PHIL 110 Logic and Critical Thinking
Course Reader (Textbook)

PHIL 110 Logic and Critical Thinking

Textbook

Acknowledgements

The following sections of this text are from the following sources:

Chapter 1 is derived from
Clear and Present Thinking, pg 15-33 “Questions, problems, and worldviews”

Chapter 2 is derived from
Clear and Present Thinking, pg 33-46 “Questions, problems, and worldviews”

Chapter 3 is derived from
Fundamental Methods of Logic Pg 1-10, 18-29
Introduction to Logic and Critical Thinking pg 1-17

Chapter 4 is derived from
Fundamental Methods of Logic Pg 10-18
Introduction to Logic and Critical Thinking pg 23-31

Chapter 5 is derived from
Introduction to Logic and Critical Thinking pg 139-146
Clear and Present Thinking pg 63-66 (plus exercises on pg 69-70)
An Introduction to Reasoning pg 2-5 (plus exercises on pg 17)

Chapter 6 is derived from
Fundamental Methods of Logic pg 163-175
Introduction to Logic and Critical Thinking pg 158-169

Chapter 7 is derived from
Fundamental Methods of Logic pg 152-163
Introduction to Logic and Critical Thinking pg 154-158

Chapter 8 is derived from
Fundamental Methods of Logic pg 29-40
Introduction to Logic and Critical Thinking pg 199-206

Chapter 9 is derived from
Fundamental Methods of Logic pg 39-46
Introduction to Logic and Critical Thinking pg 195-199

Chapter 10 is derived from
Fundamental Methods of Logic pg 45-53
Introduction to Logic and Critical Thinking pg 186-194

Chapter 11 is derived from
An Open Introduction to Logic, Chapter 5

Chapter 12 is derived from
An Open Introduction to Logic, Chapter 6

References:

Knachel, M. (2017). *Fundamental Methods of Logic* Philosophy Faculty Books. Retrieved from `http://dc.uwm.edu/phil_facbooks/1`

Myers, B., Elsby, C., Baltzer-Jaray, K. (2013). *Clear and Present Thinking.* Retrieved from `http://www.brendanmyers.net/nwpbooks/cpt.html`

Van Cleave, M J. *Introduction to Logic and Critical Thinking.* Retrieved from `https://open.umn.edu/opentextbooks/textbooks/introduction-to-logic-and-critical-thinking`

Loftis R.J., Woods C, Magnus P.D. and Robinson, R.C. (2018) *An Open Introduction to Logic.* Retrieved from
`https://github.com/robinson-philo/openintroduction`

Woods, C. (2007) *An Introduction to Reasoning.* Retrieved from `https://sites.google.com/site/anintroductiontoreasoning/`

PHIL 110 Logic and Critical Thinking

(Most recent build:)

September 4, 2019

Contents

Chapter 1

Questions, Problems, and World Views

Chapter One: Questions, Problems, and World Views

Before getting into any of the more analytic details of logical reasoning, let's consider the ways in which ideas 'play out' in the world, and the way we arrive at most of our beliefs. Most textbooks on modern logic assert that the basic unit of logic is the statement – a simple sentence which can be either true or false. But it seems to me that statements have to come from somewhere, and that they do not emerge from nothing. People do not come to believe things at random, or by magic. To my mind, the most obvious places where statements are born are one's intellectual environments, one's problems, and the questions that you and others in your environment tend to ask. Good thinking also begins in situations which prompt the mind to think differently about what it has taken for granted so far.

1.1 Intellectual Environments

Where does thinking happen? This may sound as if it's a bit of a silly question. Thinking, obviously, happens in your mind. But people do more than just think their own thoughts to themselves. People also share their thoughts with each other. Thoughts do not remain confined within your own brain: they also *express themselves* in your words and your actions. I'd like to go out on a bit of a limb here, and say that thinking happens not only in your mind, but **also any place where two or more people gather to talk to one another and share their ideas with each other**. In short, thinking happens wherever two or more people could have a dialogue with each other. In that dialogue, at least two people (but possibly many more) can express, share, trade, move around, examine, criticize, affirm, reject, modify, argue about, and generally communicate their own and each other's ideas.

The importance of dialogue in reasoning is perhaps most important, and also most obvious, when we are reasoning about moral matters. The philosopher Charles Taylor said:

> Reasoning in moral matters is always reasoning with somebody. You have an interlocutor, and you start from where that person is, or with the actual difference between you; you don't reason from the ground up, as though you were talking to someone who recognized no moral demands whatever. [1]

What Taylor says about moral reasoning also applies to other things we reason about. Whenever you have a conversation with someone about whether something is right, wrong, true, false, partially both, and so on, you do not start the conversation from nothing. Rather, you start from your own beliefs about such things, and the beliefs held by your partner in the conversation, and the extent to which your beliefs are the same, or different, as those of the other person. It is not by accident that Plato, one of the greatest philosophers in history, wrote his books in the form of dialogues between Socrates and his friends. Similarly, French philosopher Michel Foucault observed that especially among Roman writers, philosophy was undertaken as a social practice, often within institutional structures like schools, but also through informal relations like friendships and families. This

---

[1] Taylor, Malaise of Modernity, pg. 32

social aspect of one's thinking was considered normal and even expected:

> When, in the practice of the care of the self, one appealed to another person in whom one recognised an aptitude for guidance and counseling, one was exercising a right. And it was a duty that one was performing when one lavished one's assistance on another…[2]

So, to answer the question 'Where does thinking happen?' we can say: 'any place where two or more people can have a conversation with each other about the things that matter to them'. And there are lots of such places. Where the Romans might have listed the philosophy schools and the political forums among those places, we today could add:

- Movies, television, pop music, and the entertainment industry
- Internet-based social networks like Facebook and YouTube
- Streets, parks, and public squares
- Pubs, bars, and concert venues
- Schools, colleges, and universities
- Mass media
- Religious communities and institutions
- The arts
- The sciences
- Courtrooms and legal offices
- Political settings, whether on a small or large scale
- The marketplace, whether local or global
- Your own home, with your family and friends
- Can you think of any more places like this?

In each of the places where thinking happens, there's a lot of activity. Questions are asked, answers are explored, ideas are described, teachings are presented, opinions are argued over, and so on. Some questions are treated as more relevant than others, and some answers meet with greater approval than others. It often happens that in the course of this huge and complicated exchange, some ideas become more influential and more prevalent than others. You find this in the way certain words, names, phrases or definitions get used more often. And you find it as certain ways to describe, define, criticize, praise, or judge things are used more often than others. The ideas that are expressed and traded around in these ways and in these places, and especially the more *prevalent* ideas, form **the intellectual environment** that we live in.

Most of the time, your intellectual environment will roughly correspond to a social environment: that is, it will correspond (at least loosely) to a group of people, or a community that you happen to be part of. Think about all the groups and communities that you belong to, or have belonged to at one time or another:

- Families
- Sports teams
- The student body of your college
- The members of any social club you have joined
- The people at your workplace
- Your religious group (if you are religious)
- People who live in the same neighbourhood of your town or city
- People who speak the same language as you
- People who are roughly the same age as you
- People who come from the same cultural or ethnic background
- People who like the same music, movies or books as you
- People who play most of the same games as you
- Can you think of any more?

An intellectual environment will have a character of its own. That is, in one place or among one group of people, one idea or group of related ideas may be more prevalent than other ideas. In another place and among other people, a different set of ideas may dominate things. Furthermore, several groups may have very similar intellectual environments, or very different ones, or overlapping ones. Also note that you probably live in more than one social environment, and so you are probably hearing ideas from more than one intellectual environment too.

An intellectual environment, with its prevalent ideas, surrounds everyone almost all the time, and it profoundly influences the way people think. It's where we learn most of our basic ideas about life and the

---

[2] Foucault, The Care of the Self, pg. 53

world, starting at a very early age. It probably includes a handful of stock words and phrases that people can use to express themselves and be understood right away. This is not to say that people get all of their thoughts from their environment. Obviously, people can still do their own thinking wherever they are. And this is not to say that the contents of your intellectual environment will always be the same from one day to the next. The philosopher Alasdair MacIntyre observed that an intellectual tradition is often a continuity of conflict, and not just a continuity of thought. But this is to say that wherever you are, and whatever community you happen to be living in or moving through, the prevalent ideas that are expressed and shared by the people around you will influence your own thinking and your life in profound and often unexpected ways.

By itself, this fact is not something to be troubled about. Indeed, in your early childhood it was probably very important for you to learn things from the people around you. For instance, it was better for a parent to tell you not to touch a hot barbecue with your bare hand, than for you to put your hand there yourself and find out what it feels like. But as you grow into adulthood, it becomes more and more important to know what one's intellectual environment is really like. It is very important to know what ideas are prevalent there, and to know the extent to which those ideas influence you. For if you know the character and content of the intellectual environment in which you live, you will be much better able to do your own thinking. You might end up agreeing with most, or even all of the prevalent ideas around you. But you will have agreed with them for your own reasons, and not (or not primarily) because they are the ideas of the people around you. And that will make an enormous difference in your life.

Some intellectual environments are actually hostile to reason and rationality. Some people become angry, feel personally attacked, or will deliberately resist the questioning of certain ideas and beliefs. Indeed, some intellectual environments hold that intellectual thinking is bad for you! Critical reasoning sometimes takes great courage, especially when your thoughts go against the prevalent ideas of the time and place where you live.

1.2 World Views

Eventually, the ideas that you gathered from your intellectual environment, along with a few ideas of your own that you developed along the way come together in your mind. They form in your mind a kind of plan, a picture, or a model of what the world is like, and how it acts, and so on. This plan helps you to understand things, and also helps you make decisions. Philosophers sometimes call this plan a **world view**.

Think for a moment about some of the biggest, deepest and most important questions in human life. These questions might include:

- What should I do with my life? Where should I go from here? Should I get married? What career should I pursue? Where is my place in the world? How do I find it? How do I create it?
- Is there a God? What is God like? Is there one god, or many gods? Or no gods at all? And if there is, how do I know? And if there's not, how do I know?
- Why are we here? Why are we born? Is there any point to it all?
- What is my society really like? Is it just or unjust? And what is Justice?
- Who am I? What kind of person do I want to be?
- What does it mean to be an individual? What does it mean to be a member of society?
- What happens to us when we die?
- What do I have to do to pass this course?
- Just what are the biggest, deepest and most important questions anyway?

These are philosophical questions. (Well, all but one of them.) Your usual way of thinking about these questions, and others like them is your world view. Obviously, most people do not think about these questions all of the time. We are normally dealing with more practical, immediate problems. What will I have for dinner tonight? If the traffic is bad, how late might I be? Is it time to buy a new computer? What's the best way to train a cat to use the litter-box?

But every once in a while, a limit situation will appear, and it will prompt us to think about higher and deeper things. And then the way that we think about these higher and deeper things ends up influencing the way that we live, the way we make choices, the ways that we relate to other people, and the way we handle almost all of our problems. The sum of your answers to those higher and deeper questions is called your 'world view'.

The word 'world view' was first coined by German philosopher Albert Schweitzer, in a book called "The Decay and Restoration of Civilization", first published in 1923. Actually, the word that Schweitzer coined here is the German word Weltanshauung. There are several possible ways to translate this word. In the text quoted above, as you can see, it's translated as "theory of the universe". It could also be translated as "theory of things" or "world conception". Most English speakers use the simpler and more elegant sounding phrase "world view". Here's how Schweitzer himself defined it:

> The greatest of the spirit's tasks is to produce a theory of the universe. What is meant by a theory of the universe? It is the content of the thoughts of society and the individuals which compose it about the nature and object of the world in which they live, and the position and the destiny of mankind and of individual men within it. What significance has the society in which I live and I myself in the world? What do we want to do in the world? What do we hope to get from it? What is our duty to it? The answer given by the majority to these fundamental questions about existence decides what the spirit is in which they and their age live. (Schweitzer, The Decay and Restoration of Civilization, pg. 80-1)

Schweitzer's idea here is that a world-view is more than a group of beliefs about the nature of the world. It is also a **bridge between those scientific or metaphysical beliefs, and the ethical beliefs about what people can and should do in the world**. It is the intellectual narrative in terms of which the actions, choices, and purposes of individuals and groups make sense. It therefore has indispensable practical utility: it is the justification for a way of life, for individuals and for whole societies. In this sense, a world view is not just something you 'have'; it is also something that you 'live with'. And we cannot live without one. "For individuals as for the community," Schweitzer said, "life without a theory of things is a pathological disturbance of the higher capacity for self-direction." (Schweitzer, ibid, pg. 86)

Let's define a world view as follows: **A world view is the sum of a set of related answers to the most important questions in life**. Your own world view, whatever it is, will be the sum of your own answers to your philosophical questions, whatever you take those questions to be, and whether you have thought about them consciously or not. Thus your world view is intimately tied to your sense of who you are, how you want to live, how you see your place in your world and the things that are important to you. Not only your answers to the big questions, but also your choice of which questions you take to be the big questions, will form part of your world view. And by the way, that's a big part of why people don't like hearing criticism. A judgment of a world view is often taken to be a judgment of one's self and identity. But it doesn't have to be that way.

Some world views are so widely accepted by many people, perhaps millions of people, and are so historically influential, perhaps over thousands of years, that they have been given names. Here are a few examples:

Modernism: referring to the values associated with contemporary western civilization, including democracy, capitalism, industrial production, scientific reasoning, human rights, individualism, etc.

Heliocentrism: the idea that the sun is at the centre of our solar system, and that all the planets (and hundreds of asteroids, comets, minor planets, etc.) orbit around the sun.

Democracy: the idea that the legitimacy of the government comes from the will of the people, as expressed in free and fair elections, parliamentary debate, etc.

Christianity: The idea that God exists; that humankind incurred an 'original sin' due to the events in the Garden of Eden, and that God became Man in the person of Jesus to redeem humanity of its original sin.

Islam: The idea that God exists, and that Mohammed was the last of God's prophets, and that we attain blessedness when we live by the five pillars of submission: daily prayer, charity, fasting during Ramadan, pilgrimage to Mecca, and personal struggle.

Marxism: The idea that all political and economic corruption stems from the private ownership of the means of production, and that a more fair and just society is one in which working class people collectively own the means of production.

Deep Ecology: The idea that there is an important metaphysical correlation between the self and the earth, or that the earth forms a kind of expanded or extended self; and that therefore protecting the environment is as much an ethical requirement as is protecting oneself.

The Age of Aquarius / The New Age: The idea that an era of peace, prosperity, spiritual enlightenment, and complete happiness is about to dawn upon humankind. The signs of this coming era of peace can be found in astrology, psychic visions, Tarot cards, spirit communications, and so on.

And some of these world views may have other, sub-views bundled inside them. For instance:

Democracy	a. Liberalism
	b. Conservatism
	c. Democratic Socialism
Buddhism	a. Mahayana
	b. Theravada
	c. Tibetan Bon-Po
	d. Zen

Clearly, not all world views are the same. Some have different beliefs, different assumptions, different explanations for things, and different plans for how people should live. Not only do they produce different answers to these great questions, but they often start out with different great questions. Some are so radically different from each other that the people who subscribe to different world views might find it very difficult to understand each other.

In summary, your world view and the intellectual environment in which you live, when taken together, form the basic background of your thinking. They are the source of most of our ideas about nearly everything. If you are like most people, your world view and your intellectual environment overlap each other: they both support most of the same ideas. Sometimes there will be slight differences between them; sometimes you may find differences so large that you may feel that one of them must be seriously wrong, in whole or in part. Differing world views and differing intellectual environments often lead to social and personal conflict. It can be very important, therefore, to consciously and deliberately know what your own world view really is, and to know how to peacefully sort out the problems that may arise when you encounter people who have different world views.

1.3 Framing Language

One of the ways that your intellectual environment and your world view expresses itself is in the use of framing language. These are the **words, phrases, metaphors, symbols, definitions, grammatical structures, questions, and so on which we use to think and speak of things in a certain way**. We frame things by describing or defining them with certain interpretations in mind. We also frame things by the way we place emphasis on certain words and not on others. And we frame things by interpreting and responding selectively to things said by others.

As an example, think of some of the ways that people speak about their friendships and relationships. We say things like "We connected", "Let's hook up", "They're attached to each other", and "They separated". We sometimes speak of getting married as "getting hitched". These phrases borrow from the vocabulary of machine functions. And to use them is to place human relations within the frame of machine functions. Now this might be a very useful way to talk about relationships, and if so, then it is not so bad. But if for some reason you need to think or speak of a relationship differently, then you may need to invent a new framing language with which to talk about it. And if this is the only framing language you've ever used to talk about relationships, it might be extremely difficult for you to think about relationships any other way.

As a thought experiment, see if you can invent a framing language for your friendships and relationships based on something else. Try using a framing language based on cooking, or travel, or music, or house building, as examples.

Here's another example of the use of framing language. Consider the following two statements:

> "In the year 1605, Guy Fawkes attempted to start a people's revolution against corruption, inherited privilege, and social injustice in the British government."

> "In the year 1605, Guy Fawkes planned a terrorist attack against against a group of Protestant politicians, in an attempt to install a Catholic theocracy in Britain."

Both of these statements, taken as statements of fact, are true. But they are both framed very differently. In the first statement, Fawkes is portrayed as a courageous political activist. In the second, he is framed (!) as a dangerous religious fanatic. And because of the different frames, they lead the reader to understand and interpret the man's life and purposes very differently. This, in turn, leads the reader to draw different conclusions.

In other situations, the use of framing language can have serious economic or political consequences. Consider, as an example, the national debate that took place in the United States over the Affordable Health Care Act of 2009. The very name of the legislation itself framed the discussion in the realm of market economics: the word 'affordable' already suggests that the issue has to do with money. And most people who participated in that national debate, including supporters and opponents and everything in between, spoke of health care as if it is a kind of market commodity, which can be bought or sold for a price. The debate thus became primarily a matter of questions like who will pay for it (the state? individuals? insurance companies?), and whether the price is fair. But there are other ways to talk about health care besides the language of economics. Some people frame heath care as a human right. Some frame it as a form of organized human compassion, and some as a religious duty. But once the debate had been framed in the language of market economics, these other ways of thinking about health care were mostly excluded from the debate itself.

As noted earlier, it's probably not possible to speak about anything without framing it one way or another. But your use of framing language can limit or restrict the way things can be thought of and spoken about. They can even prevent certain ways of thinking and speaking. And when two or more people conversing with each other frame their topic differently, some unnecessary conflict can result, just as if they were starting from different premises or presupposing different world views. So it can be important to monitor one's own words, and know what frame you are using, and whether that frame is assisting or limiting your ability to think and speak critically about a particular issue. It can also be important to listen carefully to the framing language used by others, especially if a difference between their framing language and yours is creating problems.

And speaking of problems: this leads us to the point where the process of critical thinking begins.

1.4 Problems

Usually, logic and critical thinking skills are invoked in response to a need. And often, this need takes the form of a **problem** which can't be solved until you gather some kind of information. Sometimes the problem is practical: that is, it has to do with a specific situation in your everyday world.

For example:

- Perhaps you have an unusual illness and you want to recover as soon as possible.
- Perhaps you are an engineer and your client wants you to build something you've never built before.
- Perhaps you just want to keep cool on a very hot day and your house doesn't have an air conditioner.

The problem could also be theoretical: in that case, it has to do with a more general issue which impacts your whole life altogether, but perhaps not any single separate part of it in particular. Religious and philosophical questions tend to be theoretical in this sense.

For example:

- You might have a decision to make which will change the direction of your life irreversibly.
- You might want to make up your mind about whether God exists.
- You might be mourning the death of a beloved friend.
- You might be contemplating whether there is special meaning in a recent unusual dream.
- You might be a parent and you are considering the best way to raise your children.

The philosopher Karl Jaspers described a special kind of problem, which he thought was the origin of philosophical thinking. He called this kind of problem a *Grenzsituationen*, or a "**limit situation**".

> Limit situations are moments, usually accompanied by experiences of dread, guilt or acute anxiety, in which the human mind confronts the restrictions and pathological narrowness of its existing forms, and allows itself to abandon the securities of its limitedness, and so to enter new realm of self-consciousness. [3]

In other words, a limit situation is a situation in which you meet something in the world that is unexpected and surprising. It is a situation that more or less forces you to acknowledge that your way of thinking about the world so far has been very limited, and that you have to find new ways to think about things in order to solve your problems and move forward with your life. This acknowledgement, according to Jaspers, produces anxiety and dread. But it also opens the way to new and (hopefully!) better ways of thinking about things.

In general, a limit situation appears when something happens to you in your life that you have never experienced before, or which you have experienced very rarely. It might be a situation in which a long-standing belief you have held up until now suddenly shows itself to have no supporting evidence, or that the consequences of acting upon it turn out very differently than expected. You may encounter a person from a faraway culture whose beliefs are very different from yours, but whom you must regularly work with at your job, or around your neighbourhood. You may experience a crisis event in which you are at risk of death. A limit situation doesn't have to be the sort of experience that provokes a nervous breakdown or a crisis of faith, nor does it have to be a matter of life and death. But it does tend to be the type of situation in which your usual and regular habits of thinking just can't help you. It can also be a situation in which you have to make a decision of some kind, which doesn't necessarily require you to change your beliefs, but which you know will change your life in a non-trivial way.

1.5 Observation

Thus far, we have noted the kinds problems that tend to get thinking started, and the background in which thinking takes place. Now we can get on to studying thinking itself. In the general introduction, I wrote that clear critical thinking involves a process. The first stage of that process is *observation*.

When observing your problem, and the situation in which it appears, try to be as **objective** as possible. Being objective, here, means **being without influence from personal feelings, interests, biases, or expectations, as much as possible**. It means observing the situation as an uninvolved and disinterested third-person observer would see it. (By 'disinterested' here, I mean a person who is curious about the situation but who has no personal stake in what is happening; someone who is neither benefitted nor harmed as the situation develops.) Although it might be impossible to be totally, completely, and absolutely objective, still it certainly is possible to be objective *enough* to understand a situation as clearly and as completely as needed in order to make a good decision.

When you are having a debate with someone it is often very easy, and tempting, to simply accuse your opponent of being **biased**, and therefore in no position to understand something properly or make

---

[3] Stanford encyclopaedia of philosophy, online edition, entry on Karl Jaspers.

decisions. If someone is truly biased about a certain topic, it is rational to doubt what someone says about that topic. But having grounds for reasonable doubt is not the same as having evidence that a proposition is false. Moreover, having an opinion, or a critical judgment about something, or a world view, is not the same as having a bias. Let us define a bias here as **the holding of a belief or a judgment about something even after evidence of the weakness or the faultiness of that judgment has been presented**. We will see more about this when we discuss Value Programs. For now, just consider the various ways in which we can eliminate bias from one's observations as much as possible. Here are a few examples:

- Take stock of how clearly you can see or hear what is going on. Is something obstructing your vision? Is it too bright, or too dark? Are there other noises nearby which make it hard for you to hear what someone is saying?
- Describe your situation in words, and as much as possible use value-neutral words in your description. Make no statement in your description about whether what is happening is good or bad, for you or for anyone else. Simply state as clearly as possible what is happening. If you cannot put your situation into words, then you will almost certainly have a much harder time understanding it objectively, and reasoning about it.
- Describe, also, how your situation makes you feel. Is the circumstance making you feel angry, sad, elated, fearful, disgusted, indignant, or worried? Has someone said something that challenges your world view? Your own emotional responses to the situation is part of what is 'happening'. And these too can be described in words so that we can reason about them later.
- Also, observe your instincts and intuitions. Are you feeling a 'pull', so to speak, to do something or not do something in response to the situation? Are you already calculating or predicting what is likely to happen next? Put these into words as well.
- Using numbers can often help make the judgment more objective. Take note of anything in the situation that can be counted, or measured mathematically: times, dates, distances, heights, shapes, angles, sizes, monetary values, computer bytes (kilobytes, megabytes, etc.), and so on.
- Take note of where your attention seems to be going. Is anything striking you as especially interesting or unusual or unexpected?
- If your problem is related to some practical purpose, take note of everything you need to know in order to fulfill that purpose. For instance, if your purpose is to operate some heavy machinery, and your problem is that you've never used that machine before, take note of the condition of the safety equipment, and the signs of wear and tear on the machine itself, and who will be acting as your "spotter", and so on.
- If other people are also observing the situation with you, consult with them. Share your description of the situation with them, and ask them to share their description with you. Find out if you can see what they are seeing, and show them what you are seeing. Also, try to look for the things that they might be missing.

Separating your observations from your judgments and opinions can often be difficult. But the more serious the problem, the more important it can be to observe something non-judgmentally, *before* coming to a decision. With that in mind, here's a short exercise: which of the following are observations, and which are judgments? Or, are some of them a bit of both?

- That city bus has too many people on it.
- The letter was delivered to my door by the postman at 10:30 AM.
- The two of them were standing so close to each other that they must be lovers.
- The clothes she wore suggested she probably came from a very rich family.
- The kitchen counter looked like it had been recently cleaned.
- He was swearing like a sailor.
- The old television was too heavy for him to carry.
- There's too much noise coming from your room, and it's driving me crazy!
- The latest James Bond film was a lot of fun.
- The latest James Bond film earned more than $80 million in its first week.
- I hate computers!

- The guy who delivered the pizza pissed me off because he was late.

1.6 Questions

Perhaps more than the problems do, good questions get the mind thinking as well. Questions express doubts, identify problems, call for solutions and demand answers. Indeed we might not fully understand the nature of a given problem until we have asked a decent question about it. Moreover, the best answers to one's questions tend to become ideas, beliefs, propositions, theories, arguments and world views. These, in turn, guide our lives and our choices in numerous ways. But some kinds of questions are better than others, and it can be important to discern the differences between them.

Good questions are:

1. Tenacious. We cannot easily put them away or ignore them.

2. Direct. They address the actual problem that you are facing, and not a tangential or unrelated issue.

3. Searching. When you pose a good question, you don't already know the answer. You might have a rough or vague idea of what the answer might be, but you don't know for sure yet, and you are committed to finding out. Or, you might have several possible answers, and you want to find out whether any of them are good answers, or which one is the best.

4. Systematic. Although you don't have a clear answer to your question, still your question is associated with a method or a plan, even if only a loose one, with which you can search for an answer. In other words: even when you don't know the answer, you still know what you're doing, and you're not scrambling in the dark. You have an idea where to look for an answer. And you are covering every place where a useful answer could be found, leaving nothing out.

5. Useful. The process of answering a good question actually helps you solve your problem.

6. Open. There might be more than one possible correct answer. (There can also be more than one possible wrong answer.) With several good answers to your question, you may have to do a lot more work to find which of them is the best one, if your circumstance requires you to pick just one answer. But that work is ultimately very useful, and almost always leads us to better quality answers.

7. Fertile. Some of the better answers to the question prompt more good questions. In this way, good questions can keep the mind active.

8. Controversial. A good question is often one which addresses itself to beliefs, ideas, ways of living, etc., which people normally take for granted. It may even be a question that no one else or very few others are asking. This does not necessarily mean that the questioner is being aggressive or confrontational. It should still be a searching question, and a direct question, and so on. But with a controversial question, the questioner often places herself at odds, in some way, with those who are committed to the beliefs being questioned, or who might not want the question asked at all. Indeed a controversial question can sometimes place the questioner in some danger by the very act of asking it. That danger might be social: by asking the question, she might risk being cold-shouldered or ostracized by her friends. Or it might be physical: by asking the question, she might place herself at odds against politically or economically powerful people and institutions, such as the law or one's employer.

The more of these qualities that a question has, the better a question it is. There are also several kinds of bad questions. Here are a few examples:

Rhetorical questions. This is a question in which the questioner already knows the answer, and is trying to prompt that same answer from his or her listeners. Although rhetorical questions can be interesting and perfectly appropriate in poems or storytelling, in a nonfiction text or in a more 'straight talk' conversation they are stylistically weak. Rhetorical questions are often plain statements of belief or of fact merely phrased in the form of a question. So it is generally better to state the belief or the fact directly as a proposition. Also, it's always possible that someone else will answer the rhetorical question in an unexpected way. Rhetorical questions can also be used as forms of verbal aggression. They position the questioner as the controller of the debate, and they place others on the defensive, and make it harder for them to contribute to the debate as an equal.

Leading questions. These are questions that are designed to manipulate someone into believing something that they may or may not otherwise believe. Normally, leading questions come in a series, and the series is designed to make someone predisposed to respond to the last question in the series in a particular way. Leading questions are often used in a form of political campaigning called 'push polling' (to be discussed in the chapter on Reasonable Doubt).

Loaded or Complex Questions. A loaded question is one that cannot be given a straight answer unless the person answering it accepts a proposition that he or she might not want to accept. (More discussion of this kind of question appears in the chapter on Fallacies.) Like rhetorical questions, loaded questions can also be used aggressively, to control a debate and to subordinate the other contributors.

Obstructionist questions. This is the kind of question that someone asks in order to interrupt someone else's train of thought. Obstructionist questions often look like good questions, and in a different context they may be perfectly reasonable. But the obstructionist question is designed distract a discussion away from the original topic, and prevent the discussion from reaching a new discovery or a clear decision. Typically, the obstructionist question asks about definitions, or pushes the discussion into a very abstract realm. It may also involve needlessly hair-splitting the meaning of certain words. In this sense an obstructionist question is much like the fallacy of 'red herring'. As an example, someone might obstruct a discussion of whether same-sex couples should be allowed to marry by saying: "Well, that all depends on what you mean by 'marriage'. What is marriage, anyway?"

Framing Questions. The framing question uses specific words, terms, and phrases to limit the way a certain topic can be discussed. There's probably no such thing as a question that doesn't frame the answers that flow from it, even if only in a small way. But it is possible to 'cook' or to 'rig' a question such that the only direct answers are ones which remain within a certain limited field of assumptions, or within a certain limited world view. Framing questions may even share some of the qualities of good questions: they might allow more than one answer, or they might open the way to further questions. But they are also like loaded questions in that they presuppose a certain way of thinking or talking about the topic, and you can't give a straight answer unless you reply within the bounds of that way of thinking and talking.

Empty Questions. A question is empty when it has no answer. Sometimes people will declare a question to be empty when in fact it is 'open': but a question with more than one possible good answer is not an empty question. So it is important to understand the difference between the two. A question is empty when all its answers lead to dead ends: when, for instance, the best answers are neither true nor false, or when different answers are nothing more than different descriptions of the same situation, or when the question cannot be given a direct answer at all. Such questions might be interesting for artistic or religious or similar purposes, and they can be the basis for some beautiful poems and meditations, or some very enjoyable comedy. But reasoning about such questions in a logical or systematic way doesn't produce any new discoveries. An empty question cannot tell you anything you don't already know.

By the way: when you are trying to observe a situation as objectively as possible before making a decision about it, you can also try to observe the way other people are talking about it. What kind of questions are they asking? What kind of framing language are they using in their descriptions? This, too, is part of the first stage in the process of reasoning.

And before moving on: there are things you should look for in a good answer to a good question. One of those things is that a good answer can be expressed in the form of a proposition. But we will see more about propositions a little later on.

1.7 Differing World Views

Perhaps the most difficult things to observe and question are your own beliefs. So let's look at how to do exactly that.

Once in a while, you are going to encounter differences between your world view and the intellectual environment in which you live. And you are also likely to encounter differences between your world view and other people's world views, and differences in the intellectual environments of different religions, political arrangements and cultures. And in some of those situations, you will not be able to just stand back and 'live and let live'. A judgment may have to be made, for instance about which world view you are personally prepared to live by, or which one you will support with your money or your votes or your actions in your community. You are also going to occasionally discover places where your world view doesn't "work", that is, places where it clearly does not help you understand the world, nor do what you want it to do.

Remember, you probably subscribe to several world views at the same time, some religious, some political, some cultural, some philosophical or scientific. In fact you probably subscribe to two or three world views at the same time, without consciously realizing it. Again, there's nothing wrong with that: we probably wouldn't be able to think about anything if we didn't have one.

But not all world views are created the same. Some are problematic, whether in great or small ways. Some are seriously faulty. If some part of your world view is faulty, this can muddle your thinking, and create conflict between you and other people. Thus it is very important to learn to tell the difference between a faulty world view and an acceptable one.

Some world views are faulty because **their ideas concerning the nature of the world have been proven wrong through scientific discovery**, such as the Ptolemaic model of the solar system, the 'four elements' theory of matter or the 'four humours' theory of medicine. Others are faulty because **their political and moral consequences have turned out to be very destructive**. Mediaeval feudalism, Soviet communism, Nazism, racism, sexism, and prejudice, are the best-known examples of morally faulty world views. Some world views that are deeply faulty may have one or two features that seem very appealing and plausible. The way the sun rises in the east and sets in the west certainly makes it look as if the earth is standing still and the sun is traveling around it, as the Ptolemaic world view suggests. The 'four humours' theory of medicine seems to correspond elegantly to the 'four elements' theory of matter. Under Soviet communism, from Stalin's time in the early 1940's until the fall of the Berlin Wall in 1989, nobody was unemployed. And in Nazi Germany, productive and high-achieving workers could receive a free holiday trip, paid for by the government. But these apparent benefits should not blind you to the moral and empirical failures of a faulty world view.

Schweitzer described three properties that he thought **an acceptable world view** had to have. In his view, an acceptable world view had to be: **rational**, **ethical**, and **optimistic**. Let's see how Schweitzer explains each of these points in turn.

First, an acceptable world view is rational when it is the product of a lot of careful thinking about the way things really are.

> "Only what has been well turned over in the thought of the many, and thus recognised as truth, possesses a natural power of conviction which will work on other minds and will continue to be effective. Only where there is a constant appeal to the need of a reflective view of things are all man's spiritual capacities called into activity." (Schweitzer, ibid pg. 86-7.)

This is stipulated in order that the world view may help people come to an understanding of the world and of one another. A world-view derived from unreflective instincts and impulses, in his view, cannot properly reflect reality, nor will it have sufficient power to motivate people to take action when they should.

Now, Schwitzer's words in that quotation might seem very circular. It may look as if he's saying 'a world view is rational when it's rational'. But what I suspect Schweitzer had in mind is something like this. A world view is rational when lots of people examine it carefully and critically, and in so doing, they determine whether or not it is actually able to explain things. Thus an acceptably rational world view **corresponds appropriately and usefully to the world as people actually experience it**. In that sense, a rational world view is a highly realistic one.

Second, an acceptable world view is ethical when it can tell us something about the difference between right and wrong, and when it can help us become better human beings.

> "Ethics is the activity of man directed to secure the inner perfection of his own personality… From the ethical comes ability to develop the purposive state of mind necessary to produce action on the world and society, and to cause the co-operation of all our achievements to secure the spiritual and moral perfection of the individual which is the final end of civilization."
> (ibid pg. 94-5)

It's important to note here that when Schweitzer speaks of a world view as 'ethical', he is not saying that an acceptable world view has to include certain specific moral statements. He is not saying, for example, that an ethically acceptable world view must be Christian, or that it must be Liberal, or whatever. Rather, he is saying that it has to have *something* to say about what is right or wrong, and *something* to say about how we can become better human beings, *whatever that something might be*. One world view might say that it is always wrong to harm animals, for instance. Another might say it can be right to harm animals under certain conditions. A third might claim that it is never wrong to harm animals. The point is not that one of these three possibilities is acceptable and the others aren't. The point is that all three of them are robust propositions about morality, regardless of whether you agree or disagree with them. Thus all three of those examples can be part of an acceptable world view.

It can often be tempting to say that a world view is unacceptable or invalid because it asserts moral claims that you find disagreeable. Doing so can make you look strong-willed and more certain of your values. But it can also create unnecessary conflict with others who are just as strongly committed to their own different world views. Remember, it is possible to acknowledge that a world view is 'acceptable' in Schweitzer's sense, while at the same time disagreeing with it.

Schweitzer's third criteria for an acceptable world view is that it must be optimistic. By this he means that it must presuppose that life on earth is valuable and good.

> "That theory of the universe is optimistic which gives existence the preference as against non-existence and thus affirms life as something possessing value in itself. From this attitude to the universe and to life results the impulse to raise existence, in so far as our influence can affect it, to its highest level of value. Thence originates activity directed to the improvement of the living conditions of individuals, of society, of nations and of humanity." (Schweitzer, ibid, pp. 93-4)

Overall, according to Schweitzer, a world view that is not rational, not optimistic, and not ethical, whether in whole or in part, is (to that extent) a problematic or a faulty world view.

1.8 Value Programs

One important type of faulty world view is the kind which Canadian philosopher John McMurtry called a "value program". Value programs are world views which have the following two qualities:

- There's at least one proposition about values that cannot be questioned under any circumstances or for any reason, even when there is evidence available which shows that the proposition is weak, open to reasonable doubt, or even clearly false.
- Acting on the unquestionable proposition, and behaving and making choices as if that proposition is true, tends to cause a lot of preventable harm to people, or to their environments.

Here are McMurtry's own words, to describe what value programs are like:

> In the pure-type case, which will be our definition of a value program, all people enact its prescriptions and functions as presupposed norms of what they all ought to do. All assume its value designations and value exclusions as givens. They seek only to climb its ladder of available positions to achieve their deserved reward as their due. Lives are valued, or not valued, in terms of the system's differentials and measurements. All fulfill its specified roles without question and accept its costs, however widespread, as unavoidable manifestations of reality. In the strange incoherence of the programmed mind, the commands of the system are seen as both freely chosen and as laws of nature, or God… Those who are harmed by the value program are ignored, or else blamed for falling on its wrong side, because its rule is good and right. Its victims must, it is believed, be at fault. A value program's ideology is in great part devoted to justifying the inevitability of the condition of the oppressed.[4]

McMurtry added to his discussion that world views become value programs not due to a fault in human nature, but rather due to a kind of social or psychological conditioning: "…it is not "human nature" that is the problem. The problem is not in how we are constructed, but in the inert repetition of the mind, a condition that does not question socially conditioned value programs."[5]

It's usually easy to identify value programs from history: mediaeval feudalism, for instance. But perhaps the more important questions are:

- What are the value programs of our time?
- Are you, or the people around you, unknowingly subscribing to a value program?
- Are there propositions in your intellectual environment which cannot be questioned, or which can be questioned but only at great personal risk?
- Is anyone harmed through the ways you live your life in accordance with the teachings of your world view? How are those harms explained? And are those explanations justifiable? Why or why not?
- In what ways, if at all, does your world view meet, or fail to meet, Schweitzer's three criteria for acceptability?

As an exercise, have a look at this short list of world views of our time, and think about whether any of them are value programs, and why (or why not):

- Representative parliamentary democracy.
- Free-market capitalism.
- Human rights.
- The 'trickle-down' theory of economics.
- The right to bear arms.
- The pro-choice movement.
- The pro-life movement.
- Manifest Destiny.
- The 'fandom' of any professional sports team.
- The official platform of any major political party.
- The teachings, doctrines, and creeds of any major religion.

1.9 World Views, Civilization, and Conflict

In 1993, American historian and political scientist Samuel Huntington published a paper called "A Clash of Civilizations?" In that paper he defined 'civilization' as "the highest cultural grouping of people and the broadest level of cultural identity people have short of that which distinguishes humans from other species."[6] The idea here is like this. Think of the biggest grouping of people that you feel part of, such that the only grouping of people that is larger than that one is the human race as a whole. You will probably find yourself thinking about more than just your country or your religion, or those who speak the same language as you. Rather, you will find yourself thinking of people who share a few simple concepts in their world views, even while they live in different countries or speak different languages. With this definition in mind, Huntington thought that there are nine civilizations active in the world right now: Western, Latin American, Slavic, Middle Eastern, African, Hindu, Chinese, Buddhist, and Japanese. Huntington also thought that some countries, such as Ethiopia, and Turkey, are 'torn' countries. In a torn country, some forces in that country are working to transition the country from one civilization to another, while at the same time other forces in the same country resist that transition.

---

[4] McMurtry, "Unequal Freedoms" (Garamond, 1998) pg. 6

[5] Ibid

[6] Huntington, "A Clash of Civilisations?" Foreign Affairs, Summer 1993

Huntington further argued that differences in world view and civilization are going to be the basis for all future armed conflict.

> "…the fundamental source of conflict in this new world will not be primarily ideological or primarily economic. The great divisions among humankind and the dominating source of conflict will be cultural. Nation states will remain the most powerful actors in world affairs, but the principal conflicts of global politics will occur between nations and groups of different civilizations." (Huntington, ibid.)

Finally, Huntington also gives a particular privilege to religion. In his view, economic globalisation has had the effect of reducing the importance of the nation-state in shaping and defining personal identity. Religion, he says, has taken its place, since religion "…provides a basis for identity and commitment that transcends national boundaries and unites civilizations." (*ibid.*)

The important question here, of course, is whether or not Huntington's claim about the inevitability of conflict is correct.

1.10 Exercise for Chapter One: How Much Variety Is In Your World?

I have more than one thousand people on my Facebook list. So I see lot of "memes" every day. Memes are ideas, expressed in pictures and videos and quotations and so on, which people share with each other, and the more they are shared the more their movements seem to take on a life of their own. One day I thought it would be fun to save them to a database, and tag them according to the kind of messages they express. What would I discover? Were there some kinds of memes that are more popular than others? What are these things really telling me about the thoughts and feelings of the people around me? And what are they telling me about myself?

The original idea was to take a kind of "snapshot" of the content of my (online) intellectual environment over four days to see what was in it. My basic rules were simple. I would take only the pictures which appeared while I happened to be online. That way, I wouldn't have to be online all day. And I also promised myself not to deliberately change my web surfing habits during those days, so that I wouldn't get an artificial result. I also didn't track the links to blog posts, news articles, videos, or other online media. Just to be simple, I only tracked the photos and images. And I only tracked the ones that someone on my list shared after having seen it elsewhere. That way, each of these pictures had passed a kind of natural selection test. Someone had created the image and passed it on to someone who thought it worthy of being passed on to a third person.

After the first few hours, I had about 50 memes for my collection. And I already noticed a few general trends. So I started tagging the samples into what appeared to be the four most obvious categories: Inspirational, Humorous, Political, and Everything Else. The Humour category was already by far the largest, with more samples than the other categories combined. At the end of the first day, there was enough variety in the collection that I could create sub-categories. The largest of which was "Humour involving cats or kittens". No surprise there, I suppose.

But at the end of the second day, with about 200 samples in my collection, I started to notice something else, which was much more interesting. A small but significant number of these samples had to with social, political, or religious causes other than those that I personally support. Some promoted causes that were reasonably similar to my values, but I have never done all that much to support them. For instance, I've nothing against vegetarianism, but I'm not vegetarian myself. So I labeled those ones the "near" values, because they are not my values, but they are reasonably close, and I felt no sense of being in conflict with them. Then I noticed that some of my samples were for causes almost directly opposed to the ones I normally support. So instead of "un-friending" people with different political views than me, I saved and tracked their political statements just as I did everybody else's. And I labeled those statements the "far" values, because they expressed values fairly distant from my own.

So now I could look at all these images and put them in three broad groups: Common values, Near values, and Far values. And in doing so, I had discovered a way to statistically measure the real variety of my intellectual environment, and the extent to which I am actually exposed to seriously different world views. Let's name this measurement your 'Intellectual Environment Diversity Quotient'. Or, to be short about it, your 'DQ'.

At the end of four days, I had 458 pictures, and I had tagged them into six broad categories: Inspirational, Humour, Religion, Causes, Political, and Foreign Language. Here's how it all turned out. (Note here that if some of these numbers don't seem to add up, that is because some samples were tagged more than once, as they fit into two or (rarely) three categories.)

Total size of the dataset: 458 (100.0%)
Inspirational images: 110 (24.0%) *Humour:* 225 (49.1%) *Religion:* 36 (7.8%) *Causes:* 148 (32.3%) *Political:* 47 (10.2%) *Foreign language:* 11 (2.4%)

And by the way, only 5 of them asked the recipient to "like" or "share" the image.

Now, for the sake of calculating how much real difference there is in my intellectual environment, we have to look at just the images expressing social, political, religious, or philosophical values of some kind. This doesn't necessarily exclude the inspirational or comic pictures that had some kind of political or moral message, because as mentioned, a lot of the pictures got more than one tag. As it turned out, around half of them were making statements about values. (That, by the way, was also very interesting.)

Here's the breakdown of exactly what my friends were posting pictures about. And as you can see, there's a lot of variety. But what is interesting is not how different they are from each other. What's interesting is how many of them are different from my own point of view. You can figure this for yourself by comparing the memes in your own timeline to what you say about yourself in your own FB profile, or by just deciding with each image, one at a time, how far you agree or disagree with each one. But in either case you have to be really honest with yourself. In this way, calculating your DQ is not just about taking a snapshot of your intellectual environment. It's also about knowing yourself, and making a few small but serious decisions about what you really stand for.

Total Religion, Causes, & Political:
231 (100.0%)

Total religious: 36 (15.5%)
Buddhism: 4 (1.7%) *Christianity:* 6 (2.5%) *Pagan:* 8 (3.4%) *Northern / Asatru:* 6 (2.5%) *Aboriginal / First Nations:* 3 (1.2%) *Taoism:* 1 (0.4%) *Hindu: 1* (0.4%) *Any:* 6 (2.5%) *Atheism: 1* (0.4%)

Total causes: 148 (64.0%)
Against cruelty to animals: 3 (1.2%) *Against religious proselytization:* 3 (1.2%) *Support education, science, critical thinking:* 19 (8.2%) *Pro-vegetarian:* 1 (0.4%) *Organic and/or backyard gardening:* 3 (1.2%) *Feminism / anti-violence against women:* 3 (1.2%) *Feminism / sexual power relations:* 7 (3.0%) *Feminism / body image: 5* (2.1%) *Anti-war:* 4 (1.7%) *Israel-Iran antiwar solidarity:* 3 (1.2%) *Support for soldiers / war veterans:* 8 (3.4%) *Support for retired military dogs:* 2 (0.8%) *Support gun ownership:* 3 (1.2%) *Race relations, anti racism:* 1 (0.4%) *Support gay marriage / LGBT pride:* 10 (4.3%) *Support environmentalism: 5* (2.1%) *Support universal health care in America:* 1 (0.4%) *Support the student protest in Quebec:* 3 (1.2%) *Against fascism and Neo-Nazism:* 1 (0.4%)

Total party political: 47 (20.3%)
Right wing: 8 (3.4%) *Left wing:* 36 (15.5%) *Centre:* 3 (1.2%)

Now for the sake of figuring your DQ, we need to look at the percentage of value-expressing memes that are near to my values, and the percentage of those which are distant. That's the measure of how much of the intellectual environment you live in could really challenge you, if you let it.

Total: 231 / 100.0%
Common values = 150 / 64.9%
Near values = 64 / 27.7%
Far values = 17 / 7.3%
So, my DQ, rounded off, is **28** and **7**.

Now, you might be thinking, if I did the experiment on a different day, I'd collect different samples, and I'd get a different result. This was especially clear in the humorous pictures, because some of them depended on the time of year for their effect. For example, I got a lot of Douglas Adams references, because one of the days I was collecting the images was "Towel Day". I also got a lot of Star Wars images because I was collecting my samples on May the 4th. Similar effects can also influence the memes that were expressing values, for instance if the dataset is collected during a religious holiday. Therefore, the figure I just quoted above might not be very accurate. Well, to address that possibility, I ran the experiment again two weeks later. And here's what I got the second time.

Second set = 470
Total Religion, Causes, Political, Second Set: 243 (100.0%)
Common values = 157 (64.6%)
Near values = 77 (31.6%)
Far values = 9 (3.7%)

As you can see, it's a slightly different result. The total collection was larger, and there were a lot fewer distant values represented. And among the comic pictures, there were a lot more references to Doctor Who. But overall it wasn't a big difference. In fact the fraction of pictures which expressed some kind of value was still about 50%, just as before. So if I add the second set to the first, and do the math again, I can get a more accurate result, like this:

Both sets combined = 474 (100.0%)
Common values = 307 (64.7%)
Near values = 141 (29.7%)
Far values = 26 (5.4%)
New DQ = **30** and **4**.

Now, I don't know whether that figure is high or low, because I have no one else's data to compare it to. And I also don't know whether it would be good or bad to have a high DQ, or a low one, because, well, that's a value statement too!

But what I do know is that I can now accurately measure the extent to which my intellectual environment has a real range of different ideas and opinions. I can measure how much "otherness", social or religious or political "other-ness", exists in my world. I can also measure how much I prefer the somewhat less stressful company of people who think more or less the same way I do. Or, I can also measure the extent to which my intellectual environment serves only as a kind of echo-chamber, repeating back to me my own ideas without examining them very deeply.

But the really fun part of this experiment is that you can do it too! What's your DQ?

Chapter 2

Habits of Good and Bad Thinking

Chapter Two: Habits of Good and Bad Thinking

We have seen some of the problems that can arise when different world views and different intellectual environments come into conflict with each other. Now let us look at some of the problems that can arise when a given world view comes into conflict with *itself*. There are various ways that people think, and various ways people pull their world views together, which actually make it harder for people to find the truth about anything, communicate with each other effectively, and solve their problems. And there are other ways people think which make it easier to communicate, solve problems, and discover truths. I shall call these things 'good and bad thinking habits'.

Note that I call these principles of thinking 'habits' rather than rules. This is because there are various exceptions to each of them. There can occasionally be situations in which a good thinking habit might be inappropriate, or in which a bad thinking habit might be very useful. But such exceptions tend to be very rare. You will almost always be thinking rationally and clearly when your thinking follows the good habits and avoids the bad habits.

The bad habits tend to arise in two ways. They arise because of **how we think**: these bad habits are mostly psychological factors such as fears, motivations, and attitudes. Bad habits also arise because of **what we think**: these habits arise when our thinking involves problematic beliefs. Again, thinking in terms of such bad habits are not signs that one's thinking is *necessarily* or *inevitably* wrong. (In this way, they are different from the fallacies, which we will discuss later on.) They do, however, tend to make one's thinking very weak, and very vulnerable to criticism and objection. They also tend to make one's views and beliefs easily manipulated by other people. When they form a prominent part of one's intellectual environment, they tend to introduce faults into one's world view.

2.1.1 Self-Interest

On its own, self interest need not be a bad thing. Most people make decisions at least in part on the basis of what they think will benefit them. Self-interest can be a problem when you advance some argument or defend some world view only because you personally stand to benefit if it's true, and for no other reason.

The notion of self-interest has an important place in some specialized forms of reasoning, such as game theory and economics. We find it in sources as ancient as Aristotle: his claim that everyone by nature desires happiness was the starting place for his theory of ethics. We find it in the work of John Stuart Mill, who made the pursuit of 'utility', meaning pleasure or personal benefit, the basis of his theory of ethics, called Utilitarianism. Adam Smith, widely regarded as 'the father of modern economics', also placed self-interest at the centre of his work. To Smith, self-interest was a normal part of rational human behaviour, and often a very self-defeating kind of behaviour. But in a properly functioning economy, Smith reasoned, businesspeople and investors would direct their self-interest toward public goods.

Self-interest also plays an important part in a branch of mathematics called game theory. Without going into a lot of detail about each of these writers and others who were like them, let it suffice to say that self-interest is a very powerful psychological force in people's minds. All the writers mentioned here are very careful to specify the ways in which self-interest is rational and useful, and the ways in which it is irrational and even damaging. For this reason, some logicians prefer to separate 'intelligent self interest' from ordinary selfishness and egotism. Intelligent self-interest looks for the 'bigger picture', sees the ways in which one's own interests can align with other people's interests, is willing to sacrifice short-term benefits for the sake of longer-term benefits, and recognizes that some kinds of benefits or advantages for the self are not really worth pursuing.

Self-interest tends to get in the way of good reasoning when people have a strong emotional or economic stake in something that looks like it might be under threat from others. In such situations, people tend to get passionate and emotional, and this almost always clouds their judgments. If you secretly want something to be true, and you stand to benefit from it being true (for instance, if you might make money that way), but there's little or no reason for it to be true, you may inadvertently misinterpret the evidence, or discount contradictory evidence, or invent rationalizations that have little or no logical strength. This can lead you to a faulty understanding of your situation, and as a result you are more likely to make bad decisions.

2.1.2 Saving Face

Among the various ways that people are self-interested, most people are also interested in having a good reputation, and being liked or even admired by others around them. No one, or almost no one, enjoys having their faults, weaknesses, harmful actions, or foolish choices pointed out to them by others. Moreover nobody, or almost nobody, likes to be proven wrong by others. And this, by itself, is not a bad thing. But because of this interest, people sometimes cover up their mistakes. Or, if it is shown to them that some of their ideas or beliefs are unworkable or absurd, they might continue to argue in favour of them anyway, in order to avoid admitting that the other person might be right. When we do this, we are falling into the habit of saving face.

The habit of saving face is in some ways related to a condition described by psychologists called "**cognitive dissonance**". This is what happens when someone is confronted with, or contemplates, two or more beliefs that cannot both be true at the same time. (Especially these two contradictory thoughts: "I am a good person" and "I caused someone harm".) Most people are strongly psychologically disposed to avoid having contradictions like that in their thoughts. And most people don't like to have muddled thoughts like that pointed out to them by others: it makes us look foolish. And so people tend to invent self-interested reasons to reject one or other of the contradicting beliefs, with the real purpose of restoring their sense of self worth. But this can sometimes blind us to the truth, or even prevent people from finding out what the truth really is.

Examples:

"Only six people came to the company picnic. I was on the organizing team. But it wasn't my job to send out the invitations."

"I got an 'F' on that essay. But I'm getting an 'A' in all my other classes. Clearly, the professor doesn't know what he's doing."

"Jim has been my best friend for ten years and he's always been nice to me. So I just can't believe he is the one who stole the old man's wallet. You must be mistaken."

"Sally has been my best friend for ten years. But tonight she stole my wallet. I guess she was a bad person all along, and she just tricked me into thinking she was a good person."

