighted in bold are included in the glossary at the back.
- Answers to the exercises are given in an appendix.
- Sample exam questions with marked examples of answers are included at the end of the text.

I hope you find the book useful.

Section One

- An introduction to
  - *Qualitative and quantitative data*
  - *The scientific method*
- Choosing a research question, aims and hypotheses
- Hypotheses, including
  - *The formulation of hypotheses*
  - *The wording of hypotheses*
  - *Research, experimental and null hypotheses*
  - *Why we have a null hypothesis*
  - *Directional and non-directional hypotheses*
- Independent and dependent variables

Preliminaries

In everyday life we all speculate about the behaviour of others: what does your ex-girlfriend see in that wimp? why did your friend go to see that film *five* times? We want to understand our own behaviour as well: what did that dream of falling off the Eiffel Tower mean? why do you remember so much more information as soon as you leave the exam hall?

What is the difference between this everyday speculation and the practice of psychology? The main difference is that psychology tries to find answers by conducting systematic research in order to collect

quantitative or qualitative data. Quantitative data involves measuring a variable using some numerical basis – for example, a bird-watcher counting how many birds visited their garden would be collecting quantitative data. Qualitative data, on the other hand, emphasises the interpretation and meaning attached to experiences – perhaps in this case a description of the enjoyment felt whilst watching those birds.

Psychology and common sense explanation

In everyday life our speculations are based on a limited range of observations from a limited range of people. Our own experiences are likely to be limited to a particular culture or subculture. Our speculations are often based on second-hand information, biased observations or subjective judgements. If psychology is to progress beyond the common sense level of explanation it must use better, more systematic methods.

As you study other areas of psychology you will see that not all psychological investigations fulfil these aims. (See Section Seven for further details.)

By learning about research methodology you will also be learning skills which will help you see the strengths, the flaws and the biases in other people's research.

Exercise 1

Would the following examples produce qualitative or quantitative data?

1 You count how many kittens there are in a litter.
2 You say, 'Ah – aren't they sweet'. Your friend says, 'Oh – I can't stand cats'.
3 You ask what my reaction was to a TV programme.
4 You count how many male and female characters have major roles in popular 'soaps'.

Academic psychology has attached great importance to the use of the **scientific method** – the dominant model of research used in the natural sciences (such as biology).

When using the scientific method it is the intention that research should be:

- based on **objective** observations or earlier research...
- from which are derived testable **hypotheses**...
- which are then evaluated via well-designed studies...
- which gather quantitative data...
- which is analysed and the results reported in such a way that others can examine, repeat or extend the findings.

Recently there has been increasing criticism of complete reliance on the quantitative-data-gathering aspects of the scientific method in psychology. Qualitative methods – such as the use of case studies – have always been a part of psychology, but were often seen as a supplement to 'real' research. Nowadays, especially in areas of psychology which deal with social issues, more use has been made of qualitative data by considering individuals' own experiences and their interpretations of situations – rather than merely measuring how they perform in those situations.

Exercise 2

Give four reasons why the observations that people make in everyday life about behaviour might be flawed.

It is assumed in this book that, whatever methods you choose to use, the order of events followed when conducting a piece of research would be:

- generating a research question;
- aims and hypotheses;
- designing your study; and

- analysing your results.

The book will also follow this order.

Choosing a research question, aims and hypotheses

You begin a piece of research with an idea that you wish to investigate. This may come from a teacher or a book, may be drawn from earlier research or from an observation of your own. It is important that you are clear in your own mind what the research question that you are intending to investigate actually is. If you begin with an initial broad area of interest you need to narrow this down to a specific area.

If the research is for coursework don't be too ambitious. It is easier to get a good mark if there is earlier research on which to base the study, and to write about in the introduction and the discussion section. It is also often easier if you have just one research question to investigate – you don't get twice the marks if you have two questions!

Having chosen your topic area, you will have to determine exactly what your aim is in the research. This means deciding two things:

- the *precise* area of the study;
- what the study is actually trying to achieve.

First in your report the *aim* should be stated reasonably precisely. 'The aim of this project is to look at gender differences' is too vague: what area of gender differences? what does 'look at' mean? Second you should explain the *purpose* of the study. Is it to extend or replicate someone else's work? to test a hypothesis based on a certain theory? to test an idea of your own? This has to be explained.

Hypotheses

A hypothesis is a prediction or testable statement which a researcher aims to test to see if it is supported or rejected.

You will come across different types of hypotheses:

- the research hypothesis;
- the alternative hypothesis (also called the experimental hypothesis);
- the null hypothesis.

The **research hypothesis** is a general prediction made at the beginning of the study as to what you expect will happen. It is usually written at the end of the introduction. An example might be 'Short term memory declines with age'.

The **alternative** (or **experimental**) **hypothesis** is the *operational statement* of the research hypothesis. That means that it actually states the precise behaviours or responses that are going to be used to measure the variable under investigation. An example for the above research hypothesis might be 'Digit span for numbers in people over seventy years of age is shorter than digit span for numbers in people under twenty years of age'. The alternative or experimental hypothesis is what we hope we will find to be correct. It is a precise statement in terms of the measurements that will actually be made.

