Introduction

"I expect you all to be independent, innovative, critical thinkers who will do exactly as I say!"

The skills of reasoning

Thinking, reasoning and arguing are things we all do every day, whether we notice it or not. Here is an everyday example. Imagine you have lost your umbrella and are trying to work out where you left it. You reason to yourself as follows: I must have either left it at home, or in the café. But I clearly remember having it with my when I left the house, so it must be in the café. On returning to the café, you discover your umbrella there.

The ability to reason well is a skill. Most people can handle the sort of reasoning illustrated in the above example so easily that it is done more or less unconsciously. On the other hand, there are contexts in which people do not reason well, if at all. There is evidence that many people have great difficulty in understanding the concept of giving *reasons* for a belief that they hold. When asked to give reasons for their beliefs (concerning the underlying causes of social problems such as crime and unemployment for example) people are often able to do little more than restate their belief in different words. A growing amount of evidence from careful psychological studies suggests that we are all susceptible to systematic errors and biases in our reasoning, problem solving and decision making. Happily though, there is also evidence that reasoning skills can be improved by teaching, combined with practice. That is what this course is all about.

As the umbrella example suggests, we can all reason quite well some of the time. Much of this course then will involve making explicit principles of good reasoning which you already have some awareness of but have never formulated clearly. No matter how good you are at reasoning, there is nearly always room for improvement.

Here is a surprise quiz: Why, except during a full moon, is part of the Moon in shadow? Before going on, you might like to take a moment to think about how you would answer that question. You can find an explanation at the end of this chapter.

Arguments

In this course we will be concentrating on just one very important reasoning skill: that of assessing the quality of *arguments*.

What is an argument? We will work with the following definition:

- **Definition**

An **argument** consists of a **claim** (the **conclusion**), along with one or more **reasons** for thinking that the claim is true (**premises**).

Both the conclusion and the premises must be *statements* or *propositions*: things that can be either true or false. The conclusion is supposed to *follow from* the premises. Another way of saying the same thing is to say that the premises are supposed to provide *evidence* or *support* for the conclusion.

Consider again the reasoning involved in the story of the missing umbrella. This provides us with a simple example of an argument:

> **1.** Either I left my umbrella at the café or I left it at home.
> **2.** I didn't leave my umbrella at home.
> **Therefore**:
> **C**. I left my umbrella in the café.

The conclusion of this argument is the statement **C** (I left my umbrella in the café) and the premises or reasons given to support that conclusion are the statements **1** (Either I left my umbrella at the café or I left it at home) and **2** (I didn't leave my umbrella at home).

Arguments can be found *everywhere*. They are found wherever people are engaged in trying to decide what to do or what to believe – wherever people are engaged in attempting to discover the truth about something. Arguments are found throughout the sciences and humanities and in every field of practical endeavour. They are found in physics, chemistry and biology, where scientists construct arguments to establish whether hypotheses and theories are correct or not. Arguments are found in mathematics, where they typically go under the name of *proofs*. They are found in economics, engineering, public policy, the law, medicine, history, politics and of course in philosophy. Some examples, from a wide variety of fields, can be found in the box at the end of the chapter.

Explicit and implicit arguments

The definition of 'argument' just given is quite an abstract one. Arguments, as we have defined them, occur in a wide variety of concrete situations. One kind of situation, perhaps the most obvious case of 'giving an argument', occurs when someone tries to persuade someone else of something by giving reasons. Here is an example:

> Letter to the editor: Smoking should be completely banned in pubs, clubs and restaurants. It is now a well-established fact that passive smoking – breathing in the noxious fumes produced from other people's cigarettes – is just as unhealthy and dangerous as smoking itself. Smoking in public places should therefore be banned because it puts other innocent people at risk. *Dr. Finbar, VIC.*

Arguments like this essentially involve at least two people: the person proposing the argument and the person (or persons) they are trying to persuade. Some of those people might respond to the argument by giving an argument of their own:

> Letter to the editor the next day: Dr. Finbar is quite right to point out the dangers of passive smoking. But it does not follow that smoking should be banned. People who do not want to breathe in other people's smoke do not *have* to go out to pubs and clubs where smoking is allowed. There are plenty of venues that prohibit smoking – people can go to those places instead. So there is no need for a compulsory ban on all smoking in public places. *Mrs. Trellis, NSW.*

An argument in this sense can turn into a debate – a process that can involve many people, in which arguments about a particular topic are proposed, criticised, re-formulated or abandoned and so on. In many cases, the truth will emerge and a consensus will be established.