2.1.3 Peer Pressure

All of us are members of various communities and social groups, as we saw in the discussion of world views and intellectual environments. Each of those groups tends to have a few prevalent ideas, practices, and beliefs, that form part of the group's identity. Here let us add that most of these groups also exert a bit of psychological pressure on the members to accept the group's prevalent ideas, practices, and beliefs. Sometimes that pressure can be very subtle, and very limited. You might get nothing more than an odd look or a cold shoulder if you say something that doesn't fit with the group's main beliefs. Other times, it might be very overt and unambiguous, and perhaps connected to threats of punishment for non-conformity. You might be shut out of the group's decision-making process, or not invited to the group's events anymore, or (if one's non-conformity is persistent) even targeted with malicious gossip or threats of violence. Thus, people tend to keep their dissenting views to themselves, or they change their views to better fit the group. Now, the ideas shared by the group might be right, or they might be wrong, or they might be somewhere in between. But the number of people who believe those ideas has nothing to do with whether those ideas are any good. Problems almost always arise when someone accepts an idea or a world view *only* because it is an idea or a world view favoured by the group he or she belongs to, and for no other reason.

2.1.4 Stereotyping and Prejudice

Since we are speaking of peer pressure: a community or social group might have a few beliefs about people who belong to other groups. The group might look up to other groups, or down upon them, or attribute some quality or behavioral trait to all of them. This becomes a bad habit when there is little or no real evidence that all members of that other group share that quality. We might build stereotypes of people based on how they are characterised in entertainment media, or on your experiences meeting one or two members of that group. But in terms of the actual evidence to support the stereotype, the 'sample size' is always too small. It's usually based on only a handful of cases, and then generalized to a massively larger group. In this way it is a case of the fallacy of hasty generalization. In fact, the sample size can be as small as zero: some people develop stereotypes without any evidence at all. They've just been taught to think that way by their intellectual environment. Stereotyping almost always treats people as tokens of a type, almost never as individuals with their own distinct qualities. In this way, it prevents us from knowing the truth about individuals, and can even prevent us from knowing the truth about the various groups that person might belong to.

As stereotyping is the assumption that all members of a given social group are somehow basically the same; so too is prejudice a hostile or harmful judgment about the merit or the worth of people in that group, assigned on the basis of a stereotypical assumption. One of the ideas that a group might pressure its members to believe is the idea that one's own group is better than other groups. This almost always leads people to see the ideas and world views of rival groups in the very worst possible light. And it leads people to treat members of the rival group badly. Racism, sexism, religious discrimination, classism, poor-bashing, and able-ism, are all examples of this. Prejudice is also hurtful when the qualities it assigns are qualities that subordinate people or which deny them full membership in the human race. There might be a spectrum of intensity, which at one end attributes only a few relatively minor bad qualities such as foolishness or uncleanliness, and which at the other might incite strong feelings of hate or fear, such as criminality, emotional instability, animalistic physical features, disease, or even a secret conspiratorial agenda. But in any case, stereotyping and prejudice almost always prevents people from seeing things and people as they truly are.

Why do prejudiced beliefs persist? The main reason is because those beliefs are supported by peer pressure. When among prejudiced people, uttering a disparaging remark about the target group might be actually encouraged and rewarded in various ways: smiles, happy laughter, welcoming gestures, and approving words. In this way, prejudiced beliefs persist when people do not think for themselves, but rather when they allow other (prejudiced) people to do their thinking for them.

2.1.5. Excessive Skepticism

It is usually very healthy to be a little bit skeptical of things, and not to take things at face value all the time. Some people, however, believe that we cannot truly know anything unless we can be absolutely certain of it, and that we are beyond any possible doubt about it. That level of skepticism is almost always too much.

Excessive skepticism tends to appear when people try to estimate the riskiness of some activity. The excessively skeptical person tends to make a 'big deal' of the risks involved, and might be unwilling to do anything until he is satisfied that everything is absolutely safe and certain. Or he might be unwilling to do something because 'it's never been tried before'. But it's often the case that we have to act even in situations where success is very uncertain, and there is no way to absolutely guarantee safety. The moon landings from 1969-72 are good examples here. No one really knew whether the missions would succeed, or fail, or even end in total disaster. (At one time, astronomers thought that the dark 'seas' on the moon were made of sand, and they worried that the landing craft would sink!) The excessively skeptical person weighs the risks too heavily, and often ends up unable to act because of that skepticism. He may even try to prevent others from acting, because of his own doubts.

Excessive skepticism can also appear in matters that are almost purely theoretical. For instance, some people might doubt the reality of the world outside their own minds. It can be fun to speculate about whether or not we are being deceived by Descartes' Evil Genius, or whether we are all living inside a computer-generated virtual reality. Sometimes it can be fun to ask 'How do you know?' in an infinite regress, the way small children sometimes do.

But most of the time, we don't need to have such high standards for certainty. It is enough that one's beliefs are beyond *reasonable* doubt; they do not have to be beyond *all possible* doubt. As a rule of thumb, remember that **doubt based on speculation without evidence is not *reasonable* doubt**. It's not enough to say that something is doubtful because some alternative explanation might be possible. It's also important to say something about how probable the alternative explanation really is. If an alternative explanation is possible but very unlikely, and there isn't much evidence for it, then it isn't a good basis for skepticism. So if you dreamed last night that you ran away to a foreign country and married your worst enemy, then that 'might' be because in some parallel universe that's exactly what you did. But there's no evidence to support that possibility, so it's best to discount it as a reasonable explanation for your dream.

We shall see more about skepticism among the good thinking habits, and later on we'll see it again in the discussion of reasonable doubt.

2.1.6 Intellectual Laziness

This is the habit of "giving up too soon", or deliberately avoiding the big questions. This is the habit we indulge when we say things like: "thinking that way is too confusing," or "your questions drive me crazy", or "these questions cannot be answered, you just have to accept it". Laziness also appears when you answer a philosophical question with a witty quotation from a movie or a popular song, as if that's all that needs to be said about the topic. Some people actually go to great efforts to defend their laziness, with complex arguments for why intellectually enquiring or scientifically minded people "can't handle the mystery of things", or why they want to "take away the beauty and the magic of the world."

A variation of intellectual laziness is **willed ignorance**. This is the habit of deliberately preventing oneself from answering hard questions or acknowledging relevant facts. Some people prefer to live in a kind of bubble, where serious challenges to their world views never appear. And while it can be a sign of integrity to preserve the core values of one's world view, it is also the case that deliberately shutting out facts or realities that challenge one's world view can lead one to make poor decisions. Your world view might hold that some questions are unanswerable, or that some questions are not allowed to be asked. Similarly, you might prevent yourself from acknowledging facts or realities that could serve as evidence of the wrongness of some part of your world view. Willed ignorance actually takes some effort, and perhaps isn't precisely the same as laziness. But it has the same basic effect: it prevents people from learning things that they may need to know, and so makes it more likely that they will make bad decisions, or turn their world views into value programs.

Some people might even argue that there is no such thing as 'Truth', with a big capital T, referring to statements about the ultimate things like God, or justice, or knowledge, or reality. They might believe that it is pointless to claim that any given idea or belief or explanation of such things is true, no matter how well supported it might be by the facts or by logic. There might be an appeal to some kind of relativism as the reason for why there's no such thing as an ultimate truth. And in that sense, this line of thinking is not truly lazy: it goes to some effort to seriously defend the claim that no one can make a serious claim about such things. But the real function of such assertions is to justify a refusal to think deeply and carefully about the things that matter. It may be the case that there are, or that there are not, ultimate truths about such things. But the intellectually lazy or willfully ignorant person does none of the work needed to find out. They actually do not know, and they have made their ignorance into a kind of rule for their thinking.

It might not be polite or kind to name this habit 'laziness', but that's what it really is. Just as one can be lazy at practical tasks like cleaning your house, you can be lazy in your thinking about pressing problems or important questions. And just as laziness in your practical affairs can hurt you eventually, there are times when lazy thinking can cause you great trouble later on, too. Lazy thinking can make it easier for others to manipulate and deceive you, for instance. And it can also paralyze you into doing nothing in situations where decisions must be made.

2.1.7 Relativism

Philosophical arguments are often presented in the form of debates. Sometimes there are two positions that are opposed to each other, and each side presents arguments that support their position while showing the problems with the opposing position. Consider, as an example, a debate about the moral permissibility of the death penalty. The speakers might take these two positions:

> A: The death penalty is morally permissible (for reasons x, y, z).
> B: The death penalty is not morally permissible (for reasons a, b, c).

When assessing the evidence for these claims, philosophers are trying to establish whether it is true or false that the death penalty is morally permissible. In this case the moral permissibility of the death penalty is being treated like a fact. Often beginning philosophers are not comfortable with treating moral, epistemic, or aesthetic claims as being either right or wrong. Philosophical claims are not scientific claims for which we can provide empirical evidence, and often both sides provide very compelling arguments. This can make it seem as if both sides are right. Sometimes it makes sense to search for a middle ground, however, it is not always possible or desirable. It is, furthermore, a contradiction to say that the death penalty both is and is not morally permissible. When is it morally permissible? What makes the death penalty morally permissible in some cases but not others? More needs to be said.

Relativism is the view that a claim is only true or false relative to some other condition. There are many varieties of relativism: but the two most common kinds are:

- **Subjective relativism**, also known as **Personal Belief relativism**, is the claim that the truth about anything depends on what someone believes. It is the view that all truth is in the 'eye of the beholder'; or that something is true *if (and only if) someone believes it to be true*, and then it is true *for that person*, and perhaps only for that person. In ethics, subjective relativism is the idea that an action is morally right if the person doing that action believes it to be morally right. Nothing makes an action right or wrong except the judgment of the person doing it.

- **Cultural Relativism** is the idea that something is true, or right, etc., because it is generally believed to be so by some culture or society. Further, it is true, or right, etc., for *that* society.

Here we will examine relativism about truth as it pertains to philosophical claims about ethics and knowledge that you are likely to encounter in an introductory class. As relativism is very appealing to beginning philosophers, it is important to look at some different kinds of relativistic arguments, the problems with them, and some of the typical reasons for adopting a relativistic position.

One reason to adopt relativism is that philosophical claims, particularly ethical claims, can seem very subjective. With so much debate it can seem as if there are no correct answers, and that what is right or wrong can be different for different individuals. Alice believes the death penalty is okay and Barbara believes it is wrong, and who are we to tell them what to believe?

The problem with accepting this kind of relativism is that it makes a claim true or false relative to someone's beliefs, and takes beliefs to be above any justification. While it may seem arrogant to challenge other people's beliefs, examining what we take to be true and why is one of the basic components of philosophy. It isn't enough to say "Alice believes that X is okay, so X is right for her," perhaps Alice has never examined her beliefs, or came to hold them because she was given false information. Investigating what we believe and why can help us to have consistent beliefs, and also to be confident and conscientious in our ethical choices.

While it is respectful to consider others' points of view, differences in perspective does not entail that philosophical questions are entirely subjective. Learning how to carefully consider and assess reasons and justifications is part of studying philosophy. In some arguments disagreement between conclusions can mask similarities in underlying beliefs. For instance, two people can agree that murder is unjustified killing and disagree about what deaths count as murder. Alice might believe that the death penalty is state sanctioned murder, and so oppose it. Barbara might believe that a death that is sanctioned by the state is always justified. Their disagreement over the death penalty is then not only about whether it is right or wrong, but over acceptable justifications for taking someone's life.

Someone else might note that some cultures accept action X while some do not, and argue that X is morally permissible relative to culture. This is known as cultural relativism. Often students accept cultural relativism because they want to be sensitive to cultural differences. Different cultures have different practices, but can we say that a culture allowing the death penalty means it is sometimes morally permissible? There are two problems with this approach. One is that it does not allow people within a culture to disagree with the practice. If someone from culture A wants to argue against the death penalty they could not do so on moral grounds—their culture permitting it makes it a morally acceptable act. Another problem is changes in cultural practices. We want to say that slavery was abolished because people realized that it was wrong to treat people as property, not that it became immoral once the practice stopped.

There is a difference between issues that are moral and those that are social norms or matters of etiquette. In some cases it makes sense to accept cultural relativism about social practices, but in others it might seem as if some other factor, such as human rights, trumps concerns for cultural variation. It can be difficult to determine when we should and when we should not challenge the practices or beliefs of other cultures, but it requires rational inquiry and a sensitive analysis of the arguments that demands more than knee-jerk relativism.

The problems with relativism do not mean that we have to accept the view that ethical or epistemic truths are universal and absolute. There is a great deal of conceptual space between individual relativism and accepting a general moral principle. Likewise, there are ways to be culturally sensitive while challenging the practices of our own and other cultures. Some concepts that seem natural or objectively true to us may turn out to be contingent—if a culture has three rather than two concepts of gender we might reconsider why we think about gender as we do. Being open to other cultures' beliefs and attitudes can be very important to learning to see things in a different light, but it does not mean that we have to accept them without good reasons.

2.1.8 The Consequences of Bad Habits

The consequences of living with and falling into these bad thinking habits can be very serious. For instance, they can:

- Make you more vulnerable to being intimidated, bullied, or manipulated by others;
- Make you less able to stand up for yourself, or for others in need;
- Make it harder to tell the difference between truth and lies;
- Make you more dogmatic and closed-minded;
- Make you less flexible, less creative, and less ready to handle unpredictable changes in your situation.
- Lead you to justify moral decisions that needlessly harm people, including yourself;
- Lead you to suppress or ignore evidence that goes contrary to your beliefs, even if that evidence is very reliable;
- Provoke confusion or anger when presented with reasons why one's beliefs might be problematic or faulty;
- Prevent serious philosophical thinking about the most important problems in our lives;
- Prevent personal growth, maturity, and self-awareness.

With these observations in mind, let's look at some good habits.

2.2.1 Curiosity

As an intellectual habit, curiosity is the desire for knowledge. To be an intellectually curious person, you have to be the sort of person for whom the usual explanations of things are not enough to satisfy you. The curious person wants to find out more about whatever is new, strange, or interesting in the world. When something different, unusual, unexpected, or even weird and scary appear, the curious person doesn't hide from them or pretend they are other than what they are. She faces them directly, and makes an honest attempt to investigate them. And she does not settle for things to remain mysterious. Indeed part of the task of the philosopher, as it is with the scientist, is to render things un-mysterious: it is to understand things as completely as possible. Good rational thinkers love mysteries and puzzles: but they don't just stand back and "appreciate" them. They also try to figure them out.

It is precisely by being intellectually curious that good reasoning helps prevent closed minded dogmatism. Curiosity leads to discovery, invention, expanded awareness of the world, and of the self. Sometimes it leads to beauty; sometimes it leads to power. Most of all, it leads to, just as it depends on, a sense of wonder. Those who think that rationality is a set of rules for thinking which limit or constrain your experiences, or who think that rationality kills the sense of creativity and imagination, are simply wrong – and there's no polite way to say it. And it's probable that such people have actually limited their own experiences by excluding from their minds the most powerful, most inquisitive, and most successful way of knowing the world ever devised.

2.2.2 Self-Awareness

Above the entrance to the famous Oracle of Delphi, the religious centre of the classical Greek world, was written the phrase γνϖθι σεατον. In English, this means 'know yourself'. The idea was that people who wanted to enter the temple should have done a sustained exercise in personal soul-searching, to be fully honest about their own individual character and habits, and also to be honest about human nature (especially human mortality).

Self-awareness involves knowing your own presuppositions, desires, biases, world views, and so on. It involves knowing your habits, faults, desires, powers, and talents. And it involves knowing something about what it means to be a thinking human being. This is a more difficult prospect than it appears to be. Some people do not find out what their own world view is until someone else says or does something which challenges it. But it is an essential quality: those who do not know themselves tend to make poor decisions, and are easily manipulated by others.

2.2.3 Health

As unrelated as it may seem, taking care of your physical health is actually a good thinking habit. If you are feeling unwell, or sleep-deprived, or under stress, or for whatever reason physically uncomfortable, then it will be harder for you to observe and understand your situation, and harder to reason about it clearly. Good health, as a thinking habit, involves getting enough exercise, eating healthy real food and avoiding junk food, bathing regularly, and getting enough sleep. It also involves taking care of your mental health: and one of the simplest ways to do that is to take time every day for leisure activities that are restful.

A study conducted by psychologists in Japan found that people who gazed on forest scenery for twenty minutes produced 13.4% less salivary cortisol, a stress hormone. Walking in forests and natural settings also helped reduce high blood pressure, and reduce heart rate fluctuations. As these effects became more known, some municipalities in Japan created "forest therapy" programs for stressed-out factory workers. [7] High-stimulation activities like video games, action films, intensely athletic sports, and anything that gets your adrenaline rushing, can be a lot of fun, but they're not restful. I'm not saying you should avoid such things altogether. But good critical thinking requires calm, and peace, and quiet. To be better able to calm yourself when you need to think, give around twenty minutes or more, every day, to something genuinely relaxing, such as walking in a forest, or meditating, or reading, or cooking and eating a proper meal. Don't be multitasking at the same time. If you are experiencing a lot of frustration dealing with a certain problem, you will probably have an easier time of it after a shower, a healthy dinner, a walk in the park with a friend and a dog, and a good night's sleep.

2.2.4 Courage

Sometimes, your process of thinking about things will lead you to possibilities or conclusions that you won't like, or which your friends or associates won't like. Sometimes, you might reach a conclusion about something that might land you in trouble with your boss at work, or your teacher, your priest, your government, or anyone who has some kind of power, authority, or influence in your life. Expressing that conclusion or that thought might land you in some amount of danger: you might risk being fired from your job, or ostracized from your community. Depending on the situation, and the idea you are expressing, you might find yourself excluded, angrily criticized, ignored, arrested, imprisoned, or even killed. Even in countries where the freedom of speech and of expression and of the press is guaranteed by constitutional law, people can still run great risks by speaking their minds, even when their words are true.

Courageous thinking means thinking and expressing the dangerous thought anyway. It means **thinking and speaking without fear**. It means committing yourself to what you rationally judge to be the best conclusion, whether you like it or not, and whether your friends or your 'betters' like it or not. And this is a lot harder to do than it sounds. Strong social forces like the desire to be welcomed and included and loved, or strong institutional forces like laws or corporate policies, can lead people to keep quiet about ideas that might be controversial.

Questions and arguments can require personal courage when they challenge a very important part of one's world view. Consider the following examples:

- What if there is no god?
- What if there is no objective moral right or wrong?
- What if a very popular or charismatic person is telling half-truths or lies?
- At my workplace, am I participating in or benefitting from something unjust, or evil?
- What if life has no purpose or meaning?

---

[7] Akemi Nakamura, "'Forest Therapy' taking root" The Japan Times Online, 2 May 2008

People who take such questions seriously, and who consider answers that are radically different from the answers provided by their world views, may experience a lot of self-doubt or even despair. They may find that they have to change their lives. Even the mere act of posing the questions, aside from the attempt to answer them, can land people in trouble with their friends and families. Strong social forces might pressure the questioner to not ask certain questions, or to answer them only in acceptable ways. In such situations, it can take great courage to ask such questions, and to do one's own thinking in search of a decent answer.

Questions and arguments can require public or political courage when they challenge some arrangement in your social world. It could something as simple as choosing to support a different professional sports team other than the one based in your home city, or the one supported by all your friends and family. Or, it could be something as complex and dangerous as opposing a policy of a large corporation that you work for, or which has a significant presence in the area where you live. It can take a lot of courage to criticize the actions of some entity with political power, especially when that entity can threaten people who disagree with it. If you criticize your employer, you might lose your job. If you criticize your government, you might be arrested. If you criticize your church leaders, you might be shamed, denounced, or dismissed from the church. As the philosopher Voltaire wrote, "It is dangerous to be right in matters on which the established authority is wrong."

The classical Greek language gives us a word for statements that require this kind of courage: **parrhesia**, which roughly translates as 'bold speech'. The person who makes such a bold statement is called a *parrhesiastes*. Two qualities are necessary for a proposition to count as parrhesia. One is that the speaker incurs some personal risk from various social or political forces. The second is that the speaker's words must be true. (Thus, a person who creates controversy for the sake of creating controversy is not a parrhesiates.) Today we might call such people **'whistle-blowers'**: individuals who act like referees in a game who stops some player who breaks the rules. Whistle-blowers are people who draw public attention to some act or policy of moral wrongdoing in their workplaces, their governments, or in any other social group to which they belong. Whistleblowers often face all kinds of problems: harassment, defamation of their reputations, job losses, lawsuits, vandalism of their homes and vehicles, and in some cases death threats. But no public cause has ever succeeded "by itself", without courageous people willing to speak out in favour of it. To be a courageous thinker means to care more for the truth than for one's personal interests (and sometimes, more than for one's safety). But it also means to be an agent for necessary changes.

2.2.5 Healthy Skepticism

Earlier, we characterized 'excessive skepticism' as a bad habit. But there is another side of skepticism that is very healthy. Healthy skepticism is **the general unwillingness to accept that things are always what they appear to be**. It is the unwillingness to take things for granted, or to accept that things are as you have been told they are by anyone else, no matter who they are, or what their relation is to you.

This does not mean we have to doubt absolutely everything, nor does it mean we cannot trust anyone. It does, however, mean that we do not jump to conclusions. Healthy skepticism is to be slow to accept the popular explanations for things. It prefers to investigate many possibilities before settling on the best available explanation.

Healthy skepticism is also known as 'reasonable doubt'. We'll see more of that in a later chapter.

2.2.6. Autonomy

To think with autonomy simply means to think for yourself, and not to let other people do your thinking for you. Autonomous thinking is thinking that does not blindly accept what you have been told by parents, friends, role models of every kind, governments, newspaper columnists, or anyone who could have an influence on your thinking.

No one else can do your thinking for you. And you are under no obligation to follow anybody's party line. Your only obligation for thinking, if it is an 'obligation' at all, is to think clearly, consistently, rationally, and (where necessary) courageously.

At the end of some curious, courageous, and skeptical soul-searching, you might decide that your world view should be more or less the same as that which is held by your family, friends, role models, and other influences. That is okay – the point is that the world view is now yours, and not handed to you by others.

2.2.7 Simplicity

Sometimes you may find that things are more complex or more elaborate than they appear to be at first. And it is often the job of reason to uncover layers of complexity behind appearances. Still, if you have two or more explanations for something, all of which are about as good as each other, the explanation you should prefer is the simplest one.

This principle of simplicity in good reasoning is sometimes called **Ockham's Razor**. It was first articulated by a Franciscan monk named Brother William of Ockham, who lived from 1288 to 1348. His actual words were "Entia non sunt multiplicanda sine necessitate."[8] In English, this means 'No unnecessary repetition of identicals'. This is a fancy way of saying, 'Well it's possible that there are twenty-three absolutely identical tables occupying exactly the same position in space and time, but it's much simpler to believe that there's just one table here. So let's go with the simpler explanation.' Ockham's original point was theological: he wanted to explain why monotheism is better than polytheism. It's simpler to assume there's one infinite God, than it is to assume there are a dozen or more.

Ockham's idea has also been applied to numerous other matters, from devising scientific theories to interpreting poetry, film, and literature. Other ways to express this idea go like this: "All other things being equal, the simplest explanation tends to be the truth", and "The best explanation is the one which makes the fewest assumptions."

2.2.8 Precision

There are a lot of words in every language that have more than one meaning. This is a good thing: it allows us more flexibility of expression; it is part of what makes poetry possible; and so on. But for the purpose of reasoning as clearly and as systematically as possible, it is important to use our words very carefully. This usually means avoiding metaphors, symbols, rhetorical questions, weasel words, euphemisms, tangents, equivocations, and 'double speak'. When building a case for why something is true, or something else is not true, and so on, it is important to say exactly what one means, and to eliminate ambiguities as much as possible.

The simplest way to do this is to craft good definitions. A definition can be imprecise in several ways; here are some of them.

- *Too broad:* it covers more things than it should.
- *Too narrow:* it covers too few things.
- *Circular:* the word being defined, or one of its closest synonyms, appears in the definition itself.
- *Too vague:* The definition doesn't really say much at all about what is being defined, even though it looks like it does.

Example of a broad definition: "All dogs are four-legged animals." (Does that mean that all four-legged animals are dogs?)

Example of a narrow definition: "All tables are furniture pieces placed in the dining rooms of houses and used for serving meals." (Does that mean that tables in other rooms used for other purposes are not 'true' tables?')

Example of a Circular definition: "Beauty is that which a given individual finds beautiful." (This actually tells us nothing about what beauty is.)

Example of a vague definition: "Yellowism is not art or anti-art. Examples of Yellowism can look like works of art but are not works of art. We believe that the context for works of art is already art."[9] (And I don't know what this means at all.)

---

[8] William of Occam, Sentences of Peter Lombard, (ed. Lugd., 1495), i, dist. 27, qu. 2, K.

[9] Marcin Lodyga and Vladimir Umanets, "Manifesto of Yellowism", retrieved from www.thisisyellowism.com, 8 July 2010 / 17 February 2012.

2.2.9 Patience

Good philosophical thinking takes time. Progress in good critical thinking is often very slow. The process of critical thinking can't be called successful if it efficiently maximizes its inputs and outputs in the shortest measure of time: we do not produce thoughts in the mind like widgets in a factory.

The reason for this is because good critical thinking often needs to uncover that which subtle, hard to discern at first, and easy to overlook. I define subtlety as 'a small difference or a delicate detail which takes on greater importance the more it is contemplated.' As a demonstration, think of how many ways you can utter the word 'Yes', and mean something different every time. This also underlines the importance of precision, as a good thinking habit. As another example: think of how the colour planes in a painting by Piet Mondrian, such as his 'Composition with Yellow, Blue, and Red' have squares of white framed by black lines, but none of the white squares are exactly the same shade of white. You won't notice this if you look at the painting for only a few seconds, or if you view a photo of the painting on your computer screen, and your monitor's resolution isn't precise enough to render the subtle differences. But it is the job of reason to uncover those subtleties and lay them out to be examined directly. And the search for those subtleties cannot be rushed.

2.2.10 Consistency

When we looked at what a world view is, we defined it as 'the sum of a set of related answers to the most important questions in life.' It's important that one's world view be consistent: that your answers to the big questions generally cohere well together, and do not obviously contradict each other. Inconsistent thinking usually leads to mistakes, and can produce the uncomfortable feeling of cognitive dissonance. And it can be embarrassing, too. If you are more consistent, you might still make mistakes in your thinking. But it will be a lot easier for you to identify those mistakes, and fix them.

Consistency also means staying on topic, sticking to the facts, and following an argument to its conclusion. Obviously it can be fun to explore ideas in a random, wandering fashion. But as one's problems grow more serious, it becomes more important to stay the course. Moreover, digressing too far from the topic can also lead you to commit logical fallacies such as Straw Man, and Red Herring.

2.2.11 Open-ness and open-mindedness

Being open-minded means listening to others, taking their views seriously, and treating their ideas with respect even while critically examining them (a difficult thing to do, but not impossible). It also means not resorting to fear and force when promoting one's own views, but rather presenting them in a way that leaves them open to the critical scrutiny of others. In philosophy this is sometimes called "**the principle of charity**." The Principle of Charity requires speakers and listeners to interpret and understand each other's ideas in the very best possible light. Listeners must assume that other speakers are rational (unless you have good reasons to assume otherwise), and that what they say is rational, even if that rationality is not immediately obvious. Philosophers do this partially as a kind of professional courtesy to each other. Open-ness and open-mindedness does not, however, mean that we have to accept everyone's ideas as equally valid. Open mindedness is not the same as assuming that all things are true; it is also not the same as relativism. Rather, the open-minded person looks for the best explanation for things, whether he or she personally likes that explanation or not, and whether it fits with his or her world view or not. She is open to the idea that she might be wrong about something, or that her world view might be partially faulty, or that her thinking about something that matters to her may have to change. But she does not change her thinking at random: she is interested in the truth, whatever it might be.

An open-minded person may still find that some ideas, arguments, and explanations are better than others. But if we are open-minded, then we can be more confident that we have understood other people's views properly: we will not fall into the logical trap of the straw man (see the chapter on Fallacies). It is also much easier to find common ground with others, which is an essential step in quelling conflict. And if we reject some idea, we will have rejected it for the right reasons. Open-mindedness also helps prevent intellectual or ideological differences from descending into personal grudges.

Open-mindedness is also helpful in other ways. Suppose that some friends of mine and I went on a picnic in the park, but soon after we got to our picnic
44 site it started to rain. One member of the party might say the rain was caused by ghosts or supernatural creatures who live in the park and who don't want us to picnic there. Another might say that the rain was caused by air pressure changes in the upper atmosphere. Now the open-minded person is not necessarily the one who accepts that both explanations are equally possible, and leaves it at that. The open- minded person is the one who goes looking for the evidence for each explanation. If he doesn't find the evidence for one of those explanations, he rejects it and goes in search of the evidence for another one. The closed-minded person, by contrast, is the one who picks the explanation he likes best, whether or not there's any evidence for it, and then refuses to consider any alternative explanation. Closed-mindedness is one of the signs that someone's mind is occupied by a value program. As a rule of thumb, the closed-minded person is usually the one who is quickest to accuse other people of being closed-minded, especially when his own ideas are criticized.

The point of that example is to show how open-mindedness helps people arrive at good explanations for things that happen. It does not mean that all explanations for things are equally 'valid'. We do not have to put unlikely or weird explanations on the same footing as those with verifiable evidence or a consistent logical structure. But it can mean that every explanation or idea which appears to be sound, at least at first glance, is given a fair examination, no matter where that explanation came from, or who thought of it first.

2.2.12 Asking for help

So far, I have been stressing good thinking habits that one can practice on one's own. Good thinking tends to require independence and autonomy. And problems often arise when we allow other people to have too much influence over one's own thinking, such as when we allow ourselves to be influenced by peer pressure. However, it can also be helpful to ask others who you respect and admire, or who you believe may have relevant knowledge, to help you. And while it is important to make your own decisions about your own life, there's nothing wrong with asking others who you trust to offer you advice and guidance. And even if you do not ask anyone to offer suggestions, it can sometimes be helpful to hear a different point of view, or just to talk things over with someone who can be both critical and appreciative. The shared wisdom and experience of one's friends, elders, and associates can often lead to different perspectives and better decisions. Others people, for instance, can offer possibilities that you might not have thought of. Or they might know things that you didn't know, and thus point you in new directions. Or they might have faced a similar problem or situation in the past, and their description of their experience might help clarify something about your own situation. As an example, here's the Roman philosopher Seneca describing how some kind of social interaction is important for one's personal intellectual growth: "Skilled wrestlers are kept up to the mark by practice; a musician is stirred to action by one of equal proficiency. The wise man also needs to have his virtues kept in action; and as he prompts himself to do things, so he is prompted by another wise man." [10]

A lot may depend on who you choose to ask for advice, how much you trust them, and how often you go to them. But the overall point here is that knotty and complicated problems need not always be handled alone. A habit of asking one's elders, peers, colleagues, and friends for help can often help clarify one's thinking, and lead to better solutions.

---

[10] Seneca, Letters to Lucilius, 109, 2; trans. R. M. Grummere: Loeb Classical Library

2.3 A few summary remarks for Chapter Two

None of the bad habits of thinking *necessarily* or *inevitably* lead to unsound arguments, false beliefs, or faulty world views. They are not the same as *fallacies* (to be discussed in chapter 5.) An argument can be strong and sound even if its conclusion coincides with the speaker's personal interests, or even if it coincides with the presuppositions of the speaker's culture, etc. The bad habits are, however, **signs that one's thinking is probably not fully clear, critical, and rational**. It may even mean that one has given up the search for the truth of the matter too soon.

Similarly, the good habits, by themselves, do not guarantee that one's thinking will always be perfectly rational, but they do make one's thinking *very much more likely* to be rational.

2.4 Exercises for Chapter Two.

Consider the following situations, and ask yourself which of the good thinking habits should be applied here, and what might happen if some of the bad habits are applied instead.

- You come home at the end of the day and someone sitting on the ground near your door appears to be crying. Perhaps he is injured, or emotionally distraught. Other people passing by seem to be taking no notice, and may even be crossing the street to avoid him.
- Someone who you are fairly close to, such as a member of your family, or a colleague at your workplace, or someone you count as a good friend, unexpectedly utters a nasty racist or sexist or politically prejudiced joke. By his tone of voice and body language, you can tell that he expects you to agree with him or to go along with it.
- Someone you are fairly close to tells you that he has just been diagnosed with a medical condition that carries a strong social stigma, such as cancer, or AIDS. Or, he says he is coming "out of the closet" about his sexual preferences, or that he is changing his religion. He tells you that most of his other friends have stopped associating with him because of this situation.
- Someone who you counted on to do something for you, for instance someone with whom you have a contract, fails to uphold his promises. This person has failed you numerous times before, but you're fairly sure that confronting this person might have bad consequences for you. For instance, it might result in a lost friendship, or a malicious gossip campaign against you, a loss of money spent on the arrangement, etc.
- A friend of yours at your school, your workplace, or a social club you belong to, has been accused of a crime. The police haven't been called because all the evidence against that person is circumstantial, and it's mostly a matter of one person's word against another's. But around half of your friends are gossiping about that person as if he's obviously guilty, and the other half of your friends are certain he's innocent.
- Have you ever been in a similar situation? What were your thoughts about it? And what did you do?

Chapter 3

The Basics of Logical Analysis

What Is Logic?

In Logic, the object of study is reasoning. This is an activity that humans engage in–when we make claims and back them up with reasons, or when we make inferences about what follows from a set of statements.

Like many human activities, reasoning can be done well, or it can be done badly. The goal of logic is to distinguish good reasoning from bad. Good reasoning is not necessarily effective reasoning; in fact, as we shall see, bad reasoning is pervasive and often extremely effective–in the sense that people are often persuaded by it. In Logic, the standard of goodness is not effectiveness in the sense of persuasiveness, but rather correctness according to logical rules.

In logic, we study the rules and techniques that allow us to distinguish good, correct reasoning from bad, incorrect reasoning.

Since there is a variety of different types of reasoning, since it's possible to develop various methods for evaluating each of those types, and since there are different views on what constitutes correct reasoning, there are many approaches to the logical enterprise. We talk of logic, but also of logics. A logic is just a set of rules and techniques for distinguishing good reasoning from bad.

So, the object of study in logic is human reasoning, with the goal of distinguishing the good from the bad. It is important to note that this approach sets logic apart from an alternative way of studying human reasoning, one more proper to a different discipline: psychology. It is possible to study human reasoning in a merely descriptive mode: to identify common patterns of reasoning and explore their psychological causes, for example. This is not logic. Logic takes up reasoning in a prescriptive mode: it tells how we ought to reason, not merely how we in fact typically do.[1]

Basic Notions: Propositions and Arguments

Reasoning involves claims or statements–making them and backing them up with reasons, drawing out their consequences. Propositions are the things we claim, state, assert.

---

[1] Psychologists have determined, for example, that most people are subject to what is called "confirmation bias"–a tendency to seek out information to confirm one's pre-existing beliefs, and ignore contradictory evidence. There are lots of studies on this effect, including even brain-scans of people engaged in evaluating evidence. All of this is very interesting, but it's psychology, not logic; it's a mere descriptive study of reasoning. From a logical, prescriptive point of view, we simply say that people should try to avoid confirmation bias, because it can lead to bad reasoning.

Propositions are the kinds of things that can be true or false. They are expressed by declarative sentences.[2] 'This book is boring' is a declarative sentence; it expresses the proposition that this book is boring, which is (arguably) true (at least so far–but it's only the first page; wait until later, when things get exciting!

Other kinds of sentences do not express propositions. Imperative sentences issue commands: 'Sit down and shut up' is an imperative sentence; it doesn't make a claim, express something that might be true or false; either it's obeyed or it isn't. Interrogative sentences ask questions: 'Who will win the World Cup this year?' is an interrogative sentence; it does not assert anything that might be true or false either.

Only declarative sentences express propositions, and so they are the only kinds of sentences we will deal with at this stage of the study of logic. (More advanced logics have been developed to deal with imperatives and questions, but we won't look at those in an introductory textbook.)

EXERCISES

Which of the following sentences are statements and which are not?

1. No one understands me but you.
2. Alligators are on average larger than crocodiles.
3. Is an alligator a reptile or a mammal?
4. An alligator is either a reptile or a mammal.
5. Don't let any reptiles into the house.
6. You may kill any reptile you see in the house.
7. East Africans are not the best distance runners.
8. Obama is not a Democrat.
9. Some humans have wings.
10. Some things with wings cannot fly.
11. Was Obama born in Kenya or Hawaii?
12. Oh no! A grizzly bear!
13. Meet me in St Louis.
14. We met in St Louis yesterday.
15. I do not want to meet a grizzly bear in the wild.

The fundamental unit of reasoning is the argument. In logic, by 'argument' we don't mean a disagreement, a shouting match; rather, we define the term precisely:

> Argument = a set of propositions, one of which, the conclusion, is (supposed to be) supported by the others, the premises.

If we're reasoning by making claims and backing them up with reasons, then the claim that's being backed up is the conclusion of an argument; the reasons given to support it are the argument's premises. If we're reasoning by drawing an inference from a set of statements, then the inference we draw is the conclusion of an argument, and the statements from which its drawn are the premises.

---

[2] We distinguish propositions from the sentences that express them because a single proposition can be expressed by different sentences. 'It's raining' and 'Es regnet' both express the proposition that it's raining; one sentence does it in English, the other in German. Also, 'John loves Mary' and 'Mary is loved by John' both express the same proposition.

We include the parenthetical hedge–"supposed to be"–in the definition to make room for bad arguments. Remember, in Logic, we're evaluating reasoning. Arguments can be good or bad, logically correct or incorrect. A bad argument, very roughly speaking, is one where the premises fail to support the conclusion; a good argument's premises actually do support the conclusion.

To support the conclusion means, again very roughly, to give one good reasons for believing it. This highlights the rhetorical purpose of arguments: we use arguments when we're disputing controversial issues; they aim to persuade people, to convince them to believe their conclusion.[3] As we said, in logic, we don't judge arguments based on whether or not they succeed in this goal– there are logically bad arguments that are nevertheless quite persuasive. Rather, the logical enterprise is to identify the kinds of reasons that ought to be persuasive (even if they sometimes aren't).

Recognizing and Explicating Arguments

Before we get down to the business of evaluating arguments–deciding whether they're good or bad–we need to develop some preliminary analytical skills. The first of these is, simply, the ability to recognize arguments when we see them, and to figure out what the conclusion is (and what the premises are).

What we want to learn first is how to explicate arguments. This involves writing down a bunch of declarative sentences that express the propositions in the argument, and clearly marking which of these sentences expresses the conclusion.

Let's start with a simple example. Here's an argument:

> You really shouldn't eat at McDonald's. Why? First of all, they pay their workers very low wages. Second, the animals that go into their products are raised in deplorable, inhumane conditions. Third, the food is really bad for you. Finally, the burgers have poop in them.[4]

The passage is clearly argumentative: its purpose is to convince you of something, namely, that you shouldn't eat at McDonald's. That's the conclusion of the argument. The other claims are all reasons for believing the conclusion–reasons for not eating at McDonald's. Those are the premises.

To explicate the argument is simply to clearly identify the premises and the conclusion, by writing down declarative sentences that express them. We would explicate the McDonald's argument like this:

> McDonald's pays its workers very low wages.
> The animals that go into their products are raised in deplorable, inhumane conditions.
> McDonald's food is really bad for you.

---

[3] Reasoning in the sense of drawing inferences from a set of statements is a special case of this persuasive activity. When we draw out reasonable conclusions from given information, we're convincing ourselves that we have good reasons to believe them.

[4] I know, I know. But it's almost certainly true. Consumer Reports conducted a study in 2015, in which they tested 458 pounds of ground beef, purchased from 103 different stores in 26 different cities; all of the 458 pounds were contaminated with fecal matter. This is because most commercial ground beef is produced at facilities that process thousands of animals, and do it very quickly. The quickness ensures that sometimes – rarely, but sometimes–a knifecut goes astray and the gastrointestinal tract is nicked, releasing poop. It gets cleaned up, but again, things are moving fast, so they don't quite get all the poop. Now you've got one carcass – again, out of hundreds or thousands – contaminated with feces. But they make ground beef in a huge vat, with meat from all those carcasses mixed together. So even one accident like this contaminates the whole batch. So yeah, those burgers – basically all burgers, unless you're grinding your own meat or sourcing your beef from a local farm – have poop in them. Not much, but it's there. Of course, it won't make you sick as long as you cook it right: 160 degrees F is enough to kill the poop-bacteria (E-coli, etc.), so, you know, no big deal. Except for the knowledge that you're eating poop. Sorry.

Their burgers have poop in them.

You shouldn't eat at McDonald's.

We separate the conclusion from the premises with a horizontal line. Sometimes, you will see a special symbol in front of the conclusion, which can be read as "therefore."

Speaking of 'therefore', it's one of the words to look out for when identifying and explicating arguments. Along with words like 'consequently' and 'thus', and phrases like 'it follows that' and 'which implies that', it indicates the presence of the conclusion of an argument. Similarly, words like 'because', 'since', and 'for' indicate the presence of premises.

Premise Indicators	**Conclusion indicators**
since	therefore
because	so
for	hence
as	thus
given that	implies that
seeing that	consequently
for the reason that	it follows that
is shown by the fact that	we may conclude that

We should also note that it is possible for a single sentence to express more than one proposition. If we added this sentence to our argument–'McDonald's advertising targets children to try to create lifetime addicts to their high-calorie foods, and their expansion into global markets has disrupted native food distribution systems, harming family farmers'–we would write down two separate declarative sentences in our explication, expressing the two propositions asserted in the sentence–about children and international farmers, respectively. Indeed, it's possible for a single sentence to express an entire argument. 'You shouldn't eat at McDonald's because they're a bad corporate actor' gives you a conclusion and a premise at once. An explication would merely separate them.

Paraphrasing

The argument about McDonald's was an easy case. It didn't have a word like 'therefore' to tip us off to the presence of the conclusion, but it was pretty clear what the conclusion was anyway. All we had to do was ask ourselves, "What is this person trying to convince me to believe?" The answer to that question is the conclusion of the argument.

Another way the McDonald's argument was easy: all of the sentences were declarative sentences, so when we explicated the argument, all we had to do was write them down. But sometimes argumentative passages aren't so cooperative. Sometimes they contain non-declarative sentences. Recall, arguments are sets of propositions, and only declarative sentences express propositions; so if an argumentative passage contains non-declarative sentences (questions, commands, etc.), we need to change their wording when we explicate the argument, turning them into declarative sentences that express a proposition. This is called paraphrasing.

Suppose, for example, that the McDonald's argument were exactly as originally presented, except the first sentence were imperative, not declarative:

> Don't eat at McDonald's. Why? First of all, they pay their workers very low wages. Second, the animals that go into their products are raised in deplorable, inhumane conditions. Third, the food is really bad for you. Finally, the burgers have poop in them.

We just switched from 'You shouldn't eat at McDonald's' to 'Don't eat at McDonald's.' But it makes a difference. The first sentence is declarative; it makes a claim about how things are (morally, with respect to your obligations in some sense): you shouldn't do such-and-such. It's possible to disagree with the claim: Sure I should, and so should everybody else; their fries are delicious! 'Don't eat at McDonald's', on the other hand, is not like that. It's a command. It's possible to disobey it, but not to disagree with it; imperative sentences don't make claims about how things are, don't express propositions.

Still, the passage is clearly argumentative: the purpose remains to persuade the listener not to eat at McDonald's. We just have to be careful, when we explicate the argument, to paraphrase the first sentence–to change its wording so that it becomes a declarative, proposition-expressing sentence. 'You shouldn't eat at McDonald's' works just fine.

Let's consider a different example:

> I can't believe anyone would support a $15 per hour minimum wage. Don't they realize that it would lead to massive job losses? And the strain such a policy would put on small businesses could lead to an economic recession.

The passage is clearly argumentative: this person is engaged in a dispute about a controversial issue–the minimum wage–and is staking out a position and backing it up. What is that position? Apparently, this person opposes the idea of raising the minimum wage to $15.

There are two problems we face in explicating this argument. First, one of the sentences in the passage–the second one–is non-declarative: it's an interrogative sentence, a question. Nevertheless, it's being used in this passage to express one of the person's reasons for opposing the minimum wage increase–that it would lead to job losses. So we need to paraphrase, transforming the interrogative into a declarative–something like 'A $15 minimum wage would lead to massive job losses'.

The other problem is that the first sentence, while a perfectly respectable declarative sentence, can't be used as-is in our explication. For while it's clearly being used by to express this person's main point, the conclusion of his argument against the minimum wage increase, it does so indirectly. What the sentence literally and directly expresses is not a claim about the wisdom of the minimum wage increase, but rather a claim about the speaker's personal beliefs: 'I can't believe anyone would support a $15 per hour minimum wage'. But that claim isn't the conclusion of the argument. The speaker isn't trying to convince people that he believes (or can't believe) a certain thing; he's trying to convince them to believe the same thing he believes, namely, that raising the minimum wage to $15 is a bad idea. So, despite the first sentence being a declarative, we still have to paraphrase it. It expresses a proposition, but not the conclusion of the argument.

Our explication of the argument would look like this:

> Increasing the minimum wage to $15 per hour would lead to massive job losses.
> The policy would put a strain on small businesses that might lead to a recession.
> ---
> / Increasing the minimum wage to $15 per hour is a bad idea.

EXERCISES

Which of the following are arguments? If it is an argument, identify the conclusion of the argument.

1. The woman in the hat is not a witch since witches have long noses and she doesn't have a long nose.

2. I have been wrangling cattle since before you were old enough to tie your own shoes.

3. Albert is angry with me so he probably won't be willing to help me wash the dishes.

4. First I washed the dishes and then I dried them.

5. If the road wasn't icy, the car wouldn't have slid off the turn.

6. Albert isn't a fireman and he isn't a fisherman either.

7. Are you seeing that rhinoceros over there? It is huge!

8. The fact that obesity has become a problem in the U.S. is shown by the fact that obesity rates have risen significantly over the past four decades.

9. Bob showed me a graph with the rising obesity rates and I was very surprised to see how much they've risen.

10. Albert isn't a fireman because Albert is a Greyhound, which is a kind of dog, and dogs can't be firemen.

11. Charlie and Violet are dogs and since dogs dont sweat, it is obvious that Charlie and Violet don't sweat.

12. The reason I forgot to lock the door is that I was distracted by the clown riding a unicycle down our street while singing Lynyrd Skynyrd's "Simple Man."

13. What Bob told you is not the real reason that he missed his plane to Denver.

14. Samsung stole some of Apple's patents for their smartphones, so Apple stole some of Samsung's patents back in retaliation.

15. No one who has ever gotten frostbite while climbing K2 has survived to tell about it, therefore no one ever will.

Enthymemes: Tacit Propositions

So sometimes, when we explicate an argument, we have to take what's present in the argumentative passage and change it slightly, so that all of the sentences we write down express the propositions that are in the argument. This is paraphrasing. Other times, we have to do even more: occasionally, we have to fill in missing propositions; argumentative passages might not state all of the propositions in an argument explicitly, and in the course of explicating their arguments, we have to make these implicit, tacit propositions explicit by writing down the appropriate declarative sentences.

There's a fancy Greek word for argumentative passages that leave certain propositions unstated: enthymemes. Here's an example:

> Hillary Clinton has more experience in public office than Donald Trump; she has a much deeper knowledge of the issues; she's the only one with the proper temperament to lead our country. I rest my case.

Again, the argumentative intentions here are plain: this person is staking out a position on a controversial topic–a presidential election. But notice, that position–that one should prefer Clinton to Trump–is never stated explicitly. We get reasons for having that preference–the premises of the argument are explicit–but we never get a statement of the conclusion. But since this is clearly the upshot of the passage, we need to include a sentence expressing it in our explication:

> Clinton has more experience than Trump.
> Clinton has deeper knowledge of issues than Trump.
> Clinton has the proper temperament to lead the country, while Trump does not.
> / One should prefer Clinton to Trump in the presidential election.

In that example, the conclusion of the argument was tacit. Sometimes, premises are unstated and we should make them explicit in our explication of the argument. Now consider this passage:

> The sad fact is that wages for middle-class workers have stagnated over the past several decades. We need a resurgence of the union movement in this country.

This person is arguing in favor of labor unions; the second sentence is the conclusion of the argument. The first sentence gives the only explicit premise: the stagnation of middle-class wages. But notice what the passage doesn't say: what connection there might be between the two things. What do unions have to do with middle-class wages?

There's an implicit premise lurking in the background here–something that hasn't been said, but which needs to be true for the argument to go through. We need a claim that connects the premise to the conclusion–that bridges the gap between them. Something like this: A resurgence of unions would lead to wage growth for middle-class workers. The first sentence identifies a problem; the second sentence purports to give a solution to the problem. But it's only a solution if the tacit premise we've uncovered is true. If unions don't help raise middle-class wages, then the argument falls apart.

This is the mark of the kinds of tacit premises we want to uncover: if they're false, they undermine the argument. Often, premises like this are unstated for a reason: they're controversial claims on their own, requiring a lot of evidence to support them; so the arguer leaves them out, preferring not to get bogged down. When we draw them out, however, we can force a more robust dialectical exchange, focusing the argument on the heart of the matter. In this case, a discussion about the connection between unions and middle-class wages would be in order. There's a lot to be said on that topic.

Arguments v Explanations

One final item on the topic of "Recognizing and Explicating Arguments." We've been focusing on explication; this is a remark about the recognition side. Some passages may superficially resemble arguments–they may, for example, contain words like 'therefore' and 'because', which normally indicate conclusions and premises in argumentative passages–but which are nevertheless not argumentative. Instead, they are explanations.

Consider this passage:

> Because female authors of her time were often stereotyped as writing light-hearted romances, and because her real name was well-known for other (sometimes scandalous) reasons, Mary Ann Evans was reluctant to use her own name for her novels. She wanted her work to be taken seriously and judged on its own merits. Therefore, she adopted the pen name 'George Eliot'.

This passage has the words ‘because’ (twice), and ‘therefore’, which typically indicate the presence of premises and a conclusion, respectively. But it is not an argument. It’s not an argument because it does not have the rhetorical purpose of an argument: the aim of the passage is not to convince you of something. If it were an argument, the conclusion would be the claim following ‘therefore’, namely, the proposition that Mary Ann Evans adopted the pen name ‘George Eliot’. But this claim is not the conclusion of an argument; the passage is not trying to persuade us to believe that Evans adopted a pen name. That she did so is not a controversial claim. Rather, that’s a fact that’s assumed to be known already. The aim of the passage is to explain to us why Evans made that choice. The rhetorical purpose is not to convince; it is to inform, to edify. The passage is an explanation, not an argument.

So, to determine whether a given passage is an argument or an explanation, we need to figure out its rhetorical purpose. Why is the author saying these things to me? Is she trying to convince me of something, or is she merely trying to inform me–to give me an explanation for something I already knew? Sometimes this is easy, as with the George Eliot passage; it’s hard to imagine someone saying those things with persuasive intent. Other times, however, it’s not so easy. Consider the following:

Many of the celebratory rituals (of Christmas), as well as the timing of the holiday, have their origins outside of, and may predate, the Christian commemoration of the birth of Jesus. Those traditions, at their best, have much to do with celebrating human relationships and the enjoyment that this life has to offer. As an atheist, I have no hesitation in embracing the holiday and joining with believers and nonbelievers alike to celebrate what we have in common.[5]

Unless we understand a little bit more about the context of this passage, it’s difficult to determine the speaker’s intentions. It may appear to be an argument. That atheists should embrace a religious holiday like Christmas is, among many, a controversial claim. Controversial claims are the kinds of claims that we often try to convince skeptical people to believe. If the speaker’s audience for this passage is a bunch of hard-line atheists, who vehemently reject anything with a whiff of religiosity, who consider Christmas a humbug, then it’s pretty clear that the speaker is trying to offer reasons for them to reconsider their stance; he’s trying to convince them to embrace Christmas; he’s making an argument. If we explicated the argument, we would paraphrase the last sentence to represent the controversial conclusion: ‘Atheists should have no hesitation embracing and celebrating Christmas’.

But in a different context, with a different audience, this may not be an argument. If we leave the claim in the final sentence as-is–‘As an atheist, I have no hesitation in embracing the holiday and joining with believers and nonbelievers alike to celebrate what we have in common’–we have a claim about the speaker’s personal beliefs and inclinations. Typically, as we saw above, such claims are not suitable as the conclusions of arguments; we don’t usually spend time trying to convince people that we believe such-and-such. But what is more typical is providing people with explanations for why we believe things. If the author of our passage is an atheist, and he’s saying these things to friends of his, say, who know he’s an atheist, we might have just such an explanation. His friends know he’s not religious, but they know he loves Christmas. That’s kind of weird. Don’t atheists hate religious holidays? Not so, says our speaker. Let me explain to you why I have no problems with Christmas, despite my atheism. Again, the difference between arguments and explanations comes down to rhetorical purpose: arguments try to convince people; explanations try to inform them. Determining whether a given passage is one or the other involves figuring out the author’s

---

[5] John Teehan, 12/24/2006, “A Holiday Season for Atheists, Too,” The New York Times. Excerpted in Copi and Cohen, 2009, Introduction to Logic 13e, p. 25.

intentions. To do this, we must carefully consider the context of the passage.

EXERCISES

1. Identify the conclusions in the following arguments.

(a) Every citizen has a right–nay, a duty–to defend himself and his family. This is all the more important in these increasingly dangerous times. The framers of the Constitution, in their wisdom, enshrined the right to bear arms in that very document. We should all oppose efforts to restrict access to guns.

(b) Totino's pizza rolls are the perfect food. They have all the great flavor of pizza, with the added benefit of portability!

(c) Because they go overboard making things user-friendly, Apple phones are inferior to those with Android operating systems. If you want to change the default settings on an Apple phone to customize it to your personal preferences, it's practically impossible to figure out how. The interface is so dumbed down to appeal to the "average consumer" that it's super hard to find where the controls for advanced settings even are. On Android phones, though, everything's right there in the open.

(d) The U.S. incarcerates more people per capita than any other country on Earth, many for non-violent drug offenses. Militarized policing of our inner cities has led to scores of unnecessary deaths and a breakdown of trust between law enforcement and the communities they are supposed to serve and protect. We need to end the "War on Drugs" now. Our criminal justice system is broken. The War on Drugs broke it.

(e) The point of a watch is to tell you what time it is. Period. Rolexes are a complete waste of money. They don't do any better at telling the time, and they cost a ton!

2. Explicate the following arguments, paraphrasing as necessary.

(a) You think that if the victims of the mass shooting had been armed that would've made things better? Are you nuts? The shooting took place in a bar; not even the NRA thinks it's a good idea to allow people to carry guns in a drinking establishment. And don't be fooled by the fantasy that "good guys with guns" would prevent mass murder. More likely, the situation would've been even bloodier, with panicked people shooting randomly all over the place.

