Choose an approach for your research problem

This course is about doing empirical research with experiments, so your general approach to research has already been chosen by your professor. It’s important for you to know about other options and to continuously ask about their advantages and disadvantages.

The way that you chose and formulate problems for study is influenced by the general approach that you take to finding out information. The approach that you choose will determine where you will look for information, what kinds of data (if any) you will consider, who is likely to read your results, etc. Three approaches are described here: scholarship, theoretical research, and empirical research.

You choose an approach in the first place by choosing a major or discipline. Different disciplines will use different approaches to study the same thing. For example, linguists, cognitive psychologists, computer scientists, neurologists, language teachers, and sociologists might all study language, but they’ll use quite different approaches. Linguists, language teachers, and sociologists rarely do experiments, and computer scientists rarely do experiments with human participants. Neurologists do more case studies and focus on people with pathological conditions. Cognitive psychologists usually focus on normal adults and use experimental methods. When you choose a discipline, like Psychology, and a field within that discipline, like Cognitive Psychology, you usually adopt the preferences of the other researchers in that field. Still, regardless of the differences in approach, researchers in all of these fields are still studying language. The way you formulate your research problem will lead you to more specific choices and make your approach more precise.

Most of what is done under the name of “research” in high school and other classes is what is more technically called “scholarship”. Scholarship focuses on finding, documenting, and organizing other people’s information. If you follow this approach, you will formulate your problem in terms of existing information about topics that other people have studied and you will use their data. Scholarship adds value to existing information by organizing and evaluating it to make it easier for others to understand and use.

Research is different because it focuses on having you generate new information of your own, often about a problem that other people have not yet studied.

Theoretical research emphasizes generating new information by thinking about existing data in new ways. If you do this kind of research, you will formulate your research problem in terms of evaluating how coherent and reliable different ways of thinking (i.e., hypotheses or theories) are, given existing data. One problem with this kind of research is that very often the existing data are
only indirectly related to the research problem that you want to solve. In this case, you often cannot draw very strong or very reliable conclusions.

Empirical research, on the other hand, emphasizes collecting new data about what happens in the world (empirical comes from the Greek word for personal experience), data that is specifically chosen to help evaluate specific ways of thinking (i.e., hypotheses or theories). The big advantage of this kind of research is that the data is custom tailored to be as relevant and reliable as possible for testing a given hypothesis. This means that you can draw much stronger and more reliable conclusions with this approach. It also means that you are not limited to studying problems that other people have investigated: you can develop your own ways of producing data for whatever problem you choose.

Experimental research is one kind of empirical research – the kind that uses a particular, more rigorous procedure for data collection called an experiment.

Your research project this semester will be a piece of empirical research that you will plan, collect data for, and report on.

Science. Notice that we defined all of the approaches above in terms of how ways of thinking (hypotheses, theories, organization) are related to observable data. This mix of theory and data is one of the key characteristics of what we call science. But why is that the case? Why do we need both?

Science – or scientific research – is the most highly refined way we have of learning about what we observe, that is, of building reliable mental models for observable phenomena. One way of looking at the general principles of learning in science (we call these principles “the scientific method”) is by thinking that they derive from the very simple observation that the individual researcher has finite (and in fact, quite limited) capacities of sensation, perception, reasoning, and memory. Hundreds of studies in cognitive psychology have confirmed these limitations and teased out many of the qualitative and quantitative details, including the fact that the specific limitations are very variable from individual to individual.

So, there are kinds of information and rates of information flow that scientists simply cannot deal with: however wonderful the human cognitive apparatus is, it has very clear limits. Besides this, the existence of distractions, illusions, and hallucinations shows that our cognitive ability is also limited in reliability. In addition, reports of memory and subjective experience show that our ability is often unreliable in unpredictable ways. Finally, the concept of selective attention shows that not all of the information available from the environment is in fact used or even perceived. The inevitable conclusion is this:
The fundamental tools that scientists have for producing knowledge – sensation, perception, reason, and memory – are both imperfect and severely limited.

This means that obtaining reliable knowledge about a very complex world requires scientists to develop special strategies for getting around these limitations. The main strategy that scientists have developed is mixing thinking and data: in a nutshell, checking theories against observable data helps compensate for the limitations of how people think. And thinking about the same data with different theories helps compensate for the limitations of how people observe the world. In other words, how we understand something (our reasoning) guides our observation of it and what we in fact see modifies how we understand it. In other words, theorization in effect directs observation and observation restricts theorization.

When we combine observations and thinking, we generate a view of scientific investigation as a virtuous circle: a cycle of activities that mutually feed, stimulate, and constrain each other (See the figure, based on Bunge, 1967). Note that new theories don’t actually break this cycle: they lead researchers to do the same things in different ways. A new theory will suggest different hypotheses about existing data, predict novel observations, encourage researchers to observe different phenomena, and suggest different ways of evaluating hypotheses.

The modern view of scientific research, then, is the systematic search for explanations of observable phenomena. Part of the “magic” of science is the discovery that neither observation nor thinking alone are enough, but the synthesis of the two has turned out to be the best strategy for producing reliable knowledge.