But not all arguments occur as part of conversations or debates. In the lost umbrella example, there is only one person involved. In that case, you construct an argument in your own mind, not in order to persuade anyone else of anything, but just to work out for yourself where you left your umbrella. So not all arguments involve two people, one of whom is trying to persuade the other of something.

The umbrella example also shows that arguments do not even have to be explicitly stated or written down by anyone. We can imagine the whole process of reasoning going on in your head. Here is another example. Suppose, like me, you believe that uranium is radioactive. Now ask yourself why you believe that. Probably, again like me, you have never actually taken a piece of uranium, pointed a Geiger counter at it and established that it is indeed radioactive. Probably, like me, the reason you believe that uranium is radioactive is that you have read it in books written by experts (people who have done the experiment) or you have been told it by someone else (a teacher perhaps), who is either themselves an expert or who learnt it from experts. In that case, you have implicitly made use of the following kind of argument:

> **1.** I have read in many reputable books and heard from many people whose opinion on such matters I trust, that uranium is radioactive.
> **Therefore**:
> **C**. Uranium is radioactive.

This kind of argument is called an *argument from authority*. Of course, you have probably never actually explicitly formulated this argument, either out loud or in your head. Nonetheless, in forming your belief you have relied on argument like this, even though you have never actually explicitly stated it. You have relied on it implicitly, rather than explicitly. It can be very useful to try to make implicit arguments explicit, so they can be subjected to scrutiny. We shall see how to evaluate arguments of this kind later on in this course.

Why study arguments?

The example just given is quite representative. Most of what we know, we know not because we have worked it out for ourselves, but because we have learned it from a reputable source, such as textbook or teacher. Relying on authorities and experts is often appropriate – after all, you can't figure out everything for yourself – but sometimes it can have untoward consequences. The habit of relying too much on authorities and experts can make you more susceptible to being fooled or manipulated. Many people, when faced with an argument concerning a topic they feel unqualified to talk about will simply give up and defer to the experts. For that reason, it can be quite surprising and satisfying to learn that it is possible to

assess the quality of arguments and evidence without having to rely on expert knowledge.

One of the aims of this course is therefore to show you just how much you *can* work out for yourself in any subject at all, without having to rely on experts or authorities. When I say 'in any subject at all', I mean it quite literally. The answer to many questions certainly requires expert knowledge that not everyone can easily acquire. But as you will learn, there are some fairly simple, objective standards and criteria that can be used to distinguish good arguments from bad. These standards apply quite generally, to any subject matter at all. You do not have to be an *expert* in order to get quite a long way in assessing *for yourself* the quality of reasoning, argument and evidence in any subject that interests you. That is why the skills you will be learning in this course are so useful: they are applicable anywhere that you find reasoning and arguments.

In this course we will be focusing on one key skill of good thinking: the skill of analysing and evaluating arguments. We will not be focusing directly on skills such as problem solving or decision making. However, a solid grounding in the skills of argument analysis will certainly lead to an improvement in these areas too. As the examples in the box illustrate, the skills of argument analysis will be useful to you whatever subjects you study at university. What is more, since these skills apply quite generally, they will help you in learning and studying new things too. For that reason, these skills will also be useful in whatever career (or careers) you pursue after leaving university. Even if you are already a good thinker (as I'm sure many of you are) and can work out the right answer for yourself most of the time, the skills you be learning in this course will still be of use to you. This is because in most situations it is not enough just to be right. In most jobs, for example, you have to be able not just to give the right answers – you also have to be able to explain your reasoning. You have to be able to clearly and succinctly set out the *arguments* that support your view. This is a skill which is highly prized by employers in all fields.

Overview

Analysing arguments involves two things: *identifying* the argument (what is the conclusion? what are the premises? how are they related?) and *evaluating* the argument (does the argument provide a *good* reason for believing the conclusion?). The latter question is what you will be mostly interested in, but before you can evaluate an argument, you have to be able to say what the argument *is*. This course is therefore divided into two main parts: in the first part we will look at identifying and representing arguments, in the second part we will look at how to evaluate arguments.

To become a better thinker requires more than acquiring the skills of good reasoning. It also requires the disposition to use them. Say you recently started to play poker. Having lost most of your money, you decide to read some books about how to improve your game. You learn lots of good strategies and tips from these books. But in the heat of the game, after a few beers, with the anxiety of losing and the desire to win, it can be difficult to remember to actually use them. The same is true with the skills of argument. It is no use learning and practicing the skills of good argument if you never actually use them outside the classroom. Clearly, in order to be disposed to apply the skills of argument, you have to be able to tell when you (or someone else) has just given an argument, and more importantly, what kind of argument it is. That is you must be able to spot arguments and identify them. But this is sometimes not as easy as it seems. We will look at how to identify and represent arguments in the next chapter.

