Chapter 7
The Research Design

In this chapter you will learn about:

- What research design means
- The important functions of research design
- Issues to consider when designing your own research
- The theory of causality and the research design

Keywords: *chance variables, control group, experimental group, extraneous variables, independent variable, matching, 'maxmincon' principle, random error, randomisation, research design, study design, treatment group.*

If you are clear about your research problem, your achievement is worth praising. You have crossed one of the most important and difficult sections of your research journey. Having decided *what* you want to study, you now need to determine *how* you are going to conduct your study. There are a number of questions that need to be answered before you can proceed with your journey. What procedures will you adopt to obtain answers to research questions? How will you carry out the tasks needed to complete the different components of the research process? What should you do and what should you not do in the process of undertaking the study? Basically, answers to these questions constitute the core of a research design.

What is a research design?

> A research design is a plan, structure and strategy of investigation so conceived as to obtain answers to research questions or problems. The plan is the complete scheme or programme of the research. It includes an outline of what the investigator will do from writing the hypotheses and their operational implications to the final analysis of data. (Kerlinger 1986: 279)

> A traditional research design is a blueprint or detailed plan for how a research study is to be completed—operationalizing variables so they can be measured, selecting a sample of interest to study, collecting data to be used as a basis for testing hypotheses, and analysing the results. (Thyer 1993: 94)

A research design is a procedural plan that is adopted by the researcher to answer questions validly, objectively, accurately and economically. According to Selltiz, Deutsch and Cook, 'A research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure' (1962: 50). Through a research design you decide for yourself and communicate to others your decisions regarding what study design you propose to use, how you are going to collect information from your respondents, how you are going to select your respondents, how the information you are going to collect is to be analysed and how you are going to communicate your findings. In addition, you will need to detail in your research design the rationale and justification for each decision that shapes your answers to the 'how' of the research journey. In presenting your rationale and justification you need to support them critically from the literature reviewed. You also need to assure yourself and others that the path you have proposed will yield valid and reliable results.

The functions of a research design

The above definitions suggest that a research design has two main functions. The first relates to the identification and/or development of procedures and logistical arrangements required to undertake a study, and the second emphasises the importance of quality in these procedures to ensure their validity, objectivity and accuracy. Hence, through a research design you:

- conceptualise an operational plan to undertake the various procedures and tasks required to complete your study;
- ensure that these procedures are adequate to obtain valid, objective and accurate answers to the research questions. Kerlinger calls this function the **control of variance** (1986: 280).

Let us take the first of these functions. The research design should detail for you, your supervisor and other readers all the procedures you plan to use and the tasks you are going to perform to obtain answers to your research questions. One of the most important requirements

of a research design is to specify everything clearly so a reader will understand what procedures to follow and how to follow them. A research design, therefore, should do the following:

- Name the study design per se – that is, 'cross-sectional', 'before-and-after', 'comparative', 'control experiment' or 'random control'.
- Provide detailed information about the following aspects of the study:
  - Who will constitute the study population?
  - How will the study population be identified?
  - Will a sample or the whole population be selected?
  - If a sample is selected, how will it be contacted?
  - How will consent be sought?
  - What method of data collection will be used and why?
  - In the case of a questionnaire, where will the responses be returned?
  - How should respondents contact you if they have queries?
  - In the case of interviews, where will they be conducted?
  - How will ethical issues be taken care of?

Chapter 8 describes some of the commonly used study designs. The rest of the topics that constitute a research design are covered in the subsequent chapters.

The theory of causality and the research design

Now let's turn to the second function of the research design – ensuring that the procedures undertaken are adequate to obtain valid, objective and accurate answers to the research questions. To ensure this, it is important that you select a study design that helps you to isolate, eliminate or quantify the effects of different sets of variable influencing the independent variable. To help explain this, we look at a few examples.