In today’s science, neither theory alone nor observation are sufficient to constitute research; research is the synthesis of the processes of observation and theorization.

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data + \text{theory} = \text{reliable knowledge}\]

To be considered reliable, new research has to have clear links to existing research (this is one reason why the literature review is so important) to show how other people have thought about (part of) your problem before. Scientists would say that you want to choose a research problem that is grounded in previous research. This means that you have to choose a problem for which some research has already been done. In empirical research, to add something of your own, you need to collect your own data. This means that you have to choose a problem that you can actually collect data for.
Your research results will be based both on your view of existing explanations (the information that you find for your literature review) and the observations that you will get through your own data collection.

**Focus on a very specific problem.** You may have started a project with a topic or theme at some time. You probably found it a difficult starting point: a topic like “Memory” or “the Civil War” is just too vague to work with. If you go to the library or do a database search, you will find literally thousands of things to read. Then you are left with no idea of which ones are important and which ones to read first. This is a frustrating and unproductive approach.

Researchers do not start with this kind of topic. They start with something much more specific: a question that usually asks about the influence of something on the process that they are interested in. In fact, it is most efficient to ask yes/no questions like:

“Is there an effect of gender on reading ability in fourth-grade students?” or

“Does gender affect reading ability in fourth-grade students?”

The question that you ask formulates a hunch or hypothesis that you have (or have read about or observed). Novice researchers often find it hard to come up with such a specific problem, so the rest of this Task Package will step you through the process: it is just a case of adding details one by one.

Researchers use these more specific problems because experience shows that smaller, more specific problems lead to clearer, more reliable experiments. For example, “How does vision work?” is much harder to answer with data than a problem like “How do six-year-olds see unfamiliar letters in low lighting?”.

Focusing your research problem on a very specific situation is essential for successful research.

Nobel Prize-winner François Jacob (1982, p. 362-3) makes this same observation in an interesting way:

"Whether mythic or scientific, the view of the world that man builds is always largely a product of his imagination. For, in contrast to what is frequently believed, the scientific process does not consist merely in observing, in collecting data and deducing a theory from them. One can watch an object for years without ever producing any observation of scientific interest. Before making a valuable observation, it is necessary to have some idea of what to observe, a preconception of what is possible. Scientific advances often come from uncovering some previously unseen aspect of things, not so much as a result of using some new instrument, but rather of looking at objects from a new angle. The look is necessarily guided by a certain idea of what so-called reality might be (...) Scientific investigation begins by inventing a possible world, or a small piece of a possible world, [but] at every step, it has to meet with criticism and experimentation in order to determine what might reflect reality and what is mere wishful thinking. For science, there are many possible worlds; but the interesting one is the world that exists and has already shown itself to be at work for a long time. Science attempts to confront the possible with the actual. It is the means devised to build a representation of the world that comes ever closer to what we call reality.”
In this quote, the author emphasizes the role that the scientist/learner’s imagination plays in delimiting that which seems possible. The result of this creative effort is a hunch, hypothesis, or theory. A theory is a characterization of how the world might be, that is, of an imagined world, a mythical world, a possible world. The main difference between a world imagined by a literary, religious, or mythical mind, on the one hand, and a scientific mind, on the other, is that the world imagined by the scientist (his or her theory) has to survive a collective, continuous, and very demanding examination of its correspondences with the observed world in order to be accepted by other researchers.

**Your research problem should be very specific and focused to make it easier to execute.**

This emphasis on very specific problems is also based on the fact that scientists have to simplify or idealize whatever-it-is-that-they’re-re-studying (the “object of study”). If the problem is too complex, then they cannot understand it as clearly. Humans can only systematically observe or study a few characteristics of something at any one time, so we “abstract away” the existence of other aspects that are not of immediate interest and stop paying attention to them, for the time being at least. Idealization or simplification of the object of study, i.e., studying it a part at a time, therefore, is a crucial strategy of learning in general, and of the scientific method in particular. It also means that researchers have to make their goals explicit, so that their choices about which parts to study can be evaluated.

This makes it seem like analysis (breaking things down into parts to understand them) is the most important thing in research. However, being forced to simplify also means that:

*It is only the sum of these partial observations, studies or experiments – their synthesis – that will eventually offer a more complete or accurate view of the object of study.*

This is very important: it means that no one has the whole truth about even the most specialized topic. It means that every researcher has only a part of the whole story. It means that no one is “right” and that collaboration is essential. In science, idealization means that selective attention is made explicit: the choice of what to observe and how to observe it are problems for systematic discussion rather than intuitive guessing. The issue of idealization is often contentious in research because in practice what you focus on or ignore is most often based on a subjective assessment about which is the best strategy for learning at a given point in history. Exaggeration in either direction ("wallowing in the data" [not enough theorizing] or “pie-in-the-sky theorizing” [not enough use of data]), however, interferes with the progress of science and fragments researchers into groups that have a harder time collaborating.

*Your project will only deal with a tiny research problem. You need to be clear on how your part is related to broader problems – this will be a part of your literature review.*