Answer to the Surprise Quiz

The most common answer to this question is something like this: the Earth blocks light from the Sun, causing a shadow to be cast on part of the Moon. If that, or something very like it, is the answer you gave, then you are in good company. You are also completely wrong. What you have given is the explanation of a lunar *eclipse*, not the explanation of the phases of the moon. Lunar eclipses happen infrequently and only last for an hour or two. The real explanation is as follows. If you take a spherical object and position it near a bright light source, half of the sphere will be in shadow (its own shadow!) as seen from one side. As you move around the sphere *towards* the light source, you would see more of the sphere lit up and less in shadow. As you move around the sphere *away* from the light source, you would see less of it lit up and more in shadow. Try it out with a tennis ball or an orange!

The reason most of us get this wrong is that we don't stop to think about it – we just jump at the first idea that comes to mind. We have a tendency to ignore facts that are well known to us, but would show that our answer must be wrong. One of the skills we hope you will acquire from this course involves the ability to become aware of and correct for this tendency, which exists in everyone, no matter how clever. That is the ability and disposition to stop and think about things before jumping to conclusions.

Here is another surprise quiz question. Why is it hotter during some parts of the year (summer) than others (winter)? Think carefully! Try to think of considerations that count *against* the first answer you come up with.

Further Reading

When learning new things, it is often useful to read one or two different explanations of the same idea. There are some excellent textbooks on the subject of argument analysis and evaluation, which you might like to look at. I recommend the following:

Tracy Bowell and Gary Kemp, *Critical Thinking. A concise guide*. Routledge, 2002.

Stella Cottrell: *Critical Thinking Skills: Developing Effective Analysis and Argument.* Palgrave, 2011.

Alec Fisher: *Critical Thinking: An Introduction* (2nd edition). Cambridge University Press, 2001.

Jill LeBlanc, *Thinking Clearly*. New York: W.W. Norton & co. 1988.

Anne Thomson: *Critical Reasoning: A Practical Introduction*. Routledge, 2002.

If you are interested in the study mentioned, which presents evidence that many people find it difficult to provide reasons or arguments to support their beliefs, you can read all about it in this book:

Deanna Kuhn: *The Skills of Argument*. Cambridge University Press, 1991.

You can read about the studies showing systematic bias in people's reasoning in:

Jonathan Baron: *Thinking and Deciding*. Cambridge University Press, 1994. Chapters 14-15.

T. Gilovich: *How We Know What Isn't So: The Fallibility of Human Reason in Everyday Life.* The Free Press, 1993.

Daniel Kahneman, Amos Tversky and Paul Slovic: *Judgment Under Uncertainty: Heuristics and Biases*. Cambridge University Press, 1982.

The surprise quiz about the phases of the moon was taken from an article by Tim van Gelder:

Tim van Gelder: "Teaching Critical Thinking: Some lessons from cognitive science", *College Teaching*, vol. 53, no. 1, pp. 41-6, 2005.

And finally, if you are interested in philosophical arguments, this is an excellent introduction:

Michael Bruce and Steven Barbone: Just the Arguments: 100 of the Most Important Arguments in Western Philosophy. Wiley-Blackwell, 2011.

Arguments everywhere

1. Physics

The phenomenon known as the *photoelectric effect* was first observed by Heinrich Hertz in 1887. If a metal surface is illuminated by light of a short enough wavelength, electrons will be emitted from the metal, creating an electric current. In 1905, Albert Einstein argued that this phenomenon provided evidence for the emerging theory now known as *quantum mechanics*. According to this theory, light (and all other electromagnetic radiation) consists of a stream of discrete packets of energy called *photons*. The energy of the photons in a beam of light depends only on the wavelength of the light – shorter wavelength light consists of higher energy photons. If the wavelength is short enough, the photons will have enough energy to 'knock out' electrons from the atoms of the metal. This explanation of the photoelectric effect was independently confirmed in an experiment carried out by Millikan in 1916. In this way, Einstein had developed an argument in support of the new quantum theory: that it explained an otherwise inexplicable phenomenon.

2. Law

In Australian law, for a person to be found guilty of murder it must be shown that their actions *caused* the death of another human being. In a famous case, *R v Hallett*, the accused beat the victim unconscious and left him on the beach at low tide. A post-mortem revealed that the victim died from drowning in shallow water. At the trial, it was argued that although the accused had beaten the victim unconscious he had been alive when the accused left the beach. Therefore, it was argued, the accused's blows did not *cause* the death, as the victim died by drowning. That is, the action of the tide broke the 'chain of causation' between the accused's act and the victim's death. This argument was later rejected by the Full Court of the Supreme Court of South Australia.