(b) The heat will escape the house through the open door, which means the heater will keep running, which will make our power bill go through the roof. Then we'll be broke. So stop leaving the door open when you come into the house.

(c) Do you like delicious food? How about fun games? And I know you like cool prizes. Well then, Chuck E. Cheese's is the place for you.

3. Write down the tacit premises that the following arguments depend on for their success.

(a) Cockfighting is an exciting pastime enjoyed by many people. It should therefore be legal.

(b) The president doesn't understand the threat we face. He won't even use the phrase "Radical Islamic Terror."

4. Write down the tacit conclusion that follows most immediately from the following.

(a) If there really were an all-loving God looking down on us, then there wouldn't be so much death and destruction visited upon innocent people.

(b) The death penalty is immoral. Numerous studies have shown that there is racial bias in its application. The rise of DNA testing has exonerated scores of inmates on death row; who knows how many innocent people have been killed in the past? The death penalty is also impractical. Revenge is counterproductive:

"An eye for an eye leaves the whole world blind," as Gandhi said. Moreover, the costs of litigating death penalty cases, with their endless appeals, are enormous. The correct decision for policymakers is clear.

5. Decide whether the following are arguments or explanations, given their context. If the passage is an argument, write down its conclusion; if it is an explanation, write down the fact that is being explained.

(a) Michael Jordan is the best of all time. I don't care if Kareem scored more points; I don't care if Russell won more championships. The simple fact is that no other player in history displayed the stunning combination of athleticism, competitive drive, work ethic, and sheer jaw-dropping artistry of Michael Jordan. (Context: Sports talk radio host going on a "rant")

(b) Because different wavelengths of light travel at different velocities when they pass through water droplets, they are refracted at different angles. Because these different wavelengths correspond to different colors, we see the colors separated. Therefore, if the conditions are right, rainbows appear when the sun shines through the rain. (Context: grade school science textbook)

(c) The primary motivation for the Confederate States in the Civil War was not so much the preservation of the institution of slavery, but the preservation of the sovereignty of individual states guaranteed by the 10th Amendment to the U.S. Constitution. Southerners of the time were not the simple-minded racists they were often depicted to be. Leaders in the southern states were disturbed by the over-reach of the Federal government into issues of policy more properly decided by the states. That slavery was one of those issues is incidental. (Context: excerpt from Rebels with a Cause: An Alternative History of the Civil War)

(d) This is how natural selection works: those species with traits that promote reproduction tend to have an advantage over competitors and survive; those without such traits tend to die off. The way that humans reproduce is by having sex. Since the human species has survived, it must have traits that encourage reproduction–that encourage having sex. This is why sex feels good. Sex feels good because if it didn't, the species would not have survived. (Context: excerpt from *Evolutionary Biology for Dummies*)

Deductive and Inductive Arguments

As we noted earlier, there are different logics–different approaches to distinguishing good arguments from bad ones. One of the reasons we need different logics is that there are different kinds of arguments. In this section, we distinguish two types: deductive and inductive arguments.

> Sally Johansson does all her grocery shopping at an organic food co-op. She's a huge fan of tofu. She's really into those week-long juice cleanse thingies. And she's an active member of PETA. I conclude that she's a vegetarian.
>
> (a) Make up a new piece of information about Sally that weakens the argument.
>
> (b) Make up a new piece of information about Sally that strengthens the argument.

Diagramming Arguments

Before we get down to the business of evaluating arguments–of judging them valid or invalid, strong or weak–we still need to do some preliminary work. We need to develop our analytical skills to gain a deeper understanding of how arguments are constructed, how they hang together. So far, we've said that the premises are there to support the conclusion. But we've done very little in the way of analyzing the structure of arguments: we've just separated the premises from the conclusion. We know that the premises are supposed to support the conclusion. What we haven't explored is the question of just how the premises in a given argument do that job–how they work together to support the conclusion, what kinds of relationships they have with one another. This is a deeper level of analysis than merely distinguishing the premises from the conclusion; it will require a mode of presentation more elaborate than a list of propositions with the bottom one separated from the others by a horizontal line. To display our understanding of the relationships among premises supporting the conclusion, we are going to depict them: we are going to draw diagrams of arguments.

Here's how the diagrams will work. They will consist of three elements: (1) circles with numbers inside them–each of the propositions in the argument we're diagramming will be assigned a number, so these circled numbers in the diagram will represent the propositions; (2) arrows pointed at circled numbers–these will represent relationships of support, where one or more propositions provide a reason for believing the one pointed to; and (3) horizontal brackets–propositions connected by these will be interdependent (in a sense to be specified below).

Our diagrams will always feature the circled number corresponding to the conclusion at the bottom. The premises will be above, with brackets and arrows indicating how they collectively support the conclusion and how they're related to one another. There are a number of different relationships that premises can have to one another. We will learn how to draw diagrams of arguments by considering them in turn.

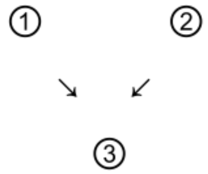
Independent Premises

Often, different premises will support a conclusion–or another premise–individually, without help from any others. When this is the case, we draw an arrow from the circled number representing that premise to the circled number representing the proposition it supports.

Consider this simple argument:

> (1) Marijuana is less addictive than alcohol. In addition, (2) it can be used as a medicine to treat a variety of conditions. Therefore, (3) marijuana should be legal.

The last proposition is clearly the conclusion (the word 'therefore' is a big clue), and the first two propositions are the premises supporting it. They support the conclusion independently. The mark of independence is this: each of the premises would still provide support for the conclusion even if the other weren't true; each, on its own, gives you a reason for believing the conclusion. In this case, then, we diagram the argument as follows:



Intermediate Premises

Some premises support their conclusions more directly than others. Premises provide more indirect support for a conclusion by providing a reason to believe another premise that supports the conclusion more directly. That is, some premises are intermediate between the conclusion and other premises.

Consider this simple argument:

(1) Automatic weapons should be illegal. (2) They can be used to kill large numbers of people in a short amount of time. This is because (3) all you have to do is hold down the trigger and bullets come flying out in rapid succession.

The conclusion of this argument is the first proposition, so the premises are propositions 2 and 3. Notice, though, that there's a relationship between those two claims. The third sentence starts with the phrase 'This is because', indicating that it provides a reason for another claim. The other claim is proposition 2; 'This' refers to the claim that automatic weapons can kill large numbers of people quickly. Why should I believe that they can do that? Because all one has to do is hold down the trigger to release lots of bullets really fast. Proposition 2 provides immediate support for the conclusion (automatic weapons can kill lots of people really quickly, so we should make them illegal); proposition 3 supports the conclusion more indirectly, by giving support to proposition 2. Here is how we diagram in this case:

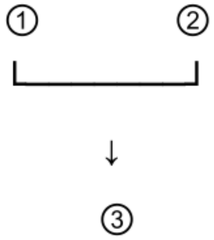
Joint Premises

Sometimes premises need each other: the job of supporting another proposition can't be done by each on its own; they can only provide support together, jointly. Far from being independent, such premises are interdependent. In this situation, on our diagrams, we join together the interdependent premises with a bracket underneath their circled numbers.

There are a number of different ways in which premises can provide joint support. Sometimes, premises just fit together like a hand in a glove; or, switching metaphors, one premise is like the key that fits into the other to unlock the proposition they jointly support. An example can make this clear:

> (1) The chef has decided that either salmon or chicken will be tonight's special. (2) Salmon won't be the special. Therefore, (3) the special will be chicken.

Neither premise 1 nor premise 2 can support the conclusion on its own. A useful rule of thumb for checking whether one proposition can support another is this: read the first proposition, then say the word 'therefore', then read the second proposition; if it doesn't make any sense, then you can't draw an arrow from the one to the other. Let's try it here: "The chef has decided that either salmon or chicken will be tonight's special; therefore, the special will be chicken." That doesn't make any sense. What happened to salmon? Proposition 1 can't support the conclusion on its own. Neither can the second: "Salmon won't be the special; therefore, the special will be chicken." Again, that makes no sense. Why chicken? What about steak, or lobster? The second proposition can't support the conclusion on its own, either; it needs help from the first proposition, which tells us that if it's not salmon, it's chicken. Propositions 1 and 2 need each other; they support the conclusion jointly. This is how we diagram the argument:



The same diagram would depict the following argument:

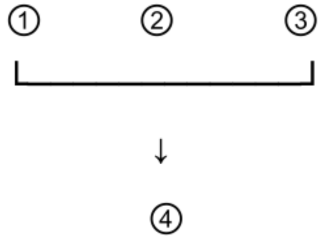
> (1) John Le Carre gives us realistic, three-dimensional characters and complex, interesting plots. (2) Ian Fleming, on the other hand, presents an unrealistically glamorous picture of international espionage, and his plotting isn't what you'd call immersive. (3) Le Carre is a better author of spy novels than Fleming.

In this example, the premises work jointly in a different way than in the previous example. Rather than fitting together hand-in-glove, these premises each give us half of what we need to arrive at the conclusion. The conclusion is a comparison between two authors. Each of the premises makes claims about one of the two authors. Neither one, on its own, can support the comparison, because the comparison is a claim about both of them. The premises can only support the conclusion together. We would diagram this argument the same way as the last one.

Another common pattern for joint premises is when general propositions need help to provide support for particular propositions. Consider the following argument:

(1) People shouldn't vote for racist, incompetent candidates for president. (2) Donald Trump seems to make a new racist remark at least twice a week. And (3) he lacks the competence to run even his own (failed) businesses, let alone the whole country. (4) You shouldn't vote for Trump to be the president.

The conclusion of the argument, the thing it's trying to convince us of, is the last proposition– you shouldn't vote for Trump. This is a particular claim: it's a claim about an individual person, Trump. The first proposition in the argument, on the other hand, is a general claim: it asserts that, generally speaking, people shouldn't vote for incompetent racists; it makes no mention of an individual candidate. It cannot, therefore, support the particular conclusion–about Trump–on its own. It needs help from other particular claims–propositions 2 and 3–that tell us that the individual in the conclusion, Trump, meets the conditions laid out in the general proposition 1: racism and incompetence. This is how we diagram the argument:



Occasionally, an argumentative passage will only explicitly state one of a set of joint premises because the others "go without saying"–they are part of the body of background information about which both speaker and audience agree. In the last example, that Trump was an incompetent racist was not uncontroversial background information. But consider this argument:

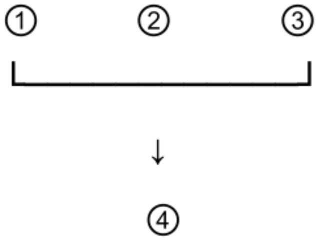
> (1) It would be good for the country to have a woman with lots of experience in public office as president. (2) People should vote for Hillary Clinton.

Diagramming this argument seems straightforward: an arrow pointing from (1) to (2) But we've got the same relationship between the premise and conclusion as in the last example: the premise is a general claim, mentioning no individual at all, while the conclusion is a particular claim about Hillary Clinton. Doesn't the general premise "need help" from particular claims to the effect that the individual in question, Hillary Clinton, meets the conditions set forth in the premise–i.e., that she's a woman and that she has lots of experience in public office? No, not really. Everybody knows those things about her already; they go without saying, and can therefore be left unstated (implicit, tacit).

But suppose we had included those obvious truths about Clinton in our presentation of the argument; suppose we had made the tacit premises explicit:

> (1) It would be good for the country to have a woman with lots of experience in public office as president. (2) Hillary Clinton is a woman. And (3) she has deep experience with public offices–as a First Lady, U.S. Senator, and Secretary of State. (4) People should vote for Hillary Clinton.

How do we diagram this? Earlier, we talked about a rule of thumb for determining whether or not it's a good idea to draw an arrow from one number to another in a diagram: read the sentence corresponding to the first number, say the word 'therefore', then read the sentence corresponding to the second number; if it doesn't make sense, then the arrow is a bad idea. But if it does make sense, does that mean you should draw the arrow? Not necessarily. Consider the first and last sentences in this passage. Read the first, then 'therefore', then the last. Makes pretty good sense! That's just the original formulation of the argument with the tacit propositions remaining implicit. And in that case we said it would be OK to draw an arrow from the general premise's number straight to the conclusion's. But when we add the tacit premises–the second and third sentences in this passage–we can't draw an arrow directly from (1) to (4) To do so would obscure the relationship among the first three propositions and misrepresent how the argument works. If we drew an arrow from (1) to (4) what would we do with (2) to (3) in our diagram? Do they get their own arrows, too? No, that won't do. Such a diagram would be telling us that the first three propositions each independently provide a reason for the conclusion. But they're clearly not independent; there's a relationship among them that our diagram must capture, and it's the same relationship we saw in the parallel argument about Trump, with the particular claims in the second and third propositions working together with the general claim in the first:



The arguments we've looked at thus far have been quite short–only two or three premises. But of course some arguments are longer than that. Some are much longer. The system of mapping generalizes to these longer arguments. In future lessons, we'll start to look at arguments with more and more premises.

EXERCISES

Diagram the following arguments.

1. (1) Hillary Clinton would make a better president than Donald Trump. (2) Clinton is a toughminded pragmatist who gets things done. (3) Trump is a thin-skinned maniac who will be totally ineffective in dealing with Congress.

2. (1) Donald Trump is a jerk who's always offending people. Furthermore, (2) he has no experience whatsoever in government. (3) Nobody should vote for him to be president.

3. (1) Human beings evolved to eat meat, so (2) eating meat is not immoral. (3) It's never immoral for a creature to act according to its evolutionary instincts.

4. (1) We need new campaign finance laws in this country. (2) The influence of Wall Street money on elections is causing a breakdown in our democracy with bad consequences for social justice. (3) Politicians who have taken those donations are effectively bought and paid for, consistently favoring policies that benefit the rich at the expense of the vast majority of citizens.

5. (1) Voters shouldn't trust any politician who took money from Wall Street bankers. (2) Hillary Clinton accepted hundreds of thousands of dollars in speaking fee from Goldman Sachs, a big Wall Street firm. (3) You shouldn't trust her.

6. (1) There are only three possible explanations for the presence of the gun at the crime scene: either the defendant just happened to hide from the police right next to where the gun was found, or the police planted the gun there after the fact, or it was really the defendant's gun like the prosecution says. (2) The first option is too crazy a coincidence to be at all believable, and (3) we've been given no evidence at all that the officers on the scene had any means or motivation to plant the weapon. Therefore, (4) it has to be the defendant's gun.

7. (1) Golden State has to be considered the clear favorite to win the NBA Championship. (2) No team has ever lost in the Finals after taking a 3-games-to-1 lead, and (3) Golden State now leads Cleveland 3-to-1. In addition, (4) Golden State has the MVP of the league, Stephen Curry.

8. (1) We should increase funding to public colleges and universities. First of all, (2) as funding has decreased, students have had to shoulder a larger share of the financial burden of attending college, amassing huge amounts of debt. (3) A recent report shows that the average college student graduates with almost $30,000 in debt. Second, (4) funding public universities is a good investment. (5) Every economist agrees that spending on public colleges is a good investment for states, where the economic benefits far outweigh the amount spent.

9. (1) LED lightbulbs last for a really long time and (2) they cost very little to keep lit. (3) They are, therefore, a great way to save money. (4) Old-fashioned incandescent bulbs, on the other hand, are wasteful. (5) You should buy LEDs instead of incandescent bulbs.

10. (1) There's a hole in my left shoe, which means (2) my feet will get wet when I wear them in the rain, and so (3) I'll probably catch a cold or something if I don't get a new pair of shoes. Furthermore, (4) having new shoes would make me look cool. (5) I should buy new shoes.

11. Look, it's just simple economics: (1) if people stop buying a product, then companies will stop producing it. And (2) people just aren't buying tablets as much anymore. (3) The CEO of Best Buy recently said that sales of tablets are "crashing" at his stores. (4) Samsung's sales of tablets were down 14% this year alone. (5) Apple's not going to continue to make your beloved iPad for much longer.

12. (1) We should increase infrastructure spending as soon as possible. Why? First, (2) the longer we delay needed repairs to things like roads and bridges, the more they will cost in the future. Second, (3) it would cause a drop in unemployment, as workers would be hired to do the work. Third, (4) with interest rates at all-time lows, financing the spending would cost relatively little. A fourth reason? (5) Economic growth. (6) Most economists agree that government spending in the current climate would boost GDP.

13. (1) Smoking causes cancer and (2) cigarettes are really expensive. (3) You should quit smoking. (4) If you don't, you'll never get a girlfriend. (5) Smoking makes you less attractive to girls: (6) it stains your teeth and (7) it gives you bad breath.

Chapter 4

Deductive and Inductive Arguments

As we noted earlier, there are different logics–different approaches to distinguishing good arguments from bad ones. One of the reasons we need different logics is that there are different kinds of arguments. In this section, we distinguish two types: deductive and inductive arguments.

Deductive Arguments

First, deductive arguments. These are distinguished by their aim: a deductive argument attempts to provide premises that guarantee, necessitate its conclusion. Success for a deductive argument, then, does not come in degrees: either the premises do in fact guarantee the conclusion, in which case the argument is a good, successful one, or they don't, in which case it fails. Evaluation of deductive arguments is a black-and-white, yes-or-no affair; there is no middle ground. We have a special term for a successful deductive argument: we call it valid. Validity is a central concept in the study of logic. It's so important, we're going to define it three times. Each of these three definitions is equivalent to the others; they are just three different ways of saying the same thing:

> An argument is valid just in case . . .
> (i) its premises guarantee its conclusion; i.e.,
> (ii) if its premises are true, then its conclusion must also be true; i.e.,
> (iii) it is impossible for its premises to be true and its conclusion false.

Here's an example of a valid deductive argument:

> All humans are mortal.
> <u>Socrates is a human.</u>
> Socrates is mortal.

This argument is valid because the premises do in fact guarantee the conclusion: if they're true (as a matter of fact, they are), then the conclusion must be true; it's impossible for the premises to be true and the conclusion false.

Here's a surprising fact about validity: what makes a deductive argument valid has nothing to do with its content; rather, validity is determined by the argument's form. That is to say, what makes our Socrates argument valid is not that it says a bunch of accurate things about Socrates, humanity, and mortality. The content doesn't make a difference. Instead, it's the form that matters–the pattern that the argument exhibits.

Later, when undertake a more detailed study of deductive logic, we will give a precise definition of logical form.[1] For now, we'll use this rough gloss: the form of an argument is what's left over when you strip away all the non-logical terms and replace them with blanks.[2]

Here's what that looks like for our Socrates argument:

All A are B.
x is A.
x is B.

The letter are the blanks: they're placeholders, variables. As a matter of convention, we're using capital letters to stand for groups of things (humans, mortals) and lower case letters to stand for individual things (Socrates).

The Socrates argument is a good, valid argument because it exhibits this good, valid form. Our third way of wording the definition of validity helps us see why this is a valid form: it's impossible for the premises to be true and the conclusion false, in that it's impossible to plug in terms for A, B, and x in such a way that the premises come out true and the conclusion comes out false. A consequence of the fact that validity is determined entirely by an argument's form is that, given a valid form, every single argument that has that form will be valid. So any argument that has the same form as our Socrates argument will be valid; that is, we can pick things at random to stick in for A, B, and x, and we're guaranteed to get a valid argument. Here's a silly example:

All apples are bananas.
Donald Trump is an apple.
Donald Trump is a banana.

This argument has the same form as the Socrates argument: we simply replaced A with 'apples', B with 'bananas', and x with 'Donald Trump'. That means it's a valid argument. That's a strange thing to say, since the argument is just silly–but it's the form that matters, not the content. Our second way of wording the definition of validity can help us here. The standard for validity is this: IF the premises are true, then the conclusion must be. That's a big 'IF'. In this case, as a matter of fact, the premises are not true (they're silly, plainly false). However, IF they were true–if in fact apples were a type of banana and Donald Trump were an apple–then the conclusion would be unavoidable: Trump would have to be a banana. The premises aren't true, but if they were, the conclusion would have to be–that's validity.

---

[1] Definitions, actually. We'll study two different deductive logics, each with its own definition of form.

[2] What counts as a "logical term," you're wondering? Unhelpful answer: it depends on the logic; different logics count different terms as logical. Again, this is just a rough gloss. We don't need precision just yet, but we'll get it eventually.

So it turns out that the actual truth or falsehood of the propositions in a valid argument are completely irrelevant to its validity. The Socrates argument has all true propositions and it's valid; the Donald Trump argument has all false propositions, but it's valid, too. They're both valid because they have a valid form; the truth/falsity of their propositions don't make any difference. This means that a valid argument can have propositions with almost any combination of truthvalues: some true premises, some false ones, a true or false conclusion. One can fiddle around with the Socrates' argument's form, plugging different things in for A, B, and x, and see that this is so. For example, plug in 'ants' for A, 'bugs' for B, and Beyoncé for x: you get one true premise (All ants are bugs), one false one (Beyoncé is an ant), and a false conclusion (Beyoncé is a bug). Plug in other things and you can get any other combination of truth-values.

Any combination, that is, but one: you'll never get true premises and a false conclusion. That's because the Socrates' argument's form is a valid one; by definition, it's impossible to generate true premises and a false conclusion in that case.

This irrelevance of truth-value to judgments about validity means that those judgments are immune to revision. That is, once we decide whether an argument is valid or not, that decision cannot be changed by the discovery of new information. New information might change our judgment about whether a particular proposition in our argument is true or false, but that can't change our judgment about validity. Validity is determined by the argument's form, and new information can't change the form of an argument. The Socrates argument is valid because it has a valid form. Suppose we discovered, say, that as a matter of fact Socrates wasn't a human being at all, but rather an alien from outer space who got a kick out of harassing random people on the streets of ancient Athens. That information would change the argument's second premise–Socrates is human–from a truth to a falsehood. But it wouldn't make the argument invalid. The form is still the same, and it's a valid one.

It's time to face up to an awkward consequence of our definition of validity. Remember, logic is about evaluating arguments–saying whether they're good or bad. We've said that for deductive arguments, the standard for goodness is validity: the good deductive arguments are the valid ones. Here's where the awkwardness comes in: because validity is determined by form, it's possible to generate valid arguments that are nevertheless completely ridiculous-sounding on their face. Remember, the Donald Trump argument–where we concluded that he's a banana–is valid. In other words, we're saying that the Trump argument is good; it's valid, so it gets the logical thumbsup. But that's nuts! The Trump argument is obviously bad, in some sense of 'bad', right? It's a collection of silly, nonsensical claims.

We need a new concept to specify what's wrong with the Trump argument. That concept is soundness. This is a higher standard of argument-goodness than validity; in order to meet it, an argument must satisfy two conditions.

> An argument is sound just in case (i) it's valid, AND (ii) its premises are in fact true.[3]

The Trump argument, while valid, is not sound, because it fails to satisfy the second condition: its premises are both false. The Socrates argument, however, which is valid and contains nothing but truths (Socrates was not in fact an alien), is sound.

---

[3] What about the conclusion? Does it have to be true? Yes: remember, for valid arguments, if the premises are true, the conclusion has to be. Sound arguments are valid, so it goes without saying that the conclusion is true, provided that the premises are.

The question now naturally arises: if soundness is a higher standard of argument-goodness than validity, why didn't we say that in the first place? Why so much emphasis on validity? The answer is this: we're doing logic here, and as logicians, we have no special insight into the soundness of arguments. Or rather, we should say that as logicians, we have only partial expertise on the question of soundness. Logic can tell us whether or not an argument is valid, but it cannot tell us whether or not it is sound. Logic has no special insight into the second condition for soundness, the actual truth-values of premises. To take an example from the silly Trump argument, suppose you weren't sure about the truth of the first premise, which claims that all apples are bananas (you have very little experience with fruit, apparently). How would you go about determining whether that claim was true or false? Whom would you ask? Well, this is a pretty easy one, so you could ask pretty much anybody, but the point is this: if you weren't sure about the relationship between apples and bananas, you wouldn't think to yourself, "I better go find a logician to help me figure this out." Propositions make claims about how things are in the world. To figure out whether they're true or false, you need to consult experts in the relevant subject-matter. Most claims aren't about logic, so logic is very little help in determining truth-values. Since logic can only provide insight into the validity half of the soundness question, we focus on validity and leave soundness to one side.

Returning to validity, then, we're now in a position to do some actual logic. Given what we know, we can demonstrate invalidity; that is, we can prove that an invalid argument is invalid, and therefore bad (it can't be sound, either; the first condition for soundness is validity, so if the argument's invalid, the question of actual truth-values doesn't even come up). Here's how:

To demonstrate the invalidity of an argument, one must write a down a new argument with the same form as the original, whose premises are in fact true and whose conclusion is in fact false. This new argument is called a counterexample.

Let's look at an example. The following argument is invalid:

Some mammals are swimmers.
<u>All whales are swimmers.</u>
All whales are mammals.

Now, it's not really obvious that the argument is invalid. It does have one thing going for it: all the claims it makes are true. But we know that doesn't make any difference, since validity is determined by the argument's form, not its content. If this argument is invalid, it's invalid because it has a bad, invalid form. This is the form:

Some A are B.
<u>All C are B.</u>
All C are A.

To prove that the original whale argument is invalid, we have to show that this form is invalid. For a valid form, we learned, it's impossible to plug things into the blanks and get true premises and a false conclusion; so for an invalid form, it's possible to plug things into the blanks and get that result. That's how we generate our counterexample: we plug things in for A, B, and C so that the premises turn out true and the conclusion turns out false. There's no real method here; you just use your imagination to come up with an A, B, and C that give the desired result.[4]

Here's a counterexample:

Some lawyers are American citizens.
All members of Congress are American citizens.
All members of Congress are lawyers.

For A, we inserted 'lawyers', for B we chose 'American citizens', and for C, 'members of Congress'. The first premise is clearly true. The second premise is true: non-citizens aren't eligible to be in Congress. And the conclusion is false: there are lots of people in Congress who are nonlawyers–doctors, businesspeople, etc. That's all we need to do to prove that the original whale-argument is invalid: come up with one counterexample, one way of filling in the blanks in its form to get true premises and a false conclusion. We only have to prove that it's possible to get true premises and a false conclusion, and for that, you only need one example.

What's far more difficult is to prove that a particular argument is valid. To do that, we'd have to show that its form is such that it's impossible to generate a counterexample, to fill in the blanks to get true premises and a false conclusion. Proving that it's possible is easy; you only need one counterexample. Proving that it's impossible is hard; in fact, at first glance, it looks impossibly hard! What do you do? Check all the possible ways of plugging things into the blanks, and make sure that none of them turn out to have true premises and a false conclusion? That's nuts! There are, literally, infinitely many ways to fill in the blanks in an argument's form. Nobody has the time to check infinitely many potential counterexamples.

Well, take heart; it's still early. For now, we're able to do a little bit of deductive logic: given an invalid argument, we can demonstrate that it is in fact invalid. We're not yet in the position we'd like to be in, namely of being able to determine, for any argument whatsoever, whether it's valid or not. Proving validity looks too hard based on what we know so far. But we'll know more later: in chapters 3 and 4 we will study two deductive logics, and each one will give us a method of deciding whether or not any given argument is valid. But that'll have to wait. Baby steps.

Inductive Arguments

That's all we'll say for now about deductive arguments. On to the other type of argument we're introducing in this section: inductive arguments. These are distinguished from their deductive cousins by their relative lack of ambition. Whereas deductive arguments aim to give premises that guarantee/necessitate the conclusion, inductive arguments are more modest: they aim merely to provide premises that make the conclusion more probable than it otherwise would be; they aim to support the conclusion, but without making it unavoidable. Here is an example of an inductive argument:

> I'm telling you, you're not going die taking a plane to visit us. Airplane crashes happen far less frequently than car crashes, for example; so you're taking a bigger risk if you drive. In fact, plane

---

[4] Possibly helpful hint: universal generalizations (All . . . are . . .) are rarely true, so if you have to make one true, as in this example, it might be good to start there; likewise, particular claims (Some . . . are . . .) are rarely false, so if you have to make one false–you don't in this particular example, but if you had one as a conclusion, you would– that would be a good place to start.

> crashes are so rare, you're far more likely to die from slipping in the bathtub. You're not going to stop taking showers, are you?

The speaker is trying to convince her visitor that he won't die in a plane crash on the way to visit her. That's the conclusion: you won't die. This claim is supported by the others–which emphasize how rare plane crashes are–but it is not guaranteed by them. After all, plane crashes sometimes do happen. Instead, the premises give reasons to believe that the conclusion–you won't die–is very probable.

Since inductive arguments have a different, more modest goal than their deductive cousins, it would be unreasonable for us to apply the same evaluative standards to both kinds of argument. That is, we can't use the terms 'valid' and 'invalid' to apply to inductive arguments. Remember, for an argument to be valid, its premises must guarantee its conclusion. But inductive arguments don't even try to provide a guarantee of the conclusion; technically, then, they're all invalid. But that won't do. We need a different evaluative vocabulary to apply to inductive arguments. We will say of inductive arguments that they are (relatively) strong or weak, depending on how probable their conclusions are in light of their premises. One inductive argument is stronger than another when its conclusion is more probable than the other, given their respective premises.

One consequence of this difference in evaluative standards for inductive and deductive arguments is that for the former, unlike the latter, our evaluations are subject to revision in light of new evidence. Recall that since the validity or invalidity of a deductive argument is determined entirely by its form, as opposed to its content, the discovery of new information could not affect our evaluation of those arguments. The Socrates argument remained valid, even if we discovered that Socrates was in fact an alien. Our evaluations of inductive arguments, though, are not immune to revision in this way. New information might make the conclusion of an inductive argument more or less probable, and so we would have to revise our judgment accordingly, saying that the argument is stronger or weaker. Returning to the example above about plane crashes, suppose we were to discover that the FBI in the visitor's hometown had recently being hearing lots of "chatter" from terrorist groups active in the area, with strong indications that they were planning to blow up a passenger plane. Yikes! This would affect our estimation of the probability of the conclusion of the argument–that the visitor wasn't going to die in a crash. The probability of not dying goes down (as the probability of dying goes up). This new information would trigger a re-evaluation of the argument, and we would say it's now weaker. If, on the other hand, we were to learn that the airline that flies between the visitor's and the speaker's towns had recently upgraded its entire fleet, getting rid of all of its older planes, replacing them with newer, more reliable model, while in addition instituting a new, more thorough and rigorous program of pre- and post-flight safety and maintenance inspections–well, then we might revise our judgment in the other direction.

Given this information, we might judge that things are even safer for the visitor as it regards plane travel; that is, the proposition that the visitor won't die is now even more probable than it was before. This new information would strengthen the argument to that conclusion.

Reasonable follow-up question: how much is the argument strengthened or weakened by the new information imagined in these scenarios? Answer: how should I know? Sorry, that's not very helpful. But here's the point: we're talking about probabilities here; sometimes it's hard to know what the probability of something happening really is. Sometimes it's not: if I flip a coin, I know that the probability of it coming up tails is 0.5. But how probable is it that a particular plane from Airline X will crash with our hypothetical visitor on board? I don't know. And how much more probable is a disaster on the assumption of increased terrorist chatter? Again, I have no idea. All I know is that the probability of dying on the plane goes up in that case. And in the scenario in which Airline X has lots of new planes and security measures, the probability of a crash goes down.

Sometimes, with inductive arguments, all we can do is make relative judgments about strength and weakness: in light of these new facts, the conclusion is more or less probable than it was before we learned of the new facts. Sometimes, however, we can be precise about probabilities and make absolute judgments about strength and weakness: we can say precisely how probable a conclusion is in light of the premises supporting it. But this is a more advanced topic. We will discuss inductive logic in chapters 5 and 6, and will go into more depth then. Until then, patience. Baby steps.

EXERCISES

1. Determine whether the following statements are true or false.

   1. Not all valid arguments are sound.
   2. An argument with a false conclusion cannot be sound.
   3. An argument with true premises and a true conclusion is valid.
   4. An argument with a false conclusion cannot be valid.

2. Demonstrate that the following argument is invalid.

Some politicians are Democrats.
<u>Hillary Clinton is a politician.</u>
Hillary Clinton is a Democrat.

The argument's form is:

Some A are B.
<u>x is A.</u>
x is B.

(where 'A' and 'B' stand for groups of things and 'x' stands for an individual)

3. Consider the following inductive argument (about a made-up person):
Sally Johansson does all her grocery shopping at an organic food co-op. She's a huge fan of tofu. She's really into those week-long juice cleanse thingies. And she's an active member of PETA. I conclude that she's a vegetarian.

   1. Make up a new piece of information about Sally that weakens the argument.
   2. Make up a new piece of information about Sally that strengthens the argument.

Arguments with missing premises

Quite often, an argument will not explicitly state a premise that we can see is needed in order for the argument to be valid. In such a case, we can supply the premise(s) needed in order so make the argument valid. Making missing premises explicit is a central part of reconstructing arguments in standard form. We have already dealt in part with this in the section on paraphrasing, but now that we have introduced the concept of validity, we have a useful tool for knowing when to supply missing premises in our reconstruction of an argument. In some cases, the missing premise will be fairly obvious, as in the following:

> Gary is a convicted sex-offender, so Gary is not allowed to work with children.

The premise and conclusion of this argument are straightforward:

Gary is a convicted sex-offender
Therefore, Gary is not allowed to work with children (from premise 1)

However, as stated, the argument is invalid. (Before reading on, see if you can provide a counterexample for this argument. That is, come up with an imaginary scenario in which the premise is true and yet the conclusion is false.) Here is just one counterexample (there could be many): Gary is a convicted sex-offender but the country in which he lives does not restrict convicted sex-offenders from working with children. I don't know whether there are any such countries, although I suspect there are (and it doesn't matter for the purpose of validity whether there are or aren't). In any case, it seems clear that this argument is relying upon a premise that isn't explicitly stated. We can and should state that premise explicitly in our reconstruction of the standard form argument. But what is the argument's missing premise? The obvious one is that no sexoffenders are allowed to work with children, but we could also use a more carefully statement like this one:

> Where Gary lives, no convicted sex-offenders are allowed to work with children.

It should be obvious why this is a more "careful" statement. It is more careful because it is not so universal in scope, which means that it is easier for the statement to be made true. By relativizing the statement that sex-offenders are not allowed to work with children to the place where Gary lives, we leave open the possibility that other places in the world don't have this same restriction. So even if there are other places in the world where convicted sex-offenders are allowed to work with children, our statements could still be true since in this place (the place where Gary lives) they aren't. (For more on strong and weak statements, see section 1.10). So here is the argument in standard form:

Gary is a convicted sex-offender.
Where Gary lives, no convicted sex-offenders are allowed to work with children.
Therefore, Gary is not allowed to work with children. (from premises 1-2)

This argument is now valid: there is no way for the conclusion to be false, assuming the truth of the premises. This was a fairly simple example where the missing premise needed to make the argument valid was relatively easy to see. As we can see from this example, a missing premise is a premise that the argument needs in order to be as strong as possible. Typically, this means supplying the statement(s) that are needed to make the argument valid. But in addition to making the argument valid, we want to make the argument plausible. This is called "the principle of charity." The principle of charity states that when reconstructing an argument, you should try to make that argument (whether inductive or deductive) as strong as possible. When it comes to supplying missing premises, this means supplying the most plausible premises needed in order to make the argument either valid (for deductive arguments) or inductively strong (for inductive arguments).

Although in the last example figuring out the missing premise was relatively easy to do, it is not always so easy. Here is an argument whose missing premises are not as easy to determine:

> Since children who are raised by gay couples often have psychological and emotional problems, the state should discourage gay couples from raising children.

The conclusion of this argument, that the state should not allow gay marriage, is apparently supported by a single premise, which should be recognizable from the occurrence of the premise indicator, "since." Thus, our initial reconstruction of the standard form argument looks like this:

> Children who are raised by gay couples often have psychological and emotional problems.
> Therefore, the state should discourage gay couples from raising children.

However, as it stands, this argument is invalid because it depends on certain missing premises. The conclusion of this argument is a normative statement— a statement about whether something ought to be true, relative to some standard of evaluation.

Normative statements can be contrasted with descriptive statements, which are simply factual claims about what is true. For example, "Russia does not allow gay couples to raise children" is a descriptive statement. That is, it is simply a claim about what is in fact the case in Russia today. In contrast, "Russia should not allow gay couples to raise children" is a normative statement since it is not a claim about what is true, but what ought to be true, relative to some standard of evaluation (for example, a moral or legal standard). An important idea within philosophy, which is often traced back to the Scottish philosopher David Hume (1711-1776), is that statements about what ought to be the case (i.e., normative statements) can never be derived from statements about what is the case (i.e., descriptive statements). This is known within philosophy as the is-ought gap. The problem with the above argument is that it attempts to infer a normative statement from a purely descriptive statement, violating the is-ought gap. We can see the problem by constructing a counterexample. Suppose that in society x it is true that children raised by gay couples have psychological problems. However, suppose that in that society people do not accept that the state should do what it can to decrease harm to children. In this case, the conclusion, that the state should discourage gay couples from raising children, does not follow. Thus, we can see that the argument depends on a missing or assumed premise that is not explicitly stated. That missing premise must be a normative statement, in order that we can infer the conclusion, which is also a normative statement. There is an important general lesson here: Many times an argument with a normative conclusion will depend on a normative premise which is not explicitly stated. The missing normative premise of this particular argument seems to be something like this:

The state should always do what it can to decrease harm to children.

Notice that this is a normative statement, which is indicated by the use of the word "should." There are many other words that can be used to capture normative statements such as: good, bad, and ought. Thus, we can reconstruct the argument, filling in the missing normative premise like this:

Children who are raised by gay couples often have psychological and emotional problems.
The state should always do what it can to decrease harm to children.
Therefore, the state should discourage gay couples from raising children. (from premises 1-2)

However, although the argument is now in better shape, it is still invalid because it is still possible for the premises to be true and yet the conclusion false. In order to show this, we just have to imagine a scenario in which both the premises are true and yet the conclusion is false. Here is one counterexample to the argument (there are many). Suppose that while it is true that children of gay couples often have psychological and emotional problems, the rate of psychological problems in children raised by gay couples is actually lower than in children raised by heterosexual couples. In this case, even if it were true that the state should always do what it can to decrease harm to children, it does not follow that the state should discourage gay couples from raising children. In fact, in the scenario I've described, just the opposite would seem to follow: the state should discourage heterosexual couples from raising children.

But even if we suppose that the rate of psychological problems in children of gay couples is higher than in children of heterosexual couples, the conclusion still doesn't seem to follow. For example, it could be that the reason that children of gay couples have higher rates of psychological problems is that in a society that is not yet accepting of gay couples, children of gay couples will face more teasing, bullying and general lack of acceptance than children of heterosexual couples. If this were true, then the harm to these children isn't so much due to the fact that their parents are gay as it is to the fact that their community does not accept them. In that case, the state should not necessarily discourage gay couples from raising children. Here is an analogy: At one point in our country's history (if not still today) it is plausible that the children of black Americans suffered more psychologically and emotionally than the children of white Americans. But for the government to discourage black Americans from raising children would have been unjust, since it is likely that if there was a higher incidence of psychological and emotional problems in black Americans, then it was due to unjust and unequal conditions, not to the black parents, per se. So, to return to our example, the state should only discourage gay couples from raising children if they know that the higher incidence of psychological problems in children of gay couples isn't the result of any kind of injustice, but is due to the simple fact that the parents are gay.

Thus, one way of making the argument (at least closer to) valid would be to add the following two missing premises:

A. The rate of psychological problems in children of gay couples is higher than in children of heterosexual couples.
B. The higher incidence of psychological problems in children of gay couples is not due to any kind of injustice in society, but to the fact that the parents are gay.

So the reconstructed standard form argument would look like this:

Children who are raised by gay couples often have psychological and emotional problems.

The rate of psychological problems in children of gay couples is higher than in children of heterosexual couples.

The higher incidence of psychological problems in children of gay couples is not due to any kind of injustice in society, but to the fact that the parents are gay.

The state should always do what it can to decrease harm to children.

Therefore, the state should discourage gay couples from raising children. (from premises 1-4)

In this argument, premises 2-4 are the missing or assumed premises. Their addition makes the argument much stronger, but making them explicit enables us to clearly see what assumptions the argument relies on in order for the argument to be valid. This is useful since we can now clearly see which premises of the argument we may challenge as false. Arguably, premise 4 is false, since the state shouldn't always do what it can to decrease harm to children. Rather, it should only do so as long as such an action didn't violate other rights that the state has to protect or create larger harms elsewhere.

The important lesson from this example is that supplying the missing premises of an argument is not always a simple matter. In the example above, I have used the principle of charity to supply missing premises. Mastering this skill is truly an art (rather than a science) since there is never just one correct way of doing it (cf. section 1.5) and because it requires a lot of skilled practice.

EXERCISES:

Supply the missing premise or premises needed in order to make the following arguments valid. Try to make the premises as plausible as possible while making the argument valid (which is to apply the principle of charity).

1. Ed rides horses. Therefore, Ed is a cowboy.

2. Tom was driving over the speed limit. Therefore, Tom was doing something wrong.

3. If it is raining then the ground is wet. Therefore, the ground must be wet.

4. All elves drink Guinness, which is why Olaf drinks Guinness.

5. Mark didn't invite me to homecoming. Instead, he invited his friend Alexia. So he must like Alexia more than me.

6. The watch must be broken because every time I have looked at it, the hands have been in the same place.

7. Olaf drank too much Guinness and fell out of his second story apartment window. Therefore, drinking too much Guinness caused Olaf to injure himself.

8. Mark jumped into the air. Therefore, Mark landed back on the ground.

9. In 2009 in the United States, the net worth of the median white household was $113,149 a year, whereas the net worth of the median black household was $5,677. Therefore, as of 2009, the United States was still a racist nation.

10. The temperature of the water is 212 degrees Fahrenheit. Therefore, the water is boiling.

11. Capital punishment sometimes takes innocent lives, such as the lives of individuals who were later found to be not guilty. Therefore, we should not allow capital punishment.

12. Allowing immigrants to migrate to the U.S. will take working class jobs away from working class folks. Therefore, we should not allow immigrants to migrate to the U.S.

13. Prostitution is a fair economic exchange between two consenting adults. Therefore, prostitution should be allowed.

14. Colleges are more interested in making money off of their football athletes than in educating them. Therefore, college football ought to be banned.

15. Edward received an F in college Algebra. Therefore, Edward should have studied more.

Chapter 5

Induction

Inductive argumentation

Inductive argumentation is a less certain, more realistic, more familiar way of reasoning that we all do, all the time. Inductive argumentation recognizes, for instance, that a premise like “All horses have four legs” comes from our previous experience of horses. If one day we were to encounter a three-legged horse, deductive logic would tell us that “All horses have four legs” is false, at which point the premise becomes rather useless for a deducer. In fact, deductive logic tells us that if the premise “All horses have four legs” is false, even if we know there are many, many four-legged horses in the world, when we go to the track and see hordes of four-legged horses, all we can really be certain of is that “There is at least one four-legged horse.”

Inductive logic allows for the more realistic premise, “The vast majority of horses have four legs”. And inductive logic can use this premise to infer other useful information, like “If I’m going to get Chestnut booties for Christmas, I should probably get four of them.” The trick is to recognize a certain amount of uncertainty in the truth of the conclusion, something for which deductive logic does not allow. In real life, however, inductive logic is used much more frequently and (hopefully) with some success.

Predicting the Future

We constantly use inductive reasoning to predict the future. We do this by compiling evidence based on past observations, and by assuming that the future will resemble the past. For instance, I make the observation that every other time I have gone to sleep at night, I have woken up in the morning. There is actually no certainty that this will happen, but I make the inference because of the fact that this is what has happened every other time. In fact, it is not the case that “All people who go to sleep at night wake up in the morning”. But I’m not going to lose any sleep over that. And we do the same thing when our experience has been less consistent. For instance, I might make the assumption that, if there’s someone at the door, the dog will bark. But it’s not outside the realm of possibility that the dog is asleep, has gone out for a walk, or has been persuaded not to bark by a clever intruder with sedative-laced bacon. I make the assumption that if there’s someone at the door, the dog will bark, because that is what usually happens.

Explaining Common Occurrences

We also use inductive reasoning to explain things that commonly happen. For instance, if I'm about to start an exam and notice that Bill is not here, I might explain this to myself with the reason that Bill is stuck in traffic. I might base this on the reasoning that being stuck in traffic is a common excuse for being late, or because I know that Bill never accounts for traffic when he's estimating how long it will take him to get somewhere. Again, that Bill is actually stuck in traffic is not certain, but I have some good reasons to think it's probable. We use this kind of reasoning to explain past events as well. For instance, if I read somewhere that 1986 was a particularly good year for tomatoes, I assume that 1986 also had some ideal combination of rainfall, sun, and consistently warm temperatures. Although it's possible that a scientific madman circled the globe planting tomatoes wherever he could in 1986, inductive reasoning would tell me that the former, environmental explanation is more likely. (But I could be wrong.)

Generalizing

Often we would like to make general claims, but in fact it would be very difficult to prove any general claim with any certainty. The only way to do so would be to observe every single case of something about which we wanted to make an observation. This would be, in fact, the only way to prove such assertions as, "All swans are white". Without being able to observe every single swan in the universe, I can never make that claim with certainty. Inductive logic, on the other hand, allows us to make the claim, with a certain amount of modesty.

Inductive Generalization

Inductive generalization allows us to make general claims, despite being unable to actually observe every single member of a class in order to make a certainly true general statement. We see this in scientific studies, population surveys, and in our own everyday reasoning. Take for example a drug study. Some doctor or other wants to know how many people will go blind if they take a certain amount of some drug for so many years. If they determine that 5% of people in the study go blind, they then assume that 5% of all people who take the drug for that many years will go blind. Likewise, if I survey a random group of people and ask them what their favourite color is, and 75% of them say "purple", then I assume that purple is the favourite colour of 75% of people. But we have to be careful when we make an inductive generalization. When you tell me that 75% of people really like purple, I'm going to want to know whether you took that survey outside a Justin Bieber concert.

Let's take an example. Let's say I asked a class of 400 students whether or not they think logic is a valuable course, and 90% of them said yes. I can make an inductive argument like this:

$$\frac{\text{90\% of 400 students believe that logic is a valuable course.}}{\text{Therefore 90\% of all students believe that logic is a valuable course.}}$$

There are certain things I need to take into account in judging the quality of this argument. For instance, did I ask this in a logic course? Did the respondents have to raise their hands so that the professor could see them, or was the survey taken anonymously? Are there enough students in the course to justify using them as a representative group for students in general?

If I did, in fact, make a class of 400 logic students raise their hands in response to the question of whether logic is valuable course, then we can identify a couple of problems with this argument. The first is bias. We can assume that anyone enrolled in a logic course is more likely to see it as valuable than any random student. I have therefore skewed the argument in favour of logic courses. I can also question whether the students were answering the question honestly. Perhaps if they are trying to save the professor's feelings, they are more likely to raise their hands and assure her that the logic course is a valuable one.

Now let's say I've avoided those problems. I have assured that the 400 students I have asked are randomly selected, say, by soliciting email responses from randomly selected students from the university's entire student population. Then the argument looks stronger.

Another problem we might have with the argument is whether I have asked enough students so that the whole population is well-represented. If the student body as a whole consists of 400 students, my argument is very strong. If the student body numbers in the tens of thousands, I might want to ask a few more before assuming that the opinions of a few mirror those of the many. This would be a problem with my sample size.

Let's take another example. Now I'm going to run a scientific study, in which I will pay someone $50 to take a drug with unknown effects and see if it makes them blind. In order to control for other variables, I open the study only to white males between the ages of 18 and 25.

A bad inductive argument would say:

40% of 1000 people who took the drug went blind.
40% of people who take the drug will go blind.

A better inductive argument would make a more modest claim:

40% of the 1000 people who took the drug went blind.
40% of white males between the ages of 18 and 25 who take the drug will go blind.

The point behind this example is to show how inductive reasoning imposes an important limitation on the possible conclusions a study or a survey can make. In order to make good generalizations, we need to ensure that our sample is representative, non-biased, and sufficiently sized.

Statistical Syllogism

Where in an inductive generalization we saw statement expressing a statistic applied to a more general group, we can also use statistics to go from the general to the particular. For instance, if I know that most computer science majors are male, and that some random individual with the androgynous name "Cameron" is an computer science major, then we can be reasonably certain that Cameron is a male. We tend to represent the uncertainty by qualifying the conclusion with the word "probably". If, on the other hand, we wanted to say that something is unlikely, like that Cameron were a female, we could use "probably not". It is also possible to temper our conclusion with other similar qualifying words.

Let's take an example.

Of the 133 people found guilty of homicide last year in Canada, 79% were jailed.
Socrates was found guilty of homicide last year in Canada.
Therefore, Socrates was probably jailed.

In this case we can be reasonably sure that Socrates is currently rotting in prison. Now the certainty of our conclusion seems to be dependent on the statistics we're dealing with. There are definitely more certain and more uncertain cases.

In the last election, 50% of voting Americans voted for Obama, while 48% voted for Romney.
Jim is a voting American.
Jim probably voted for Obama.

Clearly, this argument is not as strong as the first. It is only slightly more likely than not that Jim voted for Obama. In this case we might want to revise our conclusion to say:

(C) It is slightly more likely than not that Jim voted for Obama.

In other cases, the likelihood that something is or is not the case approaches certainty. For example:

There is a 0.00000059% chance you will die on any single flight, assuming you use one of the most poorly rated airlines.
I'm flying to Paris next week.
There's more than a million to one chance that I will die on my flight.

Note that in all of these examples, nothing is ever stated with absolute certainty. It is possible to improve the chances that our conclusions will be accurate by being more specific, or finding out more information. We would know more about Jim's voting strategy, for instance, if we knew where he lived, his previous voting habits, or if we simply asked him for whom he voted (in which case, we might also want to know how often Jim lies).

Induction is the process of justifying quantified, categorical generalizations such as “All dogs like hot dogs.” and “92% of Canadian adults are owners of a mobile phone.” based on data about particular cases which we have experienced.

Claims like this are made all the time by people in everyday life. For example, a lot of common knowledge about things are their properties is encoded in generalizations, such as “Birds have wings.” and “Bananas grow on trees.”.

Stereotypes about different nations or ethnicities, such as “All Irish people love a drink.”, are generalizations. So are superstitions such as “I always play well when I wear my lucky socks.”.

As the examples of stereotypes and superstitions show, induction in everyday life is often done hastily. Doing it properly requires collecting a large, unbiased sample, so that the percentage discovered in the sample is likely to be close to that in the population. When a categorical proposition has a quantity that is universal or near-universal it can be used in inferences which classify new objects or events. For example, if you know “Almost all dogs have tails.”, you can infer that Jack’s new dog, Jim, has a tail.

Inductive Generalization (IG)

Induction is the process of justifying quantified, categorical propositions such as “All dogs like hot dogs.” and “92% of Canadian adults are owners of a mobile phone.” based on information about particular cases which we have experienced.

People make claims like this all the time. For example, a lot of common knowledge about things and their properties is encoded in such propositions, such as “Birds have wings.” and “Bananas grow on trees.”. Stereotypes about different nations or ethnicities, such as “All Irish people love a drink.”, are also quantified categorical propositions.

These propositions are categorical in that they are about categories or classes or types of thing, rather than a particular case or instance of that type. For example, “Jim loves chasing squirrels.” is about a specific dog, Jim, while “Most dogs are things that love chasing squirrels.” (or more naturally “Most dogs love chasing squirrels.”) is about dogs in general.

These proposition are quantified in that they specify what proportion or percentage of members of the initial class belong to the class mentioned in the predicate. “Nine out of ten dentists brush with Oral-B toothbrushes.” tells us that the percentage of dentists who use an Oral-B toothbrush is 90%. If the quantity is “All” or 100%, or “None” or 0%, the proposition is universal. Universality is rarely the case; what we more often get is a proposition describing a probabilistic relation–e.g. if F is present, G is present in 90% of cases. We are happy if the frequency of joint appearance or non-appearance is very high or near-universal.

We turn now to the process of generalization from a sample to a wider population. Consider the following scenario:

Jack shakes a large opaque basket filled with 4,000 black and red cubes, reaches in without looking, and grabs 500. He counts the reds, sees that he has 450, and then on this basis infers that roughly 90% of the cubes in the basket are red.

Jack’s inference is an instance of inductive generalization (IG) (or sometimes simply induction), and in standard form (i.e. with the premises above the line and the conclusion below) it looks like this:

> Cube1 through Cube500 are all cubes in the basket.
> $\underline{\text{90\% of the 500 cubes examined are red}}$.

Roughly 90% of the 4,000 cubes in the basket are red.

(Important Note: This analysis of the inference does not use the literal propositions in the passage. Rather, the relevant information is extracted from the passage. Which information is important is about to be explained.)

This inference concerns a sample of cubes (500 of them) from a wider population (of 4,000). The population is all the cubes in the basket, and this is mentioned in the conclusion. The sample is the cubes Jack looked at, and this is mentioned in premise (1).

Since we are interested in the percentage of the cubes that are red, the cubes can divided into two types: those that are red, and those that are not red. The color of the cubes is a variable, which means that it can take multiple values, in this case two: red and black. Writing out all of the information in propositions would be a lot of work; there would be 500 premises stating that each cube is a cube in the basket (i.e. (1) Cube 1 is a cube in the basket. (2) Cube 2 is a cube in the basket. . . .) and 500 more stating the color of each cube (i.e. (1) Cube 1 is red. (2) Cube 2 is red. (3) Cube 3 is black. . . .). What we do instead is summarize all of this information in two premises. Premise (1) states that the 500 cases are cubes in the basket, while premise (2) states the proportion that are red. (The remainder are then assumed to be black.)

From the fact that 90% of the cubes in the sample are red, Jack infers that roughly 90% of the population of cubes are red. That is, he generalizes. The conclusion moves beyond the specific cubes which were examined to cubes in the basket generally.

Here is the general form of IG:

Case1 through caseN are all F.
The % of case1 through caseN are also G.
The sample is large.
The sampling method yields an unbiased sample.
Roughly % of cases of F are G.

