

Research questions and data

Finding your research question

Most research starts with an important question. Since this question is going to frame your PhD research, it is helpful if you are passionate about your question. At the beginning your question will probably be bigger than the question your PhD eventually addresses. Here are some examples of big questions:

- What causes people to develop chronic diseases as they age?
- Can I develop new types of prosthetics so that organ replacements last a lifetime?
- Is climate influenced by atmospheric microorganisms?

Questions like these define your general area of research. Honing this down to a doable project requires you to think about your access to materials or subjects and resources such as laboratories and expertise. Ideally you would have examined these issues before you first enrolled but it is essential that you have a very good understanding of resources and your supervisor's expertise before you go too far.

Refining your research question in the light of the facilities available to you

Say you were interested in the first of the three research questions. Your next step would be to decide whether you wanted to pursue work in the general area of the Biology of Ageing or whether you wanted to align yourself to one or other clinical disciplines? Alternatively, you might wish to work with indigenous people or people in low socioeconomic groups who have both early onset and greatly elevated rates of chronic disease. Having chosen this path, you might decide that your interests really lie in health promotion or population-based interventions.

Every field of research has many different areas of expertise and niche areas. You need to find the niche that best suits your personality, your skills and your passions.

Continuing with our example—should you decide to work on the biology of ageing, you are selecting a relatively controllable path because you can probably conduct your experiments in tissue culture or using a well studied animal model such as the worm *Caenorhabditis elegans*, the vinegar fly *Drosophila* or the mouse. Primates and even sheep might be much closer in physiology to humans but you want to complete your PhD in three years if possible and choosing an organism or tissue that allows you to minimise both your time and your costs will give you a good start on the road to success. Smaller organisms and tissue culture systems are also much more amenable to experimentation and so you will be able to design and control a much wider range of experiments.

If your choice is to stay working directly with people you would probably start by choosing one particular chronic disease which might be, for example, diabetes. Is your supervisor an expert in this or a closely related area? Can you get access to people with diabetes in sufficient numbers, when you require them, to conduct your study in the time available? Recruiting human subjects can be very difficult and other than making observations and measurements, you are very limited in what you can do. Will you be able to obtain Ethics approval for the study you have in mind? Do you have a tested method for recruitment of your subjects?

Making sure that the materials, equipment and techniques that you will need are either already established or readily available, is critical. If you need to develop new techniques, make sure that you can achieve this!

Note: Many PhD projects have been abandoned because of inability to obtain enough subjects or data or from having unsolvable problems developing new techniques and/or accessing equipment. Your project needs to be closely aligned with the expertise of your Supervisor - not only from the perspective of their giving you helpful guidance and evaluation but also from the perspective of building your international networks of experts.

How will you analyse your data?

You need to design your research in the light of your proposed analysis. Will you use qualitative or quantitative analytical techniques or both?

There is a plethora of analytical techniques that can be used to analyse data. Ideally you will be familiar with many of these before you start. If you are planning to use quantitative techniques, you will probably use a computer program like *SPSS* (Statistical Program for Social Sciences), *SAS* or *Excel* to analyse your data whereas if you are using qualitative techniques you will probably use *NVivo*. UniSA allows staff and students to obtain licences for *SPSS* and/or *NVivo* to work on their University and/or home computers. You will probably need to have some training or at least lots of practice to get the best out of these systems but in the long run they will give you the ability to perform a range of amazing analyses! The two statistical systems can work together, and with Word, so the writing of your thesis and papers will become quite straight forward.

Many projects on human subjects will benefit from the use of qualitative techniques at least in the first stage. Techniques like focus groups or personal interviews can give insight into your subjects' thoughts, experience and perceptions that will allow you to plan a second quantitative stage that is not only enlightened by this information but also focussed on the needs of the participants. Before you commence the major part of your data collection, discuss your plan with someone who is experienced in data analysis (possibly your supervisor but possibly an expert statistician) to make sure that the planned number of subjects and type of data will actually be suitable for your intended analysis. You may well have to undertake one or more pilot studies in order to establish that your intended experiments or data collection will work.

In general, at the start you should plan to have more time, more subjects, more data and more experiments than you think you need! Even the best laid plans can and will go wrong so allow plenty of time for unexpected contingencies. Never be afraid to ask for help and do so earlier rather than later!