The **null hypothesis** is the hypothesis that a statistical test actually tests. Siegel (1956) calls it 'a hypothesis of no differences'. An example might be 'There is no difference in the digit span for numbers in people over seventy years of age and in people under twenty years of age'. In other words it is a statement that there is no difference (or **correlation**) between the scores you have collected on the variables you are measuring.

It seems to have become a convention in A-level psychology that the alternative/experimental and null hypotheses are written at the end of the introduction, but it can be argued that they should be written in the results section.

Which hypotheses are you expected to include when writing a report?

It is difficult to give a cut-and-dried answer to this question because conventions vary from institution to institution.

- It is usual to include a *research hypothesis* at the end of the introduction to the study. This states the prediction – which has been derived from the theory or previous research described in the introduction – that you are going to test.

- You may also be expected to **operationalise** the research hypothesis so that it is stated as an *alternative/experimental hypothesis*.
- It has become a convention in A-level reports that you also write out the *null hypothesis*. At university you may find you are asked why on earth you did this!

The practice that I am going to suggest here is that you certainly include a research hypothesis in the introduction, and that you write out an alternative and a null hypothesis if you are going to receive marks for them! Thus for A-level psychology I would advise you to include them; in Higher Education you should be guided by your lecturers. Where you include them is up to you: some people write them out at the end of the introduction, whereas some people write them out in the results section along with the statistics testing them.

If you are taking an exam which involves short-answer questions on research methods and experimental design, you should know how to word all of these hypotheses as this is a common exam question.

Points on the wording of hypotheses

- You must be careful to word hypotheses clearly and precisely. While a *research hypothesis* might be phrased in fairly general terms, the *null* and *alternative/experimental hypotheses* must be 'operationalised'. 'Females are better with words than males' is far too vague: how will you measure how 'good' they are with 'words'? what age group are you testing? Your alternative/experimental hypothesis should indicate more precisely what you are going to test. Thus it might be 'Ten-year-old girls score more highly than ten-year-old boys in games of Scrabble'. You must make sure that the hypothesis clearly states *precisely* what you are investigating and identifies the variables that you are studying.
- There is some controversy over whether hypotheses should be written in the future tense ('There will be a difference...') or in the present tense ('There is a difference...'). Be guided by your lecturer

as to which they prefer. For a research hypothesis either is acceptable, but to be really correct alternative/experimental and null hypotheses should be written in the present tense.

- As the hypothesis is going to be tested in some way to see if it is supported or not, it is important that it only contains one **independent variable**. For example if your hypothesis stated 'There is a difference in the amount of aggression shown towards people who push into a queue if this person is a man or a woman or if they are over sixty or under twenty years old', what do you do if age seems to have an effect on aggression but gender doesn't? You cannot half accept a hypothesis. What you need is *two* hypotheses – one pertaining to gender and the other pertaining to age.
- Should you include the word *significant*? There is some debate as to whether 'significant' should be included in the hypothesis. Some teachers will expect you to write 'Drivers of family cars will be *significantly* more likely to stop at zebra crossings than drivers of sports cars'. Other teachers will not expect you to include it. This is a controversial issue rather beyond the scope of this book. Exam boards will accept either version, but most modern statistics books do not include the word 'significant'.

Some further examples

If you were conducting research into whether there is a relationship between grades in exams taken at the ages of sixteen and eighteen, your *research hypothesis* might be that 'Students who do well in exams at sixteen will also do well in exams when they are eighteen'. Your *alternative hypothesis* might be 'There is a correlation between the grades students obtain in exams at the age of sixteen and the grades they obtain at the age of eighteen,' while the *null hypothesis* might be 'There is no correlation between grades obtained at the age of sixteen and grades obtained at the age of eighteen'.

If you were researching helping behaviour your *research hypothesis* might be that 'People in rural areas are more likely to help someone than people in large cities'. Your *alternative hypothesis* might be 'A young woman who drops her shopping outside a village shop will receive help more quickly than a young woman who drops her shopping outside a large city superstore'. Your null hypothesis might be that 'There will be no difference in how quickly a young woman

receives help who drops her shopping outside a village shop or a large city superstore'.

Exercise 3

Write a suitable alternative hypothesis and a suitable null hypothesis for a study with the research hypothesis that 'Too many cooks spoil the broth'.

Why do we have all these types of hypotheses?

Having collected your data you will probably carry out a statistical test which tells you the **probability** that your results are due to chance. As explained above, the statistical test is testing the *null hypothesis* – testing whether the **samples** of scores that you have collected are drawn from the same **population** of scores.

We use statistics to indicate the level of probability of obtaining a particular result. If the probability that the scores we have collected are all drawn from the same population of scores is very low (usually 5 per cent or less) we may choose to accept the alternative/experimental hypothesis. (See later section on probability, pp. 184–90, for more details.)

Remember The *research hypothesis* states the general prediction that we are going to test in our study.

The *alternative* or *experimental hypothesis* operationalises this prediction in precise terms.

The *null hypothesis* states that there is no difference or no correlation in the scores of the populations that we are testing.