"F" and "G" stand for any two types of thing; they can refer to either the presence or the absence of any type of thing. The first two premises refer to a limited number of cases of F, while the conclusion refers to all Fs. The sample is numbered from 1 to n. The percentage-sign (%) stands for a proportion, expressed as a percentage (or sometimes a fraction, and in ordinary speech by a quantifying word or phrase such as "All", "Most", "A majority of", "Some", and so on). The word "roughly" (or some equivalent word) appears in the conclusion because it is improbable that the percentage of Gs in the population is exactly the same as the percentage of Gs in the sample.

IG can be used whether F and G are described positively or negatively. For example, we might be interested in the percentage of cases in which something is absent that are also cases where a second thing is absent (e.g. In 100% of places where water is absent, life is impossible), or one thing is absent and another present (e.g. 72% of buildings without sprinkler systems suffer serious damage in fires) or the first thing is present and the second absent (e.g. 97% of children who have been vaccination do not contract a certain illness).

5.1 Potential Problems with Inductive arguments and statistical generalizations

As we've seen, an inductive argument is an argument whose conclusion is supposed to follow from its premises with a high level of probability, rather than with certainty. This means that although it is possible that the conclusion doesn't follow from its premises, it is unlikely that this is the case. We said that inductive arguments are "defeasible," meaning that we could turn a strong inductive argument into a weak inductive argument simply by adding further premises to the argument. In contrast, deductive arguments that are valid can never be made invalid by adding further premises. Consider our "Tweets" argument:

Tweets is a healthy, normally functioning bird
Most healthy, normally functioning birds fly
Therefore, Tweets probably flies

Without knowing anything else about Tweets, it is a good bet that Tweets flies. However, if we were to add that Tweets is 6 ft. tall and can run 30 mph, then it is no longer a good bet that Tweets can fly (since in this case Tweets is likely an ostrich and therefore can't fly). The second premise, "most healthy, normally functioning birds fly," is a statistical generalization. Statistical generalizations are generalizations arrived at by empirical observations of certain regularities. Statistical generalizations can be either universal or partial. Universal generalizations assert that all members (i.e., 100%) of a certain class have a certain feature, whereas partial generalizations assert that most or some percentage of members of a class have a certain feature. For example, the claim that "67.5% of all prisoners released from prison are rearrested within three years" is a partial generalization that is much more precise than simply saying that "most prisoners released from prison are rearrested within three years." In contrast, the claim that "all prisoners released from prison are rearrested within three years" is a universal generalization. As we can see from these examples, deductive arguments typically use universal statistical generalizations whereas inductive arguments typically use partial statistical generalizations. Since statistical generalizations are often crucial premises in both deductive and inductive arguments, being able to evaluate when a statistical generalization is good or bad is crucial for being able to evaluate arguments. What we are doing in evaluating statistical generalizations is determining whether the premise in our argument is true (or at least wellsupported by the evidence). For example, consider the following inductive argument, whose premise is a (partial) statistical generalization:

70% of voters say they will vote for candidate X
Therefore, candidate X will probably win the election

This is an inductive argument because even if the premise is true, the conclusion could still be false (for example, an opponent of candidate X could systematically kill or intimidate those voters who intend to vote for candidate X so that very few of them will actually vote). Furthermore, it is clear that the argument is intended to be inductive because the conclusion contains the word "probably," which clearly indicates that an inductive, rather than deductive, inference is intended. Remember that in evaluating arguments we want to know about the strength of the inference from the premises to the conclusion, but we also want to know whether the premise is true! We can assess whether or not a statistical generalization is true by considering whether the statistical generalization meets certain conditions. There are two conditions that any statistical generalization must meet in order for the generalization to be deemed "good."

1. Adequate sample size: the sample size must be large enough to support the generalization.
2. Non-biased sample: the sample must not be biased.

A sample is simply a portion of a population. A population is the totality of members of some specified set of objects or events. For example, if I were determining the relative proportion of cars to trucks that drive down my street on a given day, the population would be the total number of cars and trucks that drive down my street on a given day. If I were to sit on my front porch from 12-2 pm and count all the cars and trucks that drove down my street, that would be a sample. A good statistical generalization is one in which the sample is representative of the population. When a sample is representative, the characteristics of the sample match the characteristics of the population at large. For example, my method of sampling cars and trucks that drive down my street would be a good method as long as the proportion of trucks to cars that drove down my street between 12-2 pm matched the proportion of trucks to cars that drove down my street during the whole day. If for some reason the number of trucks that drove down my street from 12-2 pm was much higher than the average for the whole day, my sample would not be representative of the population I was trying to generalize about (i.e., the total number of cars and trucks that drove down my street in a day). The "adequate sample size" condition and the "non-biased sample" condition are ways of making sure that a sample is representative. In the rest of this section, we will explain each of these conditions in turn.

It is perhaps easiest to illustrate these two conditions by considering what is wrong with statistical generalizations that fail to meet one or more of these conditions. First, consider a case in which the sample size is too small (and thus the adequate sample size condition is not met). If I were to sit in front of my house for only fifteen minutes from 12:00-12:15 and saw only one car, then my sample would consist of only 1 automobile, which happened to be a car. If I were to try to generalize from that sample, then I would have to say that only cars (and no trucks) drive down my street. But the evidence for this universal statistical generalization (i.e., "every automobile that drives down my street is a car") is extremely poor since I have sampled only a very small portion of the total population (i.e., the total number of automobiles that drive down my street). Taking this sample to be representative would be like going to Flagstaff, AZ for one day and saying that since it rained there on that day, it must rain every day in Flagstaff. Inferring to such a generalization is an informal fallacy called "hasty generalization." One commits the fallacy of hasty generalization when one infers a statistical generalization (either universal or partial) about a population from too few instances of that population. Hasty generalization fallacies are very common in everyday discourse, as when a person gives just one example of a phenomenon occurring and implicitly treats that one case as sufficient evidence for a generalization. This works especially well when fear or practical interests are involved. For example, Jones and Smith are talking about the relative quality of Fords versus Chevys and Jones tells Smith about his uncle's Ford, which broke down numerous times within the first year of owning it. Jones then says that Fords are just unreliable and that that is why he would never buy one. The generalization, which is here ambiguous between a universal generalization (i.e., all Fords are unreliable) and a partial generalization (i.e., most/many Fords are unreliable), is not supported by just one case, however convinced Smith might be after hearing the anecdote about Jones's uncle's Ford.

The non-biased sample condition may not be met even when the adequate sample size condition is met. For example, suppose that I count all the cars on my street for a three hour period from 11-2 pm during a weekday. Let's assume that counting for three hours straight give us an adequate sample size. However, suppose that during those hours (lunch hours) there is a much higher proportion of trucks to cars, since (let's suppose) many work trucks are coming to and from worksites during those lunch hours. If that were the case, then my sample, although large enough, would not be representative because it would be biased. In particular, the number of trucks to cars in the sample would be higher than in the overall population, which would make the sample unrepresentative of the population (and hence biased).

Another good way of illustrating sampling bias is by considering polls. So consider candidate X who is running for elected office and who strongly supports gun rights and is the candidate of choice of the NRA. Suppose an organization runs a poll to determine how candidate X is faring against candidate Y, who is actively anti gun rights. But suppose that the way the organization administers the poll is by polling subscribers to the magazine, Field and Stream. Suppose the poll returned over 5000 responses, which, let's suppose, is an adequate sample size and out of those responses, 89% favored candidate X. If the organization were to take that sample to support the statistical generalization that "most voters are in favor of candidate X" then they would have made a mistake. If you know anything about the magazine Field and Stream, it should be obvious why. Field and Stream is a magazine whose subscribers who would tend to own guns and support gun rights. Thus we would expect that subscribers to that magazine would have a much higher percentage of gun rights activists than would the general population, to which the poll is attempting to generalize. But in this case, the sample would be unrepresentative and biased and thus the poll would be useless. Although the sample would allow us to generalize to the population, "Field and Stream subscribers," it would not allow us to generalize to the population at large. Let's consider one more example of a sampling bias. Suppose candidate X were running in a district in which there was a high proportion of elderly voters. Suppose that candidate X favored policies that elderly voters were against. For example, suppose candidate X favors slashing Medicare funding to reduce the budget deficit, whereas candidate Y favored maintaining or increasing support to Medicare. Along comes an organization who is interested in polling voters to determine which candidate is favored in the district. Suppose that the organization chooses to administer the poll via text message and that the results of the poll show that 75% of the voters favor candidate X. Can you see what's wrong with the poll–why it is biased? You probably recognize that this polling method will not produce a representative sample because elderly voters are much less likely to use cell phones and text messaging and so the poll will leave out the responses of these elderly voters (who, we've assumed make up a large segment of the population).

Thus, the sample will be biased and unrepresentative of the target population. As a result, any attempt to generalize to the general population would be extremely ill-advised.

EXERCISES

What kinds of problems, if any, do the following statistical generalizations have? If there is a problem with the generalization, specify which of the two conditions (adequate sample size, non-biased sample) are not met. Some generalizations may have multiple problems. If so, specify all of the problems you see with the generalization.

1. Bob, from Silverton, CO drives a 4x4 pickup truck, so most people from Silverton, CO drive 4x4 pickup trucks.

2. Tom counts and categorizes birds that land in the tree in his backyard every morning from 5:00-5:20 am. He counts mostly morning doves and generalizes, “most birds that land in my tree in the morning are morning doves.”

3. Tom counts and categorizes birds that land in the tree in his backyard every morning from 5:00-6:00 am. He counts mostly morning doves and generalizes, “most birds that land in my tree during the 24-hour day are morning doves.”

4. Tom counts and categorizes birds that land in the tree in his backyard every day from 5:00-6:00 am, from 11:00-12:00 pm, and from 5:006:00 pm. He counts mostly morning doves and generalizes, “most birds that land in my tree during the 24-hour day are morning doves.”

5. Tom counts and categorizes birds that land in the tree in his backyard every evening from 10:00-11:00 pm. He counts mostly owls and generalizes, “most birds that land in my tree throughout the 24-hour day are owls.”

6. Tom counts and categorizes birds that land in the tree in his backyard every evening from 10:00-11:00 pm and from 2:00-3:00 am. He counts mostly owls and generalizes, “most birds that land in my tree throughout the night are owls.”

7. A poll administered to 10,000 registered voters who were homeowners showed that 90% supported a policy to slash Medicaid funding and decrease property taxes. Therefore, 90% of voters support a policy to slash Medicaid funding.

8. A telephone poll administered by a computer randomly generating numbers to call, found that 68% of Americans in the sample of 2000 were in favor of legalizing recreational marijuana use. Thus, almost 70% of Americans favor legalizing recreation marijuana use.

9. A randomized telephone poll in the United States asked respondents whether they supported a) a policy that allows killing innocent children in the womb or b) a policy that saves the lives of innocent children in the womb. The results showed that 69% of respondents choose option “b” over option “a.” The generalization was made that “most Americans favor a policy that disallows abortion.”

10. Steve’s first rock and roll concert was an Ani Difranco concert, in which most of the concert-goers were women with feminist political slogans written on their t-shirts. Steve makes the generalization that “most rock and roll concert-goers are women who are feminists.” He then applies this generalization to the next concert he attends (Tom Petty) and is greatly surprised by what he finds.

11. A high school principal conducts a survey of how satisfied students are with his high school by asking students in detention to fill out a satisfaction survey. Generalizing from that sample, he infers that 79% of students are dissatisfied with their high school experience. He is surprised and saddened by the result.

12. After having attended numerous Pistons home games over 20 years, Alice cannot remember a time when she didn't see ticket scalpers selling tickets outside the stadium. She generalizes that there are always scalpers at every Pistons home game.

13. After having attended numerous Pistons home games over 20 years, Alice cannot remember a time when she didn't see ticket scalpers selling tickets outside the stadium. She generalizes that there are ticket scalpers at every NBA game.

14. After having attended numerous Pistons home games over 20 years, Alice cannot remember a time when she didn't see ticket scalpers selling tickets outside the stadium. She generalizes that there are ticket scalpers at every sporting event.

15. Bob once ordered a hamburger from Burger King and got violently ill shortly after he ate it. From now on, he never eats at Burger King because he fears he will get food poisoning.

Chapter 6

Causal reasoning

When I strike a match it will produce a flame. It is natural to take the striking of the match as the cause that produces the effect of a flame. But what if the matchbook is wet? Or what if I happen to be in a vacuum in which there is no oxygen (such as in outer space)? If either of those things is the case, then the striking of the match will not produce a flame. So it isn't simply the striking of the match that produces the flame, but a combination of the striking of the match together with a number of other conditions that must be in place in order for the striking of the match to create a flame. Which of those conditions we call the "cause" depends in part on the context. Suppose that I'm in outer space striking a match (suppose I'm wearing a space suit that supplies me with oxygen but that I'm striking the match in space, where there is no oxygen). I continuously strike it but no flame appears (of course). But then someone (also in a space suit) brings out a can of compressed oxygen that they spray on the match while I strike it. All of a sudden a flame is produced. In this context, it looks like it is the spraying of oxygen that causes flame, not the striking of the match. Just as in the case of the striking of the match, any cause is more complex than just a simple event that produces some other event. Rather, there are always multiple conditions that must be in place for any cause to occur. These conditions are called *background conditions.* That said, we often take for granted the background conditions in normal contexts and just refer to one particular event as the cause. Thus, we call the striking of the match the cause of the flame. We don't go on to specify all the other conditions that conspired to create the flame (such as the presence of oxygen and the absence of water). But this is more for convenience than correctness. For just about any cause, there are a number of conditions that must be in place in order for the effect to occur. These are called necessary conditions (recall the discussion of necessary and sufficient conditions from chapter 2, section 2.7). For example, a necessary condition of the match lighting is that there is oxygen present. A necessary condition of a car running is that there is gas in the tank. We can use necessary conditions to diagnose what has gone wrong in cases of malfunction. That is, we can consider each condition in turn in order to determine what caused the malfunction. For example, if the match doesn't light, we can check to see whether the matches are wet. If we find that the matches are wet then we can explain the lack of the flame by saying something like, "dropping the matches in the water caused the matches not to light." In contrast, a sufficient condition is one which if present will always bring about the effect. For example, a person being fed through an operating wood chipper is sufficient for causing that person's death (as was the fate of Steve Buscemi's character in the movie Fargo).

Because the natural world functions in accordance with natural laws (such as the laws of physics), causes can be generalized. For example, any object near the surface of the earth will fall towards the earth at 9.8 m/s2 unless impeded by some contrary force (such as the propulsion of a rocket). This generalization applies to apples, rocks, people, wood chippers and every other object. Such causal generalizations are often parts of explanations. For example, we can explain why the airplane crashed to the ground by citing the causal generalization that all unsupported objects fall to the ground and by noting that the airplane had lost any method of propelling itself because the engines had died. So we invoke the causal generalization in explaining why the airplane crashed. Causal generalizations have a particular form:

> For any x, if x has the feature(s) F, then x has the feature G

For example:

> For any human, if that human has been fed through an operating wood chipper, then that human is dead.
>
> For any engine, if that engine has no fuel, then that engine will not operate.
>
> For any object near the surface of the earth, if that object is unsupported and not impeded by some contrary force, then that object will fall towards the earth at 9.8 m/s2.

Being able to determine when causal generalizations are true is an important part of becoming a critical thinker. Since in both scientific and every day contexts we rely on causal generalizations in explaining and understanding our world, the ability to assess when a causal generalization is true is an important skill. For example, suppose that we are trying to figure out what causes our dog, Charlie, to have seizures. To simplify, let's suppose that we have a set of potential candidates for what causes his seizures. It could be either:

1. eating human food,
2. the shampoo we use to wash him,
3. his flea treatment,
4. not eating at regular intervals,

or some combination of these things. Suppose we keep a log of when these things occur each day and when his seizures (S) occur. In the table below, I will represent the absence of the feature by a negation. So in the table below, "∼A" represents that Charlie did not eat human food on that day; "∼B" represents that he did not get a bath and shampoo that day; "∼S" represents that he did not have a seizure that day. In contrast, "B" represents that he did have a bath and shampoo, whereas "C" represents that he was given a flea treatment that day. Here is how the log looks:

Day 1	∼A	B	C	D	S
Day 2	A	∼B	C	D	∼S
Day 3	A	B	∼C	D	∼S
Day 4	A	B	C	∼D	S
Day 5	A	B	∼C	D	∼S
Day 6	A	∼B	C	D	∼S

How can we use this information to determine what might be causing Charlie to have seizures? The first thing we'd want to know is what feature is present every time he has a seizure. This would be a necessary (but not sufficient) condition. And that can tell us something important about the cause. The necessary condition test says that any candidate feature (here A, B, C, or D) that is absent when the target feature (S) is present is eliminated as a possible necessary condition of S.[1] In the table above, A is absent when S is present, so A can't be a necessary condition (i.e., day 1). D is also absent when S is present (day 4) so D can't be a necessary condition either. In contrast, B is never absent when S is present–that is every time S is present, B is also present. That means B is a necessary condition, based on the data that we have gathered so far. The same applies to C since it is never absent when S is present. Notice that there are times when both B and C are absent, but on those days the target feature (S) is absent as well, so it doesn't matter.

The next thing we'd want to know is which feature is such that every time it is present, Charlie has a seizure. The test that is relevant to determining this is called the sufficient condition test. The sufficient condition test says that any candidate that is present when the target feature (S) is absent is eliminated as a possible sufficient condition of S. In the table above, we can see that no one candidate feature is a sufficient condition for causing the seizures since for each candidate (A, B, C, D) there is a case (i.e. day) where it is present but that no seizure occurred. Although no one feature is sufficient for causing the seizures (according to the data we have gathered so far), it is still possible that certain features are jointly sufficient. Two candidate features are jointly sufficient for a target feature if and only if there is no case in which both candidates are present and yet the target is absent. Applying this test, we can see that B and C are jointly sufficient for the target feature since any time both are present, the target feature is always present. Thus, from the data we have gathered so far, we can say that the likely cause of Charlie's seizures are when we both give him a bath and then follow that bath up with a flea treatment. Every time those two things occur, he has a seizure (sufficient condition); and every time he has a seizure, those two things occur (necessary condition). Thus, the data gathered so far supports the following causal conditional:

> Any time Charlie is given a shampoo bath and a flea treatment, he has a seizure.

Although in the above case, the necessary and sufficient conditions were the same, this needn't always be the case. Sometimes sufficient conditions are not necessary conditions. For example, being fed through a wood chipper is a sufficient condition for death, but it certainly isn't necessary! (Lot's of people die without being fed through a wood chipper, so it can't be a necessary condition of dying.) In any case, determining necessary and sufficient conditions is a key part of determining a cause.

When analyzing data to find a cause it is important that we rigorously test each candidate. Here is an example to illustrate rigorous testing. Suppose that on every day we collected data about Charlie he ate human food but that on none of the days was he given a bath and shampoo, as the table below indicates.

Given this data, A trivially passes the necessary condition test since it is always present (thus, there can never be a case where A is absent when S is present). However, in order to rigorously test A as a necessary condition, we have to look for cases in which A is not present and then see if our target condition S is present. We have rigorously tested A as a necessary condition only if we have collected data in which A was not present. Otherwise, we don't really know whether A is a necessary condition. Similarly, B trivially passes the sufficient condition test since it is never present (thus, there can never be a case where B is present

---

[1] This discussion draws heavily on chapter 10, pp. 220-224 of Sinnott-Armstrong and Fogelin's Understanding Arguments, 9th edition (Cengage Learning).

Day 1	A	∼B	C	D	∼S
Day 2	A	∼B	C	D	∼S
Day 3	A	∼B	∼C	D	∼S
Day 4	A	∼B	C	∼D	S
Day 5	A	∼B	∼C	D	∼S
Day 6	A	∼B	C	D	S

but S is absent). However, in order to rigorously test B as a sufficient condition, we have to look for cases in which B is present and then see if our target condition S is absent. We have rigorously tested B as a sufficient condition only if we have collected data in which B is present. Otherwise, we don't really know whether B is a sufficient condition or not.

In rigorous testing, we are actively looking for (or trying to create) situations in which a candidate feature fails one of the tests. That is why when rigorously testing a candidate for the necessary condition test, we must seek out cases in which the candidate is not present, whereas when rigorously testing a candidate for the sufficient condition test, we must seek out cases in which the candidate is present. In the example above, A is not rigorously tested as a necessary condition and B is not rigorously tested as a sufficient condition. If we are interested in finding a cause, we should always rigorously test each candidate. This means that we should always have a mix of different situations where the candidates and targets are sometimes present and sometimes absent.

EXERCISES

Determine which of the candidates (A, B, C, D) in the following examples pass the necessary condition test or the sufficient condition test relative to the target (G). In addition, note whether there are any candidates that aren't rigorously tested as either necessary or sufficient conditions.

Case 1	A	B	∼C	D	∼G
Case 2	∼A	B	C	D	G
Case 3	A	∼B	C	D	G

Case 1	A	B	C	D	G
Case 2	∼A	B	∼C	D	∼G
Case 3	A	∼B	C	∼D	G

Case 1	A	B	C	D	G
Case 2	∼A	B	C	D	G
Case 3	A	∼B	C	D	G

Case 1	A	B	C	D	∼G
Case 2	∼A	B	C	D	G
Case 3	A	B	C	∼D	G

Case 1	A	B	∼C	D	∼G
Case 2	∼A	B	C	D	G
Case 3	A	∼B	∼C	∼D	∼G

▷ For each of the following correlations, use your background knowledge to determine whether A causes B, B causes A, a common cause C is the cause of both A and B, or the correlations is accidental.

1. There is a positive correlation between U.S. spending on science, space, and technology (A) and suicides by hanging, strangulation, and suffocation (B).
2. There is a positive correlation between our dog Charlie's weight (A) and the amount of time we spend away from home (B). That is, the more time we spend away from home, the heavier Charlie gets (and the more we are at home, the lighter Charlie is.
3. The height of the tree in our front yard (A) positively correlates with the height of the shrub in our backyard (B).
4. There is a negative correlation between the number of suicide bombings in the U.S. (A) and the number of hairs on a particular U.S President's head (B).
5. There is a high positive correlation between the number of fire engines in a particular borough of New York Cite (A) and the number of fires that occur there (B).
6. At one point in history, there was a negative correlation between the number of mules in the state (A) and the salaries paid to professors at the state university (B). That is, the more mules, the lower the professors' salaries.
7. There is a strong positive correlation between the number of traffic accidents on a particular highway (A) and the number of billboards featuring scantily-clad models (B).
8. The girth of an adult's waist (A) is negatively correlated with the height of their vertical leap (B).
9. Olympic marathon times (A) are positively correlated with the temperature during the marathon (B). That is, the more time it takes an Olympic marathoner to complete the race, the higher the temperature.
10. The number gray hairs on an individual's head (A) is positively correlated with the number of children or grandchildren they have (B).

Case 1	A	B	C	D	∼G
Case 2	∼A	B	C	∼D	∼G
Case 3	A	∼B	∼C	D	G

Causal Reasoning

Inductive arguments are used to support claims about cause and effect. These arguments come in a number of different forms. The most straightforward is what is called enumerative induction. This is an argument that makes a (non-hasty) generalization, inferring that one event or type of event causes another on the basis of a (large) number of particular observations of the cause immediately preceding the effect. To use a very famous example (from the history of philosophy, due to David Hume, the 18th century Scottish philosopher who had much to say about cause and effect and inductive reasoning), we can infer from observations of a number of billiard-ball collisions that the first ball colliding with the second causes the second ball to move. Or we can infer from a number of observations of drunkenness following the consumption of alcoholic beverages that imbibing alcohol causes one to become drunk.

This is all well and good, so far as it goes.[2] It just doesn't go very far. If we want to establish a robust knowledge of what causes the natural phenomena we're interested in, we need techniques that are more sophisticated than simple enumerative induction. There are such techniques. These are patterns of reasoning identified and catalogued by the 19th century English philosopher, scientist, logician, and politician John Stuart Mill. The inferential forms Mill enumerated have come to be called "Mill's Methods", because he thought of them as tools to be used in the investigation of nature–methods of discovering the causes of natural phenomena. In this section, we will look at Mill's Methods each in turn (there are five of them), using examples to illustrate each. We will finish with a discussion of the limitations of the methods and the difficulty of isolating causes.

The Meaning(s) of 'Cause'

Before we proceed, however, we must issue something of a disclaimer: when we say the one action or event causes another, we don't really know what the hell we're talking about. OK, maybe that's putting it a bit too strongly. The point is this: the meaning of 'cause' has been the subject of intense philosophical debate since ancient times (in both Greece and India)–debate that continues to this day. Myriad philosophical theories have been put forth over the millennia about the nature of causation, and there is no general agreement about just what it is (or whether causes are even real!).

We're not going to wade into those philosophical waters; they're too deep. Instead, we'll merely dip our toes in, by making a preliminary observation about the word 'cause'–an observation that gives some hint as to why it's been the subject of so much philosophical deliberation for so long. The observation is this: there are a number of distinct, but perfectly acceptable ways that we use the word 'cause' in everyday language. We attach different incompatible meanings to the term in different contexts.

Consider this scenario: I'm in my backyard vegetable garden with my younger daughter (age 4 at the time). She's "helping" me in my labors by watering some of the plants.[3] She asks, "Daddy, why do we have to water the plants?" I might reply, "We do that because water causes the plants to grow." This is a perfectly ordinary claim about cause and effect; it is uncontroversial and true. What do I mean by 'causes' in this sentence? I mean that water is a necessary condition for the plants to grow. Without water, there will be no growth. It is not a sufficient condition for plantgrowth, though: you also need sunlight, good soil,

---

[2] Setting aside Hume's philosophical skepticism about our ability to know that one thing causes another and about the conclusiveness of inductive reasoning.

[3] Those who have ever employed a 4-year-old to facilitate a labor-intensive project will understand the scare quotes.

etc.

Consider another completely ordinary, uncontroversial truth about causation: decapitation causes death. What do I mean by ‘causes’ in this sentence? I mean that decapitation is a sufficient condition for death. If death is the result you’re after, decapitation will do the trick on its own; nothing else is needed. It is not (thank goodness) a necessary condition for death, however. There are lots of other ways to die besides beheading.

Finally, consider this true claim: smoking causes cancer. What do I mean by ‘causes’ in this sentence? Well, I don’t mean that smoking is a sufficient condition for cancer. Lots of people smoke all their lives but are lucky enough not to get cancer. Moreover, I don’t mean that smoking is a necessary condition for cancer. Lots of people get cancer–even lung cancer–despite having never smoked. Rather, what I mean is that smoking tends to produce cancer, that it increases the probability that one will get cancer.

So, we have three totally ordinary uses of the word ‘cause’, with three completely different meanings: cause as necessary condition, sufficient condition, and mere tendency (neither necessary nor sufficient). These are incompatible, but all acceptable in their contexts. We could go on to list even more uses for the term, but the point has been made. Causation is a slippery concept, which is why philosophers have been struggling for so long to capture its precise meaning. In what follows, we will set aside these concerns and speak about cause and effect without hedging or disclaimers, but it’s useful to keep in mind that doing so papers over some deep and difficult philosophical problems.

Mill’s Methods

John Stuart Mill identified five different patterns of reasoning that one could use to discover causes. These are argument forms, the conclusions of which involve a claim to the effect that one thing causes (or is causally related to) another. They can be used alone or in combination, depending on the circumstances. As was the case with analogical reasoning, these are patterns of inference that we already employ unreflectively in everyday life. The benefit in making them explicit and subjecting them to critical scrutiny is that we thereby achieve a metacognitive perspective–a perspective from which we can become more self-aware, effective reasoners. This is especially important in the context of causal reasoning, since, as we shall see, there are many pitfalls in this domain that we a prone to fall into, many common errors that people make when thinking about cause and effect.

Method of Agreement I’ve been suffering from heartburn recently. Seems like at least two or three days a week, by about dinnertime, I’ve got that horrible feeling of indigestion in my chest and that yucky taste in my mouth. Acid reflux: ugh. I’ve got to do something about this. What could be causing my heartburn, I wonder? I know that the things you eat and drink are typical causes of the condition, so I start thinking back, looking at what I’ve consumed on the days when I felt bad. As I recall, all of the recent days on which I suffered heartburn were different in various ways: my dinners ranged from falafel to spaghetti to spicy burritos; sometimes I had a big lunch, sometimes very little; on some days I drank a lot of coffee at breakfast, but other days not any at all. But now that I think about it, one thing stands out: I’ve been in a nostalgic mood lately, thinking about the good old days, when I was a carefree college student. I’ve been listening to lots of music from that time, watching old movies, etc. And as part of that trip down memory lane, I’ve re-acquired a taste for one of my favorite beverages from that era–Mountain Dew. I’ve been treating myself to a nice bottle of the stuff with lunch now and again. And sure enough, each of the days that I got heartburn was a day when I drank Mountain Dew at lunch. Huh. I guess the Mountain Dew is causing my heartburn. I better stop drinking it.

This little story is an instance of Mill's Method of Agreement. It's a pattern of reasoning that one can use to figure out the cause of some phenomenon of interest. In this case, the phenomenon I want to discover the cause of is my recent episodes of heartburn. I eventually figure out that the cause is Mountain Dew. We could sum up the reasoning pattern abstractly thus:

> We want to find the cause of a phenomenon, call it X. We examine a variety of circumstances in which X occurs, looking for potential causes. The circumstances differ in various ways, but they each have in common that they feature the same potential cause, call it A. We conclude that A causes X.

Each of the past circumstances agrees with the others in the sense that they all feature the same potential cause–hence, the Method of Agreement. In the story above, the phenomenon X that I wanted to find the cause of was heartburn; the various circumstances were the days on which I had suffered that condition, and they varied with respect to potential causes (foods and beverages consumed); however, they all agreed in featuring Mountain Dew, which is the factor A causing the heartburn, X.

More simply, we can sum up the Method of Agreement as a simple question:

> What causal factor is present whenever the phenomenon of interest is present?

In the case of our little story, Mountain Dew was present whenever heartburn was present, so we concluded that it was the cause.

Method of Difference Everybody in my house has a rash! Itchy skin, little red bumps; it's annoying. It's not just the grownups–me and my wife–but the kids, too. Even the dog has been scratching herself constantly! What could possibly be causing our discomfort? My wife and I brainstorm, and she remembers that she recently changed brands of laundry detergent. Maybe that's it. So we re-wash all the laundry (including the pillow that the dog sleeps on in the windowsill) in the old detergent and wait. Sure enough, within a day or two, everybody's rash is gone. Sweet relief!

This story presents an instance of Mill's Method of Difference. Again, we use this pattern of reasoning to discover the cause of some phenomenon that interests us–in this case, the rash we all have. We end up discovering that the cause is the new laundry detergent. We isolated this cause by removing that factor and seeing what happened. We can sum up the pattern of reasoning abstractly thus:

> We want to find the cause of a phenomenon, call it X. We examine a variety of circumstances in which X occurs, looking for potential causes. The circumstances differ in various ways, but they each have in common that when we remove from them a potential cause–call it A–the phenomenon disappears. We conclude that A causes X.

If we introduce the same difference in all of the circumstances–removing the causal factor–we see the same effect–disappearance of the phenomenon. Hence, the Method of Difference. In our story, the phenomenon we wanted to explain, X, was the rash. The varying circumstances are the different inhabitants of my house–Mom, Dad, kids, even the dog–and the different factors affecting them. The factor that we removed from each, A, was the new laundry detergent. When we did that, the rash went away, so the detergent was the cause of the rash–A caused X.

More simply, we can sum up the Method of Difference as a simple question:

> What causal factor is absent whenever the phenomenon of interest is absent?

In the case of our little story, when the detergent was absent, so too was the rash. We concluded that the detergent caused the rash.

Joint Method of Agreement and Difference This isn't really a new method at all. It's just a combination of the first two. The Methods of Agreement and Difference are complementary; each can serve as a check on the other. Using them in combination is an extremely effective way to isolate causes.

The Joint Method is an important tool in medical research. It's the pattern of reasoning used in what we call controlled studies. In such a study, we split our subjects into two groups, one of which is the "control" group. An example shows how this works. Suppose I've formulated a pill that I think is a miracle cure for baldness. I'm gonna be rich! But first, I need to see if it really works. So I gather a bunch of bald men together for a controlled study. One group gets the actual drug; the other, control group, gets a sugar pill–not the real drug at all, but a mere placebo. Then I wait and see what happens. If my drug is a good as I think it is, two things will happen: first, the group that got the drug will grow new hair; and second, the group that got the placebo won't grow new hair. If either of these things fails to happen, it's back to the drawing board. Obviously, if the group that got the drug didn't get any new hair, my baldness cure is a dud. But in addition, if the group that got the mere placebo grew new hair, then something else besides my drug has to be the cause.

Both the Method of Agreement and the Method of Difference are being used in a controlled study. I'm using the Method of Agreement on the group that got the drug. I'm hoping that whenever the causal factor (my miracle pill) is present, so too will be the phenomenon of interest (hair growth). The control group complements this with the Method of Difference. For them, I'm hoping that whenever the causal factor (the miracle pill) is absent, so too will be the phenomenon of interest (hair growth). If both things happen, I've got strong confirmation that my drug causes hair growth. (Now all I have to do is figure out how to spend all my money!)

Method of Residues I'm running a business. Let's call it LogiCorp. For a modest fee, the highly trained logicians at LogiCorp will evaluate all of your deductive arguments, issuing Certificates of Validity (or Invalidity) that are legally binding in all fifty states. Satisfaction guaranteed. Anyway, as should be obvious from that brief description of the business model, LogiCorp is a highly profitable enterprise. But last year's results were disappointing. Profits were down 20% from the year before. Some of this was expected. We undertook a renovation of the LogiCorp World Headquarters that year, and the cost had an effect on our bottom line: half of the lost profits, 10%, can be chalked up to the renovation expenses. Also, as healthcare costs continue to rise, we had to spend additional money on our employees' benefits packages; these expenditures account for an additional 3profit shortfall. Finally, another portion of the drop in profits can be explained by the entry of a competitor into the marketplace. The upstart firm Arguments R Us, with its fast turnaround times and ultra-cheap prices, has been cutting into our market share. Their services are totally inferior to ours (you should see the shoddy shading technique in their Venn Diagrams!) and LogiCorp will crush them eventually, but for now they're hurting our business: competition from Arguments R Us accounts for a 5% drop in our profits.

As CEO, I was of course aware of all these potential problems throughout the year, so when I looked at the numbers at the end, I wasn't surprised. But, when I added up the contributions from the three factors I knew about–10% from the renovation, 3% from the healthcare expenditures, 5% from outside competition–I came up short. Those causes only account for an 18% shortfall in profit, but we were down 20% on the year; there was an extra 2% shortfall that I couldn't explain. I'm a suspicious guy, so I hired an outside security firm to monitor the activities of various highly placed employees at my firm. And I'm glad I did! Turns out my Chief Financial Officer had been taking lavish weekend vacations to Las Vegas and charging his expenses to the company credit card. His thievery surely accounts for the extra 2%. I immediately fired the jerk. (Maybe he can get a job with Arguments R Us.)

This little story presents an instance of Mill's Method of Residues. 'Residue' in this context just means the remainder, that which is left over. The pattern of reasoning, put abstractly, runs something like this:

> We observe a series of phenomena, call them X1, X2, X3, . . . , Xn. As a matter of background knowledge, we know that X1 is caused by A1, that X2 is caused by A2, and so on. But when we exhaust our background knowledge of the causes of phenomena, we're left with one, Xn, that is inexplicable in those terms. So we must seek out an additional causal factor, An, as the cause of Xn.

The leftover phenomenon, Xn, inexplicable in terms of our background knowledge, is the residue. In our story, that was the additional 2% profit shortfall that couldn't be explained in terms of the causal factors we were already aware of, namely the headquarters renovation (A1, which caused X1, a 10% shortfall), the healthcare expenses (A2, which caused X2, a 3% shortfall), and the competition from Arguments R Us (A3, which caused X3, a 5% shortfall). We had to search for another, previously unknown cause for the final, residual 2%.

Method of Concomitant Variation Fact: if you're a person who currently maintains a fairly steady weight, and you change nothing else about your lifestyle, adding 500 calories per day to your diet will cause you to gain weight. Conversely, if you cut 500 calories per day from your diet, you would lose weight. That is, calorie consumption and weight are causally related: consuming more will cause weight gain; consuming less will cause weight loss.

Another fact: if you're a person who currently maintains a steady weight, and you change nothing else about your lifestyle, adding an hour of vigorous exercise per day to your routine will cause you to lose weight. Conversely, (assuming you already exercise a heck of a lot), cutting that amount of exercise from your routine will cause you to gain weight. That is, exercise and weight are causally related: exercising more will cause weight loss; exercising less will cause weight gain.

(These are revolutionary insights, I know. My next get-rich-quick scheme is to popularize one of those fad diets. Instead of recommending eating nothing but bacon or drinking nothing but smoothies made of kale and yogurt, my fad diet will be the "Eat Less, Move More" plan. I'm gonna be rich!)

I know about the cause-and-effect relationships above because of the Method of Concomitant Variation. Put abstractly, this pattern of reasoning goes something like this:

> We observe that, holding other factors constant, an increase or decrease in some causal factor A is always accompanied by a corresponding increase or decrease in some phenomenon X. We conclude that A and X are causally related.

Things that "vary concomitantly" are things, to put it more simply, that change together. As A changes–goes up or down–X changes, too. There are two ways things can vary concomitantly: directly or inversely. If A and X vary directly, that means that an increase in one will be accompanied by an increase in the other (and a decrease in one will be accompanied by a decrease in the other); if A and X vary inversely, that means an increase in one will be accompanied by a decrease in the other.

In our first example, calorie consumption (A) and weight (X) vary directly. As calorie consumption increases, weight increases; and as calorie consumption decreases, weight decreases. In our second example, exercise (A) and weight (X) vary inversely. As exercise increases, weight decreases; and as exercise decreases, weight increases.

Either way, when things change together in this way, when they vary concomitantly, we conclude that they are causally related.

The Difficulty of Isolating Causes

Mill's Methods are useful in discovering the causes of phenomena in the world, but their usefulness should not be overstated. Unless they are employed thoughtfully, they can lead an investigator astray. A classic example of this is the parable of the drunken logician.[4] After a long day at work on a Monday, a certain logician heads home wanting to unwind. So he mixes himself a "7 and 7"–Seagram's 7 Crown whiskey and 7-Up. It tastes so good, he makes another–and another, and another. He drinks seven of these cocktails, passes out in his clothes, and wakes up feeling terrible (headache, nausea, etc.). On Tuesday, after dragging himself into work, toughing it through the day, then finally getting home, he decides to take the edge off with a different drink: brandy and 7-Up. He gets carried away again, and ends up drinking seven of these cocktails, with the same result: passing out in his clothes and waking up feeling awful on Wednesday. So, on Wednesday night, our logician decides to mix things up again: scotch and 7-Up. He drinks seven of these; same results. But he perseveres: Thursday night, it's seven vodka and 7-Ups; another blistering hangover on Friday. So on Friday at work, he sits down to figure out what's going on. He's got a phenomenon–hangover symptoms every morning of that week–that he wants to discover the cause of. He's a professional logician, intimately familiar with Mill's Methods, so he figures he ought to be able to discover the cause. He looks back at the week and uses the Method of Agreement, asking, "What factor was present every time the phenomenon was?" He concludes that the cause of his hangovers is 7-Up.

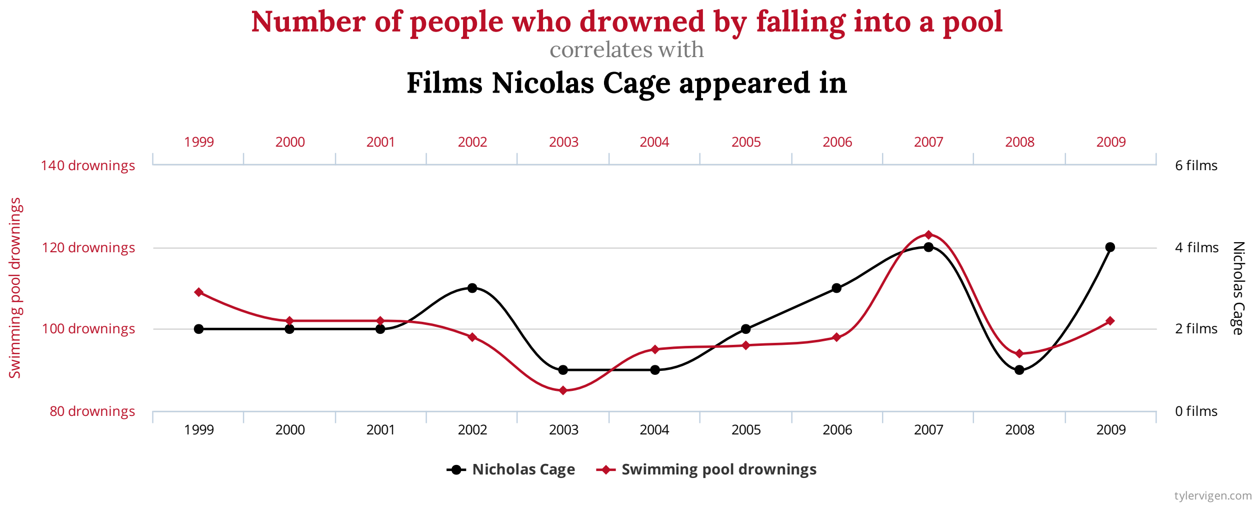
Our drunken logician applied the Method of Agreement correctly: 7-Up was indeed present every time. But it clearly wasn't the cause of his hangovers. The lesson is that Mill's Methods are useful tools for discovering causes, but their results are not always definitive. Uncritical application of the methods can lead one astray. This is especially true of the Method of Concomitant Variation. You may have heard the old saw that "correlation does not imply causation." It's useful to keep this corrective in mind when using the Method of Concomitant Variation. That two things vary concomitantly is a hint that they may be causally related, but it is not definitive proof that they are. They may be separate effects of a different, unknown cause; they may be completely causally unrelated. It is true, for example, that among children, shoe size

---

[4] Inspired by Copi and Cohen, p. 547.

and reading ability vary directly: children with bigger feet are better readers than those with smaller feet. Wow! So large feet cause better reading? Of course not. Larger feet and better reading ability are both effects of the same cause: getting older. Older kids wear bigger shoes than younger kids, and they also do better on reading tests. Duh. It is also true, for example, that hospital quality and death rate vary directly: that is, the higher quality the hospital (prestige of doctors, training of staff, sophistication of equipment, etc.), on average, the higher the death rate at that hospital. That's counterintuitive! Does that mean that high hospital quality causes high death rates? Of course not. Better hospitals have higher mortality rates because the extremely sick, most badly injured patients are taken to those hospitals, rather than the ones with lower-quality staff and equipment. Alas, these people die more often, but not because they're at a good hospital; it's exactly the reverse.

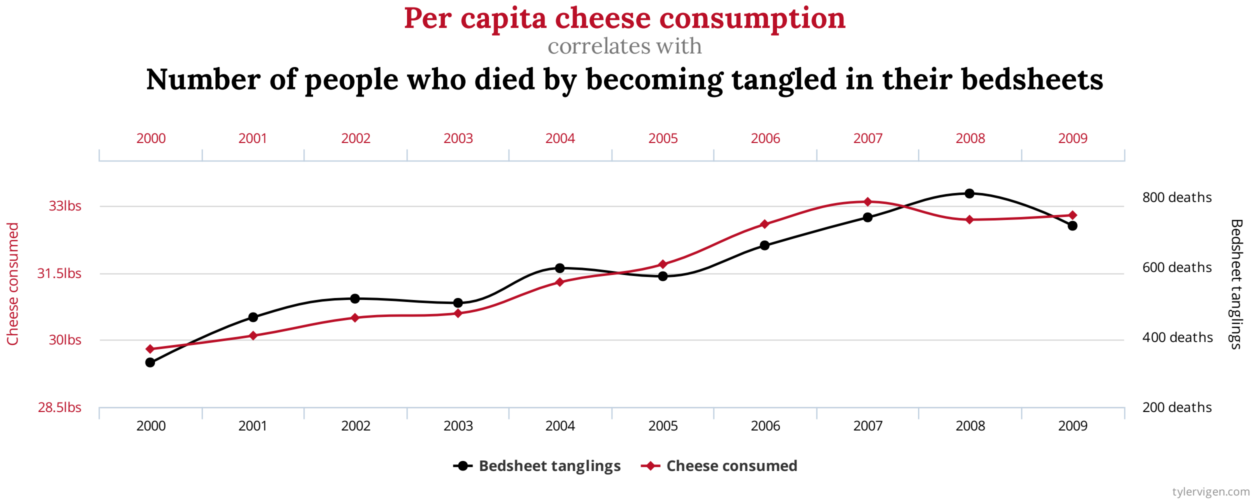
Spurious correlations–those that don't involve any causal connection at all–are easy to find in the age of "big data." With publicly available databases archiving large amounts of data, and computers with the processing power to search them and look for correlations, it is possible to find many examples of phenomena that vary concomitantly but are obviously not causally connected. A very clever person named Tyler Vigen set about doing this and created a website where he posted his (often very amusing) discoveries.[5] For example, he found that between 2000 and 2009, per capita cheese consumption among Americans was very closely correlated with the number of deaths caused by people becoming entangled in their bedsheets:



These two phenomena vary directly, but it's hard to imagine how they could be causally related. It's even more difficult to imagine how the following two phenomena could be causally related:

---

[5] `http://tylervigen.com/spurious-correlations`. The site has a tool that allows the user to search for correlations. It's a really amusing way to kill some time.



So, Mill's Methods can't just be applied willy-nilly; one could end up "discovering" causal connections where none exist. They can provide clues as to potential causal relationships, but care and critical analysis are required to confirm those results. It's important to keep in mind that the various methods can work in concert, providing a check on each other. If the drunken logician, for example, had applied the Method of Difference–removing the 7-Up but keeping everything else the same–he would have discovered his error (he would've kept getting hangovers). The combination of the Methods of Agreement and Difference–the Joint Method, the controlled study–is an invaluable tool in modern scientific research. A properly conducted controlled study can provide quite convincing evidence of causal connections (or a lack thereof).

Of course, properly conducting a controlled study is not as easy as it sounds. It involves more than just the application of the Joint Method of Agreement and Difference. There are other potentially confounding factors that must be accounted for in order for such a study to yield reliable results. For example, it's important to take great care in separating subjects into the test and control groups: there can be no systematic difference between the two groups other than the factor that we're testing; if there is, we cannot say whether the factor we're testing or the difference between the groups is the cause of any effects observed. Suppose we were conducting a study to determine whether or not vitamin C was effective in treating the common cold.[6] We gather 100 subjects experiencing the onset of cold symptoms. We want one group of 50 to get vitamin C supplements, and one group of 50–the control group–not to receive them. How do we decide who gets placed into which group? We could ask for volunteers. But doing so might create a systematic difference between the two groups. People who hear "vitamin C" and think, "yeah, that's the group for me" might be people who are more inclined to eat fruits and vegetables, for example, and might therefore be healthier on average than people who are turned off by the idea of receiving vitamin C supplements. This difference between the groups might lead to different results between the how their colds progress. Instead of asking for volunteers, we might just assign the first 50 people who show up to the vitamin C group, and the last 50 to the control group. But this could lead to differences, as well. The people who show up earlier might be early-risers, who might be healthier on average than those who straggle in late.

The best way to avoid systematic differences between test and control groups is to randomly assign subjects to each. We refer to studies conducted this way as randomized controlled studies. And besides

---

[6] Despite widespread belief that it is, researchers have found very little evidence to support this claim.

randomization, other measures can be taken to improve reliability. The best kinds of controlled studies are “double-blind”. This means that neither the subjects nor the people conducting the study know which group is the control and which group is receiving the actual treatment. (This information is hidden from the researchers only while the study is ongoing; they are told later, of course, so they can interpret the results.) This measure is necessary because of the psychological tendency for people’s observations to be biased based on their expectations. For example, if the control group in our vitamin C experiment knew they were not getting any treatment for their colds, they might be more inclined to report that they weren’t feeling any better. Conversely, if the members of the group receiving the vitamin supplements knew that they were getting treated, they might be more inclined to report that their symptoms weren’t as bad. This is why the usual practice is to keep subjects in the dark about which group they’re in, giving a placebo to the members of the control group. It’s important to keep the people conducting the study “blind” for the same reasons. If they knew which group was which, they might be more inclined to observe improvement in the test group and a lack of improvement in the control group. In addition, in their interactions with the subjects, they may unknowingly give away information about which group was which via subconscious signals.

Hence, the gold standard for medical research (and other fields) is the double-blind controlled study. It’s not always possible to create those conditions–sometimes the best doctors can do is to use the Method of Agreement and merely note commonalities amongst a group of patients suffering from the same condition, for example–but the most reliable results come from such tests. Discovering causes is hard in many contexts. Mill’s Methods are a useful starting point, and they accurately model the underlying inference patterns involved in such research, but in practice they must be supplemented with additional measures and analytical rigor in order to yield definitive results. They can give us clues about causes, but they aren’t definitive evidence. Remember, these are inductive, not deductive arguments.

EXERCISES

1. What is meant by the word ‘cause’ in the following–necessary condition, sufficient condition, or mere tendency?
   (a) (a) Throwing a brick through a window causes it to break.
   (b) (b) Slavery caused the American Civil War.
   (c) (c) Exposure to the cold causes frostbite.
   (d) (d) Running causes knee injuries.
   (e) (e) Closing your eyes causes you not to be able to see.
2. Consider the following scenario and answer the questions about it:
   - ▷ Alfonse, Bertram, Claire, Dominic, Ernesto, and Francine all go out to dinner at a local greasy spoon. There are six items on the menu: shrimp cocktail, mushroom/barley soup, burger, fries, steamed carrots, and ice cream. This is what they ate:
   - ▷ Alfonse: shrimp, soup, fries
   - ▷ Bertram: burger, fries, carrots, ice cream

- ▷ Claire: soup, burger, fries, carrots
- ▷ Dominic: shrimp, soup, fries, ice cream
- ▷ Ernesto: burger, fries, carrots
- ▷ Francine: ice cream
- ▷ That night, Alfonse, Claire, and Dominic all came down with a wicked case of foodpoisoning. The others felt fine.

(a) (a) Using only the Method of Agreement, how far can we narrow down the list of possible causes for the food poisoning?

(b) (b) Using only the Method of Difference, how far can we narrow down the list of possible causes for the food poisoning?

(c) (c) Using the Joint Method, we can identify the cause. What is it?

3. For each of the following, identify which of Mill's Methods is being used to draw the causal conclusion.

(a) (a) A farmer noticed a marked increase in crop yields for the season. He started using a new and improved fertilizer that year, and the weather was particularly ideal–just enough rain and sunshine. Nevertheless, the increase was greater than could be explained by these factors. So he looked into it and discovered that his fields had been colonized by hedgehogs, who prey on the kinds of insect pests that usually eat crops.

(b) (b) I've been looking for ways to improve the flavor of my vegan chili. I read on a website that adding soy sauce can help: it has lots of umami flavor, and that can help compensate for the lack of meat. So the other day, I made two batches of my chili, one using my usual recipe, and the other made exactly the same way, except for the addition of soy sauce. I invited a bunch of friends over for a blind taste test, and sure enough, the chili with the soy sauce was the overwhelming favorite!

(c) (c) The mere presence of guns in circulation can lead to higher murder rates. The data are clear on this. In countries with higher numbers of guns per capita, the murder rate is higher; and in countries with lower numbers of guns per capita, the murder rate is correspondingly lower.

(d) (d) There's a simple way to end mass shootings: outlaw semiautomatic weapons. In 1996, Australia suffered the worst mass shooting episode in its history, when a man in Tasmania used two semiautomatic rifles to kill 35 people (and wound an additional 19). The Australian government responded by making such weapons illegal. There hasn't been a mass shooting in Australia since.

(e) (e) A pediatric oncologist was faced with a number of cases of childhood leukemia over a short period of time. Puzzled, he conducted thorough examinations of all the children, and also compared their living situations. He was surprised to discover that all of the children lived in houses that were located very close to high-voltage power lines. He concluded that exposure to electromagnetic fields causes cancer.

(f) (f) Many people are touting the benefits of the so-called "Mediterranean" diet because it apparently lowers the risk of heart disease. Residents of countries like Italy and Greece, for example, consume large amounts of vegetables and olive oil and suffer from heart problems at a much lower rate than Americans.

(g) (g) My daughter came down with what appeared to be a run-of-the-mill case of the flu: fever, chills, congestion, sore throat. But it was a little weird. She was also experiencing really intense headaches and an extreme sensitivity to light. Those symptoms struck me as atypical of mere influenza, so I took her to the doctor. It's a good thing I did! It turns out she had a case of bacterial meningitis, which is so serious that it can cause brain damage if not treated early. Luckily, we caught it in time and she's doing fine.

Chapter 7

Analogical arguments

Another kind of common inductive argument is an argument from analogy. In an argument from analogy, we note that since some thing x shares similar properties to some thing y, then since y has characteristic A, x probably has characteristic A as well. For example, suppose that I have always owned Subaru cars in the past and that they have always been reliable and I argue that the new car I've just purchased will also be reliable because it is a Subaru. The two things in the analogy are 1) the Subarus I have owned in the past and 2) the current Subaru I have just purchased. The similarity between these two things is just that they are both Subarus. Finally, the conclusion of the argument is that this Subaru will share the characteristic of being reliable with the past Subarus I have owned. Is this argument a strong or weak inductive argument? Partly it depends on how many Subarus I've owned in the past. If I've only owned one, then the inference seems fairly weak (perhaps I was just lucky in that one Subaru I've owned). If I've owned ten Subarus then the inference seems much stronger. Thus, the reference class that I'm drawing on (in this case, the number of Subarus I've previously owned) must be large enough to generalize from (otherwise we would be committing the fallacy of "hasty generalization"). However, even if our reference class was large enough, what would make the inference even stronger is knowing not simply that the new car is a Subaru, but also specific things about its origin. For example, if I know that this particular model has the same engine and same transmission as the previous model I owned and that nothing significant has changed in how Subarus are made in the intervening time, then my argument is strengthened. In contrast, if this new Subaru was made after Subaru was bought by some other car company, and if the engine and transmission were actually made by this new car company, then my argument is weakened. It should be obvious why: the fact that the car is still called "Subaru" is not relevant establishing that it will have the same characteristics as the other cars that I've owned that were called "Subarus." Clearly, what the car is called has no inherent relevance to whether the car is reliable. Rather, what is relevant to whether the car is reliable is the quality of the parts and assembly of the car. Since it is possible that car companies can retain their name and yet drastically alter the quality of the parts and assembly of the car, it is clear that the name of the car isn't itself what establishes the quality of the car. Thus, the original argument, which invoked merely that the new car was a Subaru is not as strong as the argument that the car was constructed with the same quality parts and quality assembly as the other cars I'd owned (and that had been reliable for me). What this illustrates is that better arguments from analogy will invoke more relevant similarities between the things being compared in the analogy. This is a key condition for any good argument from analogy: the similar characteristics between the two things cited in the premises must be relevant to the characteristic cited in the conclusion.