Suppose you want to find out the effectiveness of a marriage counselling service provided by an agency – that is, the extent to which the service has been able to resolve the marital problems of its clients. In studying such relationships you must understand that in real life there are many outside factors that can influence the outcome of your intervention. For example, during visits to your agency for counselling, your client may get a better job. If some of the marital problems came about because of economic hardship, and if the problem of money is now solved, it may be a factor in reducing the marital problems. On the other hand, if a client loses his/her job, the increase in the economic problems may either intensify or lessen the marital problems; that is, for some couples a perceived financial threat may increase marital problems, whereas, for others, it may create more closeness between partners. In some situations, an improvement in a marriage may have very little to do with the counselling received, coming about almost entirely because of a change in economic circumstances. Other events such as the birth of a child to a couple or a couple's independent 'self-realisation', independently arrived at, may also affect the extent and nature of marital problems. Figure 7.1 lists other possible factors under the category of extraneous variables. This does not exhaust the list by any means.

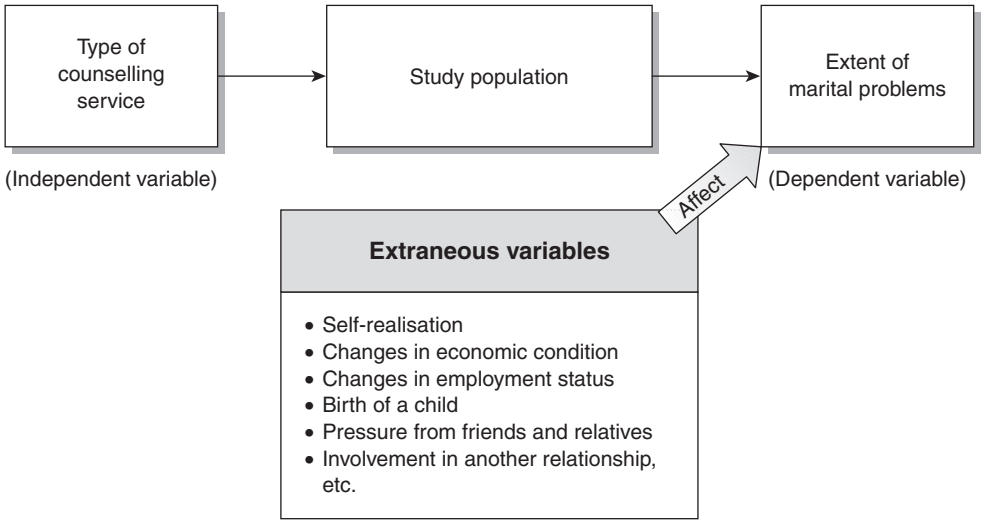


FIGURE 7.1 *Factors affecting the relationship between a counselling service and the extent of marital problems*

Continuing the example of marriage and counselling, there are sets of factors that can affect the relationship between counselling and marriage problems, and each is a defined category of variables:

1 Counselling per se.
2 All the factors other than counselling that affect the marital problems.
3 The outcome – that is, the change or otherwise in the extent of the marital problems.
4 Sometimes, the variation in response to questions about marital problems can be accounted for by the mood of respondents or ambiguity in the questions. Some respondents may either overestimate or underestimate their marital problems because of their state of mind at the time. Or some respondents, in spite of being in exactly the same situation, may respond to non-specific or ambiguous questions differently, according to how they interpret the question.

As already explained in Chapter 5, any variable that is responsible for bringing about a change is called an *independent variable*. In this example, the counselling is an independent variable. When you study a cause-and-effect relationship, usually you study the impact of only one independent variable. Occasionally you may study the impact of two independent variables, or (very rarely) more than two, but these study designs are more complex.

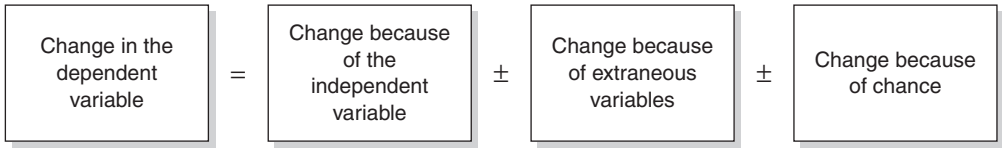
For this example *counselling* was the assumed cause of change in the *extent of marital problems*; hence, the extent of marital problems is the *dependent variable*, as the change in the degree of marital problems was dependent upon counselling.

All other factors that affect the relationship between marital problems and counselling are called *extraneous variables*. In the social sciences, extraneous variables operate in every study and cannot be eliminated. However, they can be controlled to some extent. (Some of the methods

for controlling them are described later in this chapter.) Nevertheless, it is possible to find out the impact attributable to extraneous variables. This is done with the introduction of a **control group** in the study design. The sole function of a control group is to quantify the impact of extraneous variables on the dependent variable(s).