Directional and non-directional hypotheses

If the hypothesis predicts the expected direction of the result then it is called a **directional** (or **one-tailed**) **hypothesis**. For example:

'School children who eat breakfast do *better* at school than those who do not', or
'There is a *positive* correlation between height and weight'.

If the hypothesis just says that there will be a difference or a correlation – but does not predict the direction – then it is called a **non-directional** (or **two-tailed) hypothesis**. For example:

'Dogs and cats differ in how quickly they learn a maze' (note that the hypothesis doesn't state which will learn fastest), or
'There is a correlation between exam results and hours spent watching TV' (note that it doesn't say if watching a lot of TV will be related to better or worse exam results).

When do you choose a directional hypothesis?

Traditionally you might select a directional hypothesis when the weight of earlier research makes it possible to make a clear prediction. For example if there have been five or six studies that have found dogs *do* learn mazes faster than cats then you might feel able to say 'Dogs learn a simple maze faster than cats'. *If you do select a directional hypothesis you should justify this choice in your report.*

There are some controversies associated with this, however. MacRae (1994) argues that in psychology we can never really make sufficiently clear predictions to justify the use of directional hypotheses. It is also argued by some statisticians that you should not choose a directional hypothesis if you are collecting data at a nominal level. Nominal categories are, by definition, unordered and so it is not logical to select a directional hypothesis. (There is further discussion of this point in Section Twelve, pp. 153–7, when discussing the chi-square test.)

If you do select a directional hypothesis, you can't have it both ways! If your data comes out the opposite way to your prediction you *must* accept the null hypothesis – you must *not* accept the research hypothesis, even if the data shows a big difference in the 'wrong' direction. So if you predict dogs will learn your maze faster than cats, and then you find the cats are fastest (as they probably would be given the contrary nature of cats), you can't change your mind and say 'Oh great – I've got a significant result anyway'. You haven't got a significant result. You've got a non-significant result because your

particular prediction has not been supported by the evidence. (This is why MacRae suggests that directional hypotheses should not be used.)

Exercise 4

It is a common exam question to ask candidates to write a suitable hypothesis for a study, so make sure you practise this. (In an exam you can often use words from the exam paper to produce a clear, precise hypothesis.)

1 For each of the following studies write a suitable directional alternative/experimental hypothesis, a suitable non-directional alternative/experimental hypothesis and a null hypothesis:

   (a) A psychologist conducts a study on students to see if the amount of fish eaten affects IQ scores.
   (b) A study investigates the length of time babies spend looking at simple shapes or human faces.
   (c) A gardener compares the number of tomatoes produced by plants in 'grow bags' or in the ground.
   (d) A psychologist investigates the relationship between IQ at the age of eleven and IQ at the age of sixteen.
   (e) A bus company investigates the relationship between the fares charged over a five-year period and the number of passengers catching their buses.

2 Identify whether these hypotheses are directional or non-directional:

   (a) Young children prefer chocolate to cabbage.
   (b) Lack of sleep makes people irritable.
   (c) Girls talk more than boys.
   (d) The quality of service in a café affects its popularity.
   (e) Age affects short-term memory.

The hypotheses above are not well-phrased. They are not operationalised because they don't explain how the variables involved will be measured. They need rephrasing to make them more precise. As a further exercise you could consider how the variables involved could be operationalised.

Independent and dependent variables

It was stated earlier that when you write your research hypothesis it must be operationalised and that this means that you need to identify the **variables** that you are going to study.

- The word 'variable' is used to describe something that alters when we are conducting research.

In experimental research a variable is deliberately altered by the researcher so that the effects on another variable can be measured.

- A variable which is manipulated in research is called an independent variable or an IV.
- A variable which is measured is called a **dependent variable** or a DV.

Learn the jargon now.

Can you think of a mnemonic to help you remember it? or will you have to repeat it over and over again until you are sure you know it? It is important you get this right!

You alter an IV; you measure a DV.

Not all variables can be controlled by the researcher. Such uncontrolled variables can alter in an unsystematic way. (The issue of uncontrolled variables is dealt with in Section Seven.)

When using the *experimental method* we alter an independent variable and see if this produces a change in a dependent variable. If it does, and we cannot see any uncontrolled factors in the situation that might have affected the result, we assume that the change in the IV has led to the change we observed in the DV. In other words we infer that there is a causal relationship between the two variables.

Exercise 5

Identify the independent variables and dependent variables in the following experiments:

1 One group of students is kept awake for forty-eight hours and their ability to remember a list of twelve words is compared with that of a group who have slept normally.
2 The reaction time of fifteen people who have just run a mile is compared with that of a group who have just driven cars for a mile.
3 A researcher presents sparrows with different-sized bugs. Some are smaller than their usual food, some are the same size, some are larger but still edible. The type of bugs eaten by the sparrows is noted.
4 Participants are given the description of a person to read. All descriptions are identical except that some participants are told the person is of the same ethnic group as themselves, while others are told they are from a different group. Having read the description participants are asked to select characteristics they think describe the person.
5 An occupational psychologist measures the number of packets of cereal that are packed in thirty minutes if workers are alone, in a group of six or in a group of twelve.