Here is an ethical argument that is an argument from analogy.[1] Suppose that Bob uses his life savings to buy an expensive sports car. One day Bob parks his car and takes a walk along a set of train tracks. As he walks, he sees in the distance a small child whose leg has become caught in the train tracks. Much to his alarm, he sees a train coming towards the child. Unfortunately, the train will reach the child before he can (since it is moving very fast) and he knows it will be unable to stop in time and will kill the child. At just that moment, he sees a switch near him that he can throw to change the direction of the tracks and divert the train onto another set of tracks so that it won't hit the child. Unfortunately, Bob sees that he has unwittingly parked his car on that other set of tracks and that if he throws the switch, his expensive car will be destroyed. Realizing this, Bob decides not to throw the switch and the train strikes and kills the child, leaving his car unharmed. What should we say of Bob? Clearly, that was a horrible thing for Bob to do and we would rightly judge him harshly for doing it. In fact, given the situation described, Bob would likely be criminally liable. Now consider the following situation in which you, my reader, likely find yourself (whether you know it or not—well, now you do know it). Each week you spend money on things that you do not need. For example, I sometimes buy $5 espressos from Biggby's or Starbuck's. I do not need to have them and I could get a much cheaper caffeine fix, if I chose to (for example, I could make a strong cup of coffee at my office and put sweetened hazelnut creamer in it). In any case, I really don't need the caffeine at all! And yet I regularly purchase these $5 drinks. (If $5 drinks aren't the thing you spend money on, but in no way need, then fill in the example with whatever it is that fits your own life.) With the money that you could save from forgoing these luxuries, you could, quite literally, save a child's life. Suppose (to use myself as an example) I were to buy two $5 coffees a week (a conservative estimate). That is $10 a week, roughly $43 a month and $520 a year. Were I to donate that amount (just $40/month) to an organization such as the Against Malaria Foundation, I could save a child's life in just six years.[2] Given these facts, and comparing these two scenarios (Bob's and your own), the argument from analogy proceeds like this:

Bob chose to have a luxury item for himself rather than to save the life of a child.
"We" regularly choose having luxury items rather than saving the life of a child.
What Bob did was morally wrong.
Therefore, what we are doing is morally wrong as well.

The two things being compared here are Bob's situation and our own. The argument then proceeds by claiming that since we judge what Bob did to be morally wrong, and since our situation is analogous to Bob's in relevant respects (i.e., choosing to have luxury items for ourselves rather than saving the lives of dying children), then our actions of purchasing luxury items for ourselves must be morally wrong for the same reason.

One way of arguing against the conclusion of this argument is by trying to argue that there are relevant disanalogies between Bob's situation and our own. For example, one might claim that in Bob's situation, there was something much more immediate he could do to save the child's life right then and there. In contrast, our own situation is not one in which a child that is physically proximate to us is in imminent

---

[1] This argument comes (with interpretive liberties on my part) from Peter Singer's, "The Singer Solution to World Poverty" published in the NY Times Magazine, September 5, 1999.

[2] http://www.givewell.org/giving101/Your-dollar-goes-further-overseas

danger of death, where there is something we can immediately do about it. One might argue that this disanalogy is enough to show that the two situations are not analogous and that, therefore, the conclusion does not follow. Whether or not this response to the argument is adequate, we can see that the way of objecting to an argument from analogy is by trying to show that there are relevant differences between the two things being compared in the analogy. For example, to return to my car example, even if the new car was a Subaru and was made under the same conditions as all of my other Subarus, if I purchased the current Subaru used, whereas all the other Subarus had been purchased new, then that could be a relevant difference that would weaken the conclusion that this Subaru will be reliable.

So we've seen that an argument from analogy is strong only if the following two conditions are met:

1. The characteristics of the two things being compared must be similar in relevant respects to the characteristic cited in the conclusion.
2. There must not be any relevant disanalogies between the two things being compared.

Arguments from analogy that meet these two conditions will tend to be stronger inductive arguments.

EXERCISES

Evaluate the following arguments from analogy as either strong or weak. If the argument is weak, cite what you think would be a relevant disanalogy.

1. Every painting by Rembrandt contains dark colors and illuminated faces, therefore the original painting that hangs in my high school is probably by Rembrandt, since it contains dark colors and illuminated faces.
2. I was once bitten by a poodle. Therefore, this poodle will probably bite me too.
3. Every poodle I've ever met has bitten me (and I've met over 300 poodles). Therefore this poodle will probably bite me too.
4. My friend took Dr. Van Cleave's logic class last semester and got an A. Since Dr. Van Cleave's class is essentially the same this semester and since my friend is no better a student than I am, I will probably get an A as well.
5. Bill Cosby used his power and position to seduce and rape women. Therefore, Bill Cosby probably also used his power to rob banks.
6. Every car I've ever owned had seats, wheels and brakes and was also safe to drive. This used car that I am contemplating buying has seats, wheels and brakes. Therefore, this used car is probably safe to drive.
7. Every Volvo I've ever owned was a safe car to drive. My new car is a Volvo. Therefore, my new car is probably safe to drive.
8. Dr. Van Cleave did not give Jones an excused absence when Jones missed class for his grandmother's funeral. Mary will have to miss class to attend her aunt's funeral. Therefore, Dr. Van Cleave should not give Mary an excused absence either.

9. Dr. Van Cleave did not give Jones an excused absence when Jones missed class for his brother's birthday party. Mary will have to miss class to attend her aunt's funeral. Therefore, Dr. Van Cleave should not give Mary an excused absence either.
10. If health insurance companies pay for heart surgery and brain surgery, which can both increase an individual's happiness, then they should also pay for cosmetic surgery, which can also increase an individual's happiness.
11. A knife is an eating utensil that can cut things. A spoon is also an eating utensil. So a spoon can probably cut things as well.
12. Any artificial, complex object like a watch or a telescope has been designed by some intelligent human designer. But naturally occurring objects like eyes and brains are also very complex objects. Therefore, complex naturally occurring objects must have been designed by some intelligent non-human designer.
13. The world record holding runner, Kenenisa Bekele ran 100 miles per week and twice a week did workouts comprised of ten mile repeats on the track in the weeks leading up to his 10,000 meter world record. I have run 100 miles per week and have been doing ten mile repeats twice a week. Therefore, the next race I will run will probably be a world record.
14. I feel pain when someone hits me in the face with a hockey puck. We are both human beings, so you also probably feel pain when you are hit in the face with a hockey puck.
15. The color I experience when I see something as "green" has a particular quality (that is difficult to describe). You and I are both human beings, so the color you experience when you see something green probably has the exact same quality. (That is, what you and I experience when we see something green is the exact same experiential color.)

Inductive Logics

Back in Chapter 1, we made a distinction between deductive and inductive arguments. While deductive arguments attempt to provide premises that guarantee their conclusions, inductive arguments are less ambitious. They merely aim to provide premises that make the conclusion more probable. Because of this difference, it is inappropriate to evaluate deductive and inductive arguments by the same standards. We do not use the terms 'valid' and 'invalid' when evaluating inductive arguments: technically, they're all invalid because their premises don't guarantee their conclusions; but that's not a fair evaluation, since inductive arguments don't even pretend to try to provide such a guarantee. Rather, we say of inductive arguments that they are strong or weak– the more probable the conclusion in light of the premises, the stronger the inductive argument; the less probable the conclusion, the weaker. These judgments can change in light of new information. Additional evidence may have the effect of making the conclusion more or less probable–of strengthening or weakening the argument.

The topic of this chapter and the next will be inductive logic: we will be learning about the various types of inductive arguments and how to evaluate them. Inductive arguments are a rather motley bunch. They come in a wide variety of forms that can vary according to subject matter; they resist the uniform treatment we were able to provide for their deductive cousins. We will have to examine a wide variety of approaches–different inductive logics. While all inductive arguments have in common that they attempt to give their conclusions more probable, it is not always possible for us to make precise judgments about exactly how probable their conclusions are in light of their premises. When that is the case, we will make relative judgments: this argument is stronger or weaker than that argument, though I can't say how much stronger or weaker, precisely. Sometimes, however, it will be possible to render precise judgments about the probability of conclusions, so it will be necessary for us to acquire basic skills in calculating probabilities. With those in hand, we will be in a position to model an ideally rational approach to revising our judgments about the strength of inductive arguments in light of new evidence. In addition, since so many inductive arguments use statistics, it will be necessary for us to acquire a basic understanding of some fundamental statistical concepts. With these in hand, we will be in a position to recognize the most common types of statistical fallacies–mistakes and intentionally misleading arguments that use statistics to lead us astray.

Probability and statistics will be the subject of a future chapter. In this chapter, we will look at two very common types of inductive reasoning: arguments from analogy and inferences involving causation. The former are quite common in everyday life; the latter are the primary methods of scientific and medical research. Each type of reasoning exhibits certain patterns, and we will look at the general forms analogical and causal arguments; we want to develop the skill of recognizing how particular instances of reasoning fit these general patterns. We will also learn how these types of arguments are evaluated. For arguments from analogy, we will identify the criteria that we use to make relative judgments about strength and weakness. For causal reasoning, we will compare the various forms of inference to identify those most likely to produce reliable results, and we will examine some of the pitfalls peculiar to each that can lead to errors.

Arguments from Analogy

Analogical reasoning is ubiquitous in everyday life. We rely on analogies–similarities between present circumstances and those we've already experienced–to guide our actions. We use comparisons to familiar people, places, and things to guide our evaluations of novel ones. We criticize people's arguments based on their resemblance to obviously absurd lines of reasoning.

In this section, we will look at the various uses of analogical reasoning. Along the way, we will identify a general pattern that all arguments from analogy follow and learn how to show that particular arguments fit the pattern. We will then turn to the evaluation of analogical arguments: we will identify six criteria that govern our judgments about the relative strength of these arguments. Finally, we will look at the use of analogies to refute other arguments.

The Form of Analogical Arguments

Perhaps the most common use of analogical reasoning is to predict how the future will unfold based on similarities to past experiences. Consider this simple example. When I first learned that the movie The Wolf of Wall Street was coming out, I predicted that I would like it. My reasoning went something like this:

> The Wolf of Wall Street is directed by Martin Scorsese, and it stars Leonardo DiCaprio. Those two have collaborated several times in the past, on Gangs of New York, The Aviator, The Departed, and Shutter Island. I liked each of those movies, so I predict that I will like The Wolf of Wall Street.

Notice, first, that this is an inductive argument. The conclusion, that I will like The Wolf of Wall Street is not guaranteed by the premises; as a matter of fact, my prediction was wrong and I really didn't care for the film. But our real focus here is on the fact that the prediction was made on the basis of an analogy. Actually, several analogies, between The Wolf of Wall Street, on the one hand, and all the other Scorsese/DiCaprio collaborations on the other. The new film is similar in important respects to the older ones; I liked all of those; so, I'll probably like the new one.

We can use this pattern of reasoning for more overtly persuasive purposes. Consider the following:

> Eating pork is immoral. Pigs are just as smart, cute, and playful as dogs and dolphins. Nobody would consider eating those animals. So why are pigs any different?

That passage is trying to convince people not to eat pork, and it does so on the basis of analogy: pigs are just like other animals we would never eat–dogs and dolphins.

Analogical arguments all share the same basic structure. We can lay out this form schematically as follows:

$$\begin{array}{l} \text{a1, a2, \ldots an, and c all have P1, P2, \ldots Pk} \\ \underline{\text{a1, a2, \ldots an all have Q}} \\ \text{c has Q} \end{array}$$

This is an abstract schema, and it's going to take some getting used to, but it represents the form of analogical reasoning succinctly and clearly. Arguments from analogy have two premises and a conclusion. The first premise establishes an analogy. The analogy is between some thing, marked 'c' in the schema, and some number of other things, marked 'a1', 'a2', and so on in the schema. We can refer to these as the "analogues". They're the things that are similar, analogous to c. This schema is meant to cover every possible argument from analogy, so we do not specify a particular number of analogues; the last one on the list is marked ‘an’, where ‘n’ is a variable standing for any number whatsoever. There may be only one analogue; there may be a hundred. What’s important is that the analogues are similar to the thing designated by ‘c’. What makes different things similar? They have stuff in common; they share properties. Those properties–the similarities between the analogues and c–are marked ‘P1’, ‘P2’, and so on in the diagram. Again, we don’t specify a particular number of properties shared: the last is marked ‘Pk’, where ‘k’ is just another variable (we don’t use ‘n’ again, because the number of analogues and the number of properties can of course be different). This is because our schema is generic: every argument from analogy fits into the framework; there may be any number of properties involved in any particular argument. Anyway, the first premise establishes the analogy: c and the analogues are similar because they have various things in common–P1, P2, P3, . . . Pk.

Notice that ‘c’ is missing from the second premise. The second premise only concerns the analogues: it says that they have some property in common, designated ‘Q’ to highlight the fact that it’s not among the properties listed in the first premise. It’s a separate property. It’s the very property we’re trying to establish, in the conclusion, that c has (‘c’ is for conclusion). The thinking is something like this: c and the analogues are similar in so many ways (first premise); the analogues have this additional thing in common (Q in the second premise); so, c is probably like that, too (conclusion: c has Q).

It will be helpful to apply these abstract considerations to concrete examples. We have two in hand. The first argument, predicting that I would like The Wolf of Wall Street, fits the pattern. Here’s the argument again, for reference:

> The Wolf of Wall Street is directed by Martin Scorsese, and it stars Leonardo DiCaprio. Those two have collaborated several times in the past, on Gangs of New York, The Aviator, The Departed, and Shutter Island. I liked each of those movies, so I predict that I will like The Wolf of Wall Street.

The conclusion is something like ‘I will like The Wolf of Wall Street’. Putting it that way, and looking at the general form of the conclusion of analogical arguments (c has Q), it’s tempting to say that ‘c’ designates me, while the property Q is something like ‘liking The Wolf of Wall Street’. But that’s not right. The thing that ‘c’ designates has to be involved in the analogy in the first premise; it has to be the thing that’s similar to the analogues. The analogy that this argument hinges on is between the various movies. It’s not I that ‘c’ corresponds to; it’s the movie we’re making the prediction about. The Wolf of Wall Street is what ‘c’ picks out. What property are we predicting it will have? Something like ‘liked by me’. The analogues, the a’s in the schema, are the other movies: Gangs of New York, The Aviator, The Departed, and Shutter Island. (In this example, n is 4; the movies are a1, a2, a3, and a4.) These we know have the property Q (liked by me): I had already seen and liked these movies. That’s the second premise: that the analogues have Q. Finally, the first premise, which establishes the analogy among all the movies. What do they have in common? They were all directed by Martin Scorsese, and they all starred Leonardo DiCaprio. Those are the P’s–the properties they all share. P1 is ‘directed by Scorsese’; P2 is ‘stars DiCaprio’.

The second argument we considered, about eating pork, also fits the pattern. Here it is again, for reference:

> Eating pork is immoral. Pigs are just as smart, cute, and playful as dogs and dolphins. Nobody would consider eating those animals. So why are pigs any different?

Again, looking at the conclusion–'Eating pork is immoral'–and looking at the general form of conclusions for analogical arguments–'c has Q'–it's tempting to just read off from the syntax of the sentence that 'c' stands for 'eating pork' and Q for 'is immoral'. But that's not right. Focus on the analogy: what things are being compared to one another? It's the animals: pigs, dogs, and dolphins; those are our a's and c. To determine which one is picked out by 'c', we ask which animal is involved in the conclusion. It's pigs; they are picked out by 'c'. So we have to paraphrase our conclusion so that it fits the form 'c has Q', where 'c' stands for pigs. Something like 'Pigs shouldn't be eaten' would work. So Q is the property 'shouldn't be eaten'. The analogues are dogs and dolphins. They clearly have the property: as the argument notes, (most) everybody agrees they shouldn't be eaten. This is the second premise. And the first establishes the analogy. What do pigs have in common with dogs and dolphins? They're smart, cute, and playful. P1 = 'is smart'; P2 = 'is cute'; and P3 = 'is playful'.

The Evaluation of Analogical Arguments

Unlike in the case of deduction, we will not have to learn special techniques to use when evaluating these sorts of arguments. It's something we already know how to do, something we typically do automatically and unreflectively. The purpose of this section, then, is not to learn a new skill, but rather subject a practice we already know how to engage in to critical scrutiny. We evaluate analogical arguments all the time without thinking about how we do it. We want to achieve a metacognitive perspective on the practice of evaluating arguments from analogy; we want to think about a type of thinking that we typically engage in without much conscious deliberation. We want to identify the criteria that we rely on to evaluate analogical reasoning–criteria that we apply without necessarily realizing that we're applying them. Achieving such metacognitive awareness is useful insofar as it makes us more self-aware, critical, and therefore effective reasoners.

Analogical arguments are inductive arguments. They give us reasons that are supposed to make their conclusions more probable. How probable, exactly? That's very hard to say. How probable was it that I would like The Wolf of Wall Street given that I had liked the other four Scorsese/DiCaprio collaborations? I don't know. How probable is it that it's wrong to eat pork given that it's wrong to eat dogs and dolphins? I really don't know. It's hard to imagine how you would even begin to answer that question.

As we mentioned, while it's often impossible to evaluate inductive arguments by giving a precise probability of its conclusion, it is possible to make relative judgments about strength and weakness. Recall, new information can change the probability of the conclusion of an inductive argument. We can make relative judgments of like this: if we add this new information as a premise, the new argument is stronger/weaker than the old argument; that is, the new information makes the conclusion more/less likely.

It is these types of relative judgments that we make when we evaluate analogical reasoning. We compare different arguments–with the difference being new information in the form of an added premise, or a different conclusion supported by the same premises–and judge one to be stronger or weaker than the other. Subjecting this practice to critical scrutiny, we can identify six criteria that we use to make such judgments.

We're going to be making relative judgments, so we need a baseline argument against which to compare others. Here is such an argument:

> Alice has taken four Philosophy courses during her time in college. She got an A in all four. She has signed up to take another Philosophy course this semester. I predict she will get an A in that course, too.

This is a simple argument from analogy, in which the future is predicted based on past experience. It fits the schema for analogical arguments: the new course she has signed up for is designated by 'c'; the property we're predicting it has (Q) is that it is a course Alice will get an A in; the analogues are the four previous courses she's taken; what they have in common with the new course (P 1) is that they are also Philosophy classes; and they all have the property Q–Sally got an A in each.

Anyway, how strong is the baseline argument? How probable is its conclusion in light of its premises? I have no idea. It doesn't matter. We're now going to consider tweaks to the argument, and the effect that those will have on the probability of the conclusion. That is, we're going to consider slightly different arguments, with new information added to the original premises or changes to the prediction based on them, and ask whether these altered new arguments are stronger or weaker than the baseline argument. This will reveal the six criteria that we use to make such judgments. We'll consider one criterion at a time.

Number of Analogues Suppose we alter the original argument by changing the number of prior Philosophy courses Alice had taken. Instead of Alice having taken four philosophy courses before, we'll now suppose she has taken 14. We'll keep everything else about the argument the same: she got an A in all of them, and we're predicting she'll get an A in the new one. Are we more or less confident in the conclusion–the prediction of an A–with the altered premise? Is this new argument stronger or weaker than the baseline argument?

It's stronger! We've got Alice getting an A 14 times in a row instead of only four. That clearly makes the conclusion more probable. (How much more? Again, it doesn't matter.)

What we did in this case is add more analogues. This reveals a general rule: other things being equal, the more analogues in an analogical argument, the stronger the argument (and conversely, the fewer analogues, the weaker). The number of analogues is one of the criteria we use to evaluate arguments from analogy.

Variety of Analogues You'll notice that the original argument doesn't give us much information about the four courses Alice succeeded in previously and the new course she's about to take. All we know is that they're all Philosophy courses. Suppose we tweak things. We're still in the dark about the new course Alice is about to take, but we know a bit more about the other four: one was a course in Ancient Greek Philosophy; one was a course on Contemporary Ethical Theories; one was a course in Formal Logic; and the last one was a course in the Philosophy of Mind. Given this new information, are we more or less confident that she will succeed in the new course, whose topic is unknown to us? Is the argument stronger or weaker than the baseline argument?

It is stronger. We don't know what kind of Philosophy course Alice is about to take, but this new information gives us an indication that it doesn't really matter. She was able to succeed in a wide variety of courses, from Mind to Logic, from Ancient Greek to Contemporary Ethics. This is evidence that Alice is good at Philosophy generally, so that no matter what kind of course she's about to take, she'll probably do well in it.

Again, this points to a general principle about how we evaluate analogical arguments: other things being equal, the more variety there is among the analogues, the stronger the argument (and conversely, the less variety, the weaker).

Number of Similarities In the baseline argument, the only thing the four previous courses and the new course have in common is that they're Philosophy classes. Suppose we change that. Our newly tweaked argument predicts that Alice will get an A in the new course, which, like the four she succeeded in before, is cross-listed in the Department of Religious Studies and covers topics in the Philosophy of Religion. Given this new information–that the new course and the four older courses were similar in ways we weren't aware of–are we more or less confident in the prediction that Alice will get another A? Is the argument stronger or weaker than the baseline argument?

Again, it is stronger. Unlike the last example, this tweak gives us new information both about the four previous courses and the new one. The upshot of that information is that they're more similar than we knew; that is, they have more properties in common. To P1 = 'is a Philosophy course' we can add P2 = 'is cross-listed with Religious Studies' and P3 = 'covers topics in Philosophy of Religion'. The more properties things have in common, the stronger the analogy between them. The stronger the analogy, the stronger the argument based on that analogy. We now know not just that Alice did well in not just in Philosophy classes–but specifically in classes covering the Philosophy of Religion; and we know that the new class she's taking is also a Philosophy of Religion class. I'm much more confident predicting she'll do well again than I was when all I knew was that all the classes were Philosophy; the new one could've been in a different topic that she wouldn't have liked.

General principle: other things being equal, the more properties involved in the analogy–the more similarities between the item in the conclusion and the analogues–the stronger the argument (and conversely, the fewer properties, the weaker).

Number of Differences An argument from analogy is built on the foundation of the similarities between the analogues and the item in the conclusion–the analogy. Anything that weakens that foundation weakens the argument. So, to the extent that there are differences among those items, the argument is weaker.

Suppose we add new information to our baseline argument: the four Philosophy courses Alice did well in before were all courses in the Philosophy of Mind; the new course is about the history of Ancient Greek Philosophy. Given this new information, are we more or less confident that she will succeed in the new course? Is the argument stronger or weaker than the baseline argument? Clearly, the argument is weaker. The new course is on a completely different topic than the other ones. She did well in four straight Philosophy of Mind courses, but Ancient Greek Philosophy is quite different. I'm less confident that she'll get an A than I was before.

If I add more differences, the argument gets even weaker. Supposing the four Philosophy of Mind courses were all taught by the same professor (the person in the department whose expertise is in that area), but the Ancient Greek Philosophy course is taught by someone different (the department's specialist in that topic). Different subject matter, different teachers: I'm even less optimistic about Alice's continued success.

Generally speaking, other things being equal, the more differences there are between the analogues and the item in the conclusion, the weaker the argument from analogy.

Relevance of Similarities and Differences Not all similarities and differences are capable of strengthening or weakening an argument from analogy, however. Suppose we tweak the original argument by adding the new information that the new course and the four previous courses all have their weekly meetings in the same campus building. This is an additional property that the courses have in common, which, as we just saw, other things being equal, should strengthen the argument. But other things are not equal in this case. That's because it's very hard to imagine how the location of the classroom would have anything to do with the prediction we're making–that Alice will get an A in the course. Classroom location is simply not relevant to success in a course.[3] Therefore, this new information does not strengthen the argument. Nor does it weaken it; I'm not inclined to doubt Alice will do well in light of the information about location. It simply has no effect at all on my appraisal of her chances.

Similarly, if we tweak the original argument to add a difference between the new class and the other four, to the effect that while all of the four older classes were in the same building, while the new one is in a different building, there is no effect on our confidence in the conclusion. Again, the building in which a class meets is simply not relevant to how well someone does.

Contrast these cases with the new information that the new course and the previous four are all taught by the same professor. Now that strengthens the argument! Alice has gotten an A four times in a row from this professor–all the more reason to expect she'll receive another one. This tidbit strengthens the argument because the new similarity–the same person teaches all the courses–is relevant to the prediction we're making–that Alice will do well. Who teaches a class can make a difference to how students do–either because they're easy graders, or because they're great teachers, or because the student and the teacher are in tune with one another, etc. Even a difference between the analogues and the item in the conclusion, with the right kind of relevance, can strengthen an argument. Suppose the other four philosophy classes were taught be the same teacher, but the new one is taught by a TA–who just happens to be her boyfriend. That's a difference, but one that makes the conclusion–that Alice will do well–more probable.

Generally speaking, careful attention must be paid to the relevance of any similarities and differences to the property in the conclusion; the effect on strength varies.

Modesty/Ambition of the Conclusion Suppose we leave everything about the premises in the original baseline argument the same: four Philosophy classes, an A in each, new Philosophy class. Instead of adding to that part of the argument, we'll tweak the conclusion. Instead of predicting that Alice will get an A in the class, we'll predict that she'll pass the course. Are we more or less confident that this prediction will come true? Is the new, tweaked argument stronger or weaker than the baseline argument?

It's stronger. We are more confident in the prediction that Alice will pass than we are in the prediction that she will get another A, for the simple reason that it's much easier to pass than it is to get an A. That is, the prediction of passing is a much more modest prediction than the prediction of an A.

Suppose we tweak the conclusion in the opposite direction–not more modest, but more ambitious. Alice has gotten an A in four straight Philosophy classes, she's about to take another one, and I predict that she will do so well that her professor will suggest that she publish her term paper in one of the most prestigious philosophical journals and that she will be offered a three-year research fellowship at the Institute for Advanced Study at Princeton University. That's a bold prediction! Meaning, of course, that it's very unlikely to happen. Getting an A is one thing; getting an invitation to be a visiting scholar at one of the most prestigious academic institutions in the world is quite another. The argument with this ambitious conclusion is weaker than the baseline argument.

---

[3] I'm sure someone could come up with some elaborate backstory for Alice according to which the location of the class somehow makes it more likely that she will do well, but set that aside. No such story is on the table here.

General principle: the more modest the argument's conclusion, the stronger the argument; the more ambitious, the weaker.

Refutation by Analogy

We can use arguments from analogy for a specific logical task: refuting someone else's argument, showing that it's bad. Recall the case of deductive arguments. To refute those–to show that they are bad, i.e., invalid–we had to produce a counterexample–a new argument with the same logical form as the original that was obviously invalid, in that its premises were in fact true and its conclusion in fact false. We can use a similar procedure to refute inductive arguments. Of course, the standard of evaluation is different for induction: we don't judge them according to the black and white standard of validity. And as a result, our judgments have less to do with form than with content. Nevertheless, refutation along similar lines is possible, and analogies are the key to the technique.

To refute an inductive argument, we produce a new argument that's obviously bad–just as we did in the case of deduction. We don't have a precise notion of logical form for inductive arguments, so we can't demand that the refuting argument have the same form as the original; rather, we want the new argument to have an analogous form to the original. The stronger the analogy between the refuting and refuted arguments, the more decisive the refutation. We cannot produce the kind of knock-down refutations that were possible in the case of deductive arguments, where the standard of evaluation–validity–does not admit of degrees of goodness or badness, but the technique can be quite effective.

Consider the following:

> "Duck Dynasty" star and Duck Commander CEO Willie Robertson said he supports Trump because both of them have been successful businessmen and stars of reality TV shows.
>
> By that logic, does that mean Hugh Hefner's success with "Playboy" and his occasional appearances on "Bad Girls Club" warrant him as a worthy president? Actually, I'd still be more likely to vote for Hefner than Trump.[4]

The author is refuting the argument of Willie Robertson, the "Duck Dynasty" star. Robertson's argument is something like this: Trump is a successful businessman and reality TV star; therefore, he would be a good president. To refute this, the author produces an analogous argument–Hugh Hefner is a successful businessman and reality TV star; therefore, Hugh Hefner would make a good president–that he regards as obviously bad. What makes it obviously bad is that it has a conclusion that nobody would agree with: Hugh Hefner would make a good president. That's how these refutations work. They attempt to demonstrate that the original argument is lousy by showing that you can use the same or very similar reasoning to arrive at an absurd conclusion.

Here's another example, from a group called "Iowans for Public Education". Next to a picture of an apparently well-to-do lady is the following text:

---

[4] Austin Faulds, "Weird celebrity endorsements fit for weird election," Indiana Daily Student, 10/12/16, http://www.idsnews.com/article/2016/10/weird-celebrity-endorsements-for-weird-election.

> “My husband and I have decided the local parks just aren’t good enough for our kids. We’d rather use the country club, and we are hoping state tax dollars will pay for it. We are advocating for Park Savings Accounts, or PSAs. We promise to no longer use the local parks. To hell with anyone else or the community as a whole. We want our tax dollars to be used to make the best choice for our family.”
>
> Sound ridiculous? Tell your legislator to vote NO on Education Savings Accounts (ESAs), aka school vouchers.

The argument that Iowans for Public Education put in the mouth of the lady on the poster is meant to refute reasoning used by advocates for “school choice”, who say that they ought to have the right to opt out of public education and keep the tax dollars they would otherwise pay for public schools and use it to pay to send their kids to private schools. A similar line of reasoning sounds pretty crazy when you replace public schools with public parks and private schools with country clubs.

Since these sorts of refutations rely on analogies, they are only as strong as the analogy between the refuting and refuted arguments. There is room for dispute on that question. Advocates for school vouchers might point out that schools and parks are completely different things, that schools are much more important to the future prospects of children, and that given the importance of education, families should have to right choose what they think is best. Or something like that. The point is, the kinds of knock-down refutations that were possible for deductive arguments are not possible for inductive arguments. There is always room for further debate.

EXERCISES

1. Show how the following arguments fit the abstract schema for arguments from analogy:

   $$\frac{\begin{array}{l}\text{a1, a2, \ldots an, and c all have P1, P2, \ldots Pk}\\ \text{a1, a2, \ldots an all have Q}\end{array}}{\text{c has Q}}$$

   (a) You should really eat at Papa Giorgio’s; you’ll love it. It’s just like Mama DiSilvio’s and Matteo’s, which I know you love: they serve old-fashioned Italian-American food, they have a laid-back atmosphere, and the wine list is extensive.

   (b) George R.R. Martin deserves to rank among the greats in the fantasy literature genre. Like C.S. Lewis and J.R.R. Tolkien before him, he has created a richly detailed world, populated it with compelling characters, and told a tale that is not only exciting, but which features universal and timeless themes concerning human nature.

   (c) Yes, African Americans are incarcerated at higher rates than whites. But blaming this on systemic racial bias in the criminal justice system is absurd. That’s like saying the NBA is racist because there are more black players than white players, or claiming that the medical establishment is racist because African Americans die young more often.

2. Consider the following base-line argument:

   > I've taken vacations to Florida six times before, and I've enjoyed each visit. I'm planning to go to Florida again this year, and I fully expect yet another enjoyable vacation.

   Decide whether each of the following changes produces an argument that's weaker or stronger than the baseline argument, and indicate which of the six criteria for evaluating analogical arguments justifies that judgment.

   (a) All of my trips were visits to Disney World, and this one will be no different.

   (b) In fact, I've vacationed in Florida 60 times and enjoyed every visit.

   (c) I expect that I will enjoy this trip so much I will decide to move to Florida.

   (d) On my previous visits to Florida, I've gone to the beaches, the theme parks, the Everglades National Park, and various cities, from Jacksonville to Key West.

   (e) I've always flown to Florida on Delta Airlines in the past; this time I'm going on a United flight.

   (f) All of my past visits were during the winter months; this time I'm going in the summer.

   (g) I predict that I will find this trip more enjoyable than a visit to the dentist.

   (h) I've only been to Florida once before.

   (i) On my previous visits, I drove to Florida in my Dodge minivan, and I'm planning on driving the van down again this time.

   (j) All my visits have been to Daytona Beach for the Daytona 500; same thing this time.

   (k) I've stayed in beachside bungalows, big fancy hotels, time-share condominiums–even a shack out in the swamp.

3. For each of the following passages, explicate the argument being refuted and the argument or arguments doing the refuting.

   (a) Republicans tell us that, because at some point 40 years from now a shortfall in revenue for Social Security is projected, we should cut benefits now. Cut them now because we might have to cut them in the future? I've got a medium-sized tree in my yard. 40 years from now, it may grow so large that its branches hang over my roof. Should I chop it down?

   (b) Opponents of gay marriage tell us that it flies in the face of a tradition going back millennia, that marriage is between a man and a woman. There were lots of traditions that lasted a long time: the tradition that it was OK for some people to own other people as slaves, the tradition that women couldn't participate in the electoral process–the list goes on. That it's traditional doesn't make it right.

   (c) Some people claim that their children should be exempted from getting vaccinated for common diseases because the practice conflicts with their religious beliefs. But religion can't be used to justify just anything. If a Satanist tried to defend himself against charges of abusing children by claiming that such practices were a form of religious expression, would we let him get away with it?

Chapter 8

Logical Fallacies: Formal and Informal

Generally and crudely speaking, a logical fallacy is just a bad argument. Bad, that is, in the logical sense of being incorrect–not bad in sense of being ineffective or unpersuasive. Alas, many fallacies are quite effective in persuading people; that is why they're so common. Often, they're not used mistakenly, but intentionally–to fool people, to get them to believe things that maybe they shouldn't. The goal of this chapter is to develop the ability to recognize these bad arguments for what they are so as not to be persuaded by them.

There are formal and informal logical fallacies. The formal fallacies are simple: they're just invalid deductive arguments. Consider the following:

> If the Democrats retake Congress, then taxes will go up.
> But the Democrats won't retake Congress. Taxes won't go up.

This argument is invalid. It's got an invalid form: If A then B; not A; therefore, not B. Any argument of this form is fallacious, an instance of "Denying the Antecedent."[1] We can leave it as an exercise for the reader to fill in propositions for A and B to get true premises and a false conclusion. Intuitively, it's possible for that to happen: maybe a Republican Congress raises taxes for some reason (unlikely, but not unprecedented).

Our concern in this chapter is not with formal fallacies–arguments that are bad because they have a bad form–but with informal fallacies. These arguments are bad, roughly, because of their content. More than that: their content, context, and/or mode of delivery.

Consider Hitler. Here's a guy who convinced a lot of people to believe things they had no business believing (because they were false). How did he do it? With lots of fallacious arguments. But it wasn't just the contents of the arguments (appeals to fear and patriotism, personal attacks on opponents, etc.) that made them fallacious; it was also the context in which he made them, and the (extremely effective) way he delivered them. Leni Riefenstahl's famous 1935 documentary/propaganda film Triumph of the Will, which follows Hitler during a Nazi party rally in Nuremberg, illustrates this. It has lots of footage of Hitler giving speeches. We hear the jingoistic slogans and vitriolic attacks–but we also see important elements of his persuasive technique. First, the setting. We see Hitler marching through row upon row of neatly formed and impeccably outfitted German troops–thousands of them–approaching a massive raised dais, behind which are stories-high banners with the swastika on a red field. The setting, the context for Hitler's speeches, was

---

[1] If/then propositions like the first premise are called "conditional" propositions. The A part is the so-called "antecedent" of the conditional. The second premise denies it.

literally awesome–designed to inspire awe. It makes his audience all the more receptive to his message, all the more persuadable. Moreover, Hitler's speechifying technique was masterful. He is said to have practiced assiduously in front of a mirror, and it shows. His array of hand gestures, facial contortions, and vocal modulations were all expertly designed to have maximum impact on the audience.

This consideration of Hitler highlights a couple of important things about the informal fallacies. First, they're more than just bad arguments–they're rhetorical tricks, extra-logical techniques used intentionally to try to convince people of things they maybe ought not to believe. Second, they work! Hitler convinced an entire nation to believe all sorts of crazy things. And advertisers and politicians continue to use these same techniques all the time. It's incumbent upon a responsible citizen and consumer to be aware of this, and to do everything possible to avoid being bamboozled. That means learning about the fallacies. Hence, this chapter.

There are lots of different informal logical fallacies, lots of different ways of defining and characterizing them, lots of different ways of organizing them into groups. Since Aristotle first did it in his Sophistical Refutations, authors of logic books have been defining and classifying the informal fallacies in various ways. These remarks are offered as a kind of disclaimer: the reader is warned that the particular presentation of the fallacies in this chapter will be unique and will disagree in various ways with other presentations, reflecting as it must the author's own idiosyncratic interests, understanding, and estimation of what is important. This is as it should be and always is. The interested reader is encouraged to consult alternative sources for further edification.

We will discuss many different informal fallacies, and we will group them into four families: (1) Fallacies of Distraction, (2) Fallacies of Weak Induction, (3) Fallacies of Illicit Presumption, and (4) Fallacies of Linguistic Emphasis. We take these up in turn.

Fallacies of Distraction

We will discuss five informal fallacies under this heading. What they all have in common is that they involve arguing in such a way that issue that's supposed to be under discussion is somehow sidestepped, avoided, or ignored. These fallacies are often called "Fallacies of Relevance" because they involve arguments that are bad insofar as the reasons given are irrelevant to the issue at hand. People who use these techniques with malicious intent are attempting to distract their audience from the central questions they're supposed to be addressing, allowing them to appear to win an argument that they haven't really engaged in.

Appeal to Emotion (Argumentum ad Populum) The Latin name[2] of this fallacy literally means "argument to the people," where 'the people' is used in the pejorative sense of "the unwashed masses," or "the fickle mob"–the hoi polloi. It's notoriously effective to play on people's emotions to get them to go along with you, and that's the technique identified here. But, the thought is, we shouldn't decide whether or not to believe things based on an emotional response; emotions are a distraction, blocking hard-headed, rational analysis.

Go back to Hitler for a minute. He was an expert at the appeal to emotion. He played on Germans' fears and prejudices, their economic anxieties, their sense of patriotism and nationalistic pride. He stoked

---

[2] Many of the fallacies have Latin names, because, as we noted, identifying the fallacies has been an occupation of logicians since ancient times, and because ancient and medieval work comes down to us in Latin, which was the language of scholarship in the West for centuries.

these emotions with explicit denunciations of Jews and non-Germans, promises of the return of glory for the Fatherland–but also using the sorts of techniques we canvassed above, with awesome settings and hyper-sensational speechifying.

There are as many different versions of the appeal to emotion as there are human emotions. Fear is perhaps the most commonly exploited emotion for politicians. Political ads inevitably try to suggest to voters that one's opponent will take away medical care or leave us vulnerable to terrorists, or some other scary outcome–usually without a whole lot in the way of substantive proof that these fears are at all reasonable. This is a fallacious appeal to emotion.

Advertisers do it, too. Think of all the ads with sexy models schilling for cars or beers or whatever. What does sexiness have to do with how good a beer tastes? Nothing. The ads are trying to engage your emotions to get you thinking positively about their product.

An extremely common technique, especially for advertisers, is to appeal to people's underlying desire to fit in, to be hip to what everybody else is doing, not to miss out. This is the bandwagon appeal. The advertisement assures us that a certain television show is number 1 in the ratings–with the tacit conclusion being that we should be watching, too. But this is a fallacy. We've all known it's a fallacy since we were little kids, the first time we did something wrong because all of our friends were doing it, too, and our moms asked us, "If all of your friends jumped off a bridge, would you do that too?"

One more example: suppose you're one of those sleazy personal injury lawyers–an "ambulance chaser". You've got a client who was grocery shopping at Wal-Mart, and in the produce aisle she slipped on a grape that had fallen on the floor and injured herself. Your eyes turn into dollar signs and a cha-ching noise goes off in your brain: Wal-Mart has deep pockets. So on the day of the trial, what do you do? How do you coach your client? Tell her to wear her nicest outfit, to look her best? Of course not! You wheel her into the courtroom in a wheelchair (whether she needs it or not); you put one of those foam neck braces on her, maybe give her an eye patch for good measure. You tell her to periodically emit moans of pain. When you're summing up your case before the jury, you spend most of your time talking about the horrible suffering your client has undergone since the incident in the produce aisle: the hospital stays, the grueling physical therapy, the addiction to pain medications, etc., etc.

All of this is a classic fallacious appeal to emotion–specifically, in this case, pity. The people you're trying to convince are the jurors. The conclusion you have to convince them of, presumably, is that Wal-Mart was negligent and hence legally liable in the matter of the grape on the floor. The details don't matter, but there are specific conditions that have to be met–proved beyond a reasonable doubt–in order for the jury to find Wal-Mart guilty. But you're not addressing those (probably because you can't). Instead, you're trying to distract the jury from the real issue by playing to their emotions. You're trying to get them feeling sorry for your client, in the hopes that those emotions will cause them to bring in the verdict you want. That's why the appeal to emotion is a Fallacy of Distraction: the goal is to divert your attention from the dispassionate evaluation of premises and the degree to which they support their conclusion, to get you thinking with your heart instead of your brain.

Appeal to Force (Argumentum ad Baculum[3])

Perhaps the least subtle of the fallacies is the appeal to force, in which you attempt to convince your interlocutor to believe something by threatening him. Threats pretty clearly distract one from the business

---

[3] In Latin, 'baculus' refers to a stick or a club, which you could clobber someone with, presumably.

of dispassionately appraising premises' support for conclusions, so it's natural to classify this technique as a Fallacy of Distraction.

There are many examples of this technique throughout history. In totalitarian regimes, there are often severe consequences for those who don't toe the party line (see George Orwell's 1984 for a vivid, though fictional, depiction of the phenomenon). The Catholic Church used this technique during the infamous Spanish Inquisition: the goal was to get non-believers to accept Christianity; the method was to torture them until they did.

An example from much more recent history: when it became clear in 2016 that Donald Trump would be the Republican nominee for president, despite the fact that many rank-and-file Republicans thought he would be a disaster, the Chairman of the Republican National Committee (allegedly) sent a message to staffers informing them that they could either support Trump or leave their jobs. Not a threat of physical force, but a threat of being fired; same technique.

Again, the appeal to force is not usually subtle. But there is a very common, very effective debating technique that belongs under this heading, one that is a bit less overt than explicitly threatening someone who fails to share your opinions. It involves the sub-conscious, rather than conscious, perception of a threat.

Here's what you do: during the course of a debate, make yourself physically imposing; sit up in your chair, move closer to your opponent, use hand gestures, like pointing right in their face; cut them off in the middle of a sentence, shout them down, be angry and combative. If you do these things, you're likely to make your opponent very uncomfortable–physically and emotionally. They might start sweating a bit; their heart may beat a little faster. They'll get flustered and maybe trip over their words. They may lose their train of thought; winning points they may have made in the debate will come out wrong or not at all. You'll look like the more effective debater, and the audience's perception will be that you made the better argument.

But you didn't. You came off better because your opponent was uncomfortable. The discomfort was not caused by an actual threat of violence; on a conscious level, they never believed you were going to attack them physically. But you behaved in a way that triggered, at the sub-conscious level, the types of physical/emotional reactions that occur in the presence of an actual physical threat. This is the more subtle version of the appeal to force. It's very effective and quite common (watch cable news talk shows and you'll see it; Bill O'Reilly is the master).

Straw Man This fallacy involves the misrepresentation of an opponent's viewpoint–an exaggeration or distortion of it that renders it indefensible, something nobody in their right mind would agree with. You make your opponent out to be a complete wacko (even though he isn't), then declare that you don't agree with his (made-up) position. Thus, you merely appear to defeat your opponent: your real opponent doesn't hold the crazy view you imputed to him; instead, you've defeated a distorted version of him, one of your own making, one that is easily dispatched. Instead of taking on the real man, you construct one out of straw, thrash it, and pretend to have achieved victory. It works if your audience doesn't realize what you've done, if they believe that your opponent really holds the crazy view.

Politicians are most frequently victims (and practitioners) of this tactic. After his 2005 State of the Union Address, President George W. Bush's proposals were characterized thus:

> George W. Bush's State of the Union Address, masked in talk of "freedom" and "democracy,"

> was an outline of a brutal agenda of endless war, global empire, and the destruction of what remains of basic social services.[4]

Well who's not against "endless war" and "destruction of basic social services"? That Bush guy must be a complete nut! But of course this characterization is a gross exaggeration of what was actually said in the speech, in which Bush declared that we must "confront regimes that continue to harbor terrorists and pursue weapons of mass murder" and rolled out his proposal for privatization of Social Security accounts. Whatever you think of those actual policies, you need to do more to undermine them than to mic-characterize them as "endless war" and "destruction of social services." That's distracting your audience from the real substance of the issues.

In 2009, during the (interminable) debate over President Obama's healthcare reform bill–the Patient Protection and Affordable Care Act–former vice presidential candidate Sarah Palin took to Facebook to denounce the bill thus:

> The America I know and love is not one in which my parents or my baby with Down Syndrome will have to stand in front of Obama's "death panel" so his bureaucrats can decide, based on a subjective judgment of their "level of productivity in society," whether they are worthy of health care. Such a system is downright evil.

Yikes! That sounds like the evilest bill in the history of evil! Bureaucrats euthanizing Down Syndrome babies and their grandparents? Holy Cow. 'Death panel' and 'level of productivity in society' are even in quotes. Did she pull those phrases from the text of the bill? Of course she didn't. This is a completely insane distortion of what's actually in the bill (the kernel of truth behind the "death panels" thing seems to be a provision in the Act calling for Medicare to fund doctor-patient conversations about end-of-life care); the non-partisan fact-checking outfit

Politifact named it their "Lie of the Year" in 2009. Palin is not taking on the bill or the president themselves; she's confronting a made-up version, defeating it (which is easy, because the madeup bill is evil as heck; I can't get the disturbing idea of a Kafkaesque Death Panel out of my head), and pretending to have won the debate. But this distraction only works if her audience believes her straw man is the real thing. Alas, many did. But of course this is why these techniques are used so frequently: they work.

Red Herring This fallacy gets its name from the actual fish. When herring are smoked, they turn red and are quite pungent. Stinky things can be used to distract hunting dogs, who of course follow the trail of their quarry by scent; if you pass over that trail with a stinky fish and run off in a different direction, the hound may be distracted and follow the wrong trail. Whether or not this practice was ever used to train hunting dogs, as some suppose, the connection to logic and argumentation is clear. One commits the red herring fallacy when one attempts to distract one's audience from the main thread of an argument, taking things off in a different direction. The diversion is often subtle, with the detour starting on a topic closely related to the original–but gradually wandering off into unrelated territory. The tactic is often (but not always) intentional: one commits the red herring fallacy because one is not comfortable arguing about a particular topic on the merits, often because one's case is weak; so instead, the arguer changes the subject to an issue

---

[4] International Action Center, Feb. 4 2005, http://iacenter.org/folder06/stateoftheunion.htm

about which he feels more confident, makes strong points on the new topic, and pretends to have won the original argument.[5]

A fictional example can illustrate the technique. Consider Frank, who, after a hard day at work, heads to the tavern to unwind. He has far too much to drink, and, unwisely, decides to drive home. Well, he's swerving all over the road, and he gets pulled over by the police. Let's suppose that Frank has been pulled over in a posh suburb where there's not a lot of crime. When the police officer tells him he's going to be arrested for drunk driving, Frank becomes belligerent:

> "Where do you get off? You're barely even real cops out here in the 'burbs. All you do is sit around all day and pull people over for speeding and stuff. Why don't you go investigate some real crimes? There's probably some unsolved murders in the inner city they could use some help with. Why do you have to bother a hard-working citizen like me who just wants to go home and go to bed?"

Frank is committing the red herring fallacy (and not very subtly). The issue at hand is whether or not he deserves to be arrested for driving drunk. He clearly does. Frank is not comfortable arguing against that position on the merits. So he changes the subject–to one about which he feels like he can score some debating points. He talks about the police out here in the suburbs, who, not having much serious crime to deal with, spend most of their time issuing traffic violations. Yes, maybe that's not as taxing a job as policing in the city. Sure, there are lots of serious crimes in other jurisdictions that go unsolved. But that's beside the point! It's a distraction from the real issue of whether Frank should get a DUI.

Politicians use the red herring fallacy all the time. Consider a debate about Social Security–a retirement stipend paid to all workers by the federal government. Suppose a politician makes the following argument:

> We need to cut Social Security benefits, raise the retirement age, or both. As the baby boom generation reaches retirement age, the amount of money set aside for their benefits will not be enough cover them while ensuring the same standard of living for future generations when they retire. The status quo will put enormous strains on the federal budget going forward, and we are already dealing with large, economically dangerous budget deficits now. We must reform Social Security.

Now imagine an opponent of the proposed reforms offering the following reply:

> Social Security is a sacred trust, instituted during the Great Depression by FDR to insure that no hard-working American would have to spend their retirement years in poverty. I stand by that principle. Every citizen deserves a dignified retirement. Social Security is a more important part of that than ever these days, since the downturn in the stock market has left many retirees with very little investment income to supplement government support.

The second speaker makes some good points, but notice that they do not speak to the assertion made by the first: Social Security is economically unsustainable in its current form. It's possible to address that point

---

[5] People often offer red herring arguments unintentionally, without the subtle deceptive motivation to change the subject–usually because they're just parroting a red herring argument they heard from someone else. Sometimes a person's response will be off-topic, apparently because they weren't listening to their interlocutor or they're confused for some reason. I prefer to label such responses as instances of Missing the Point (Ignoratio Elenchi), a fallacy that some books discuss at length, but which I've just relegated to a footnote.

head on, either by making the case that in fact the economic problems are exaggerated or non-existent, or by making the case that a tax increase could fix the problems. The respondent does neither of those things, though; he changes the subject, and talks about the importance of dignity in retirement. I'm sure he's more comfortable talking about that subject than the economic questions raised by the first speaker, but it's a distraction from that issue–a red herring.

Perhaps the most blatant kind of red herring is evasive: used especially by politicians, this is the refusal to answer a direct question by changing the subject. Examples are almost too numerous to cite; to some degree, no politician ever answers difficult questions straightforwardly (there's an old axiom in politics, put nicely by Robert McNamara: "Never answer the question that is asked of you. Answer the question that you wish had been asked of you.").

A particularly egregious example of this occurred in 2009 on CNN's Larry King Live. Michele Bachmann, Republican Congresswoman from Minnesota, was the guest. The topic was "birtherism," the (false) belief among some that Barack Obama was not in fact born in America and was therefore not constitutionally eligible for the presidency. After playing a clip of Senator Lindsey Graham (R, South Carolina) denouncing the myth and those who spread it, King asked Bachmann whether she agreed with Senator Graham. She responded thus:

> "You know, it's so interesting, this whole birther issue hasn't even been one that's ever been brought up to me by my constituents. They continually ask me, where's the jobs? That's what they want to know, where are the jobs?"

Bachmann doesn't want to respond directly to the question. If she outright declares that the "birthers" are right, she looks crazy for endorsing a clearly false belief. But if she denounces them, she alienates a lot of her potential voters who believe the falsehood. Tough bind. So she blatantly, and rather desperately, tries to change the subject. Jobs! Let's talk about those instead. Please?

Argumentum ad Hominem Everybody always used the Latin for this one–usually shortened to just 'ad hominem', which means 'at the person'. You commit this fallacy when, instead of attacking your opponent's views, you attack your opponent himself.

This fallacy comes in a lot of different forms; there are a lot of different ways to attack a person while ignoring (or downplaying) their actual arguments. To organize things a bit, we'll divide the various ad hominem attacks into two groups: Abusive and Circumstantial.

Abusive ad hominem is the more straightforward of the two. The simplest version is simply calling your opponent names instead of debating him. Donald Trump has mastered this technique. During the 2016 Republican presidential primary, he came up with catchy little nicknames for his opponents, which he used just about every time he referred to them: "Lyin' Ted" Cruz, "Little Marco" Rubio, "Low-Energy Jeb" Bush. If you pepper your descriptions of your opponent with tendentious, unflattering, politically charged language, you can get a rhetorical leg-up. Here's another example, from Wisconsin Supreme Court Justice Rebecca Bradley reacting to the election of Bill Clinton in her college newspaper:

> Congratulations everyone. We have now elected a tree-hugging, baby-killing, potsmoking, flag-burning, queer-loving, draft-dodging, bull-spouting '60s radical socialist adulterer to the highest

> office in our nation. Doesn't it make you proud to be an American? We've just had an election which proves that the majority of voters are either totally stupid or entirely evil.[6]

Whoa. I guess that one speaks for itself.

Another abusive ad hominem attack is guilt by association. Here, you tarnish your opponent by associating him or his views with someone or something that your audience despises. Consider the following:

> Former Vice President Dick Cheney was an advocate of a strong version of the so-called Unitary Executive interpretation of the Constitution, according to which the president's control over the executive branch of government is quite firm and far-reaching. The effect of this is to concentrate a tremendous amount of power in the Chief Executive, such that those powers arguably eclipse those of the supposedly co-equal Legislative and Judicial branches of government. You know who else was in favor of a very strong, powerful Chief Executive? That's right, Hitler.

We just compared Dick Cheney to Hitler. Ouch. Nobody likes Hitler, so.... Not every comparison like this is fallacious, of course. But in this case, where the connection is particularly flimsy, we're clearly pulling a fast one.[7]

The circumstantial ad hominem fallacy is not as blunt an instrument as its abusive counterpart. It also involves attacking one's opponent, focusing on some aspect of his person–his circumstances–as the core of the criticism. This version of the fallacy comes in many different forms, and some of the circumstantial criticisms involved raise legitimate concerns about the relationship between the arguer and his argument. They only rise (sink?) to the level of fallacy when these criticisms are taken to be definitive refutations, which, on their own, they cannot be.