Changes in the dependent variable, because of the respondent's state of mood or ambiguity in the research instrument, are called **random variables** or **chance variables.** The error thus introduced is called the *chance* or *random error*. In most cases the net effect of chance variables is considered to be negligible as respondents who overreport tend to cancel out those who underreport. The same applies to responses to ambiguous questions in a research instrument.

Hence in any causal relationship, changes in the dependent variable may be attributed to three types of variable:



Let us take another example. Suppose you want to study the impact of different teaching models on the level of comprehension of students for which you adopt a comparative study design. In this study, the change in the level of comprehension, in addition to the teaching models, can be attributed to a number of other factors, some of which are shown in Figure 7.2:

[change in level of comprehension] =

[change attributable to the teaching model] ±
[change attributable to extraneous variables] ±
[change attributable to chance variables]

In fact, in any study that attempts to establish a causal relationship, you will discover that there are three sets of variables operating to bring about a change in the dependent variable. This can be expressed as an equation:

[change in the outcome variable] =

[change because of the chance variable] ±
[change because of extraneous variables] ±
[change because of chance or random variables]

or in other words:

[change in the dependent variable] =

[change attributable to the independent variable] ±
[change attributable to extraneous variables] ±
[change attributable to chance variables]

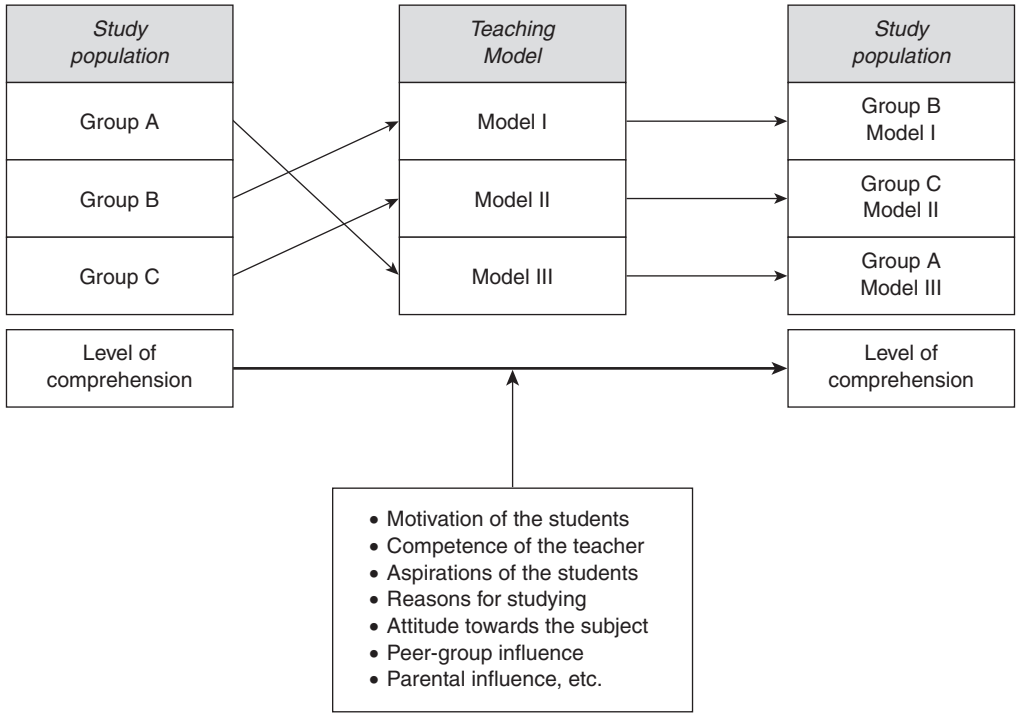


FIGURE 7.2 *The relationship between teaching models and comprehension*

or in technical terms:

[total variance] =

[variance attributable to the independent variable] ±
[variance attributable to extraneous variables] ±
[random or chance variance]

It can also be expressed graphically (Figure 7.3).