3. Economics

The economists of the nineteenth century held that in a free market economy, there would be a natural tendency towards full employment. Any deviation from full employment would be automatically corrected by a corresponding drop in prices, leading to increased demand for products, which would in turn lead to more jobs being created. In *The General Theory of Employment, Interest and Money* (1936) John Maynard Keynes revolutionised economics by arguing that this 'classical' economic theory could not be correct. Keynes pointed out that the sharp and sustained fall in employment and output in the 1930s (The Great Depression) could not be explained on the basis of such a theory. Keyne's alternative theory was that the main driver of economic output was the total demand for goods and services in the economy (aggregate demand). On this basis, Keyne's argued, against the classical economic theory, that government intervention could be a successful means of stimulating the economy. Governments should not simply leave things to the supposed 'invisible hand' of the free market economy. Instead, the proper solution to high unemployment during a recession was for governments to increase spending and reduce taxes, in order to stimulate demand.

4. Mathematics

The *whole* numbers are 1, 2, 3, 4, …. A *prime number* is a whole number which is not divisible by any other smaller whole number (except 1). 7 is a prime number because it is not exactly divisible by any smaller whole number. 6 is not a prime number because it is

divisible by 3 and by 2. Numbers which are not prime are called *composite* numbers. There is a sense in which the prime numbers are like the atoms from which all the other whole numbers are made. For example, *every* whole number is exactly divisible by one of the prime numbers. The ancient Greek mathematician Euclid gave an argument for this claim around 300 BC. The argument can be found in Euclid's book *The Elements*, which is concerned mostly with geometry and is one of the most famous books of all time. Choose any whole number you like. If the number you have chosen is a prime number, then it is certainly divisible by a prime number (itself). But what if the number you have chosen is composite? That means it is divisible by a smaller number. So let's consider that smaller number. If that number is a prime, then our original number is divisible by a prime number! But what if the smaller number is composite? Then that means it is divisible by an even *smaller* number. And if *that* number is prime, we again have our desired conclusion. … and so on. Perhaps you think this process might go on forever, generating smaller and smaller numbers. But that is impossible, for we cannot get any smaller whole number than 1. So eventually we *must* find a prime number which divides our original number exactly.

5. Medicine

Around 1848, Dr. John Snow argued that cholera was commonly transmitted by drinking water. This claim contradicted the prevailing hypothesis of the time, that cholera was spread through the atmosphere by noxious fumes generated by decomposing organic matter. Snow's theory was that cholera was a disease of the gut and that its symptoms were entirely the result of fluid loss. Therefore, Snow argued, the germ involved must enter by the mouth and multiply in the gut. Hence, the disease could then be spread over long distances by drinking water contaminated with raw sewage containing the germ. Five years later, there was a cholera epidemic in London that allowed Snow to put his hypothesis to the test. Around the Golden Square area of London, there was a particular intense outbreak of the disease, killing about 500 men, women and children in just 10 days, in area of only a few square blocks. Dr. Snow was asked to investigate and he immediately turned his attention to the water supply. At that time, water was supplied by private companies who set up street pumps from which water could be drawn. After making enquiries, Snow discovered that nearly all the deaths had taken place near a particular water pump on Broad Street. Investigating further, Snow established that indeed, a majority of the people who had died in the area had been in the habit of drinking water from this particular pump. On this basis, Snow arranged to have the handle removed from the pump on Broad Street. The number of cholera deaths in the area dropped dramatically.

6. Philosophy

In 1936, the British philosopher A. J. Ayer published one of the most widely read philosophy books of the twentieth century: *Language, Truth and Logic*. In that book, Ayer, propounded the views of a radical and influential movement in philosophy which became known as *Logical Positivism*. The central tenet of logical positivism was the *principle of verification*, according to which a statement is meaningful only if it is either true by definition or capable of being verified (or refuted) by observation or experiment. Using this principle, the positivists hoped to exclude the more extreme varieties of speculative metaphysics and theology and provide an answer to the perennial philosophical problem of scepticism concerning the external world. How do you know you are not dreaming everything you see around you? How do you know that everything you see, hear, feel, smell and taste is not an elaborate illusion, perhaps created by a vast supercomputer attached to your brain? In *Language, Truth and Logic*, Ayer argued that the hypothesis that you are

such a 'brain in a vat' was meaningless. The hypothesis that *everything* you perceive is really an illusion cannot be verified or refuted by experience. No experience could ever rule out the 'brain in a vat' hypothesis, because *any* experience you have is consistent with that hypothesis. Therefore, argued Ayer, it follows from the verification principle that the hypothesis is meaningless and so cannot be true (or even false, for that matter).