To see what we're talking about, consider the circumstantial ad hominem attack that points out one's opponent's self-interest in making the argument he does. Consider:

> A recent study from scientists at the University of Minnesota claims to show that glyphosate–the main active ingredient in the widely used herbicide Roundup–is safe for humans to use. But guess whose business school just got a huge donation from Monsanto, the company that produces Roundup? That's right, the University of Minnesota. Ever hear of conflict of interest? This study is junk, just like the product it's defending.

This is a fallacy. It doesn't follow from the fact that the University received a grant from Monsanto that scientists working at that school faked the results of a study. But the fact of the grant does raise a red flag. There may be some conflict of interest at play. Such things have happened in the past (e.g., studies funded by Big Tobacco showing that smoking is harmless). But raising the possibility of a conflict is not enough, on its own, to show that the study in question can be dismissed out of hand. It may be appropriate to subject it to heightened scrutiny, but we cannot shirk our duty to assess its arguments on their merits.

A similar thing happens when we point to the hypocrisy of someone making a certain argument– when their actions are inconsistent with the conclusion they're trying to convince us of. Consider the following:

---

[6] Marquette Tribune, 11/11/92

[7] Comparing your opponent to Hitler–or the Nazis–is quite common. Some clever folks came up with a fake-Latin term for the tactic: Argumentum ad Nazium (cf. the real Latin phrase, ad nauseum–to the point of nausea). Such comparisons are so common that author Mike Godwin formulated "Godwin's Law of Nazi Analogies: As an online discussion grows longer, the probability of a comparison involving Nazis or Hitler approaches one." ("Meme, Counter-meme", Wired, 10/1/94)

> The head of the local branch of the American Federation of Teachers union wrote an op-ed yesterday in which she defended public school teachers from criticism and made the case that public schools' quality has never been higher. But guess what? She sends her own kids to private schools out in the suburbs! What a hypocrite. The public school system is a wreck and we need more accountability for teachers.

This passage makes a strong point, but then commits a fallacy. It would appear that, indeed, the AFT leader is hypocritical; her choice to send her kids to private schools suggests (but doesn't necessarily prove) that she doesn't believe her own assertions about the quality of public schools. Again, this raises a red flag about her arguments; it's a reason to subject them to heightened scrutiny. But it is not a sufficient reason to reject them out of hand, and to accept the opposite of her conclusions. That's committing a fallacy. She may have perfectly good reasons, having nothing to do with the allegedly low quality of public schools, for sending her kids to the private school in the suburbs. Or she may not. She may secretly think, deep down, that her kids would be better off not going to public schools. But none of this means her arguments in the op-ed should be dismissed; it's beside the point. Do her premises back up her conclusion? Are her premises true? That's how we evaluate an argument; hypocrisy on the part of the arguer doesn't relieve us of the responsibility to conduct thorough, dispassionate logical analysis.

A very specific version of the circumstantial ad hominem, one that involves pointing out one's opponent's hypocrisy, is worth highlighting, since it happens so frequently. It has its own Latin name: tu quoque, which translates roughly as "you, too." This is the "I know you are but what am I?" fallacy; the "pot calling the kettle black"; "look who's talking". It's a technique used in very specific circumstances: your opponent accuses you of doing or advocating something that's wrong, and, instead of making an argument to defend the rightness of your actions, you simply throw the accusation back in your opponent's face–they did it too. But that doesn't make it right!

An example. In February 2016, Supreme Court Justice Antonin Scalia died unexpectedly. President Obama, as is his constitutional duty, nominated a successor. The Senate is supposed to 'advise and consent' (or not consent) to such nominations, but instead of holding hearings on the nominee (Merrick Garland), the Republican leaders of the Senate declared that they wouldn't even consider the nomination. Since the presidential primary season had already begun, they reasoned, they should wait until the voters has spoken and allow the new president to make a nomination. Democrats objected strenuously, arguing that the Republicans were shirking their constitutional duty. The response was classic tu quoque. A conservative writer asked, "Does any sentient human being believe that if the Democrats had the Senate majority in the final year of a conservative president's second term–and Justice [Ruth Bader] Ginsburg's seat came open–they would approve any nominee from that president?"[8] Senate Majority Leader Mitch McConnell said that he was merely following the "Biden Rule," a principle advocated by Vice President Joe Biden when he was a Senator, back in the election year of 1992, that then-President Bush should wait until after the election season was over before appointing a new Justice (the rule was hypothetical; there was no Supreme Court vacancy at the time).

This is a fallacious argument. Whether or not Democrats would do the same thing if the circumstances were reversed is irrelevant to determining whether that's the right, constitutional thing to do.

The final variant of the circumstantial ad hominem fallacy is perhaps the most egregious. It's certainly

---

[8] David French, National Review, 2/14/16

the most ambitious: it's a preemptive attack on one's opponent to the effect that, because of the type of person he is, nothing he says on a particular topic can be taken seriously; he is excluded entirely from debate. It's called poisoning the well. This phrase was coined by the famous 19th century Catholic intellectual John Henry Cardinal Newman, who was a victim of the tactic. In the course of a dispute he was having with the famous Protestant intellectual Charles Kingsley, Kingsley is said to have remarked that anything Newman said was suspect, since, as a Catholic priest, his first allegiance was not to the truth (but rather to the Pope). As Newman rightly pointed out, this remark, if taken seriously, has the effect of rendering it impossible for him or any other Catholic to participate in any debate whatsoever. He accused Kingsley of "poisoning the wells."

We poison the well when we exclude someone from a debate because of who they are. Imagine an Englishman saying something like, "It seems to me that you Americans should reform your healthcare system. Costs over here are much higher than they are in England. And you have millions of people who don't even have access to healthcare. In the UK, we have the NHS (National Health Service); medical care is a basic right of every citizen." Suppose an American responded by saying, "What you know about it, Limey? Go back to England." That would be poisoning the well (with a little name-calling thrown in). The Englishman is excluded from debating American healthcare just because of who he is–an Englishman, not an American.

Tu quoque "Tu quoque" is a Latin phrase that can be translated into English as "you too" or "you, also." The tu quoque fallacy is a way of avoiding answering a criticism by bringing up a criticism of your opponent rather than answer the criticism. For example, suppose that two political candidates, A and B, are discussing their policies and A brings up a criticism of B's policy. In response, B brings up her own criticism of A's policy rather than respond to A's criticism of her policy. B has here committed the tu quoque fallacy. The fallacy is best understood as a way of avoiding having to answer a tough criticism that one may not have a good answer to. This kind of thing happens all the time in political discourse.

Tu quoque, as I have presented it, is fallacious when the criticism one raises is simply in order to avoid having to answer a difficult objection to one's argument or view. However, there are circumstances in which a tu quoque kind of response is not fallacious. If the criticism that A brings toward B is a criticism that equally applies not only to A's position but to any position, then B is right to point this fact out. For example, suppose that A criticizes B for taking money from special interest groups. In this case, B would be totally right (and there would be no tu quoque fallacy committed) to respond that not only does A take money from special interest groups, but every political candidate running for office does. That is just a fact of life in American politics today. So A really has no criticism at all to B since everyone does what B is doing and it is in many ways unavoidable. Thus, B could (and should) respond with a "you too" rebuttal and in this case that rebuttal is not a tu quoque fallacy.

Genetic fallacy The genetic fallacy occurs when one argues (or, more commonly, implies) that the origin of something (e.g., a theory, idea, policy, etc.) is a reason for rejecting (or accepting) it. For example, suppose that Jack is arguing that we should allow physician assisted suicide and Jill responds that that idea first was used in Nazi Germany. Jill has just committed a genetic fallacy because she is implying that because the idea is associated with Nazi Germany, there must be something wrong with the idea itself. What she should have done instead is explain what, exactly, is wrong with the idea rather than simply assuming that there must be something wrong with it since it has a negative origin. The origin of an idea has nothing inherently to do with its truth or plausibility. Suppose that Hitler constructed a mathematical proof in his early adulthood (he didn't, but just suppose). The validity of that mathematical proof stands on its own; the fact that Hitler was a horrible person has nothing to do with whether the proof is good. Likewise with any other idea: ideas must be assessed on their own merits and the origin of an idea is neither a merit nor demerit of the idea.

Although genetic fallacies are most often committed when one associates an idea with a negative origin, it can also go the other way: one can imply that because the idea has a positive origin, the idea must be true or more plausible. For example, suppose that Jill argues that the Golden Rule is a good way to live one's life because the Golden Rule originated with Jesus in the Sermon on the Mount (it didn't, actually, even though Jesus does state a version of the Golden Rule). Jill has committed the genetic fallacy in assuming that the (presumed) fact that Jesus is the origin of the Golden Rule has anything to do with whether the Golden Rule is a good idea.

I'll end with an example from William James's seminal work, The Varieties of Religious Experience. In that book (originally a set of lectures), James considers the idea that if religious experiences could be explained in terms of neurological causes, then the legitimacy of the religious experience is undermined. James, being a materialist who thinks that all mental states are physical states– ultimately a matter of complex brain chemistry, says that the fact that any religious experience has a physical cause does not undermine that veracity of that experience. Although he doesn't use the term explicitly, James claims that the claim that the physical origin of some experience undermines the veracity of that experience is a genetic fallacy. Origin is irrelevant for assessing the veracity of an experience, James thinks. In fact, he thinks that religious dogmatists who take the origin of the Bible to be the word of God are making exactly the same mistake as those who think that a physical explanation of a religious experience would undermine its veracity. We must assess ideas for their merits, James thinks, not their origins.

Appeal to consequences The appeal to consequences fallacy is like the reverse of the genetic fallacy: whereas the genetic fallacy consists in the mistake of trying to assess the truth or reasonableness of an idea based on the origin of the idea, the appeal to consequences fallacy consists in the mistake of trying to assess the truth or reasonableness of an idea based on the (typically negative) consequences of accepting that idea. For example, suppose that the results of a study revealed that there are IQ differences between different races (this is a fictitious example, there is no such study that I know of). In debating the results of this study, one researcher claims that if we were to accept these results, it would lead to increased racism in our society, which is not tolerable. Therefore, these results must not be right since if they were accepted, it would lead to increased racism. The researcher who responded in this way has committed the appeal to consequences fallacy. Again, we must assess the study on its own merits. If there is something wrong with the study, some flaw in its design, for example, then that would be a relevant criticism of the study. However, the fact that the results of the study, if widely circulated, would have a negative effect on society is not a reason for rejecting these results as false. The consequences of some idea (good or bad) are irrelevant to the truth or reasonableness of that idea.

Notice that the researchers, being convinced of the negative consequences of the study on society, might rationally choose not to publish the study (for fear of the negative consequences). This is totally fine and is not a fallacy. The fallacy consists not in choosing not to publish something that could have adverse consequences, but in claiming that the results themselves are undermined by the negative consequences they could have. The fact is, sometimes truth can have negative consequences and falsehoods can have positive consequences. This just goes to show that the consequences of an idea are irrelevant to the truth or reasonableness of an idea.

Chapter 9

Fallacies of Weak Induction

As their name suggests, what these fallacies have in common is that they are bad – that is, weak – inductive arguments. Recall, inductive arguments attempt to provide premises that make their conclusions more probable. We evaluate them according to how probable their conclusions are in light of their premises: the more probable the conclusion (given the premises), the stronger the argument; the less probable, the weaker. The fallacies of weak induction are arguments whose premises do not make their conclusions very probable – but that are nevertheless often successful in convincing people of their conclusions. We will discuss five informal fallacies that fall under this heading.

Argument from Ignorance (Argumentum ad Ignorantiam)

This is a particularly egregious and perverse fallacy. In essence, it's an inference from premises to the effect that there's a lack of knowledge about some topic to a definite conclusion about that topic. We don't know; therefore, we know!

Of course, put that baldly, it's plainly absurd; actual instances are more subtle. The fallacy comes in a variety of closely related forms. It will be helpful to state them in bald/absurd schematic fashion first, then elucidate with more subtle real-life examples. The first form can be put like this:

> Nobody knows how to explain phenomenon X.
> ____________________________________
> My crazy theory about X is true.

That sounds silly, but consider an example: those "documentary" programs on cable TV about aliens. You know, the ones where they suggest that extraterrestrials built the pyramids or something (there are books and websites, too). How do they get you to believe that crazy theory? By creating mystery! By pointing to facts that nobody can explain. The Great Pyramid at Giza is aligned (almost) exactly with the magnetic north pole! On the day of the summer solstice, the sun sets exactly between two of the pyramids! The height of the Great Pyramid is (almost) exactly one one-millionth the distance from the Earth to the Sun! How could the ancient Egyptians have such sophisticated astronomical and geometrical knowledge? Why did the Egyptians, careful recordkeepers in (most) other respects, (apparently) not keep detailed records of the construction of the pyramids? Nobody knows. Conclusion: aliens built the pyramids. In other words, there are all sorts of (sort of) surprising facts about the pyramids, and nobody knows how to explain them. From these premises, which establish only our ignorance, we're encouraged to conclude that we know something: aliens built the pyramids. That's quite a leap – too much of a leap.

Another form this fallacy takes can be put crudely thus:

Nobody can PROVE that I'm wrong. I'm right.

The word 'prove' is in all-caps because stressing it is the key to this fallacious argument: the standard of proof is set impossibly high, so that almost no amount of evidence would constitute a refutation of the conclusion.

An example will help. There are lots of people who claim that evolutionary biology is a lie: there's no such thing as evolution by natural selection, and it's especially false to claim that humans evolved from earlier species, that we share a common ancestor with apes. Rather, the story goes, the Bible is literally true: the Earth is only about 6,000 years old, and humans were created as-is by God just as the Book of Genesis describes. The Argument from Ignorance is one of the favored techniques of proponents of this view. They are especially fond of pointing to 'gaps' in the fossil record – the so-called 'missing link' between humans and a pre-human, ape-like species and claim that the incompleteness of the fossil record vindicates their position.

But this argument is an instance of the fallacy. The standard of proof – a complete fossil record without any gaps – is impossibly high. Evolution has been going on for a LONG time (the Earth is actually about 4.5 billion years old, and living things have been around for at least 3.5 billion years). So many species have appeared and disappeared over time that it's absurd to think that we could even come close to collecting fossilized remains of anything but the tiniest fraction of them. It's hard to become a fossil, after all: a creature has to die under special circumstances to even have a chance for its remains to do anything than turn into compost. And we haven't been searching for fossils in a systematic way for very long (only since the mid-1800s or so). It's no surprise that there are gaps in the fossil record, then. What's surprising, in fact, is that we have as rich a fossil record as we do. Many, many transitional species have been discovered, both between humans and their ape-like ancestors, and between other modern species and their distant forbears (whales used to be land-based creatures, for example; we know this (in part) from the fossils of early protowhale species with longer and longer rear hip- and leg-bones). We will never have a fossil record complete enough to satisfy skeptics of evolution. But their standard is unreasonably high, so their argument is fallacious. Sometimes they put it even more simply: nobody was around to witness evolution in action; therefore, it didn't happen. This is patently absurd, but it follows the same pattern: an unreasonable standard of proof (witnesses to evolution in action; impossible, since it takes place over such a long period of time), followed by the leap to the unwarranted conclusion.

Yet another version of the Argument from Ignorance goes like this:

I can't imagine/understand how X could be true.
———————————————
X is false.

Of course lack of imagination on the part of an individual isn't evidence for or against a proposition, but people often argue this way. A (hilarious) example comes from the rap duo Insane Clown Posse in their 2009 single, 'Miracles'. Here's the line:

Water, fire, air and dirt
F**king magnets, how do they work?

And I don't wanna talk to a scientist
Ya'll mother**kers lying, and getting me pissed.

Violent J and Shaggy 2 Dope can't understand how there could be a scientific, non-miraculous explanation for the workings of magnets. They conclude, therefore, that magnets are miraculous. A final form of the Argument from Ignorance can be put crudely thus:

<u>No evidence has been found that X is true.</u>
X is false.

You may have heard the slogan, "Absence of evidence is not evidence of absence." This is an attempt to sum up this version of the fallacy. But it's not quite right. What it should say is that absence of evidence is not always definitive evidence of absence. An example will help illustrate the idea. During the 2016 presidential campaign, a reporter (David Fahrentold) took to Twitter to announce that despite having "spent weeks looking for proof that [Donald Trump] really does give millions of his own [money] to charity . . . " he could only find one donation, to the NYC Police Athletic League. Trump has claimed to have given millions of dollars to charities over the years. Does this reporter's failure to find evidence of such giving prove that Trump's claims about his charitable donations are false? No. To rely only on this reporter's testimony to draw such a conclusion would be to commit the fallacy.

However, the failure to uncover evidence of charitable giving does provide some reason to suspect Trump's claims may be false. How much of a reason depends on the reporter's methods and credibility, among other things.[1] But sometimes a lack of evidence can provide strong support for a negative conclusion. This is an inductive argument; it can be weak or strong. For example, despite multiple claims over many years (centuries, if some sources can be believed), no evidence has been found that there's a sea monster living in Loch Ness in Scotland. Given the size of the body of water, and the extensiveness of the searches, this is pretty good evidence that there's no such creature – a strong inductive argument to that conclusion. To claim otherwise – that there is such a monster, despite the lack of evidence – would be to commit the version of the fallacy whereby one argues "You can't PROVE I'm wrong; therefore, I'm right," where the standard of proof is unreasonably high.

One final note on this fallacy: it's common for people to mislabel certain bad arguments as arguments from ignorance; namely, arguments made by people who obviously don't know what the heck they're talking about. People who are confused or ignorant about the subject on which they're offering an opinion are liable to make bad arguments, but the fact of their ignorance is not enough to label those arguments as instances of the fallacy. We reserve that designation for arguments that take the forms canvassed above: those that rely on ignorance – and not just that of the arguer, but of the audience as well – as a premise to support the conclusion.

Appeal to Inappropriate Authority

One way of making an inductive argument – of lending more credence to your conclusion – is to point to the fact that some relevant authority figure agrees with you. In law, for example, this kind of argument is

---

[1] And, in fact, Fahrentold subsequently performed and documented (in the Washington Post on 9/12/16) a rather exhaustive unsuccessful search for evidence of charitable giving, providing strong support for the conclusion that Trump didn't give as he'd claimed.

indispensable: appeal to precedent (Supreme Court rulings, etc.) is the attorney's bread and butter. And in other contexts, this kind of move can make for a strong inductive argument. If I'm trying to convince you that fluoridated drinking water is safe and beneficial, I can point to the Centers for Disease Control, where a wealth of information supporting that claim can be found.[2] Those people are scientists and doctors who study this stuff for a living; they know what they're talking about.

One commits the fallacy when one points to the testimony of someone who's not an authority on the issue at hand. This is a favorite technique of advertisers. We've all seen celebrity endorsements of various products. Sometimes the celebrities are appropriate authorities: there was a Buick commercial from 2012 featuring Shaquille O'Neal, the Hall of Fame basketball player, testifying to the roominess of the car's interior (despite its compact size). Shaq, a very, very large man, is an appropriate authority on the roominess of cars! But when Tiger Woods was shilling for Buicks a few years earlier, it wasn't at all clear that he had any expertise to offer about their merits relative to other cars. Woods was an inappropriate authority; those ads committed the fallacy. Usually, the inappropriateness of the authority being appealed to is obvious. But sometimes it isn't. A particularly subtle example is AstraZeneca's hiring of Dr. Phil McGraw in 2016 as a spokesperson for their diabetes outreach campaign. AstraZeneca is a drug manufacturing company. They make a diabetes drug called Bydureon. The aim of the outreach campaign, ostensibly, is to increase awareness among the public about diabetes; but of course the real aim is to sell more Bydureon. A celebrity like Dr. Phil can help. Is he an appropriate authority? That's a hard question to answer. It's true that Dr. Phil had suffered from diabetes himself for 25 years, and that he personally takes the medication. So that's a mark in his favor, authority-wise. But is that enough? We'll talk about how feeble Phil's sort of anecdotal evidence is in supporting general claims (in this case, about a drug's effectiveness) when we discuss the hasty generalization fallacy; suffice it to say, one person's positive experience doesn't prove that the drug is effective. But, Dr. Phil isn't just a person who suffers from diabetes; he's a doctor! It's right there in his name (everybody always simply refers to him as "Dr. Phil"). Surely that makes him an appropriate authority on the question of drug effectiveness. Or maybe not. Phil McGraw is not a medical doctor; he's a PhD. He has a doctorate in Psychology. He's not a licensed psychologist; he cannot legally prescribe medication. He has no relevant professional expertise about drugs and their effectiveness. He is not an appropriate authority in this case. He looks like one, though, which makes this a very sneaky, but effective, advertising campaign.

Post hoc ergo propter hoc

Here's another fallacy for which people always use the Latin, usually shortening it to "post hoc". The whole phrase translates to "After this, therefore because of this", which is a pretty good summation of the pattern of reasoning involved. Crudely and schematically, it looks like this:

X occurred before Y.
X caused Y.

This is not a good inductive argument. That one event occurred before another gives you some reason to believe it might be the cause – after all, X can't cause Y if it happened after Y did – but not nearly enough to conclude that it is the cause. A silly example: I, your humble author, was born on June 19th, 1974; this was

---

[2] Check it out: https://www.cdc.gov/fluoridation/

just shortly before a momentous historical event, Richard Nixon's resignation of the Presidency on August 9th later that summer. My birth occurred before Nixon's resignation; but this is (obviously!) not a reason to think that it caused his resignation. Though this kind of reasoning is obviously shoddy – a mere temporal relationship clearly does not imply a causal relationship – it is used surprisingly often. In 2012, New York Yankees shortstop Derek Jeter broke his ankle. It just so happened that this event occurred immediately after another event, as Donald Trump pointed out on Twitter: "Derek Jeter broke ankle one day after he sold his apartment in Trump World Tower." Trump followed up: "Derek Jeter had a great career until 3 days ago when he sold his apartment at Trump World Tower - I told him not to sell - karma?" No, not karma; just bad luck.

Nowhere is this fallacy more in evidence than in our evaluation of the performance of presidents of the United States. Everything that happens during or immediately after their administrations tends to be pinned on them. But presidents aren't all-powerful; they don't cause everything that happens during their presidencies. On July 9th, 2016, a short piece appeared in the Washington Post with the headline "Police are safer under Obama than they have been in decades". What does a president have to do with the safety of cops? Very little, especially compared to other factors like poverty, crime rates, policing practices, rates of gun ownership, etc., etc., etc. To be fair, the article was aiming to counter the equally fallacious claims that increased violence against police was somehow caused by Obama. Another example: in October 2015, US News & World Report published an article asking (and purporting to answer) the question, "Which Presidents Have Been Best for the Economy?" It had charts listing GDP growth during each administration since Eisenhower. But while presidents and their policies might have some effect on economic growth, their influence is certainly swamped by other factors. Similar claims on behalf of state governors are even more absurd. At the 2016 Republican National Convention, Governors Scott Walker and Mike Pence – of Wisconsin and Indiana, respectively – both pointed to record-high employment in their states as vindication of their conservative, Republican policies. But some other states were also experiencing record-high employment at the time: California, Minnesota, New Hampshire, New York, Washington. Yes, they were all controlled by Democrats. Maybe there's a separate cause for those strong jobs numbers in differently governed states? Possibly it has something to do with the improving economy and overall health of the job market in the whole country?

Hasty Generalization

Many inductive arguments involve an inference from particular premises to a general conclusion; this is generalization. For example, if you make a bunch of observations every morning that the sun rises in the east, and conclude on that basis that, in general, the sun always rises in the east, this is a generalization. And it's a good one! With all those particular sunrise observations as premises, your conclusion that the sun always rises in the east has a lot of support; that's a strong inductive argument.

One commits the hasty generalization fallacy when one makes this kind of inference based on an insufficient number of particular premises, when one is too quick – hasty – in inferring the general conclusion.

People who deny that global warming is a genuine phenomenon often commit this fallacy. In February of 2015, the weather was unusually cold in Washington, DC. Senator James Inhofe of Oklahoma famously took to the Senate floor wielding a snowball. "In case we have forgotten, because we keep hearing that 2014 has been the warmest year on record, I ask the chair, 'You know what this is?' It's a snowball, from outside here.

So it's very, very cold out. Very unseasonable." He then tossed the snowball at his colleague, Senator Bill Cassidy of Louisiana, who was presiding over the debate, saying, "Catch this." Senator Inhofe commits the hasty generalization fallacy. He's trying to establish a general conclusion – that 2014 wasn't the warmest year on record, or that global warming isn't really happening (he's on the record that he considers it a "hoax"). But the evidence he presents is insufficient to support such a claim. His evidence is an unseasonable coldness in a single place on the planet, on a single day. We can't derive from that any conclusions about what's happening, temperature-wise, on the entire planet, over a long period of time. That the earth is warming is not a claim that everywhere, at every time, it will always be warmer than it was; the claim is that, on average, across the globe, temperatures are rising. This is compatible with a couple of cold snaps in the nation's capital.

Many people are susceptible to hasty generalizations in their everyday lives. When we rely on anecdotal evidence to make decisions, we commit the fallacy. Suppose you're thinking of buying a new car, and you're considering a Subaru. Your neighbor has a Subaru. So what do you do? You ask your neighbor how he likes his Subaru. He tells you it runs great, hasn't given him any trouble. You then, fallaciously, conclude that Subarus must be terrific cars. But one person's testimony isn't enough to justify that conclusion; you'd need to look at many, many more drivers' experiences to reach such a conclusion (this is why the magazine Consumer Reports is so useful). A particularly pernicious instantiation of the Hasty Generalization fallacy is the development of negative stereotypes. People often make general claims about religious or racial groups, ethnicities and nationalities, based on very little experience with them. If you once got mugged by a Puerto Rican, that's not a good reason to think that, in general, Puerto Ricans are crooks. If a waiter at a restaurant in Paris was snooty, that's no reason to think that French people are stuck up. And yet we see this sort of faulty reasoning all the time.

Slippery Slope

Like the post hoc fallacy, the slippery slope fallacy is a weak inductive argument to a conclusion about causation. This fallacy involves making an insufficiently supported claim that a certain action or event will set off an unstoppable causal chain-reaction – putting us on a slippery slope – leading to some disastrous effect.

This style of argument was a favorite tactic of religious conservatives who opposed gay marriage. They claimed that legalizing same-sex marriage would put the nation on a slippery slope to disaster. Famous Christian leader Pat Robertson, on his television program The 700 Club, puts the case nicely. When asked about gay marriage, he responded with this:

We haven't taken this to its ultimate conclusion. You've got polygamy out there. How can we rule that polygamy is illegal when you say that homosexual marriage is legal? What is it about polygamy that's different? Well, polygamy was outlawed because it was considered immortal according to Biblical standards. But if we take Biblical standards away in homosexuality, well what about the other? And what about bestiality? And ultimately what about child molestation and pedophilia? How can we criminalize these things, at the same time have Constitutional amendments allowing same-sex marriage among homosexuals? You mark my words, this is just the beginning of a long downward slide in relation to all the things that we consider to be abhorrent.

This a classic slippery slope fallacy; he even uses the phrase "long downward slide"! The claim is that allowing gay marriage will force us to decriminalize polygamy, bestiality, child molestation, pedophilia – and ultimately, “all the things that we consider to be abhorrent.” Yikes! That’s a lot of things. Apparently, gay marriage will lead to utter anarchy. There are genuine slippery slopes out there – unstoppable causal chain-reactions. But this isn’t one of them. The mark of the slippery slope fallacy is the assertion that the chain can’t be stopped, with reasons that are insufficient to back up that assertion. In this case, Pat Robertson has given us the abandonment of “Biblical standards” as the lubrication for the slippery slope. But this is obviously insufficient. Biblical standards are expressly forbidden, by the “establishment clause” of the First Amendment to the U.S. Constitution, from forming the basis of the legal code. The slope is not slippery. As recent history has shown, the legalization of same sex marriage does not lead to the acceptance of bestiality and pedophilia; the argument is fallacious. Fallacious slippery slope arguments have long been deployed to resist social change. Those opposed to the abolition of slavery warned of economic collapse and social chaos. Those who opposed women’s suffrage asserted that it would lead to the dissolution of the family, rampant sexual promiscuity, and social anarchy. Of course none of these dire predictions came true; the slopes simply weren’t slippery.

Slippery Slope

Philosophers continue to argue and debate about how to resolve the sorites paradox, but the point for us is just to illustrate the concept of vagueness. The concept "heap" is a vague concept in this example. But so are so many other concepts, such a color concepts (red, yellow, green, etc.), moral concepts (right, wrong, good, bad), and just about any other concept you can think of. The one domain that seems to be unaffected by vagueness is mathematical and logical concepts. There are two fallacies related to vagueness: the causal slippery slope and the conceptual slippery slope. We'll cover the conceptual slippery slope first since it relates most closely to the concept of vagueness I've explained above.

Conceptual slippery slope It may be true that there is no essential difference between 499 grains of sand and 500 grains of sand. But even if that is so, it doesn't follow that there is no difference between 1 grain of sand and 5 billion grains of sand. In general, just because we cannot draw a distinction between A and B, and we cannot draw a distinction between B and C, it doesn't mean we cannot draw a distinction between A and C. Here is an example of a conceptual slippery slope fallacy.

> It is illegal for anyone under 21 to drink alcohol. But there is no difference between someone who is 21 and someone who is 20 years 11 months old. So there is nothing wrong with someone who is 20 years and 11 months old drinking. But since there is no real distinction between being one month older and one month younger, there shouldn't be anything wrong with drinking at any age. Therefore, there is nothing wrong with allowing a 10 year old to drink alcohol.

Imagine the life of an individual in stages of 1 month intervals. Even if it is true that there is no distinction in kind between any one of those stages, it doesn't follow that there isn't a distinction to be drawn at the extremes of either end. Clearly there is a difference between a 5 year old and a 25 year old – a distinction in kind that is relevant to whether they should be allowed to drink alcohol. The conceptual slippery slope fallacy assumes that because we cannot draw a distinction between adjacent stages, we cannot draw a distinction at all between any stages. One clear way of illustrating this is with color. Think of a color spectrum from purple to red to orange to yellow to green to blue. Each color grades into the next without there being any distinguishable boundaries between the colors – a continuous spectrum. Even if it is true that for any two adjacent hues on the color wheel, we cannot distinguish between the two, it doesn't follow from this that there is no distinction to be drawn between any two portions of the color wheel, because then we'd be committed to saying that there is no distinguishable difference between purple and yellow! The example of the color spectrum illustrates the general point that just because the boundaries between very similar things on a spectrum are vague, it doesn't follow that there are no differences between any two things on that spectrum. Whether or not one will identify an argument as committing a conceptual slippery slope fallacy, depends on the other things one believes about the world. Thus, whether or not a conceptual slippery slope fallacy has been committed will often be a matter of some debate. It will itself be vague. Here is a good example that illustrates this point.

People are found not guilty by reason of insanity when they cannot avoid breaking the law. But people who are brought up in certain deprived social circumstances are not much more able than the legally insane to avoid breaking the law. So we should not find such individuals guilty any more than those who are legally insane.

Whether there is conceptual slippery slope fallacy here depends on what you think about a host of other things, including individual responsibility, free will, the psychological and social effects of deprived social circumstances such as poverty, lack of opportunity, abuse, etc. Some people may think that there are big differences between those who are legally insane and those who grow up in deprived social circumstances. Others may not think the differences are so great. The issues here are subtle, sensitive, and complex, which is why it is difficult to determine whether there is any fallacy here or not. If the differences between those who are insane and those who are the product of deprived social circumstances turn out to be like the differences between one shade of yellow and an adjacent shade of yellow, then there is no fallacy here. But if the differences turn out to be analogous to those between yellow and green (i.e., with many distinguishable stages of difference between) then there would indeed be a conceptual slippery slope fallacy here. The difficulty of distinguishing instances of the conceptual slippery slope fallacy, and the fact that distinguishing it requires us to draw on our knowledge about the world, shows that the conceptual slippery slope fallacy is an informal fallacy.

Causal slippery slope fallacy The causal slippery slope fallacy is committed when one event is said to lead to some other (usually disastrous) event via a chain of intermediary events. If you have ever seen Direct TV's "get rid of cable" commercials, you will know exactly what I'm talking about. (If you don't know what I'm talking about you should Google it right now and find out. They're quite funny.) Here is an example of a causal slippery slope fallacy (it is adapted from one of the Direct TV commercials):

If you use cable, your cable will probably go on the fritz. If your cable is on the fritz, you will probably get frustrated. When you get frustrated you will probably hit the table. When you hit the table, your young daughter will probably imitate you. When your daughter imitates you, she will probably get thrown out of school. When she gets thrown out of school, she will probably meet undesirables. When she meets undesirables, she will probably marry undesirables. When she marries undesirables, you will probably have a grandson with a dog collar. Therefore, if you use cable, you will probably have a grandson with dog collar.

This example is silly and absurd, yes. But it illustrates the causal slippery slope fallacy. Slippery slope fallacies are always made up of a series of conjunctions of probabilistic conditional statements that link the first event to the last event. A causal slippery slope fallacy is committed when one assumes that just because each individual conditional statement is probable, the conditional that links the first event to the last event is also probable. Even if we grant that each "link" in the chain is individually probable, it doesn't follow that the whole chain (or the conditional that links the first event to the last event) is probable. Suppose, for the sake of the argument, we assign probabilities to each "link" or conditional statement, like this. (I have italicized the consequents of the conditionals and assigned high conditional probabilities to them. The high probability is for the sake of the argument; I don't actually think these things are as probable as I've assumed here.)

If you use cable, then your cable will probably go on the fritz (.9)
If your cable is on the fritz, then you will probably get angry (.9)
If you get angry, then you will probably hit the table (.9)
If you hit the table, your daughter will probably imitate you (.8)
If your daughter imitates you, she will probably be kicked out of school (.8)
If she is kicked out of school, she will probably meet undesirables (.9)

If she meets undesirables, she will probably marry undesirables (.8)
If she marries undesirables, you will probably have a grandson with a dog collar (.8)

However, even if we grant the probabilities of each link in the chain is high (80-90% probable), the conclusion doesn't even reach a probability higher than chance. Recall that in order to figure the probability of a conjunction, we must multiply the probability of each conjunct:

(.9) x (.9) x (.9) x (.8) x (.8) x (.9) x (.8) x (.8) = .27

That means the probability of the conclusion (i.e., that if you use cable, you will have a grandson with a dog collar) is only 27%, despite the fact that each conditional has a relatively high probability! The causal slippery slope fallacy is actually a formal probabilistic fallacy and so could have been discussed in chapter 3 with the other formal probabilistic fallacies. What makes it a formal rather than informal fallacy is that we can identify it without even having to know what the sentences of the argument mean. I could just have easily written out a nonsense argument comprised of series of probabilistic conditional statements. But I would still have been able to identify the causal slippery slope fallacy because I would have seen that there was a series of probabilistic conditional statements leading to a claim that the conclusion of the series was also probable. That is enough to tell me that there is a causal slippery slope fallacy, even if I don't really understand the meanings of the conditional statements.

It is helpful to contrast the causal slippery slope fallacy with the valid form of inference, hypothetical syllogism. Recall that a hypothetical syllogism has the following kind of form:

$A \rightarrow B$
$B \rightarrow C$
$C \rightarrow D$
$D \rightarrow E$
So, $A \rightarrow E$

The only difference between this and the causal slippery slope fallacy is that whereas in the hypothetical syllogism, the link between each component is certain, in a causal slippery slope fallacy, the link between each event is probabilistic. It is the fact that each link is probabilistic that accounts for the fallacy. One way of putting this is point is that probability is not transitive. Just because A makes B probable and B makes C probable and C makes X probable, it doesn't follow that A makes X probable. In contrast, when the links are certain rather than probable, then if A always leads to B and B always leads to C and C always leads to X, then it has to be the case that A always leads to X.

Chapter 10

Fallacies of Illicit Presumption

This is a family of fallacies whose common characteristic is that they (often tacitly, implicitly) presume the truth of some claim that they're not entitled to. They are arguments with a premise (again, often hidden) that is assumed to be true, but is actually a controversial claim, which at best requires support that's not provided, which at worst is simply false. We will look at six fallacies under this heading.

Accident

This fallacy is the reverse of the hasty generalization. That was a fallacious inference from insufficient particular premises to a general conclusion; accident is a fallacious inference from a general premise to a particular conclusion. What makes it fallacious is an illicit presumption: the general rule in the premise is assumed, incorrectly, not to have any exceptions; the particular conclusion fallaciously inferred is one of the exceptional cases.

Here's a simple example to help make that clear:

> Cutting people with knives is illegal.
> Surgeons cut people with knives.
> Surgeons should be arrested.

One of the premises is the general claim that cutting people with knives is illegal. While this is true in almost all cases, there are exceptions–surgery among them. We pay surgeons lots of money to cut people with knives! It is therefore fallacious to conclude that surgeons should be arrested, since they are an exception to the general rule. The inference only goes through if we presume, incorrectly, that the rule is exceptionless.

Another example. Suppose I volunteer at my first grade daughter's school; I go in to her class one day to read a book aloud to the children. As I'm sitting down on the floor with the kiddies, crisscross applesauce, as they say, I realize that I can't comfortably sit that way because of the .44 Magnum revolver that I have tucked into my waistband.[1] So I remove the piece from my pants and set it down on the floor in front of me, among the circled-up children. The teacher screams and calls the office, the police are summoned, and I'm arrested. As they're hauling me out of the room, I protest: "The Second Amendment to the Constitution

---

[1] That's Dirty Harry's gun, "the most powerful handgun in the world."

guarantees my right to keep and bear arms! This state has a 'concealed carry' law, and I have a license to carry that gun! Let me go!"

I'm committing the fallacy of Accident in this story. True, the Second Amendment guarantees the right to keep and bear arms; but that rule is not without exceptions. Similarly, concealed carry laws also have exceptions–among them being a prohibition on carrying weapons into elementary schools. My insistence on being released only makes sense if we presume, incorrectly, that the legal rules I'm citing are without exception.

One more example from real life. After the financial crisis in 2008, the Federal Reserve–the central bank in the United States, whose task it is to create conditions leading to full employment and moderate inflation–found itself in a bind. The economy was in a free-fall, and unemployment rates were skyrocketing, but the usual tool it used to mitigate such problems–cutting the shortterm federal funds rate (an interest rate banks charge each other for overnight loans)–was unavailable, because they had already cut the rate to zero (the lowest it could go). So they had to resort to unconventional monetary policies, among them something called "quantitative easing". This involved the purchase, by the Federal Reserve, of financial assets like mortgage-backed securities and longer-term government debt (Treasury notes).[2]

Now, the nice thing about being the Federal Reserve is that when you want to buy something–in this case a bunch of financial assets–it's really easy to pay for it: you have the power to create new money out of thin air! That's what the Federal Reserve does; it controls the amount of money that exists. So if the Fed wants to buy, say, $10 million worth of securities from Bank of America, they just press a button and presto–$10 million dollars that didn't exist a second ago comes into being as an asset of Bank of America.[3]

This quantitative easing policy was controversial. Many people worried that it would lead to runaway inflation. Generally speaking, the more money there is, the less each bit of it is worth. So creating more money makes things cost more–inflation. The Fed was creating money on a very large scale–on the order of a trillion dollars. Shouldn't that lead to a huge amount of inflation?

Economist Art Laffer thought so. In June of 2009, he wrote an op-ed in the Wall Street Journal warning that "[t]he unprecedented expansion of the money supply could make the '70s look benign."[4] (There was a lot of inflation in the '70s.)

Another famous economist, Paul Krugman, accused Laffer of committing the fallacy of accident. While it's generally true that an increase in the supply of money leads to inflation, that rule is not without exceptions. He had described such exceptional circumstances in 1998[5], and pointed out that the economy of 2009 was in that condition (which economists call a "liquidity trap"): "Let me add, for the 1.6 trillionth time, we are in a liquidity trap. And in such circumstances a rise in the monetary base does not lead to inflation."[6]

It turns out Krugman was correct. The expansion of the monetary supply did not lead to runaway inflation; as a matter of fact, inflation remained below the level that the Federal Reserve wanted, barely

---

[2] The hope was to push down interest rates on mortgages and government debt, encouraging people to buy houses and spend money instead of saving it–thus stimulating the economy.

[3] It's obviously a bit more complicated than that, but that's the essence of it.

[4] Art Laffer, "Get Ready for Inflation and Higher Interest Rates," June 11, 2009, Wall Street Journal

[5] "But if current prices are not downwardly flexible, and the public expects price stability in the long run, the economy cannot get the expected inflation it needs; and in that situation the economy finds itself in a slump against which shortrun monetary expansion, no matter how large, is ineffective." From Paul Krugman, "It's baack: Japan's Slump and the Return of the Liquidity Trap," 1998, Brookings Papers on Economic Activity, 2

[6] Paul Krugman, June 13, 2009, The New York Times

moving at all. Laffer had indeed committed the fallacy of accident.

Begging the Question (Petitio Principii)

First things first: ‘begging the question’ is not synonymous with ‘raising the question’; this is an extremely common usage, but it is wrong. You might hear a newscaster say, “Today Donald Trump’s private jet was spotted at the Indianapolis airport, which begs the question: ‘Will he choose Indiana Governor Mike Pence as running mate?’” This is a mistaken usage of ‘begs the question’; the newscaster should have said ‘raises the question’ instead.

’Begging the question’ is a translation of the Latin ‘petitio principii’, which refers to the practice of asking (begging, petitioning) your audience to grant you the truth of a claim (principle) as a premise in an argument–but it turns out that the claim you’re asking for is either identical to, or presupposes the truth of, the very conclusion of the argument you’re trying to make.

In other words, when you beg the question, you’re arguing in a circle: one of the reasons for believing the conclusion is the conclusion itself! It’s a Fallacy of Illicit Presumption where the proposition being presumed is the very proposition you’re trying to demonstrate; that’s clearly an illicit presumption.

Here’s a stark example. If I’m trying to convince you that Donald Trump is a dangerous idiot (the conclusion of my argument is ‘Donald Trump is a dangerous idiot’), then I can’t ask you to grant me the claim ‘Donald Trump is a dangerous idiot’. The premise can’t be the same as the conclusion. Imagine a conversation:

> Me: “Donald Trump is a dangerous idiot.”
> You: “Really? Why do you say that?”
> Me: “Because Donald Trump is a dangerous idiot.”
> You: “So you said. But why should I agree with you? Give me some reasons.”
> Me: “Here’s a reason: Donald Trump is a dangerous idiot.”

And round and round we go. Circular reasoning; begging the question.

It’s not always so blatant. Sometimes the premise is not identical to the conclusion, but merely presupposes its truth. Why should we believe that the Bible is true? Because it says so right there in the Bible that it’s the infallible Word of God. This premise is not the same as the conclusion, but it can only support the conclusion if we take the Bible’s word for its own truthfulness, i.e., if we assume that the Bible is true. But that was the very claim we were trying to prove!

Sometimes the premise is just a re-wording of the conclusion. Consider this argument: “To allow every man unbounded freedom of speech must always be, on the whole, advantageous to the state; for it is highly conducive to the interests of the community that each individual should enjoy a liberty, perfectly unlimited, of expressing his sentiments.”[7] Replacing synonyms with synonyms, this comes down to “Free speech is good for society because free speech is good for society.” Not a good argument.[8]

Consider the following argument:

> Capital punishment is justified for crimes such as rape and murder because it is quite legitimate and appropriate for the state to put to death someone who has committed such heinous and

---

[7] This is a classic example, from Richard Whately’s 1826 Elements of Logic.

[8] Though it’s valid! P, therefore P is a valid form: if the premise is true, the conclusion must be; they’re the same.

inhuman acts.

The premise indicator, "because" denotes the premise and (derivatively) the conclusion of this argument. In standard form, the argument is this:

It is legitimate and appropriate for the state to put to death someone who commits rape or murder.
2. Therefore, capital punishment is justified for crimes such as rape and murder.

You should notice something peculiar about this argument: the premise is essentially the same claim as the conclusion. The only difference is that the premise spells out what capital punishment means (the state putting criminals to death) whereas the conclusion just refers to capital punishment by name, and the premise uses terms like "legitimate" and "appropriate" whereas the conclusion uses the related term, "justified." But these differences don't add up to any real differences in meaning. Thus, the premise is essentially saying the same thing as the conclusion. This is a problem: we want our premise to provide a reason for accepting the conclusion. But if the premise is the same claim as the conclusion, then it can't possibly provide a reason for accepting the conclusion! Begging the question occurs when one (either explicitly or implicitly) assumes the truth of the conclusion in one or more of the premises. Begging the question is thus a kind of circular reasoning.

One interesting feature of this fallacy is that formally there is nothing wrong with arguments of this form. Here is what I mean. Consider an argument that explicitly commits the fallacy of begging the question. For example,

Capital punishment is morally permissible
Therefore, capital punishment is morally permissible

Now, apply any method of assessing validity to this argument and you will see that it is valid by any method. If we use the informal test (by trying to imagine that the premises are true while the conclusion is false), then the argument passes the test, since any time the premise is true, the conclusion will have to be true as well (since it is the exact same statement). Likewise, the argument is valid by our formal test of validity, truth tables. But while this argument is technically valid, it is still a really bad argument. Why? Because the point of giving an argument in the first place is to provide some reason for thinking the conclusion is true for those who don't already accept the conclusion. But if one doesn't already accept the conclusion, then simply restating the conclusion in a different way isn't going to convince them. Rather, a good argument will provide some reason for accepting the conclusion that is sufficiently independent of that conclusion itself. Begging the question utterly fails to do this and this is why it counts as an informal fallacy. What is interesting about begging the question is that there is absolutely nothing wrong with the argument formally.

Whether or not an argument begs the question is not always an easy matter to sort out. As with all informal fallacies, detecting it requires a careful understanding of the meaning of the statements involved in the argument. Here is an example of an argument where it is not as clear whether there is a fallacy of begging the question:

> Christian belief is warranted because according to Christianity there exists a being called "the Holy Spirit" which reliably guides Christians towards the truth regarding the central claims of

> Christianity.[9]

One might think that there is a kind of circularity (or begging the question) involved in this argument since the argument appears to assume the truth of Christianity in justifying the claim that Christianity is true. But whether or not this argument really does beg the question is something on which there is much debate within the sub-field of philosophy called epistemology ("study of knowledge"). The philosopher Alvin Plantinga argues persuasively that the argument does not beg the question, but being able to assess that argument takes patient years of study in the field of epistemology (not to mention a careful engagement with Plantinga's work). As this example illustrates, the issue of whether an argument begs the question requires us to draw on our general knowledge of the world. This is the mark of an informal, rather than formal, fallacy.

Loaded Questions

Loaded questions are questions the very asking of which presumes the truth of some claim. Asking these can be an effective debating technique, a way of sneaking a controversial claim into the discussion without having outright asserted it.

The classic example of a loaded question is, "Have you stopped beating your wife?" Notice that this is a yes-or-no question, and no matter which answer one gives, one admits to beating his wife: if the answer is 'no', then the person continues to beat his wife; if the answer is 'yes', then he admits to beating his wife in the past. Either way, he's a wife-beater. The question itself presumes the truth of this claim; that's what makes it "loaded".

Strategic deployment of loaded yes-or-no questions can be an extremely effective debating technique. If you catch your opponent off-guard, they will struggle to respond to your question, since a simple 'yes' or 'no' commits them to the truth of the illicit presumption, which they want to deny. This makes them look evasive, shifty. And as they struggle to come up with a response, you can pounce on them: "It's a simple question. Yes or no? Why won't you answer the question?" It's a great way to appear to be winning a debate, even if you don't have a good argument. Imagine the following dialogue:

> Liberal TV Host: "Are you or are you not in favor of the president's plan to force wealthy business owners to pay their fair share in taxes to protect the vulnerable and aid this nation's underprivileged?"
> Conservative Guest: "Well, I don't agree with the way you've laid out the question. As a matter of fact…"
> Host: "It's a simple question. Should business owners pay their fair share; yes or no?"
> Guest: "You're implying that the president's plan would correct some injustice. But corporate taxes are already very …"
> Host: "Stop avoiding the question! It's a simple yes or no!"

Combine this with the sort of subconscious appeal to force discussed above–yelling, fingerpointing, etc.– and the host might come off looking like the winner of the debate, with his opponent appearing evasive,

---

[9] This is a much simplified version of the view defended by Christian philosophers such as Alvin Plantinga. Plantinga defends (something like) this claim in: Plantinga, A. 2000. Warranted Christian Belief. Oxford, UK: Oxford University Press.

uncooperative, and inarticulate.

Another use for loaded questions is the particularly sneaky political practice of “push polling”. In a normal opinion poll, you call people up to try to discover what their views are about the issues. In a push poll, you call people up pretending to be conducting a normal opinion poll, pretending only to be interested in discovering their views, but with a different intention entirely: you don’t want to know what their views are; you want to shape their views, to convince them of something. And you use loaded questions to do it.

A famous example of this occurred during the Republican presidential primary in 2000. George W. Bush was the front-runner, but was facing a surprisingly strong challenge from the upstart John McCain. After McCain won the New Hampshire primary, he had a lot of momentum. The next state to vote was South Carolina; it was very important for the Bush campaign to defeat McCain there and reclaim the momentum. So they conducted a push poll designed to spread negative feelings about McCain–by implanting false beliefs among the voting public. “Pollsters” called voters and asked, “Would you be more or less likely to vote for John McCain for president if you knew he had fathered an illegitimate black child?” The aim, of course, is for voters to come to believe that McCain fathered an illegitimate black child. But he did no such thing. He and his wife adopted a daughter, Bridget, from Bangladesh.

A final note on loaded questions: there’s a minimal sense in which every question is loaded. The social practice of asking questions is governed by implicit norms. One of these is that it’s only appropriate to ask a question when there’s some doubt about the answer. So every question carries with it the presumption that this norm is being adhered to, that it’s a reasonable question to ask, that the answer is not certain. One can exploit this fact, again to plant beliefs in listeners’ minds that they otherwise wouldn’t hold. In a particularly shameful bit of alarmist journalism, the cover of the July 1, 2016 issue of Newsweek asks the question, “Can ISIS Take Down Washington?” The cover is an alarming, eye-catching shade of yellow, and shows four missiles converging on the Capitol dome. The simple answer to the question, though, is ‘no, of course not’. There is no evidence that ISIS has the capacity to destroy the nation’s capital. But the very asking of the question presumes that it’s a reasonable thing to wonder about, that there might be a reason to think that the answer is ‘yes’. The goal is to scare readers (and sell magazines) by getting them to believe there might be such a threat.

False Choice

This fallacy occurs when someone tries to convince you of something by presenting it as one of limited number of options and the best choice among those options. The illicit presumption is that the options are limited in the way presented; in fact, there are additional options that are not offered. The choice you’re asked to make is a false choice, since not all the possibilities have been presented.

Most frequently, the number of options offered is two. In this case, you’re being presented with a false dilemma. I manipulate my kids with false choices all the time. My younger daughter, for example, loves cucumbers; they’re her favorite vegetable by far. We have a rule at dinner: you’ve got to choose a vegetable to eat. Given her ’druthers, she’d choose cucumber every night. Carrots are pretty good, too; they’re the second choice. But I need her to have some more variety, so I’ll sometimes lie and tell her we’re out of cucumbers and carrots, and that we only have two options: broccoli or green beans, for example. That’s a false choice; I’ve deliberately left out other options. I give her the false choice as a way of manipulating her into choosing green beans, because I know she dislikes broccoli.

Politicians often treat us like children, presenting their preferred policies as the only acceptable choice among an artificially restricted set of options. We might be told, for example, that we need to raise the retirement age or cut Social Security benefits across the board; the budget can't keep up with the rising number of retirees. Well, nobody wants to cut benefits, so we have to raise the retirement age. Bummer. But it's a false choice. There are any number of alternative options for funding an increasing number of retirees: tax increases, re-allocation of other funds, means-testing for benefits, etc.

Liberals are often ambivalent about free trade agreements. On the one hand, access to American markets can help raise the living standards of people from poor countries around the world; on the other hand, such agreements can lead to fewer jobs for American workers in certain sectors of the economy (e.g., manufacturing). So what to do? Support such agreements or not? Seems like an impossible choice: harm the global poor or harm American workers. But it may be a false choice, as this economist argues:

> But trade rules that are more sensitive to social and equity concerns in the advanced countries are not inherently in conflict with economic growth in poor countries. Globalization's cheerleaders do considerable damage to their cause by framing the issue as a stark choice between existing trade arrangements and the persistence of global poverty. And progressives needlessly force themselves into an undesirable tradeoff. . . . Progressives should not buy into a false and counter-productive narrative that sets the interests of the global poor against the interests of rich countries' lower and middle classes. With sufficient institutional imagination, the global trade regime can be reformed to the benefit of both.[10]

When you think about it, almost every election in America is a False Choice. With the dominance of the two major political parties, we're normally presented with a stark, sometimes unpalatable, choice between only two options: the Democrat or the Republican. But of course if enough people decided to vote for a third-party candidate, that person could win. Such candidates do exist. But it's perceived as wasting a vote when you choose someone like that. This fact was memorably highlighted on The Simpsons back in the fall of 1996, before the presidential election between Bill Clinton and Bob Dole. In the episode, the diabolical, scheming aliens Kang and Kodos (the green guys with the tentacles and giant heads who drool constantly) contrive to abduct the two majorparty candidates and perform a "bio-duplication" procedure that allows Kang and Kodos to appear as Dole and Clinton, respectively. The disguised aliens hit the campaign trail and give speeches, making bizarre campaign promises.[11] When Homer reveals the subterfuge to a horrified crowd, Kodos taunts the voters: "It's true; we are aliens. But what are you going to do about it? It's a twoparty system. You have to vote for one of us." When a guy in the crowd declares his intention to vote for a third-party candidate, Kang responds, "Go ahead, throw your vote away!" Then Kang and Kodos laugh maniacally. Later, as Marge and Homer–chained together and wearing neckcollars–are being whipped by an alien slave-driver, Marge complains and Homer quips, "Don't blame me; I voted for Kodos."