As the total change measures the combined effect of all three components it is difficult to isolate the individual impact of each of them (see Figure 7.3). Since your aim as a researcher is to determine the change that can be attributed to the independent variable, you need to design your study to ensure that the independent variable has the *maximum* opportunity to have its full effect on the dependent variable, while the effects that are attributed to extraneous and chance variables are minimised (if possible) or quantified or eliminated. This is what Kerlinger (1986: 286) calls the 'maxmincon' principle of variance.

One of the most important questions is: how do we minimise the effect attributable to extraneous and chance variables? The answer is that in most situations we cannot;

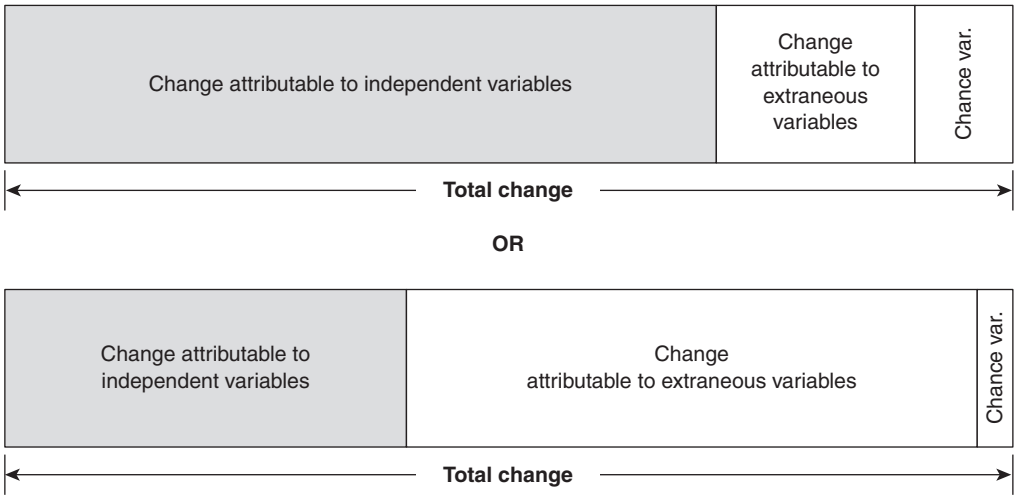


FIGURE 7.3 *The proportion attributable to the three components may vary markedly*

however, it can be quantified. The sole purpose of having a control group, as mentioned earlier, is to measure the change that is a result of extraneous variables. The effect of chance variables is often assumed to be none or negligible. As discussed, chance variation comes primarily from two sources: respondents and the research instrument. It is assumed that if some respondents affect the dependent variable positively, others will affect it negatively. For example, if some respondents are extremely positive in their attitude towards an issue, being very liberal or positively biased, there are bound to be others who are extremely negative (being very conservative or negatively biased). Hence, they tend to cancel each other out so the net effect is assumed to be zero. However, if in a study population most individuals are either negatively or positively biased, a systematic error in the findings will be introduced. Similarly, if a research instrument is not reliable (i.e. it is not measuring correctly what it is supposed to measure), a systematic bias may be introduced into the study.

In the physical sciences a researcher can control extraneous variables as experiments are usually done in a laboratory. By contrast, in the social sciences, the laboratory is society, over which the researcher lacks control. Since no researcher has control over extraneous variables, their effect, as mentioned, in most situations cannot be minimised. The best option is to quantify their impact through the use of a control group, though the introduction of a control group creates the problem of ensuring that the extraneous variables have a similar effect on both control and experimental groups. In some situations their impact can be eliminated (this is possible only where one or two variables have a marked impact on the dependent variable). There are two methods used to ensure that extraneous variables have a similar effect on control and experimental groups and two methods for eliminating extraneous variables:

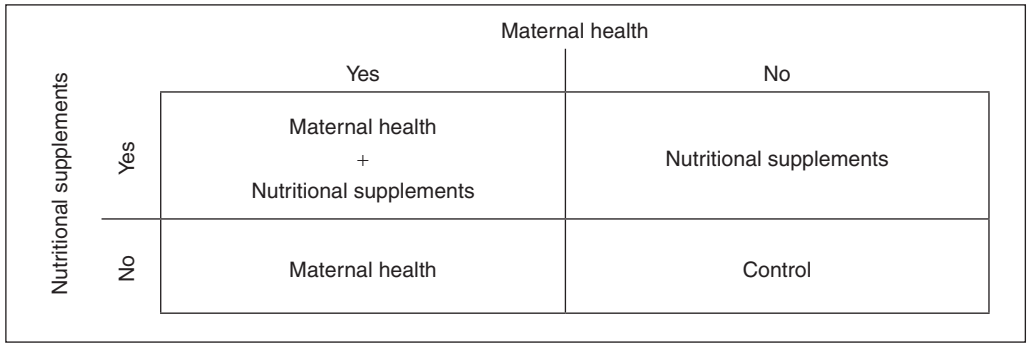


FIGURE 7.4 *Building into the design*

1 **Ensure that extraneous variables have a similar impact on control and experimental groups.** It is assumed that if two groups are comparable, the extent to which the extraneous variables will affect the dependent variable will be similar in both groups. The following two methods ensure that the control and experimental groups are comparable with one another:

   (a) **Randomisation** – Ensures that the two groups are comparable with respect to the variable(s). It is assumed that if the groups are comparable, the extent to which extraneous variables are going to affect the dependent variable is the same in each group.
   (b) **Matching** – Another way of ensuring that the two groups are comparable so that the effect of extraneous variables will be the same in both groups (discussed in Chapter 8).

2 **Eliminate extraneous variable(s).** Sometimes it is possible to eliminate the extraneous variable or to build it into the study design. This is usually done when there is strong evidence that the extraneous variable has a high correlation with the dependent variable, or when you want to isolate the impact of the extraneous variable. There are two methods used to achieve this:

   (a) **Build the affecting variable into the design of the study** – To explain this concept let us take an example. Suppose you want to study the impact of maternal health services on the infant mortality of a population. It can be assumed that the nutritional status of children also has a marked effect on infant mortality. To study the impact of maternal health services per se, you adopt a two-by-two factorial design as explained in Figure 7.4. In this way you can study the impact of the extraneous variables separately and interactively with the independent variable.
   (b) **Eliminate the variable** – To understand this, let us take another example. Suppose you want to study the impact of a health education programme on the attitudes towards, and beliefs about, the causation and treatment of a certain illness among non-indigenous Australians and indigenous Australians living in a particular community. As attitudes and beliefs vary markedly from culture to culture, studying non-indigenous Australians and indigenous Australians as one group will not provide an accurate picture. In such studies it is appropriate to eliminate the cultural variation in the study population by selecting and studying the populations separately or by constructing culture-specific cohorts at the time of analysis.

Summary

In this chapter you have learnt about the functions of a research design. A research design serves two important functions: (1) to detail the procedures for undertaking a study; and (2) to ensure that, in the case of causality, the independent variable has the maximum opportunity to have its effect on the dependent variable while the effect of extraneous and chance variables is minimised. In terms of the first function, a research design should outline the logistical details of the whole process of the research journey. You need to spell out in detail what type of study design per se you are proposing to use and why, who are going to be your respondents and how they will be selected, from how many you are proposing to get the needed information, how the information will be collected by you and how you are going to analyse the information. For each aspect you need to provide your rationale and justification and as far as possible support them from the literature reviewed.

Through the second function, 'Control of variance', when establishing association or causality, it ensures your supervisor and readers that you have set up your study in such a way that your independent variable has the maximum chance of affecting the dependent variable and that the effects of extraneous and chance variables are minimised, quantified and/or controlled (the 'maxmincon' principle of variance).

A study without a control group measures the total change (change attributable to independent variable $\pm$ extraneous variables $\pm$ chance variables) in a phenomenon or situation. The purpose of introducing a control group is to quantify the impact of extraneous and chance variables.

The study design is a part of the research design. It is the design of the study per se, whereas the research design also includes other details related to the carrying out of the study.

For You to Think About

- *Refamiliarise yourself with the keywords listed at the beginning of this chapter and if you are uncertain about the meaning or application of any of them revisit these in the chapter before moving on.*
- *What are the main functions of a research design? Why is it important to have a research design before undertaking a study?*
- *Provide examples from your own area of study to illustrate the main variables in terms of causality (you may find it useful to refer back to Chapter 5).*
- *Identify one or two examples from an area that interests you to demonstrate how the 'maxmincon' principle of variance can be applied.*