Composition

The fallacy of Composition rests on an illicit presumption about the relationship between a whole thing and the parts that make it up. This is an intuitive distinction, between whole and parts: for example, a person

---

[10] Dani Rodrik, "A Progressive Logic of Trade," Project Syndicate, 4/13/2016

[11] Kodos: "I am Clin-ton. As overlord, all will kneel trembling before me and obey my brutal command. End communication."

can be considered as a whole individual thing; it is made up of lots of parts– hands, feet, brain, lungs, etc., etc. We commit the fallacy of Composition when we mistakenly assume that any property that all of the parts share is also a property of the whole. Schematically, it looks like this:

> All of the parts of X have property P.
> Any property shared by all of the parts of a thing is also a property of the whole.
> ---
> X has the property P.

The second premise is the illicit presumption that makes this argument go through. It is illicit because it is simply false: sometimes all the parts of something have a property in common, but the whole does not have that property.

Consider the 1980 U.S. Men's Hockey Team. They won the gold medal at the Olympics that year, beating the unstoppable-seeming Russian team in the semifinals. (That game is often referred to as "The Miracle on Ice" after announcer Al Michaels' memorable call as the seconds ticked off at the end: "Do you believe in miracles? Yes!") Famously, the U.S. team that year was a rag-tag collection of no-name college guys; the average age on the team was 21, making them the youngest team ever to compete for the U.S. in the Olympics. The Russian team, on the other hand, was packed with seasoned hockey veterans with world-class talent.

In this example, the team is the whole, and the individual players on the team are the parts. It's safe to say that one of the properties that all of the parts shared was mediocrity–at least, by the standards of international competition at the time. They were all good hockey players, of course– Division I college athletes–but compared to the Hall of Famers the Russians had, they were mediocre at best. So, all of the parts have the property of being mediocre. But it would be a mistake to conclude that the whole made up of those parts–the 1980 U.S. Men's Hockey Team–also had that property. The team was not mediocre; they defeated the Russians and won the gold medal! They were a classic example of the whole being greater than the sum of its parts.

Consider the following argument:

> Each member on the gymnastics team weighs less than 110 lbs. Therefore, the whole gymnastics team weighs less than 110 lbs.

This arguments commits the composition fallacy. In the composition fallacy one argues that since each part of the whole has a certain feature, it follows that the whole has that same feature. However, you cannot generally identify any argument that moves from statements about parts to statements about wholes as committing the composition fallacy because whether or not there is a fallacy depends on what feature we are attributing to the parts and wholes. Here is an example of an argument that moves from claims about the parts possessing a feature to a claim about the whole possessing that same feature, but doesn't commit the composition fallacy:

> Every part of the car is made of plastic. Therefore, the whole car is made of plastic.

This conclusion does follow from the premises; there is no fallacy here. The difference between this argument and the preceding argument (about the gymnastics team) isn't their form. In fact both arguments have the same form:

Every part of X has the feature f. Therefore, the whole X has the feature f.

And yet one of the arguments is clearly fallacious, while the other isn't. The difference between the two arguments is not their form, but their content. That is, the difference is what feature is being attributed to the parts and wholes. Some features (like weighing a certain amount) are such that if they belong to each part, then it does not follow that they belong to the whole. Other features (such as being made of plastic) are such that if they belong to each part, it follows that they belong to the whole.

Here is another example:

Every member of the team has been to Paris. Therefore the team has been to Paris.

The conclusion of this argument does not follow. Just because each member of the team has been to Paris, it doesn't follow that the whole team has been to Paris, since it may not have been the case that each individual was there at the same time and was there in their capacity as a member of the team. Thus, even though it is plausible to say that the team is composed of every member of the team, it doesn't follow that since every member of the team has been to Paris, the whole team has been to Paris. Contrast that example with this one:

Every member of the team was on the plane. Therefore, the whole team was on the plane.

This argument, in contrast to the last one, contains no fallacy. It is true that if every member is on the plane then the whole team is on the plane. And yet these two arguments have almost exactly the same form. The only difference is that the first argument is talking about the property, having been to Paris, whereas the second argument is talking about the property, being on the plane. The only reason we are able to identify the first argument as committing the composition fallacy and the second argument as not committing a fallacy is that we understand the relationship between the concepts involved. In the first case, we understand that it is possible that every member could have been to Paris without the team ever having been; in the second case we understand that as long as every member of the team is on the plane, it has to be true that the whole team is on the plane. The take home point here is that in order to identify whether an argument has committed the composition fallacy, one must understand the concepts involved in the argument. This is the mark of an informal fallacy: we have to rely on our understanding of the meanings of the words or concepts involved, rather than simply being able to identify the fallacy from its form.

Division

The fallacy of Division is the exact reverse of the fallacy of Composition. It's an inference from the fact that a whole has some property to a conclusion that a part of that whole has the same property, based on the illicit presumption that wholes and parts must have the same properties. Schematically:

X has the property P.
Any property of a whole thing is shared by all of its parts.
x, which is a part of X, has property P.

The second premise is the illicit presumption. It is false, because sometimes parts of things don't have the same properties as the whole. George Clooney is handsome; does it follow that his large intestine is also handsome? Of course not. Toy Story 3 is a funny movie. Remember when Mr. Potato Head had to use a tortilla for his body? Or when Buzz gets flipped into Spanish mode and does the flamenco dance with Jessie? Hilarious. But not all of the parts of the movie are funny. When it looks like all the toys are about to be incinerated at the dump? When Andy finally drives off to college? Not funny at all!

The division fallacy is like the composition fallacy and they are easy to confuse. The difference is that the division fallacy argues that since the whole has some feature, each part must also have that feature. The composition fallacy, as we have just seen, goes in the opposite direction: since each part has some feature, the whole must have that same feature. Here is an example of a division fallacy:

> The house costs 1 million dollars. Therefore, each part of the house costs 1 million dollars.

This is clearly a fallacy. Just because the whole house costs 1 million dollars, it doesn't follow that each part of the house costs 1 million dollars. However, here is an argument that has the same form, but that doesn't commit the division fallacy:

> The whole team died in the plane crash. Therefore each individual on the team died in the plane crash.

In this example, since we seem to be referring to one plane crash in which all the members of the team died ("the" plane crash), it follows that if the whole team died in the crash, then every individual on the team died in the crash. So this argument does not commit the division fallacy. In contrast, the following argument has exactly the same form, but does commit the division fallacy:

> The team played its worst game ever tonight. Therefore, each individual on the team played their worst game ever tonight.

It can be true that the whole team played its worst game ever even if it is true that no individual on the team played their worst game ever. Thus, this argument does commit the fallacy of division even though it has the same form as the previous argument, which doesn't commit the fallacy of division. This shows (again) that in order to identify informal fallacies (like composition and division), we must rely on our understanding of the concepts involved in the argument. Some concepts (like "team" and "dying in a plane crash") are such that if they apply to the whole, they also apply to all the parts. Other concepts (like "team" and "worst game played") are such that they can apply to the whole even if they do not apply to all the parts.

Equivocation

Typical of natural languages is the phenomenon of homonymy24: when words have the same spelling and pronunciation, but different meanings–like 'bat' (referring to the nocturnal flying mammal) and 'bat' (referring to the thing you hit a baseball with). This kind of natural-language messiness allows for potential fallacious exploitation: a sneaky debater can manipulate the subtleties of meaning to convince people of things that aren't true–or at least not justified based on what they say. We call this kind of maneuver the fallacy of equivocation

Here's an example. Consider a banker; let's call him Fred. Fred is the president of a bank, a real big-shot. He's married, but he's not faithful: he's carrying on an affair with one of the tellers at his bank, Linda.

Fred and Linda have a favorite activity: they take long lunches away from their workplace, having romantic picnics at a beautiful spot they found a short walk away. They lay out their blanket underneath an old, magnificent oak tree, which is situated right next to a river, and enjoy champagne and strawberries while canoodling and watching the boats float by. One day–let's say it's the anniversary of when they started their affair–Fred and Linda decide to celebrate by skipping out of work entirely, spending the whole day at their favorite picnic spot. (Remember, Fred's the boss, so he can get away with this.) When Fred arrives home that night, his wife is waiting for him. She suspects that something is up: "What are you hiding, Fred? Are you having an affair? I called your office twice, and your secretary said you were 'unavailable' both times. Tell me this: Did you even go to work today?" Fred replies, "Scout's honor, dear. I swear I spent all day at the bank today."

See what he did there? 'Bank' can refer either to a financial institution or the side of a river–a river bank. Fred and Linda's favorite picnic spot is on a river bank, and Fred did indeed spend the whole day at that bank. He's trying to convince his wife he hasn't been cheating on her, and he exploits this little quirk of language to do so. That's equivocation.

Consider the following argument:

> Children are a headache. Aspirin will make headaches go away.
> Therefore, aspirin will make children go away.

This is a silly argument, but it illustrates the fallacy of equivocation. The problem is that the word "headache" is used equivocally–that is, in two different senses. In the first premise, "headache" is used figuratively, whereas in the second premise "headache" is used literally. The argument is only successful if the meaning of "headache" is the same in both premises. But it isn't and this is what makes this argument an instance of the fallacy of equivocation. Here's another example:

> Taking a logic class helps you learn how to argue. But there is already too much hostility in the world today, and the fewer arguments the better. Therefore, you shouldn't take a logic class.

In this example, the word "argue" and "argument" are used equivocally. Hopefully, at this point in the text, you recognize the difference. (If not, go back and reread section 1.1.)

The fallacy of equivocation is not always so easy to spot. Here is a trickier example. A common argument for the existence of God relies on equivocation between these two senses of 'law':

> There are laws of nature.
> By definition, laws are rules imposed by an Authority.
> So the laws of nature were imposed by an Authority.
> The only Authority who could impose such laws is an all-powerful Creator–God.
> God exists.

This argument relies on fallaciously equivocating between the two senses of 'law'–human and natural. It's true that human laws are by definition imposed by an authority; but that is not true of natural laws. Additional argument is needed to establish that those must be so imposed.

As with every informal fallacy we have examined in this section, equivocation can only be identified by understanding the meanings of the words involved. In fact, the definition of the fallacy of equivocation refers to this very fact: the same word is being used in two different senses (i.e., with two different meanings). So, unlike formal fallacies, identifying the fallacy of equivocation requires that we draw on our understanding of the meaning of words and of our understanding of the world, generally.

Accent

This is one of the original 13 fallacies that Aristotle recognized in his Sophistical Refutations. Our usage, however, will depart from Aristotle's. He identifies a potential for ambiguity and misunderstanding that is peculiar to his language–ancient Greek. That language–in written form–used diacritical marks along with the alphabet, and transposition of these could lead to changes in meaning. English is not like this, but we can identify a fallacy that is roughly in line with the spirit of Aristotle's accent: it is possible, in both written and spoken English (along with every other language), to convey different meanings by stressing individual words and phrases. The devious use of stress to emphasize contents that are helpful to one's rhetorical goals, and to suppress or obscure those that are not–that is the fallacy of accent.

There are a number of techniques one can use with the written word that fall in the category of accent. Perhaps the simplest way to emphasize favorable contents, and de-emphasize unfavorable ones, is to vary the size of one's text. We see this in advertising all the time. You drive past a store that's having a sale, which they advertise with a sign in the window. In the largest, most eye- catching font, you read, "70% OFF!" "Wow," you might think, "that's a really steep discount. I should go in to the store and get a great deal." At least, that's what the store wants you to think. They're emphasizing the fact of (at least one) steep discount. If you look more closely at the sign, however, you'll see the things that they're legally required to say, but that they'd like to de- emphasize. There's a tiny 'Up to' in front of the gigantic '70% OFF!'. For all you know, there's one crappy item that nobody wants, tucked in the back of the store, that's discounted at 70everything else has much smaller discounts, or none at all. Also, if you squint really hard, you'll see an asterisk after the '70% OFF!', which leads to some text at the bottom of the poster, in the tiniest font possible, that reads, "While supplies last. See store details. Not available in all locations. Offer not valid weekends or holidays. All sales are final." This is the proverbial "fine print". It makes the sale look a lot less exciting. So they hide it.

Footnotes are generally a good place to hide unfavorable content. We all know that CEOs of big companies–especially banks–get paid ridiculous sums of money. Some of it is just their salary and stock options; those amounts are huge enough to turn most people off. But there are other perks that are so over-the-top, companies and executives feel like it's best to hide them from the public (and their shareholders) in the footnotes of CEO contracts and SEC reports. Michelle Leder runs a website called footnoted.com, which is dedicated to combing through these documents and exposing outrageous compensation packages. She's uncovered executives spending over $700,000 to renovate their offices, demanding helicopters in addition to their corporate jets, receiving millions of dollars' worth of private security services, etc., etc. These additional, extravagant forms of compensation seem excessive to most people, so companies do all they can to hide them from the public.

Another abuse of footnotes can occur in academic or legal writing. Legal briefs and opinions and academic papers seek to persuade. If you're writing such a document, and you relegate a strong objection to your conclusion to a brief mention in the footnotes23, you're de-emphasizing that point of view and making it less likely that the reader will reject your arguments. That's a fallacious suppression of opposing content, a sneaky trick to try to convince people you're right without giving them a forthright presentation of the merits (and demerits) of your position.

The fallacy of accent can occur in speech as well as writing. The audible correlate of "fine print" is that guy talking really fast at the end of the commercial, rattling off all the unpleasant side effects and legal disclaimers that, if given a full, deliberate presentation might make you less likely to buy the product they're selling. The reason, by the way, that we know about such horrors as the possibility of driving while not awake (a side-effect of some sleep aids) and a four-hour erection (side-effect of erectile-dysfunction drugs), is that drug companies are required, by federal law, not to commit the fallacy of accent if they want to market drugs directly to consumers. They have to read what's called a "major statement" that lists all of these side-effects explicitly, and no fair cramming them in at the end and talking over them really fast. When we speak, how we stress individual words and phrases can alter the meaning that we convey with our utterances. Consider the sentence 'We should not steal our neighbor's car.' Now consider various utterances of that sentence, each stressing a different word; different meanings will be conveyed:

1. *We* should not steal our neighbor's car.
2. We *shouldn't* steal our neighbor's car.
3. We should not *steal* our neighbor's car.
4. We should not steal *our* neighbor's car.
5. We should not steal our *neighbor's* car.
6. We should not steal our neighbor's *car*.

Try saying each of the above sentences out loud, giving special emphasis on a different word each time, and note the change in meaning when you do. By stressing a different word, you change the focus, and thus the meaning, of the sentences. To turn an argument on the ambiguity captured in two or more sentences such as these risks committing the fallacy of accent.

Amphiboly

Finally, the fallacy of amphiboly comes about due to an ambiguity that is attributable to the poor grammatical structure of the sentence. In particular, this will come about when the poor grammical structure causes the sentences to sound strong and logical, when in fact it is not.

Here's an example:

> I'm going to return this car to the dealer I bought this car from. Their ad said "Used 1995 Ford Taurus with air conditioning, cruise, leather, new exhaust and chrome rims." But the chrome rims aren't new at all.

Here, the argument turns on the grammatical ambiguity of the scope of the term "new". Should it be read as including only the exhaust, or also the chrome rims? From the grammar alone, it is impossible to tell. However, from the context, it is probably clear that chrome rims on a 1995 Ford Taurus will not be new, even if the exhaust system is.

Here's another:

> I took some pictures of some kids playing basketball today at the park, but they weren't any good.

From the grammar alone, it's not possible to tell whether the dogs were any good. However, from the context of the speaker, it may be clear. Thus, if we were to make some inference, such as for example, "therefore, those kids should have basketball lessons," we might be making a fallacious inference based on the poor grammatical structure of the original sentence.

Let me end with a famous joke from Groucho Marx: "*One morning I shot an elephant in my pajamas. How he got into my pajamas I'll never know.*"

Chapter 11

Sentential Logic

This chapter introduces a logical language called SL. It is a version of *sentential logic*, because the basic units of the language will represent statements, and a statement is usually given by a complete sentence in English.

11.1 Sentence Letters

The most basic unit in our formal language SL is an individual capital letter—A, B, C, D, etc. These letters, called SENTENCE LETTERS, are used to represent individual statements. Earlier, we defined a statement as some bit of language that can be true or false, and listed all kinds of things that count as statements in English, from "*Tyrannosaurus rex* went extinct 65 million years ago" to "Lady Gaga is pretty." In SL, all these statements are reduced to single capital letters.

Considered only as a symbol of SL, the letter A could mean any statement. In order to specify what we mean, we need to provide a key saying what the sentence letters represent. We will call a list that assigns English phrases or sentences to variable names a TRANSLATION KEY. These are sometimes also called "symbolization keys" or simply just "dictionaries."

Consider this argument (recall that the portion of the passage in italics establishes the context, and is not part of the passage):

> *A teacher is looking to see who has come to class* There is an apple on the desk. If there is an apple on the desk, then Jenny made it to class. Therefore, Jenny made it to class.

In canonical form, the argument would look like this:

1. There is an apple on the desk.
2. If there is an apple on the desk, then Jenny made it to class.

∴ Jenny made it to class.

A good symbolization key for this passage would look like this:

A: There is an apple on the desk.

B: Jenny made it to class.

Why do the symbolization key this way? The argument we are looking at is obviously valid in English. In symbolizing it, we want to preserve the structure of the argument that makes it valid. We could have made each sentence in the original argument into its own letter. Then the symbolization key would look like this:

A: There is an apple on the desk.
B: If there is an apple on the desk, then Jenny made it to class.
C: Jenny made it to class.

But that would mean the argument would look like this:

1. A
2. B

$\therefore C$

There is no necessary connection between some sentence A, which could be any statement, and some other sentences B and C, which could also be anything. The structure of the argument has been completely lost in this translation.

The important thing about the argument is that the second premise is not merely *any* statement, logically divorced from the other statement in the argument. The second premise contains the first premise and the conclusion *as parts*. Our original symbolization key allows us to write the argument like this.

1. A
2. If A, then B.

$\therefore B$

This preserves the structure of the argument that makes it valid, but it still makes use of the English expression "If... then...." Although we ultimately want to replace all of the English expressions with logical notation, this is a good start.

The individual sentence letters in SL are called atomic statements, because they are the basic building blocks out of which more complex sentences can be built. We can identify atomic statements in English as well. An ATOMIC STATEMENT is one that cannot be broken into parts that are themselves sentences. "There is an apple on the desk" is an atomic statement in English, because you can't find any proper part of it that forms a complete statement. For instance "an apple on the desk" is a noun phrase, not a complete statement. Similarly "on the desk" is a prepositional phrase, and not a statement, and "is an" is not any kind of phrase at all. This is what you will find no matter how you divide "There is an apple on the desk." On the other hand you can find two proper parts of "If there is an apple on the desk, then Jenny made it to class" that are complete sentences: "There is an apple on the desk" and "Jenny made it to class." As a general rule, we will want to use atomic sentences in SL (that is, the sentence letters) to represent atomic statement in English. Otherwise, we will lose some of the logical structure of the English sentence, as we have just seen.

Symbol	What it is called	What it means
$\sim$	negation	“It is not the case that. . .”
$\&$	conjunction	“Both . . . and . . .”
$\vee$	disjunction	“Either . . . or . . .”
$\supset$	conditional	“If . . . then . . .”
$\equiv$	biconditional	“. . . if and only if . . .”

Table 11.1: The Sentential Connectives.

There are only 26 letters of the alphabet, but there is no logical limit to the number of atomic statement. We can use the same letter to symbolize different atomic statement by adding a subscript, a small number written after the letter. We could have a symbolization key that looks like this:

$\mathbf{A}_1$: The apple is under the armoire.
$\mathbf{A}_2$: Arguments in SL always contain atomic sentences.
$\mathbf{A}_3$: Adam Ant is taking an airplane from Anchorage to Albany.
⋮
$\mathbf{A}_{294}$: Alliteration angers otherwise affable astronauts.

Keep in mind that each of these is a different sentence letter. When there are subscripts in the symbolization key, it is important to keep track of them.

11.2 Sentential Connectives

The previous section introduced the basic elements of SL, the sentence letters. But when we were looking at the argument involving Jenny and the apple, we saw that the best way to write a dictionary for the argument left the words “if” and “then” in English. In this section we will introduce ways to connect the sentence letters together that will allow us to form a complete artificial language.

The symbols used to connect sentence letters are called SENTENTIAL CONNECTIVES , naturally enough. SL uses five sentential connectives: $\&$, $\vee$, $\sim$, $\supset$, and $\equiv$. To write the sentence about Jenny and the apple we use the symbol “$\supset$.” Using the dictionary above, “If there is an apple on the desk, then Jenny made it to class” becomes $A \supset B$. Table 11.1 summarizes the meaning of the five sentential connectives.

The sentential connectives are a kind of LOGICAL CONSTANT, because their meaning is fixed by the formal language that we have chosen. The other logical constants in SL are the parentheses. These are the things we cannot change in the symbolization key. The sentence letters, by contrast, are NONLOGICAL SYMBOLS, because their meaning can change as we change the symbolization key. We can decide that A stands for “Arthur is an aardvark” in one translation key and “Apu is an anthropologist” in the next. But we can’t say that the the $\sim$ symbol will mean “not” in one argument and “perhaps” in another.

The subsections below describe each connective in more detail.

Negation

Consider how we might symbolize these sentences:

1. Mary is in Barcelona.
2. Mary is not in Barcelona.
3. Mary is somewhere other than Barcelona.

In order to symbolize sentence 1, we will need one sentence letter. We can provide a symbolization key:

B: Mary is in Barcelona.

Note that here we are giving B a different interpretation than we did in the previous section. The symbolization key only specifies what B means *in a specific context*. It is vital that we continue to use this meaning of B so long as we are talking about Mary and Barcelona. Later, when we are symbolizing different sentences, we can write a new symbolization key and use B to mean something else.

Now, sentence 1 is simply B. Sentence 2 is obviously related to sentence 1: it is basically 1 with a "not" added. We could put the sentence partly our symbolic language by writing "Not B." This means we do not want to introduce a different sentence letter for 2. We just need a new symbol for the "not" part. Let's use the symbol '∼,' which we will call NEGATION. Now we can translate 'Not B' to $\sim B$.

Sentence 3 is about whether or not Mary is in Barcelona, but it does not contain the word "not." Nevertheless, it is obviously logically equivalent to sentence 2. They both say that if you are looking for Mary, you shouldn't look in Barcelona. We can say that two sentences in English are logically equivalent if they always have the same truth value. For our purposes, this means that they basically say the same thing. It is clear then that 2 and 3 are logically equivalent, so we can translate them both as $\sim B$.

Consider these further examples:

4. The widget can be replaced if it breaks.
5. The widget is irreplaceable.
6. The widget is not irreplaceable.

If we let R mean "The widget is replaceable", then sentence 4 can be translated as R. Sentence 5 means the opposite of sentence 4, so we can translate it $\sim R$. Sentence 6 adds another negation to sentence 5. We know, as competent English speakers, that the two negations cancel each other out, so that sentence 6 is equivalent to sentence 4. But the fact that two negations cancel each other out is a part of the logic of English that we actually want to capture with our formal language SL. So we will represent the two negations in sentence 6 as two negations in SL: $\sim\sim R$. We will now have to be sure that in SL the sentences R and $\sim\sim R$ mean the same thing.

As the above examples begin to indicate, English has all kinds of ways to negate a sentence. Sometimes we use an explicit "not." Sometimes we use a prefix like the "ir-" in "irreplaceable." SL has just one way to form a negation: slap a ∼in front of the sentence. There is an English expression, however, that always occurs in the same place in an English sentence as the ∼occurs in the sentence SL. The English phrase is "It is not the case that." Although this phrase sounds awkward, it always occurs in front of the sentence it is negating, just as the symbol ∼does. This makes it useful in translating sentences from SL back into English. $\sim R$ can be translated "it is not the case that this widget is replaceable." In the earlier example, $\sim B$ can be translated "It is not the case that Mary is in Barcelona."

A sentence can be symbolized as $\sim\mathcal{A}$ can always be paraphrased in English as "It is not the case that $\mathcal{A}$."

Sometimes negations in English do not function as neatly as the $\sim$does in SL, because two things aren't perfect opposites. Consider these sentences:

7. Elliott is happy.
8. Elliott is unhappy.

If we let H mean "Elliot is happy", then we can symbolize sentence 7 as H, but does 8 really mean the same thing as $\sim H$? Saying "Elliott is unhappy" indicates that Elliott is actively sad. But $\sim H$ can be paraphrase as simply "It is not the case that Elliott is happy," which might merely mean that Elliott is just feeling neutral. The logics we discuss in this textbook are *bivalent*; statements are only either true or false. Everything is in black and white, and issues like Elliott's fine gradations in mood cannot be directly represented in our system. So in SL, sentences 7 and 8 would generally be represented by separate sentence letters.

One way of capturing the meaning of a sentential connective is to make a table which shows how the connective changes the meaning of the sentences it is applied to. The negation simply reverses the truth value of any sentence it is put in front of. For any sentence $\mathcal{A}$: If $\mathcal{A}$ is true, then $\sim\mathcal{A}$ is false. If $\sim\mathcal{A}$ is true, then $\mathcal{A}$ is false. Using T for true and F for false, we can summarize this in a *characteristic truth table* for negation:

$\mathcal{A}$	$\sim\mathcal{A}$
T	F
F	T

We will discuss truth tables at greater length in the next chapter.

Conjunction

Consider these sentences:

9. Adam is athletic.
10. Barbara is athletic.
11. Adam is athletic, and Barbara is also athletic.

We will need separate sentence letters for 9 and 10, so we define this symbolization key:

A: Adam is athletic.
B: Barbara is athletic.

Sentence 9 can be symbolized as A. Sentence 10 can be symbolized as B. Sentence 11 can be paraphrased as "A and B." In order to fully symbolize this sentence, we need another symbol. We will use & . We translate "A and B" as $A \,\&\, B$. The logical connective &is called the CONJUNCTION, and A and B are each called CONJUNCTS.

Notice that we make no attempt to symbolize "also" in sentence 11. Words like "both" and "also" function to draw our attention to the fact that two things are being conjoined. They are not doing any further logical work, so we do not need to represent them in SL.

Some more examples:

12. Barbara is athletic and energetic.
13. Barbara and Adam are both athletic.
14. Although Barbara is energetic, she is not athletic.
15. Barbara is athletic, but Adam is more athletic than she is.

Sentence 12 is obviously a conjunction. The sentence says two things about Barbara, that she is athletic and engergetic. In English, it is acceptable to only say "Barbara" once, even though two statements are being made about her. Because of this, you might be tempted just to translate the first part of the English sentence with a sentence letter and leave the second part dangling. B would then stand for "Barbara is athletic," and the full sentence would be "B and energetic." But this doesn't work, because "and energetic" isn't a statement. On its own, it can't be true or false. We should instead paraphrase the sentence as "B and Barbara is energetic." Now we need to add a sentence letter to the symbolization key. Let E mean "Barbara is energetic." Now the sentence can be translated as $B \& E$.

A sentence can be symbolized as $\mathcal{A} \& \mathcal{B}$ if it can be paraphrased in English as 'Both $\mathcal{A}$, and $\mathcal{B}$.' Each of the conjuncts must be a sentence.

Sentence 13 says one thing about two different subjects. It says of both Barbara and Adam that they are athletic, and in English we use the word "athletic" only once. In translating to SL, it is important to realize that the sentence can be paraphrased as, "Barbara is athletic, and Adam is athletic." This translates as $B \& A$.

Sentence 14 is a bit more complicated. The word "although" sets up a contrast between the first part of the sentence and the second part. Nevertheless, the sentence says both that Barbara is energetic and that she is not athletic. In order to make each of the conjuncts an atomic statement, we need to replace "she" with "Barbara."

So we can paraphrase sentence 14 as, "*Both* Barbara is energetic, *and* Barbara is not athletic." The second conjunct contains a negation, so we paraphrase further: "*Both* Barbara is energetic *and it is not the case that* Barbara is athletic." This translates as $E \& {\sim}B$.

Sentence 15 contains a similar contrastive structure. It is irrelevant for the purpose of translating to SL, so we can paraphrase the sentence as "*Both* Barbara is athletic, *and* Adam is more athletic than Barbara." (Notice that we once again replace the pronoun "she" with her name.) How should we translate the second conjunct? We already have the sentence letter A which is about Adam's being athletic and B which is about Barbara's being athletic, but neither is about one of them being more athletic than the other. We need a new sentence letter. Let R mean "Adam is more athletic than Barbara." Now the sentence translates as $B \& R$.

Sentences that can be paraphrased "$\mathcal{A}$, but $\mathcal{B}$" or "Although $\mathcal{A}$, $\mathcal{B}$" are best symbolized using conjunction $\mathcal{A}\ \& \mathcal{B}$.

It is important to keep in mind that the sentence letters A, B, and R are atomic statements. Considered as symbols of SL, they have no meaning beyond being true or false. We have used them to symbolize different English language sentences that are all about people being athletic, but this similarity is completely lost when we translate to SL. No formal language can capture all the structure of the English language, but as long as this structure is not important to the argument there is nothing lost by leaving it out.

As with the negation, we can understand the meaning of the conjunction by making a table that shows how the conjunction affects the truth value of the sentences it is bringing together. For any sentences $\mathcal{A}$ and $\mathcal{B}$, $\mathcal{A}\ \&\ \mathcal{B}$ is true if and only if both $\mathcal{A}$ and $\mathcal{B}$ are true. We can summarize this in the characteristic truth table for conjunction:

$\mathcal{A}$	$\mathcal{B}$	$\mathcal{A}\ \&\ \mathcal{B}$
T	T	T
T	F	F
F	T	F
F	F	F

Conjunction is symmetrical because we can swap the conjuncts without changing the truth value of the sentence. Regardless of what $\mathcal{A}$ and $\mathcal{B}$ are, $\mathcal{A}\ \&\ \mathcal{B}$ is logically equivalent to $\mathcal{B}\ \&\ \mathcal{A}$.

Disjunction

Consider these sentences:

16. Either Denison will play golf with me, or he will watch movies.
17. Either Denison or Ellery will play golf with me.

For these sentences we can use this symbolization key:

D: Denison will play golf with me.
E: Ellery will play golf with me.
M: Denison will watch movies.

Sentence 16 is "Either D or M." To fully symbolize this, we introduce a new symbol. The sentence becomes $D \vee M$. The $\vee$ connective is called DISJUNCTION, and D and M are called DISJUNCTS.

Sentence 17 is only slightly more complicated. There are two subjects, but the English sentence only gives the verb once. In translating, we can paraphrase it as "Either Denison will play golf with me, or Ellery will play golf with me." Now it obviously translates as $D \vee E$.

A sentence can be symbolized as $\mathcal{A} \vee \mathcal{B}$ if it can be paraphrased in English as "Either $\mathcal{A}$ or $\mathcal{B}$." Each of the disjuncts must be a sentence.

The English word "or" is somewhat ambiguous. Sometimes in English, when we say "this or that," we mean that either option is possible, but not both. For instance, if a restaurant menu says, "Entrées come with either soup or salad" we naturally assume you can have soup, or you can have salad; but, if you want *both* soup *and* salad, then you will have to pay extra. This kind of disjunction is called an EXCLUSIVE OR , because it excludes the possibility that both disjuncts are true.

At other times, the word "or" allows for the possibility that both disjuncts might be true. This is probably the case with sentence 17, above. I might play with Denison, with Ellery, or with both Denison and Ellery. Sentence 17 merely says that I will play with *at least* one of them. The INCLUSIVE OR is the kind of disjunction that allows for the possibility that both disjuncts are true. The inclusive or says "This or that, or both."

To goal of a formal language is to remove ambiguity, so we need to pick one of these ors. SL follows tradition and uses the symbol $\vee$ to represent an *inclusive or*. This winds up being reflected in the characteristic truth table for the $\vee$. The sentence $D \vee E$ is true if D is true, if E is true, or if both D and E are true. It is false only if both D and E are false. The truth table looks like this:

$\mathcal{A}$	$\mathcal{B}$	$\mathcal{A} \vee \mathcal{B}$
T	T	T
T	F	T
F	T	T
F	F	F

Like conjunction, disjunction is symmetrical. $\mathcal{A} \vee \mathcal{B}$ is logically equivalent to $\mathcal{B} \vee \mathcal{A}$.

Conditional

We already met the conditional at the start of this section, when we were discussing the sentence "If there is an apple on the table, Jenny made it to class," which became $A \supset B$. The symbol $\supset$ is called a CONDITIONAL. The sentence on the left-hand side of the conditional (R in this example) is called the ANTECEDENT. . The sentence on the right-hand side (B) is called the CONSEQUENT.

Like the English word "or," the English phrase "if. . . then. . . " has some ambiguity. Consider our original example, "If there is an apple on the table, Jenny made it to class." The statements tells us what we should infer if there is an apple on the table, but what if there *isn't* an apple on the table. Does that guarantee that Jenny did not make it to class? It could be that an apple on the table is a clear sign that Jenny made it to class, because no one else would put an apple on the table, but nevertheless Jenny sometimes comes to class without putting an apple on the table.

We can get a good sense of the decision we face if we try to write up the characteristic truth table for the conditional. The first two lines are easy. The sentence"If $\mathcal{A}$, then $\mathcal{B}$" means that if $\mathcal{A}$ is true, then so is $\mathcal{B}$. This would be confirmed by the situation where both $\mathcal{A}$ and $\mathcal{B}$ are true, but falsified by the situation where $\mathcal{A}$ is true and $\mathcal{B}$ is false. In terms of our example, if we came to class and found the apple there, but Jenny absent, we would know that the statement "If there is an apple on the table, Jenny made it to class" is false. But if we came to class and found both Jenny and the apple present, we could say that the statement "If there is an apple on the table, Jenny made it to class" is true. That gives us this much of a truth table.

$\mathcal{A}$	$\mathcal{B}$	$\mathcal{A} \supset \mathcal{B}$
T	T	T
T	F	F
F	T	?
F	F	?

How do we fill in the question marks in the last two lines? In real life, we would generally make judgments on a case by case basis, relying heavily on the context we are in. But for a formal language we just want to lay down a simple rule. The traditional solution for sentential logic is to say that the conditional is what logicians call a "material conditional." If the antecedent of a material conditional is false, then the whole statement is automatically true, regardless of the truth value of $\mathcal{B}$. In short, $\mathcal{A} \supset \mathcal{B}$ is false if and only if $\mathcal{A}$ is true and $\mathcal{B}$ is false. We can summarize this with a characteristic truth table for the conditional.

$\mathcal{A}$	$\mathcal{B}$	$\mathcal{A} \supset \mathcal{B}$
T	T	T
T	F	F
F	T	T
F	F	T

The conditional is asymmetrical. You cannot swap the antecedent and consequent without changing the meaning of the sentence, because $\mathcal{A} \supset \mathcal{B}$ and $\mathcal{B} \supset \mathcal{A}$ are not logically equivalent.

Not all sentences of the form "If…, then…" are conditionals. Consider this sentence:

18. If anyone wants to see me, then I will be on the porch.

When I say this, it means that I will be on the porch, regardless of whether anyone wants to see me or not—but if someone did want to see me, then they should look for me there. If we let P mean "I will be on the porch," then sentence 18 can be translated simply as P.

Biconditional

The conditional was an asymmetric connective. The sentence $A \supset B$ does not mean the same thing as the sentence $B \supset A$. It is convenient to have a single symbol that combines the meaning of these two sentences. The BICONDITIONAL—written as double headed arrow, $\equiv$—is a sentential connective used to represent a situation where A implies B and B implies A.

To draw up the characteristic truth table for the biconditional, we need to think about the situations where $A \supset B$ and $B \supset A$ are false. The sentence $A \supset B$ is only false when A is true and B is false. For $B \supset A$ the reverse is true. It is false when B is true and A is false. Our biconditional $A \equiv B$ needs to avoid both of these situations to be true, because it is only true when $A \supset B$ and $B \supset A$ are true. This, then, is the characteristic truth table for the biconditional. It says that the biconditional is true when the truth values of the two sides match.

$\mathcal{A}$	$\mathcal{B}$	$\mathcal{A} \equiv \mathcal{B}$
T	T	T
T	F	F
F	T	F
F	F	T

If the bioconditional holds between two sentences, we can that the two sentences are logically equivalent. We can say that two sentences were logically equivalent if they always have the same truth value. That is exactly what is happening here.

11.3 More Complicated Translations

The previous section introduced the five sentential connectives. Now we will look at some trickier translations involving those connectives

Combining connectives

A single sentence in SL can use multiple connectives.

Consider the English sentence "If it is not raining, we will have a picnic." There are two aspects of this sentence we will want to represent with sentential connectives in SL, the "if…then…" structure and the negation in the first part of the sentence. The rest of the sentence can be represented by these sentence letters

A**:** It is raining.
M**:** We will have a picnic.

We can then translate the whole sentence into SL like this: $\sim A \supset B$. We can make sentences as complicated as we want this way, even to the point where the equivalent English sentence would be impossible to follow. The sentence $\sim(P \,\&\, Q) \supset [(R \vee S) \equiv \sim(T \,\&\, U)]$ is perfectly acceptable in SL, even if any English sentence it translates into would be a monster. This is part of the power of a complete formal language like SL, but it is also why arguments in SL begin to resemble the ob/ob mouse more than they resemble any argument you might encounter in the wild.

Although sentences in SL can be as long as you like, you can't just combine symbols any old way. There is a specific set of rules you have to follow. These are outlined in section 11.3, below.

The fact that we can write these more complicated sentences means we can actually do without some of the connectives we have given ourselves in SL. For instance, we don't really need the biconditional. Any sentence of the form $\mathscr{A} \equiv \mathscr{B}$ is going to be equivalent to the sentence $(\mathscr{A} \supset \mathscr{B}) \,\&\, (\mathscr{B} \supset \mathscr{A})$. This just follows from the way we defined the biconditional earlier. Nevertheless, tradition and convenience mandate that we give the biconditional a separate symbol.

Unless

Because our connectives can be put together in different ways, some English sentences can be represented equally well by multiple sentences in SL. English sentences involving the word "unless" are a case in point.

19. Unless you wear a jacket, you will catch cold.
20. You will catch cold unless you wear a jacket.

These are basically two different version of the same English sentence. The only difference is that in one case, the "unless" clause comes first, and in the other it comes second. Let J mean "You will wear a jacket" and let C mean "You will catch a cold." We can paraphrase sentence 19 as "Unless J, C." This means that if you do not wear a jacket, then you will catch cold. With this in mind, we might translate it as $\sim J \supset C$. It also means that if you do not catch a cold, then you must have worn a jacket; with this in mind, we might translate it as $\sim C \supset J$.

Which of these is the correct translation of sentence 19? Both translations are correct, because the two translations are logically equivalent in SL. Sentence 20, in English, is logically equivalent to sentence 19. So, it also can be translated as either $\sim J \supset D$ or $\sim D \supset J$.

When symbolizing sentences like sentence 19 and sentence 20, it is easy to get turned around. We have two different versions of the English sentence and two different versions of the sentence in SL. The important thing to see here is that none of these sentences are equivalent to $J \supset \sim D$. The negated statement must be the antecedent to the conditional.

If this is too many options to keep track of, there is a simpler alternative. It turns out that any "unless" statement is actually equivalent to an "or" statement. Both statements 19 and 20 mean that you will wear a jacket or—if you do not wear a jacket—then you will catch a cold. So we can translate them as $J \vee D$. (You might worry that the "or" here should be an *exclusive or*. However, the sentences do not exclude the possibility that you might *both* wear a jacket *and* catch a cold; jackets do not protect you from all the possible ways that you might catch a cold.)

If a sentence can be paraphrased as "Unless $\mathcal{A}$, $\mathcal{B}$," then it can be symbolized as $\mathcal{A} \vee \mathcal{B}$.

Only

[The word "only" can reverse the meaning of a conditional sentence in SL.]For the following sentences, let R mean "You will cut the red wire" and B mean "The bomb will explode."

21. If you cut the red wire, then the bomb will explode.
22. The bomb will explode only if you cut the red wire.

Sentence 21 can be translated partially as "If R, then B." Sentence 22 is also a conditional. Since the word "if" appears in the second half of the sentence, it might be tempting to symbolize this in the same way as sentence 21. That would be a mistake.

The conditional $R \supset B$ says that *if* R were true, *then* B would also be true. It does not say that you cutting the red wire is the *only* way that the bomb could explode. Someone else might cut the wire, or the bomb might be on a timer. The sentence $R \supset B$ does not say anything about what to expect if R is false. Sentence 22 is different. It says that the only conditions under which the bomb will explode involve you having cut the red wire; i.e., if the bomb explodes, then you must have cut the wire. As such, sentence 22 should be symbolized as $B \supset R$.

It is important to remember that the connective $\supset$ says only that, if the antecedent is true, then the consequent is true. It says nothing about the *causal* connection between the two events. Translating sentence 22 as $B \supset R$ does not mean that the bomb exploding would somehow have caused you cutting the wire. Both sentence 21 and 22 suggest that, if you cut the red wire, you cutting the red wire would be the cause of the bomb exploding. They differ on the *logical* connection. If sentence 22 were true, then an explosion would tell us—those of us safely away from the bomb—that you had cut the red wire. Without an explosion, sentence 22 tells us nothing.

The paraphrased sentence "$\mathcal{A}$ only if $\mathcal{B}$" is logically equivalent to "If $\mathcal{A}$, then $\mathcal{B}$."

Things can get a bit more complicated, because English also allows you to reverse the order of the clauses. Think about this sentence

23. The bomb will explode, if you cut the red wire

This is just sentence 21 with the order of the clauses reversed, so it still means $R \supset B$. Changing the order of the English clauses does not change the sentence in SL, but adding the word "only" does.

If this gets confusing, just remember this rule:

“If. . . ” introduces the antecedent. “Only if. . . ” introduces the consequent.

Because “if” and “only if” have opposite meanings, when we put them together, we get the biconditional. Consider these sentences:

24. The figure on the board is a triangle only if it has exactly three sides.
25. The figure on the board is a triangle if it has exactly three sides.
26. The figure on the board is a triangle if and only if it has exactly three sides.

Let T mean “The figure is a triangle” and S mean “The figure has three sides.” Sentence 24, for reasons discussed above, can be translated as $T \supset S$. Sentence 25 is importantly different. It can be paraphrased as “If the figure has three sides, then it is a triangle.” So it can be translated as $S \supset T$.

Sentence 26 says that T is true *if and only if* S is true; we can infer S from T, and we can infer T from S. In other words, 26 is equivalent to $T \supset S$ and $S \supset T$, which is the same as $T \equiv S$

A final way to think about the way “only” effects a conditional sentence is to think about the difference between necessary and sufficient conditions. In a way, the terms are pretty much self explanatory. Nevertheless, it is really easy to get them confused, to the extent that even professional logicians and trained philosophers can get them mixed up.

A NECESSARY CONDITION is one that is needed for something else to be true, just like the name says. Having gas in the tank is a *necessary* condition for the car to move. It just doesn’t go anywhere without gas. However, having gas in the tank isn’t *all you need* to get the car moving. You also have to put the key in the ignition and turn it.

A SUFFICIENT CONDITION, on the other hand, is *all you need* for something else to be true. If something is a dog, that is a *sufficient* condition for it to be a mammal. Once you know Cupcake (Fig. 11.1) is a dog, you have enough information to infer that she is a mammal. Being a dog is not a necessary condition for being a mammal however. You can also be a mammal being being a cat, or a human, or a wombat.

The conditional symbol in SL represents a sufficient condition, at least when read forward. That is, the antecedent is a sufficient condition for the consequent. If you have the antecedent, that is all you need to know to infer the consequent. So if D is “Cupcake is a dog” and M is “Cupcake is a mammal, then $D \supset C$ is true. Being a dog is sufficient for being a mammal. As it turns out, if the relationship is sufficient going one direction, it is necessary going the other. So being a mammal is a necessary condition for being a mammal. If cupcake weren’t a mammal, there would be no way for her to be a dog. Figure 11.2 shows this relationship.

Combining negation with conjunction and disjunction

Tricky things happen when you combine a negation with a conjunction or disjunction, so it is worth taking a closer look here. Consider these sentences

27. Either you will not have soup, or you will not have salad.
28. You will have neither soup nor salad.

We let S_1 mean that you get soup and S_2 mean that you get salad. Sentence 27 can be paraphrased in this way: “Either *it is not the case that* you get soup, or *it is not the case that* you get salad.” Translating this requires both disjunction and negation. It becomes $\sim S_1 \vee \sim S_2$.

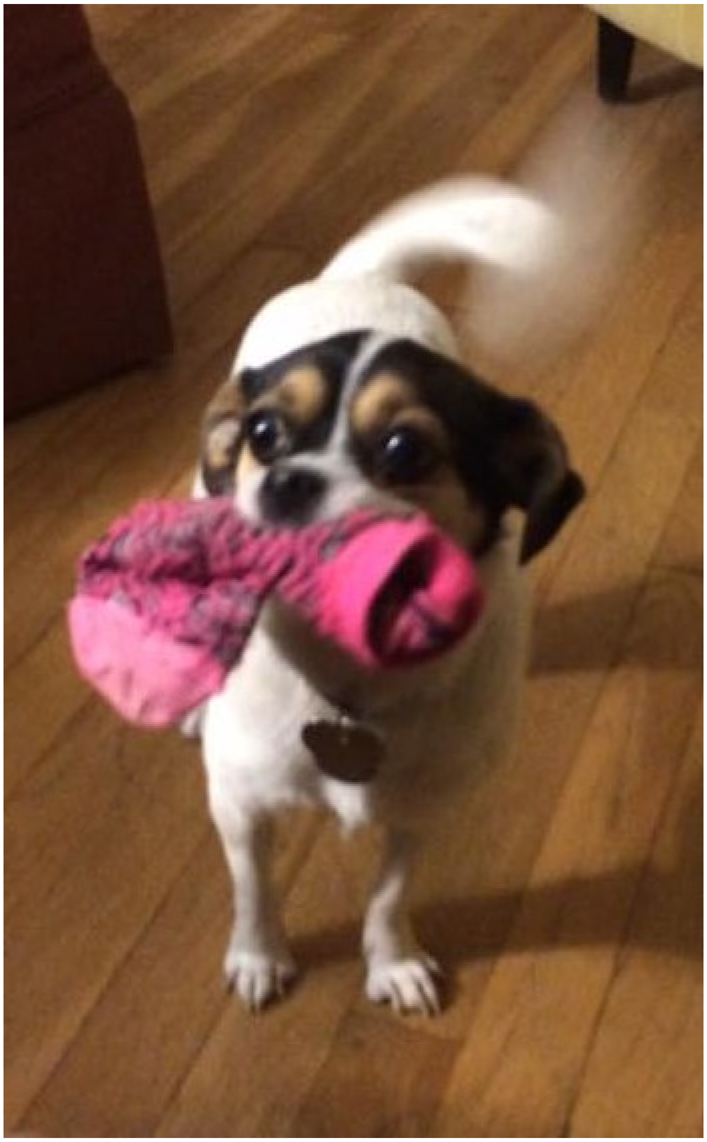


Figure 11.1: This is Cupcake. The fact that she is a dog is a *sufficient* condition for her to be a mammal. She also likes socks.

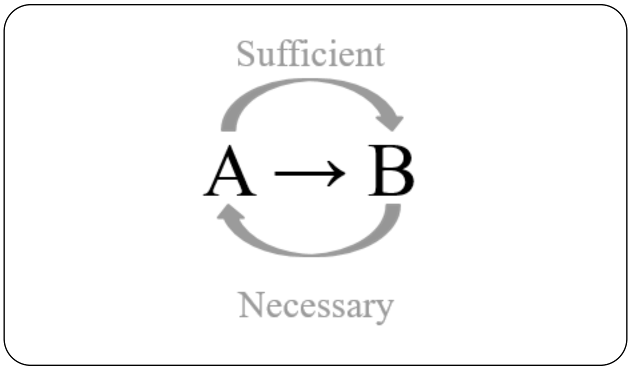


Figure 11.2: The antecedent of a material conditional is a sufficient condition for the consequent, while the consequent is a necessary condition for the antecedent.

Sentence 28 also requires negation. It can be paraphrased as, "*It is not the case that* either you get soup or you get salad." We need some way of indicating that the negation does not just negate the right or left disjunct, but rather negates the entire disjunction. In order to do this, we put parentheses around the disjunction: "It is not the case that $(S_1 \vee S_2)$." This becomes simply $\sim(S_1 \vee S_2)$. Notice that the parentheses are doing important work here. The sentence $\sim S_1 \vee S_2$ would mean "Either you will not have soup, or you will have salad."

Something similar happens with negation and conjunction. Consider these sentences

29. You can't have soup and you can't have salad.
30. You can't have both soup and salad.

In sentence 29, the two parts of the sentence are negated individually. We would translate it into SL like this: $\sim S_1 \,\&\, \sim S_2$. In sentence 30, the negation applies to soup and salad taken together. You are allowed to have soup only, or salad only. You just can't have both together. We would translate sentence 30 like this: $\sim(S_1 \,\&\, S_2)$.

You can combine disjunction, conjunction, and negation to represent the exclusive or, as in this sentence.

31. You get either soup or salad, but not both.

Remember on page 151, we said that the $\vee$ in SL represented an inclusive or. It said "this or that or both." If we want to represent an exclusive or, we need to combine disjunction, conjuction and negation. We can break the sentence into two parts. The first part says that you get one or the other. We translate this as $(S_1 \vee S_2)$. The second part says that you do not get both. We can paraphrase this as "It is not the case both that you get soup and that you get salad." Using both negation and conjunction, we translate this as $\sim(S_1 \,\&\, S_2)$. Now we just need to put the two parts together. As we saw above, "but" can usually be translated as a conjunction. Sentence 31 can thus be translated as $(S_1 \vee S_2) \,\&\, \sim(S_1 \,\&\, S_2)$.

11.4 Recursive Syntax for SL

The previous two sections gave you a rough, informal sense of how to create sentences in SL. If I give you an English sentence like "Grass is either green or brown," you should be able to write a corresponding sentence in SL: "$A \vee B$." In this section we want to give a more precise definition of a sentence in SL. When we defined statements in English, we did so using the concept of truth: Sentences were units of language that can be true or false. When we talk abotu strings of symbols in SL, we can actually say whether they are actually parts of SL without talking about their truth. So we are going to call them sentences rather than statements, and we are going to define a sentence in SL just by looking at its structure. This is one respect in which a formal language like SL is more precise than a natural language like English.

The structure of a sentence in SL considered without reference to truth or falsity is called its syntax. More generally SYNTAX refers to the study of the properties of language that are there even when you don't consider meaning. Whether a sentence is true or false is considered part of its meaning. In this chapter, we will be giving a purely syntactical definition of a sentence in SL. The contrasting term is SEMANTICS the study of aspects of language that relate to meaning, including truth and falsity. (The word "semantics" comes from the Greek word for "mark")

If we are going to define a sentence in SL just using syntax, we will need to carefully distinguish SL from the language that we use to talk about SL. When you create an artificial language like SL, the language that you are creating is called the OBJECT LANGUAGE. The language that we use to talk about the object language is called the METALANGUAGE. Imagine building a house. The object language is like the house itself. It is the thing we are building. While you are building a house, you might put up scaffolding around it. The scaffolding isn't part of the the house. You just use it to build the house. The metalanguage is like the scaffolding.

The object language in this chapter is SL. For the most part, we can build this language just by talking about it in ordinary English. However we will also have to build some special scaffolding that is not a part of SL, but will help us build SL. Our metalanguage will thus be ordinary English plus this scaffolding.

An important part of the scaffolding are the METAVARIABLES These are the fancy script letters we have been using in the characteristic truth tables for the connectives: $\mathcal{A}$, $\mathcal{B}$, $\mathcal{C}$, etc. These are letters that can refer to any sentence in SL. They can represent sentences like P or Q, or they can represent longer sentences, like $(((A \vee B) \,\&\, G) \supset (P \equiv Q))$. Just as the sentence letters A, B, etc. are variables that range over any English sentence, the metavariables $\mathcal{A}$, $\mathcal{B}$, etc. are variables that range over any sentence in SL, including the sentence letters A, B, etc.

As we said, in this chapter we will give a syntactic definition for "sentence of SL." The definition itself will be given in mathematical English, the metalanguage. Table 11.2 gives the basic elements of SL.

Most random combinations of these symbols will not count as sentences in SL. Any random connection of these symbols will just be called a "string" or "expression" Random strings only become meaningful sentences when the are structured according to the rules of syntax. We saw from the earlier two sections that individual sentence letters, like A and G_{13} counted as sentences. We also saw that we can put these sentences together using connectives so that $\sim A$ and $\sim G_{13}$ is a sentence. The problem is, we can't simply list all the different sentences we can put together this way, because there are infinitely many of them. Instead, we will define a sentence in SL by specifying the process by which they are constructed.

Consider negation: Given any sentence $\mathcal{A}$ of SL, $\sim\mathcal{A}$ is a sentence of SL. It is important here that $\mathcal{A}$ is not

Element	Symbols
sentence letters	$A, B, C, \ldots, Z$ $A_1, B_1, Z_1, A_2, A_{25}, J_{375}, \ldots$
connectives	$\sim, \&, \vee, \supset, \equiv$
parentheses	(,)

Table 11.2: The basic elements of SL

the sentence letter A. Rather, it is a metavariable: part of the metalanguage, not the object language. Since $\mathcal{A}$ is not a symbol of SL, $\sim\mathcal{A}$ is not an expression of SL. Instead, it is an expression of the metalanguage that allows us to talk about infinitely many expressions of SL: all of the expressions that start with the negation symbol.

We can say similar things for each of the other connectives. For instance, if $\mathcal{A}$ and $\mathcal{B}$ are sentences of SL, then $(\mathcal{A} \,\&\, \mathcal{B})$ is a sentence of SL. Providing clauses like this for all of the connectives, we arrive at the following formal definition for a SENTENCE OF SL:

1. Every atomic statement is a sentence.
2. If $\mathcal{A}$ is a sentence, then $\sim\mathcal{A}$ is a sentence of SL.
3. If $\mathcal{A}$ and $\mathcal{B}$ are sentences, then $(\mathcal{A} \,\&\, \mathcal{B})$ is a sentence.
4. If $\mathcal{A}$ and $\mathcal{B}$ are sentences, then $(\mathcal{A} \vee \mathcal{B})$ is a sentence.
5. If $\mathcal{A}$ and $\mathcal{B}$ are sentences, then $(\mathcal{A} \supset \mathcal{B})$ is a sentence.
6. If $\mathcal{A}$ and $\mathcal{B}$ are sentences, then $(\mathcal{A} \equiv \mathcal{B})$ is a sentence.
7. All and only sentences of SL can be generated by applications of these rules.

We can apply this definition to see whether an arbitrary string is a sentence. Suppose we want to know whether or not $\sim\sim\sim D$ is a sentence of SL. Looking at the second clause of the definition, we know that $\sim\sim\sim D$ is a sentence *if* $\sim\sim D$ is a sentence. So now we need to ask whether or not $\sim\sim D$ is a sentence. Again looking at the second clause of the definition, $\sim\sim D$ is a sentence *if* $\sim D$ is. Again, $\sim D$ is a sentence *if* D is a sentence. Now D is a sentence letter, an atomic statementof SL, so we know that D is a sentence by the first clause of the definition. So for a compound formula like $\sim\sim\sim D$, we must apply the definition repeatedly. Eventually we arrive at the atomic statement from which the sentence is built up.

Definitions like this are called recursive. RECURSIVE DEFINITIONS begin with some specifiable base elements and define ways to indefinitely compound the base elements. Just as the recursive definition allows complex sentences to be built up from simple parts, you can use it to decompose sentences into their simpler parts. To determine whether or not something meets the definition, you may have to refer back to the definition many times. Recursive definitions are also sometimes called "inductive definitions."

We are now in a position to define what it means for a system of logic to be a system of sentential logic. A SENTENTIAL LOGIC is a system of logic in which statements can be defined using a recursive definition with only sentences in the base class. This book defines on system of sentential logic, which we call SL. Other books use other systems.

When you use a connective to build a longer sentence from shorter ones, the shorter sentences are said to be in the SCOPE of the connective. So in the sentence $(A \,\&\, B) \supset C$, the scope of the connective $\supset$ includes $(A \,\&\, B)$ and C. In the sentence $\sim(A \,\&\, B)$ the scope of the $\sim$ is $(A \,\&\, B)$. On the other hand, in the sentence $\sim A \,\&\, B$ the scope of the $\sim$ is just A.

The last connective that you add when you assemble a sentence using the recursive definition is the MAIN CONNECTIVE of that sentence. For example: The main logical operator of $\sim(E \vee (F \supset G))$ is negation, $\sim$. The main logical operator of $(\sim E \vee (F \supset G))$ is disjunction, $\vee$. The main connective of any sentence will have all the rest of the sentence in its scope.

Because statement in our language is defined recursively, we can say it is "uniquely readable." UNIQUE READABILITY is a property of formal languages which is present when each statement can only be constructed in a single way. Every process of building up a sentence recursively yields a unique sentence, and every sentence is the product of a unique process of recursive definitions. This means that in an important sense our language SL is free of ambiguity, which is a key goal in the construction of any formal language. Every sentence in SL will have a unambiguous main connective and every connective in a sentence will have an unambiguous scope. This makes logicians happy.

Notational conventions

A sentence like $(Q \,\&\, R)$ must be surrounded by parentheses, because we might apply the definition again to use this as part of a more complicated sentence. If we negate $(Q \,\&\, R)$, we get $\sim(Q \,\&\, R)$. If we just had $Q \,\&\, R$ without the parentheses and put a negation in front of it, we would have $\sim Q \,\&\, R$. It is most natural to read this as meaning the same thing as $(\sim Q \,\&\, R)$, something very different than $\sim(Q \,\&\, R)$. The sentence $\sim(Q \,\&\, R)$ means that it is not the case that both Q and R are true; Q might be false or R might be false, but the sentence does not tell us which. The sentence $(\sim Q \,\&\, R)$ means specifically that Q is false and that R is true. As such, parentheses are crucial to the meaning of the sentence.

So, strictly speaking, $Q \,\&\, R$ without parentheses is *not* a sentence of SL. When using SL, however, we will often be able to relax the precise definition so as to make things easier for ourselves. We will do this in several ways.

First, we understand that $Q \,\&\, R$ means the same thing as $(Q \,\&\, R)$. As a matter of convention, we can leave off parentheses that occur *around the entire sentence.*

Second, it can sometimes be confusing to look at long sentences with many nested pairs of parentheses. We adopt the convention of using square brackets [and] in place of parentheses. There is no logical difference between $(P \vee Q)$ and $[P \vee Q]$, for example. The unwieldy sentence

$$(((H \supset I) \vee (I \supset H)) \,\&\, (J \vee K))$$

could be written in this way:

$$\big[(H \supset I) \vee (I \supset H)\big] \,\&\, (J \vee K)$$

Third, we will sometimes want to translate the conjunction of three or more sentences. For the sentence "Alice, Bob, and Candice all went to the party," suppose we let A mean "Alice went," B mean "Bob went," and C mean "Candice went." The definition only allows us to form a conjunction out of two sentences, so we can translate it as $(A \,\&\, B) \,\&\, C$ or as $A \,\&\, (B \,\&\, C)$. There is no reason to distinguish between these, since the two translations are logically equivalent. There is no logical difference between the first, in which $(A \,\&\, B)$ is conjoined with C, and the second, in which A is conjoined with $(B \,\&\, C)$. So we might as well just write $A \,\&\, B \,\&\, C$. As a matter of convention, we can leave out parentheses when we conjoin three or more sentences.

Fourth, a similar situation arises with multiple disjunctions. "Either Alice, Bob, or Candice went to the party" can be translated as $(A \vee B) \vee C$ or as $A \vee (B \vee C)$. Since these two translations are logically equivalent, we may write $A \vee B \vee C$.

These latter two conventions only apply to multiple conjunctions or multiple disjunctions. If a series of connectives includes both disjunctions and conjunctions, then the parentheses are essential; as with $(A \,\&\, B) \vee C$ and $A \,\&\, (B \vee C)$. The parentheses are also required if there is a series of conditionals or biconditionals; as with $(A \supset B) \supset C$ and $A \equiv (B \equiv C)$.

We have adopted these four rules as notational conventions, not as changes to the definition of a sentence. Strictly speaking, $A \vee B \vee C$ is still not a sentence. Instead, it is a kind of shorthand. We write it for the sake of convenience, but we really mean the sentence $(A \vee (B \vee C))$.

If we had given a different definition for a sentence, then these could count as sentences. We might have written rule 3 in this way: "If $\mathcal{A}$, $\mathcal{B}$, $\ldots$ $\mathcal{Z}$ are sentences, then $(\mathcal{A} \,\&\, \mathcal{B} \,\&\, \ldots \,\&\, \mathcal{Z})$, is a sentence ." This would make it easier to translate some English sentences, but would have the cost of making our formal language more complicated. We would have to keep the complex definition in mind when we develop truth tables and a proof system. We want a logical language that is expressively simple and allows us to translate easily from English, but we also want a formally simple language. Adopting notational conventions is a compromise between these two desires.

Practice Exercises

Part A Using the symbolization key given, translate each English-language sentence into SL.

M: Those creatures are men in suits.
C: Those creatures are chimpanzees.
G: Those creatures are gorillas.

Example: If those creatures are not men in suits, they are gorillas.
Answer: $\sim M \supset G$

(1) Those creatures are not men in suits.

(2) Those creatures are men in suits, or they are not.

(3) Those creatures are either gorillas or chimpanzees.

(4) Those creatures are not gorillas, but they are not chimpanzees either.

(5) Those creatures cannot be both gorillas and men in suits.

(6) If those creatures are not gorillas, then they are men in suits

(7) Those creatures are men in suits only if they are not gorillas.

(8) Those creatures are chimpanzees if and only if they are not gorillas.

(9) Those creatures are neither gorillas nor chimpanzees.

(10) Unless those creatures are men in suits, they are either chimpanzees or they are gorillas.

Part B Using the symbolization key given, translate each English-language sentence into SL.

A: Mister Ace was murdered.
B: The butler did it.
C: The cook did it.
D: The Duchess is lying.
E: Mister Edge was murdered.
F: The murder weapon was a frying pan.

(1) Either Mister Ace or Mister Edge was murdered.

(2) If Mister Ace was murdered, then the cook did it.

(3) If Mister Edge was murdered, then the cook did not do it.

(4) Either the butler did it, or the Duchess is lying.

(5) The cook did it only if the Duchess is lying.

(6) If the murder weapon was a frying pan, then the culprit must have been the cook.

(7) If the murder weapon was not a frying pan, then the culprit was neither the cook nor the butler.

(8) Mister Ace was murdered if and only if Mister Edge was not murdered.

(9) The Duchess is lying, unless it was Mister Edge who was murdered.

(10) Mister Ace was murdered, but not with a frying pan.

(11) The butler and the cook did not both do it.

(12) Of course the Duchess is lying!

Part C Using the symbolization key given, translate each English-language sentence into SL.

E_1: Ava is an electrician.
E_2: Harrison is an electrician.
F_1: Ava is a firefighter.
F_2: Harrison is a firefighter.
S_1: Ava is satisfied with her career.
S_2: Harrison is satisfied with his career.

(1) Ava and Harrison are both electricians.

(2) If Ava is a firefighter, then she is satisfied with her career.

(3) Ava is a firefighter, unless she is an electrician.

(4) Harrison is an unsatisfied electrician.

(5) Neither Ava nor Harrison is an electrician.

(6) Both Ava and Harrison are electricians, but neither of them find it satisfying.

(7) Harrison is satisfied only if he is a firefighter.

(8) If Ava is not an electrician, then neither is Harrison, but if she is, then he is too.

(9) Ava is satisfied with her career if and only if Harrison is not satisfied with his.

(10) If Harrison is both an electrician and a firefighter, then he must be satisfied with his work.

(11) It cannot be that Harrison is both an electrician and a firefighter.

(12) Harrison and Ava are both firefighters if and only if neither of them is an electrician.

Part D Using the symbolization key given, translate each English-language sentence into SL.

J_1: John Coltrane played tenor sax.
J_2: John Coltrane played soprano sax.
J_3: John Coltrane played tuba
M_1: Miles Davis played trumpet
M_2: Miles Davis played tuba

(1) John Coltrane played tenor and soprano sax.

(2) Neither Miles Davis nor John Coltrane played tuba.

(3) John Coltrane did not play both tenor sax and tuba.

(4) John Coltrane did not play tenor sax unless he also played soprano sax.

(5) John Coltrane did not play tuba, but Miles Davis did.

(6) Miles Davis played trumpet only if he also played tuba.

(7) If Miles Davis played trumpet, then John Coltrane played at least one of these three instruments: tenor sax, soprano sax, or tuba.

(8) If John Coltrane played tuba then Miles Davis played neither trumpet nor tuba.

(9) Miles Davis and John Coltrane both played tuba if and only if Coltrane did not play tenor sax and Miles Davis did not play trumpet.

Part E Give a symbolization key and symbolize the following sentences in SL.

(1) Alice and Bob are both spies.

(2) If either Alice or Bob is a spy, then the code has been broken.

(3) If neither Alice nor Bob is a spy, then the code remains unbroken.

(4) The German embassy will be in an uproar, unless someone has broken the code.

(5) Either the code has been broken or it has not, but the German embassy will be in an uproar regardless.

(6) Either Alice or Bob is a spy, but not both.

Part F Give a symbolization key and symbolize the following sentences in SL.

(1) If Gregor plays first base, then the team will lose.

(2) The team will lose unless there is a miracle.

(3) The team will either lose or it won't, but Gregor will play first base regardless.

(4) Gregor's mom will bake cookies if and only if Gregor plays first base.

(5) If there is a miracle, then Gregor's mom will not bake cookies.

Part G For each argument, write a symbolization key and translate the argument into SL, putting the argument in canonical form.

Example: If Dorothy plays the piano in the morning, then Roger wakes up cranky. Dorothy plays piano in the morning unless she is distracted. So if Roger does not wake up cranky, then Dorothy must be distracted.

Answer:

A: Dorothy plays the piano in the morning
B: Roger wakes up cranky
C: Dorothy is distracted

P_1: $A \supset B$

P_2: $A \vee C$

C: $\sim B \supset C$

(1) It will either rain or snow on Tuesday. If it rains on Tuesday, Neville will be sad. If it snows on Tuesday, Neville will be cold. Therefore, Neville will either be sad or cold on Tuesday.

(2) If Zoog remembered to do his chores, then things are clean but not neat. If he forgot, then things are neat but not clean. Therefore, things are either neat or clean—but not both.

Part H For each argument, write a symbolization key and translate the argument as well as possible into SL. The part of the passage in italics is there to provide context for the argument, and doesn't need to be symbolized.

(1) It is going to rain soon. I know because my leg is hurting, and my leg hurts if it's going to rain.

(2) *Spider-man tries to figure out the bad guy's plan.* If Doctor Octopus gets the uranium, he will blackmail the city. I am certain of this because if Doctor Octopus gets the uranium, he can make a dirty bomb, and if he can make a dirty bomb, he will blackmail the city.

(3) *A westerner tries to predict the policies of the Chinese government.* If the Chinese government cannot solve the water shortages in Beijing, they will have to move the capital. They don't want to move the capital. Therefore they must solve the water shortage. But the only way to solve the water shortage is to divert almost all the water from the Yangzi river northward. Therefore the Chinese government will go with the project to divert water from the south to the north.

Part I

(1) Are there any sentences of SL that contain no sentence letters? Why or why not?

(2) In the chapter, we symbolized an *exclusive or* using $\vee$, $\&$, and $\sim$. How could you translate an *exclusive or* using only two connectives? Is there any way to translate an *exclusive or* using only one kind of connective?

Key Terms

Antecedent

Atomic statement

Biconditional

Conditional

Conjunct

Conjunction

Consequent

Disjunct

Disjunction

Exclusive or

Inclusive or

Logical constant

Main connective

Metalanguage

Metavariables

Necessary condition

Negation

Nonlogical symbol

Object language

Recursive definition

Scope

Semantics

Sentence letter

Sentence of SL

Sentential connective

Sufficient condition

Symbolization key

Syntax

Translation key

Chapter 12

Truth Tables

This chapter introduces a way of evaluating sentences and arguments of SL called the truth table method. As we shall see, the truth table method is *semantic* because it involves one aspect of the meaning of sentences, whether those sentences are true or false. As we saw on page 159, semantics is the study of aspects of language related to meaning, including truth and falsity. Although it can be laborious, the truth table method is a purely mechanical procedure that requires no intuition or special insight.

12.1 Basic Concepts

In the previous chapter, we said that a formal language is built from two kinds of elements: logical constants and nonlogical symbols. The LOGICAL CONSTANTS have their meaning fixed by the formal language, while the NONLOGICAL SYMBOLS get their meaning in the symbolization key. The logical constants in SL are the sentential connectives and the parentheses, while the nonlogical symbols are the sentence letters.

When we assign meaning to the nonlogical symbols of a language using a dictionary, we say we are giving an "interpretation" of the language. More formally an INTERPRETATION of a language is a correspondence between elements of the object language and elements of some other language or logical structure. The symbolization keys we defined in Chapter 11 (p. 145) are one sort of interpretation. Fancier languages will have more complicated kinds of interpretations.

The truth table method will also involve giving an interpretation of sentences, but they will be much simpler than the translation keys we used in Chapter 11. We will not be concerned with what the individual sentence letters mean. We will only care whether they are true or false. In other words, our interpretations will assign truth values to the sentence letters.

We can get away with only worrying about the truth values of sentence letters because of the way that the meaning of larger sentences is generated by the meaning of their parts. Any larger sentence of SL is composed of atomic sentences with sentential connectives. The truth value of the compound sentence depends only on the truth value of the atomic sentences that it comprises. In order to know the truth value of $D \equiv E$, for instance, you only need to know the truth value of D and the truth value of E. Connectives that work in this way are called truth functional. More technically, we define a TRUTH-FUNCTIONAL CONNECTIVE as an operator that builds larger sentences out of smaller ones, and fixes the truth value of the resulting sentence

$\mathcal{A}$	$\sim\mathcal{A}$
T	F
F	T

$\mathcal{A}$	$\mathcal{B}$	$\mathcal{A} \,\&\, \mathcal{B}$	$\mathcal{A} \vee \mathcal{B}$	$\mathcal{A} \supset \mathcal{B}$	$\mathcal{A} \equiv \mathcal{B}$
T	T	T	T	T	T
T	F	F	T	F	F
F	T	F	T	T	F
F	F	F	F	T	T

Table 12.2: The characteristic truth tables for the connectives of SL.

based only on the truth value of the component sentences.

Because all of the logical symbols in SL are truth functional, we can study the the semantics of SL looking only at truth and falsity. If we want to know about the truth of the sentence $A \,\&\, B$, the only thing we need to know is whether A and B are true. It doesn't actually matter what else they mean. So if A is false, then $A \,\&\, B$ is false no matter what false sentence A is used to represent. It could be "I am the Pope" or "Pi is equal to 3.19." The larger sentence $A \,\&\, B$ is still false. So to give an interpretation of sentences in SL, all we need to do is create a truth assignment. A truth assignment is a function that maps the sentence letters in SL onto our two truth values. In other words, we just need to assign Ts and Fs to all our sentence letters.

It is worth knowing that most languages are not built only out of truth functional connectives. In English, it is possible to form a new sentence from any simpler sentence $\mathcal{X}$ by saying "It is possible that $\mathcal{X}$." The truth value of this new sentence does not depend directly on the truth value of $\mathcal{X}$. Even if $\mathcal{X}$ is false, perhaps in some sense $\mathcal{X}$ *could* have been true—then the new sentence would be true. Some formal languages, called *modal logics*, have an operator for possibility. In a modal logic, we could translate "It is possible that $\mathcal{X}$" as $\diamond\mathcal{X}$. However, the ability to translate sentences like these comes at a cost: The $\diamond$ operator is not truth-functional, and so modal logics are not amenable to truth tables.

12.2 Complete Truth Tables

In the last chapter we introduced the characteristic truth tables for the different connectives. To put them all in one place, the truth tables for the connectives of SL are repeated in Table 12.2. On the left is the truth table for negation, and on the right is the truth table for the other four connectives. Notice that the truth table for the negation is shorter than the other table. This is because there is only one metavariable here, $\mathcal{A}$, which can either be true or false. The other connectives involve two metavariables, which give us four possibilities of true and false. The columns to the left of the double line in these tables are called the reference columns. They just specify the truth values of the individual sentence letters. Each row of the table assigns truth values to all the variables. Each row is thus a truth assignment—a kind of interpretation—for that sentence. Because the full table gives all the possible truth assignments for the sentence, it gives all the possible interpretations of it.

The truth table of sentences that contain only one connective is given by the characteristic truth table for that connective. So the truth table for the sentence $P \,\&\, Q$ looks just like the characteristic truth table for $\&$, with the sentence letters P and Q substituted in. The truth tables for more complicated sentences can simply be built up out of the truth tables for these basic sentences. Consider the sentence $(H \& I) \supset H$. This sentence has two sentence letters, so we can represent all the possible truth assignments using a four line truth table. We can start by writing out all the possible combinations of true and false for H and I in the reference columns. We then copy the truth values for the sentence letters and write them underneath the letters in the sentence.

H	I	$(H$	$\&$	$I)$	$\supset$	H
T	T	T		T		T
T	F	T		F		T
F	T	F		T		F
F	F	F		F		F

Now consider just one part of the sentence above, the subsentence $H \& I$. This is a conjunction $\mathscr{A} \& \mathscr{B}$ with H as $\mathscr{A}$ and with I as $\mathscr{B}$. H and I are both true on the first row. Since a conjunction is true when both conjuncts are true, we write a T underneath the conjunction symbol. We continue for the other three rows and get this:

		$\mathscr{A} \& \mathscr{B}$				
H	I	$(H$	$\&$	$I)$	$\supset$	H
T	T	T	**T**	T		T
T	F	T	**F**	F		T
F	T	F	**F**	T		F
F	F	F	**F**	F		F

Next we need to fill in the final column under the conditional. The conditional is the main connective of the sentence, so the whole sentence is of the form $\mathscr{A} \supset \mathscr{B}$ with $(H \& I)$ as $\mathscr{A}$ and with H as $\mathscr{B}$. So to fill the final column, we just need to look at the characteristic truth table for the conditional. For the first row, the sentence $(H \& I)$ is true and the sentence H is also true. The truth table for he conditional tells us this means that the whole sentence is true. Filling out the rest of the column gives us this:

		$\mathscr{A}$			$\supset$	$\mathscr{B}$
H	I	$(H$	$\&$	$I)$	$\supset$	H
T	T	T	T	T	**T**	T
T	F	T	F	F	**T**	T
F	T	F	F	T	**T**	F
F	F	F	F	F	**T**	F

The column of Ts underneath the conditional tells us that the sentence $(H \& I) \supset H$ is true regardless of the truth values of H and I. They can be true or false in any combination, and the compound sentence still comes out true. It is crucial that we have considered all of the possible combinations. If we only had a two-line truth table, we could not be sure that the sentence was not false for some other combination of truth values.

In this example, the script letters over the table have just been there to indicate how the columns get filled in. We won't need them in the final product. Also, the reference columns are redundant with the columns under the individual sentence letters, so we can eliminate those as well. Most of the time, when you see truth tables, we will just write them out this way:

$(H$	$\&$	$I)$	$\supset$	H
T	T	T	T	T
T	F	F	T	T
F	F	T	T	F
F	F	F	T	F

The truth value of the sentence on each row is just the column underneath the *main connective* (see p. 161) of the sentence, in this case, the column underneath the conditional.

A COMPLETE TRUTH TABLE is a table that gives all the possible interpretations for a sentence or set of sentences in SL. It has a row for each possible assignment of T and F to all of the sentence letters. The size of the complete truth table depends on the number of different sentence letters in the table. A sentence that contains only one sentence letter requires only two rows, as in the characteristic truth table for negation. This is true even if the same letter is repeated many times, as in this sentence:

$$[(C \equiv C) \supset C] \,\&\, {\sim}(C \supset C).$$

The complete truth table requires only two lines because there are only two possibilities: C can be true, or it can be false. A single sentence letter can never be marked both T and F on the same row. The truth table for this sentence looks like this:

$[(C$	$\equiv$	$C)$	$\supset$	$C]$	$\&$	$\sim$	$(C$	$\supset$	$C)$
T	T	T	T	T	F	F	T	T	T
F	T	F	F	F	F	F	F	T	F

Looking at the column underneath the main connective, we see that the sentence is false on both rows of the table; i.e., it is false regardless of whether C is true or false.

A sentence that contains two sentence letters requires four lines for a complete truth table, as we saw above in the table for $(H \,\&\, I) \supset I$.

A sentence that contains three sentence letters requires eight lines, as in this example. Here the reference columns are included so you can see how to arrange the truth values for the individual sentence letters so that all the possibilities are covered.

M	N	P	M	$\&$	$(N$	$\vee$	$P)$
T	T	T	T	T	T	T	T
T	T	F	T	T	T	T	F
T	F	T	T	T	F	T	T
T	F	F	T	F	F	F	F
F	T	T	F	F	T	T	T
F	T	F	F	F	T	T	F
F	F	T	F	F	F	T	T
F	F	F	F	F	F	F	F

From this table, we know that the sentence $M \,\&\, (N \vee P)$ might be true or false, depending on the truth values of M, N, and P.

A complete truth table for a sentence that contains four different sentence letters requires 16 lines. For five letters, 32 lines are required. For six letters, 64 lines, and so on. To be perfectly general: If a complete truth table has n different sentence letters, then it must have 2^n rows.

By convention, the reference columns are filled in with the right most row alternating Ts and Fs. The next column over alternates sets of two Ts and two Fs. For the third column from the right, you have sets of four Ts and four Fs. This continues until you reach the leftmost column, which will always have the top have all Ts and the bottom half all Fs. This convention is completely arbitrary. There are other ways to be sure that all the possible combinations are covered, but everything is easier if we all stick to the same pattern.

Practice Exercises

Part A Identify the main connective in the each sentence.

Example: $(A \supset C) \,\&\, {\sim}D$

Answer: $(A \supset C) \,\&\, {\sim}D$

(1) ${\sim}(A \vee {\sim}B)$

(2) ${\sim}(A \vee {\sim}B) \vee {\sim}(A \,\&\, D)$

(3) $[{\sim}(A \vee {\sim}B) \vee {\sim}(A \,\&\, D)] \supset E$

(4) $[(A \supset B) \,\&\, C] \equiv [A \vee (B \,\&\, C)]$

(5) ${\sim}{\sim}{\sim}[A \vee (B \,\&\, (C \vee D))]$

Part B Identify the main connective in the each sentence.

(1) $[(A \equiv B) \,\&\, C] \supset D$

(2) $[(D \,\&\, (E \,\&\, F)) \vee G] \equiv {\sim}[A \supset (C \vee G)]$

(3) ${\sim}({\sim}Z \vee {\sim}H)$

(4) $({\sim}(P \,\&\, S) \equiv G) \,\&\, Y$

(5) $(A \,\&\, (B \supset C)) \vee {\sim}D$

Part C Assume A, B, and C are true and X, Y, and Z are false and evaluate the truth of the each sentence by writing a one-line truth table.

Example: $(A \,\&\, {\sim}X) \equiv (B \vee Y)$

Answer:

(A	&	∼	X)	≡	(B	∨	Y)
T	T	T	F	T	T	T	F

(1) ${\sim}((A \,\&\, B) \supset X)$

(2) $(Y \vee Z) \equiv ({\sim}X \equiv B)$

(3) $[(X \supset A) \vee (A \supset X)] \,\&\, Y$

(4) $(X \supset A) \vee (A \supset X)$

(5) $[A \,\&\, (Y \,\&\, Z)] \vee A$

Part D Assume A, B, and C are true and X, Y, and Z are false and evaluate the truth of the each sentence by writing a one-line truth table..

(1) ${\sim}{\sim}({\sim}{\sim}{\sim}A \vee X)$

(2) $(A \supset B) \supset X$

(3) $((A \vee B) \,\&\, (C \equiv X)) \vee Y$

(4) $(A \supset B) \vee (X \,\&\, (Y \,\&\, Z))$

(5) $((A \vee X) \supset Y) \,\&\, B$

Part E Write complete truth tables for the following sentences and mark the column that represents the possible truth values for the whole sentence.

Example: $D \supset (D \,\&\, ({\sim}F \vee F))$

Answer:

D	⊃	(D	&	(∼	F	∨	F))
T	T	T	T	F	T	T	T
T	T	T	T	T	F	T	F
F	T	F	F	F	T	T	T
F	T	F	F	T	F	T	F

(1) ${\sim}(S \equiv (P \supset S))$

(2) ${\sim}[(X \,\&\, Y) \vee (X \vee Y)]$

(3) $(A \supset B) \equiv ({\sim}B \equiv {\sim}A)$

(4) $[C \equiv (D \vee E)] \,\&\, {\sim}C$

(5) ${\sim}(G \,\&\, (B \,\&\, H)) \equiv (G \vee (B \vee H))$

Part F Write complete truth tables for the following sentences and mark the column that represents the possible truth values for the whole sentence.

(1) $(D \,\&\, {\sim}D) \supset G$

(2) $({\sim}P \vee {\sim}M) \equiv M$

(3) ${\sim}{\sim}({\sim}A \,\&\, {\sim}B)$

(4) $[(D \,\&\, R) \supset I] \supset {\sim}(D \vee R)$

(5) ${\sim}[(D \equiv O) \equiv A] \supset ({\sim}D \,\&\, O)$

12.3 Using Truth Tables

Because truth table show all the possible interpretations of a sentence or set of sentences we can use them to explore the logical properties we first introduced in the previous Chapter.

Tautologies, contradictions, and contingent sentences

We can define a tautology as a statement that must be true as a matter of logic, no matter how the world is. A statement like “Either it is raining or it is not raining” is always true, no matter what the weather is like outside. Something similar goes on in truth tables. With a complete truth table, we consider all of the ways that the world might be. Each line of the truth table corresponds to a way the world might be. This means that if the sentence is true on every line of a complete truth table, then it is true as a matter of logic, regardless of what the world is like.

We can use this fact to create a test for whether a sentence is a tautology: if the column under the main connective of a sentence is a T on every row, the sentence is a tautology. We already have seen an example of this. On page 170 that the sentence $(H \& I) \supset H$ had only T’s under its main connective, so it is a tautology.

Not every tautology in English will correspond to a tautology in SL. The sentence “All bachelors are unmarried” is a tautology in English, but we cannot represent it as a tautology in SL, because it just translates as a single sentence letter, like B. On the other hand, if something is a tautology in SL, it will also be a tautology in English. No matter how you translate $A \vee \sim A$, if you translate the As consistently, the statement will be a tautology.

Rather than thinking of complete truth tables as an imperfect test for the English notion of a tautology, we can define a separate notion of a tautology in SL based on truth tables. A statement is a SEMANTIC TAUTOLOGY IN SL if and only if the column under the main connective in the complete truth table for the sentence contains only Ts. This is the semantic definition of a tautology in SL, because it uses truth tables. Later we will create a separate, syntactic definition and show that it is equivalent to the semantic definition. We will be doing the same thing for all the concepts defined in this section.

We will define a contradiction as a sentence that is false no matter how the world is. This means we can define a SEMANTIC CONTRADICTION IN SL as a sentence that has only Fs in the column under them main connective of its complete truth table. We saw on page 170 that the sentence $[(C \equiv C) \supset C] \& \sim(C \supset C)$ was a contradiction in this sense. As with the definition of a semantic tautology, this is a semantic definition because it uses truth tables.

Finally, a sentence is contingent if it is sometimes true and sometimes false. Similarly, a sentence is SEMANTICALLY CONTINGENT IN SL if and only if its complete truth table for has both Ts and Fs under the main connective. We saw on page 171 that the sentence $M \& (N \vee P)$ was contingent.

Logical equivalence

Two sentences are logically equivalent in English if they have the same truth value as a matter of logic. Once again, we can use truth tables to define a similar property in SL: Two sentences are SEMANTICALLY LOGICALLY EQUIVALENT IN SL if they have the same truth value on every row of a complete truth table.

Consider the sentences $\sim(A \vee B)$ and $\sim A \,\&\, \sim B$. Are they logically equivalent? To find out, we construct a truth table.

$\sim$	$(A$	$\vee$	$B)$	$\sim$	A	$\&$	$\sim$	B
F	T	T	T	F	T	F	F	T
F	T	T	F	F	T	F	T	F
F	F	T	T	T	F	F	F	T
T	F	F	F	T	F	T	T	F

Look at the columns for the main connectives; negation for the first sentence, conjunction for the second. On the first three rows, both are F. On the final row, both are T. Since they match on every row, the two sentences are logically equivalent.

Consistency

A set of sentences in English is consistent if it is logically possible for them all to be true at once. This means that a sentence is SEMANTICALLY CONSISTENT IN SL if and only if there is at least one line of a complete truth table on which all of the sentences are true. It is semantically inconsistent otherwise.

Consider the three sentences $A \supset B$, $B \supset C$ and $C \supset A$. Since we are considering them as a set, we will put curly braces around them, as is done in set theory: $\{A \supset B, B \supset C, C \supset A\}$. The conditionals in this set form a little loop, but it is possible for all the sentences to be true at the same time, as this truth table shows.

A	$\supset$	B	B	$\supset$	C	C	$\supset$	A
T	T	T	T	T	T	T	T	T
T	T	T	T	F	F	F	T	T
T	F	F	F	T	T	T	T	T
T	F	F	F	T	F	F	T	T
F	T	T	T	T	T	T	F	F
F	T	T	T	F	F	F	T	F
F	T	F	F	T	T	T	F	F
F	T	F	F	T	F	F	T	F

Validity

Logic is the study of argument, so the most important use of truth tables is to test the validity of arguments. An argument in English is valid if it is logically impossible for the premises to be true and for the conclusion to be false at the same time. So we can define an argument as SEMANTICALLY VALID IN SL if there is no row of a complete truth table on which the premises are all marked "T" and the conclusion is marked "F." An argument is invalid if there is such a row.

Consider this argument:

1. $\sim L \supset (J \vee L)$
2. $\sim L$

$\therefore\ J$

Is it valid? To find out, we construct a truth table.

J	L	$\sim$	L	$\supset$	$(J$	$\vee$	$L)$	$\sim$	L	J
T	T	F	T	T	T	T	T	F	T	T
T	F	T	F	T	T	T	F	T	F	T
F	T	F	T	T	F	T	T	F	T	F
F	F	T	F	F	F	F	F	T	F	F

Yes, the argument is valid. The only row on which both the premises are T is the second row, and on that row the conclusion is also T.

In Chapters 1 and 2 we used the three dots $\therefore$ to represent an inference in English. We used this symbol to represent any kind of inference. The truth table method gives us a more specific notion of a valid inference. We will call this semantic entailment and represent it using a new symbol, $\models$, called the "double turnstile." The $\models$ is like the $\therefore$, except for arguments verified by truth tables. When you use the double turnstile, you write the premises as a set, using curly brackets, { and }, which mathematicians use in set theory. The argument above would be written $\{\sim L \supset (J \vee L), \sim L\} \models J$.

More formally, we can define the double turnstile this way: $\{\mathcal{A}_1 \ldots \mathcal{A}_n\} \models \mathcal{B}$ if and only if there is no truth value assignment for which $\mathcal{A}_1 \ldots \mathcal{A}_n$ are true and $\mathcal{B}$ is false. Put differently, it means that $\mathcal{B}$ is true for any and all truth value assignments for which $\mathcal{A}_1 \ldots \mathcal{A}_n$ are true.

We can also use the double turnstile to represent other logical notions. Since a tautology is always true, it is like the conclusion of a valid argument with no premises. The string $\models \mathcal{C}$ means that $\mathcal{C}$ is true for all truth value assignments. This is equivalent to saying that the sentence is entailed by anything. We can represent logical equivalence by writing the double turnstile in both directions: $\mathcal{A} \Dashv\models \mathcal{B}$ For instance, if we want to point out that the sentence $A \& B$ is equivalent to $B \& A$ we would write this: $A \& B \Dashv\models B \& A$.

Practice Exercises

If you want additional practice, you can construct truth tables for any of the sentences and arguments in the exercises for the previous chapter.

Part A Determine whether each sentence is a tautology, a contradiction, or a contingent sentence, using a complete truth table.

Example: $(A \supset B) \vee (B \supset A)$

Answer:

(A	$\supset$	B)	$\vee$	(B	$\supset$	A)
T	T	T	T	T	T	T
T	F	F	T	F	T	T
F	T	T	T	T	F	F
F	T	F	T	F	T	F

Tautology

(1) $A \supset A$

(2) $C \supset {\sim}C$

(3) $(A \equiv B) \equiv {\sim}(A \equiv {\sim}B)$

(4) $(A \,\&\, B) \supset (B \vee A)$

(5) $[({\sim}A \vee A) \vee B] \supset B$

(6) $[(A \vee B) \,\&\, {\sim}A] \,\&\, (B \supset A)$

Part B Determine whether each sentence is a tautology, a contradiction, or a contingent sentence, using a complete truth table.

(1) ${\sim}B \,\&\, B$

(2) ${\sim}D \vee D$

(3) $(A \,\&\, B) \vee (B \,\&\, A)$

(4) ${\sim}[A \supset (B \supset A)]$

(5) $A \equiv [A \supset (B \,\&\, {\sim}B)]$

(6) $[(A \,\&\, B) \equiv B] \supset (A \supset B)$

Part C Determine whether each the following statements are equivalent using complete truth tables. If the two sentences really are logically equivalent, write "Logically equivalent." Otherwise write, "Not logically equivalent."

Example: $A \vee B \dashv\models {\sim}A \supset B$

Answer:

A	$\vee$	B	$\sim$	A	$\supset$	B
T	T	T	F	T	T	T
T	T	F	F	T	T	F
F	T	T	T	F	T	T
F	F	F	T	F	F	F

Logically Equivalent

(1) $A \dashv\models {\sim}A$

(2) $A \,\&\, {\sim}A \dashv\models {\sim}B \equiv B$

(3) $[(A \vee B) \vee C] \dashv\models [A \vee (B \vee C)]$

(4) $A \vee (B \,\&\, C) \dashv\models (A \vee B) \,\&\, (A \vee C)$

(5) $[A \,\&\, (A \vee B)] \supset B \dashv\models A \supset B$

Part D Determine whether each the following statements of equivalence are true or false using complete truth tables. If the two sentences really are logically equivalent, write "Logically equivalent." Otherwise write, "Not logically equivalent."

(1) $A \supset A \dashv\models A \equiv A$

(2) ${\sim}(A \supset B) \dashv\models {\sim}A \supset {\sim}B$

(3) $A \lor B \dashv\models {\sim}A \supset B$

(4) $(A \supset B) \supset C \dashv\models A \supset (B \supset C)$

(5) $A \equiv (B \equiv C) \dashv\models A \,\&\, (B \,\&\, C)$

Part E Determine whether each set of sentences is consistent or inconsistent using a complete truth table.

Example: $\{{\sim}(A \lor B),\ {\sim}A \lor B,\ A \lor {\sim}B\}$

Answer:

∼	(A	∨	B),	∼	A	∨	B,	A	∨	∼	B	Consistent
F	T	T	T	F	T	T	T	T	T	F	T	
F	T	T	F	F	T	F	F	T	T	T	F	
F	F	T	T	T	F	T	T	F	F	F	T	
T	F	F	F	T	F	**T**	F	F	**T**	T	F	

(1) $\{A \,\&\, {\sim}B,\ {\sim}(A \supset B),\ B \supset A\}$

(2) $\{A \lor B,\ A \supset {\sim}A,\ B \supset {\sim}B\}$

(3) $\{{\sim}({\sim}A \lor B),\ A \supset {\sim}C,\ A \supset (B \supset C)\}$

(4) $\{A \supset B,\ A \,\&\, {\sim}B\}$

(5) $\{A \supset (B \supset C),\ (A \supset B) \supset C,\ A \supset C\}$

Part F Determine whether each set of sentences is consistent or inconsistent, using a complete truth table.

(1) $\{{\sim}B,\ A \supset B,\ A\}$

(2) $\{{\sim}(A \lor B),\ A \equiv B,\ B \supset A\}$

(3) $\{\ A \lor B,\ {\sim}B,\ {\sim}B \supset {\sim}A\}$

(4) $\{A \equiv B,\ {\sim}B \lor {\sim}A,\ A \supset B\}$

(5) $\{(A \lor B) \lor C,\ {\sim}A \lor {\sim}B,\ {\sim}C \lor {\sim}B\}$

Part G Determine whether each argument is valid or invalid, using a complete truth table.

Example: $A \lor B,\ C \supset A,\ C \supset B \models C$

Answer:

A	∨	B	C	⊃	A	C	⊃	B	C	Invalid
T	T	T	T	T	T	T	T	T	T	
T	**T**	T	F	**T**	T	F	**T**	T	**F**	
T	T	F	T	T	T	T	F	F	T	
T	T	F	F	T	T	F	T	F	F	
F	T	T	T	F	F	T	T	T	T	
F	T	T	F	T	F	F	T	T	F	
F	F	F	T	F	F	T	F	F	T	
F	F	F	F	T	F	F	T	F	F	

(1) $A \supset A \models A$

(2) $A \supset B,\ B \models A$

(3) $A \equiv B,\ B \equiv C \models A \equiv C$

(4) $A \supset B,\ A \supset C \models B \supset C$

(5) $A \supset B,\ B \supset A \models A \equiv B$

Part H Determine whether each argument is valid or invalid, using a complete truth table.

(1) $A \vee [A \supset (A \equiv A)] \models A$

(2) $A \vee B,\ B \vee C,\ {\sim}B \models A \& C$

(3) $A \supset B,\ {\sim}A \models {\sim}B$

(4) $A,\ B \models {\sim}(A \supset {\sim}B)$

(5) ${\sim}(A \& B),\ A \vee B,\ A \equiv B \models C$

12.4 Partial Truth Tables

In order to show that a sentence is a tautology, we need to show that it is T on every row. So we need a complete truth table. To show that a sentence is *not* a tautology, however, we only need one line: a line on which the sentence is F. Therefore, in order to show that something is not a tautology, it is enough to provide a one-line *partial truth table*—regardless of how many sentence letters the sentence might have in it.

Consider, for example, the sentence $(U \& T) \supset (S \& W)$. We want to show that it is *not* a tautology by providing a partial truth table. To begin, we fill in F for the entire sentence, the reverse of how we started when we were doing complete truth tables.

S	T	U	W	$(U$	$\&$	$T)$	$\supset$	$(S$	$\&$	$W)$
							F			

The main connective of the sentence is a conditional. In order for the conditional to be false, the antecedent must be true (T) and the consequent must be false (F). So we fill these in on the table:

S	T	U	W	$(U$	$\&$	$T)$	$\supset$	$(S$	$\&$	$W)$
					T		F		F	

In order for the $(U \& T)$ to be true, both U and T must be true.

S	T	U	W	$(U$	$\&$	$T)$	$\supset$	$(S$	$\&$	$W)$
	T	T		T	T	T	F		F	

Now we just need to make $(S \& W)$ false. To do this, we need to make at least one of S and W false. We can make both S and W false if we want. All that matters is that the whole sentence turns out false on this line. Making an arbitrary decision, we finish the table in this way:

S	T	U	W	$(U$	$\&$	$T)$	$\supset$	$(S$	$\&$	$W)$
F	T	T	F	T	T	T	F	F	F	F

Property	Truth table required to show presence	Truth table required to show absence
being a tautology	complete	one-line partial
being a contradiction	complete	one-line partial
contingency	two-line partial	complete truth
equivalence	complete	one-line partial
consistency	one-line partial	complete
validity	complete	one-line partial

Table 12.12: Complete or partial truth tables to test for different properties

Showing that something is a contradiction requires a complete truth table. Showing that something is *not* a contradiction requires only a one-line partial truth table, where the sentence is true on that one line.

A sentence is contingent if it is neither a tautology nor a contradiction. So showing that a sentence is contingent requires a *two-line* partial truth table: The sentence must be true on one line and false on the other. For example, we can show that the sentence above is contingent with this truth table:

S	T	U	W	$(U$	&	$T)$	$\supset$	$(S$	&	$W)$
F	T	T	F	T	T	T	F	F	F	F
F	T	F	F	F	F	T	T	F	F	F

Note that there are many combinations of truth values that would have made the sentence true, so there are many ways we could have written the second line.

Showing that a sentence is *not* contingent requires providing a complete truth table, because it requires showing that the sentence is a tautology or that it is a contradiction. If you do not know whether a particular sentence is contingent, then you do not know whether you will need a complete or partial truth table. You can always start working on a complete truth table. If you complete rows that show the sentence is contingent, then you can stop. If not, then complete the truth table. Even though two carefully selected rows will show that a contingent sentence is contingent, there is nothing wrong with filling in more rows.

Showing that two sentences are logically equivalent requires providing a complete truth table. Showing that two sentences are *not* logically equivalent requires only a one-line partial truth table: Make the table so that one sentence is true and the other false.

Showing that a set of sentences is consistent requires providing one row of a truth table on which all of the sentences are true. The rest of the table is irrelevant, so a one-line partial truth table will do. Showing that a set of sentences is inconsistent, on the other hand, requires a complete truth table: You must show that on every row of the table at least one of the sentences is false.

Showing that an argument is valid requires a complete truth table. Showing that an argument is *invalid* only requires providing a one-line truth table: If you can produce a line on which the premises are all true and the conclusion is false, then the argument is invalid.

Table 12.12 summarizes when a complete truth table is required and when a partial truth table will do.

Practice Exercises

Part A Determine whether each sentence is a tautology, a contradiction, or a contingent sentence. Justify your answer with a complete or partial truth table where appropriate.

(1) $A \supset {\sim}A$

(2) $A \supset (A \,\&\, (A \vee B))$

(3) $(A \supset B) \equiv (B \supset A)$

(4) $A \supset {\sim}(A \,\&\, (A \vee B))$

(5) ${\sim}B \supset [({\sim}A \,\&\, A) \vee B]$

(6) ${\sim}(A \vee B) \equiv ({\sim}A \,\&\, {\sim}B)$

(7) $[(A \,\&\, B) \,\&\, C] \supset B$

(8) ${\sim}\big[(C \vee A) \vee B\big]$

(9) $\big[(A \,\&\, B) \,\&\, {\sim}(A \,\&\, B)\big] \,\&\, C$

(10) $(A \,\&\, B)] \supset [(A \,\&\, C) \vee (B \,\&\, D)]$

Part B Determine whether each sentence is a tautology, a contradiction, or a contingent sentence. Justify your answer with a complete or partial truth table where appropriate.

(1) ${\sim}(A \vee A)$

(2) $(A \supset B) \vee (B \supset A)$

(3) $[(A \supset B) \supset A] \supset A$

(4) ${\sim}[(A \supset B) \vee (B \supset A)]$

(5) $(A \,\&\, B) \vee (A \vee B)$

(6) ${\sim}(A \,\&\, B) \equiv A$

(7) $A \supset (B \vee C)$

(8) $(A \,\&\, {\sim}A) \supset (B \vee C)$

(9) $(B \,\&\, D) \equiv [A \equiv (A \vee C)]$

(10) ${\sim}[(A \supset B) \vee (C \supset D)]$

Part C Determine whether each the following statements of equivalence are true or false using complete truth tables. If the two sentences really are logically equivalent, write "Logically equivalent." Otherwise write, "Not logically equivalent."

(1) $A \dashv\vDash {\sim}A$

(2) $A \supset A \dashv\vDash A \equiv A$

(3) $A \,\&\, (B \,\&\, C) \dashv\vDash A \,\&\, {\sim}A$

(4) $A \,\&\, {\sim}A \dashv\vDash {\sim}B \equiv B$

(5) ${\sim}(A \supset B) \dashv\vDash {\sim}A \supset {\sim}B$

(6) $A \equiv B \dashv\vDash {\sim}[(A \supset B) \supset {\sim}(B \supset A)]$

(7) $(A \,\&\, B) \supset ({\sim}A \vee {\sim}B) \dashv\vDash {\sim}(A \,\&\, B)$

(8) $[(A \vee B) \vee C] \dashv\vDash [A \vee (B \vee C)]$

(9) $(Z \,\&\, ({\sim}R \supset O)) \dashv\vDash {\sim}(R \supset {\sim}O)$

Part D Determine whether each the following statements of equivalence are true or false using complete truth tables. If the two sentences really are logically equivalent, write "Logically equivalent." Otherwise write, "Not logically equivalent."

(1) $A \dashv\vDash A \vee A$

(2) $A \dashv\vDash A \,\&\, A$

(3) $A \vee {\sim}B \dashv\vDash A \supset B$

(4) $(A \supset B) \dashv\vDash ({\sim}B \supset {\sim}A)$

(5) ${\sim}(A \,\&\, B) \dashv\vDash {\sim}A \vee {\sim}B$

(6) $((U \supset (X \vee X)) \vee U) \dashv\vDash {\sim}(X \,\&\, (X \,\&\, U))$

(7) $((C \,\&\, (N \equiv C)) \equiv C) \dashv\vDash ({\sim}{\sim}{\sim}N \supset C)$

(8) $[(A \vee B) \,\&\, C] \dashv\vDash [A \vee (B \,\&\, C)]$

(9) $((L \,\&\, C) \,\&\, I) \dashv\vDash L \vee C$

Part E Determine whether each set of sentences is consistent or inconsistent. Justify your answer with a complete or partial truth table where appropriate.

(1) $\{A \supset A,\ {\sim}A \supset {\sim}A,\ A \,\&\, A,\ A \vee A\}$

(2) $\{A \supset {\sim}A,\ {\sim}A \supset A\}$

(3) $\{A \vee B,\ A \supset C,\ B \supset C\}$

(4) $\{A \vee B,\ A \supset C,\ B \supset C,\ {\sim}C\}$

(5) $\{B \,\&\, (C \vee A),\ A \supset B,\ {\sim}(B \vee C)\}$

(6) $\{(A \equiv B) \supset B,\ B \supset {\sim}(A \equiv B),\ A \vee B\}$

(7) $\{A \equiv (B \vee C),\ C \supset {\sim}A,\ A \supset {\sim}B\}$

(8) $\{A \equiv B,\ {\sim}B \vee {\sim}A,\ A \supset B\}$

(9) $\{A \equiv B,\ A \supset C,\ B \supset D,\ {\sim}(C \vee D)\}$

(10) $\{{\sim}(A \,\&\, {\sim}B),\ B \supset {\sim}A,\ {\sim}B\ \}$

Part F Determine whether each set of sentences is consistent or inconsistent. Justify your answer with a complete or partial truth table where appropriate.

(1) $\{A \& B,\ C \supset {\sim}B,\ C\}$

(2) $\{A \supset B,\ B \supset C,\ A,\ {\sim}C\}$

(3) $\{A \vee B,\ B \vee C,\ C \supset {\sim}A\}$

(4) $\{A,\ B,\ C,\ {\sim}D,\ {\sim}E,\ F\}$

(5) $\{A \& (B \vee C),\ {\sim}(A \& C),\ {\sim}(B \& C)\}$

(6) $\{A \supset B,\ B \supset C,\ {\sim}(A \supset C)\}$

Part G Determine whether each argument is valid or invalid. Justify your answer with a complete or partial truth table where appropriate.

(1) $A \supset (A \& {\sim}A) \models {\sim}A$

(2) $A \vee B,\ A \supset B,\ B \supset A \models A \equiv B$

(3) $A \vee (B \supset A) \models {\sim}A \supset {\sim}B$

(4) $A \vee B,\ A \supset B,\ B \supset A \models A \& B$

(5) $(B \& A) \supset C,\ (C \& A) \supset B \models (C \& B) \supset A$

(6) ${\sim}({\sim}A \vee {\sim}B),\ A \supset {\sim}C \models A \supset (B \supset C)$

(7) $A \& (B \supset C),\ {\sim}C \& ({\sim}B \supset {\sim}A) \models C \& {\sim}C$

(8) $A \& B,\ {\sim}A \supset {\sim}C,\ B \supset {\sim}D \models A \vee B$

(9) $A \supset B \models (A \& B) \vee ({\sim}A \& {\sim}B)$

(10) ${\sim}A \supset B, {\sim}B \supset C, {\sim}C \supset A \models {\sim}A \supset ({\sim}B \vee {\sim}C)$

Part H Determine whether each argument is valid or invalid. Justify your answer with a complete or partial truth table where appropriate.

(1) $A \equiv {\sim}(B \equiv A) \models A$

(2) $A \vee B,\ B \vee C,\ {\sim}A \models B \& C$

(3) $A \supset C,\ E \supset (D \vee B),\ B \supset {\sim}D \models (A \vee C) \vee (B \supset (E \& D))$

(4) $A \vee B,\ C \supset A,\ C \supset B \models A \supset (B \supset C)$

(5) $A \supset B,\ {\sim}B \vee A \models A \equiv B$

Part I Answer each of the questions below and justify your answer.

(1) Suppose that $\mathcal{A}$ and $\mathcal{B}$ are logically equivalent. What can you say about $\mathcal{A} \equiv \mathcal{B}$?

(2) Suppose that $(\mathcal{A} \& \mathcal{B}) \supset \mathcal{C}$ is contingent. What can you say about the argument $\mathcal{A},\ \mathcal{B}, \models \mathcal{C}$?

(3) Suppose that $\{\mathcal{A}, \mathcal{B}, \mathcal{C}\}$ is inconsistent. What can you say about $(\mathcal{A} \& \mathcal{B} \& \mathcal{C})$?

(4) Suppose that $\mathcal{A}$ is a contradiction. What can you say about the argument $\{\mathcal{A},\ \mathcal{B}\} \models \mathcal{C}$?

(5) Suppose that $\mathcal{C}$ is a tautology. What can you say about the argument $\{\mathcal{A},\ \mathcal{B}\} \models \mathcal{C}$?

(6) Suppose that $\mathcal{A}$ and $\mathcal{B}$ are *not* logically equivalent. What can you say about $(\mathcal{A} \vee \mathcal{B})$?

12.5 Expressive Completeness

We could leave the biconditional ($\equiv$) out of the language. If we did that, we could still write "$A \equiv B$" so as to make sentences easier to read, but that would be shorthand for $(A \supset B) \& (B \supset A)$. The resulting language would be formally equivalent to SL, since $A \equiv B$ and $(A \supset B) \& (B \supset A)$ are logically equivalent in SL. If we valued formal simplicity over expressive richness, we could replace more of the connectives with notational conventions and still have a language equivalent to SL.

There are a number of equivalent languages with only two connectives. You could do logic with only the negation and the material conditional. Alternately you could just have the negation and the disjunction. You will be asked to prove that these things are true in the last problem set. You could even have a language with only one connective, if you designed the connective right. The *Sheffer stroke* is a logical connective with the following characteristic truth table:

$\mathcal{A}$	$\mathcal{B}$	$\mathcal{A}\|\mathcal{B}$
T	T	F
T	F	T
F	T	T
F	F	T

The Sheffer stroke has the unique property that it is the only connective you need to have a complete system of logic. You will be asked to prove that this is true in the last problem set also.

Practice Exercises

Part A

(1) In section 12.5, we said that you could have a language that only used the negation and the material conditional. Prove that this is true by writing sentences that are logically equivalent to each of the following using only parentheses, sentence letters, negation ($\sim$), and the material conditional ($\supset$).

  (a) $A \vee B$

  (b) $A \& B$

  (c) $A \equiv B$

(2) We also said in section 3.5 that you could have a language which used only the negation and the disjunction. Show this: Using only parentheses, sentence letters, negation ($\sim$), and disjunction ($\vee$), write sentences that are logically equivalent to each of the following.

  (a) $A \& B$

  (b) $A \supset B$

  (c) $A \equiv B$

(3) Write a sentence using the connectives of SL that is logically equivalent to $(A|B)$.

(4) Every sentence written using a connective of SL can be rewritten as a logically equivalent sentence using one or more Sheffer strokes. Using only the Sheffer stroke, write sentences that are equivalent to each of the following.

(a) $\sim A$

(b) $(A \& B)$

(c) $(A \vee B)$

(d) $(A \supset B)$

(e) $(A \equiv B)$

Key Terms

Complete truth table

Interpretation

Logical constant

Nonlogical symbol

Semantic contradiction in SL

Semantic tautology in SL

Semantically consistent in SL

Semantically contingent in SL

Semantically logically equivalent in SL

Semantically valid in SL

Truth assignment

Truth-functional connective