*Logic***works**

A short course in logic

The practice of thinking logically – or at least of not thinking illogically – has been crucial in people's everyday lives for longer than there have been philosophers. And it is sure to remain so.

At its most elementary, logical thinking is just 'straight' thinking – thinking, that is, which enables us to order our thoughts in order to make sense of world around us.

But it does not follow from this that logic is an inflexible tool for reaching dull conclusions. Properly conceived, it is a tool for celebrating the flexibility and complexity of the world. Of course, that very complexity and flexibility can make abiding by the rules of logic rather tricky. But there are also simple mistakes that people regularly make in their thinking.

This short course focuses on some of these traps as well as trying to develop a sense of fascination, if not fun, in organising our conceptual 'map' of the world.

It can be dipped into to give variety to your philosophy sessions. However, it does need to be followed pretty much in the order given.

How to use Logicworks

The introductions to the main parts of this course and to the exercises are written for the organiser. They should be adapted to make short presentations to students followed by tasks contained in the exercises. These could be photocopied or written up on the board by the organiser.

It is often best for the organiser to help the students through the tasks using illustrations on the board and checking for agreement and disagreement within the group. In this way the exercises can become enjoyable collaborative efforts. This pattern of short presentations using examples followed by collaborative work is recommended as a good way to teach basic logic.

When the pattern is established, individual students could present their solutions to the group at the board and ask for comments, thereby taking over some of the role of the organiser.

History

The ancestor of our English word 'logic' is an ancient Greek word, 'logos', which is sometimes translated as 'reasoning' and sometimes simply as 'word'.

Not all reasoning is in words, of course. We only have to think of making models to realise this. When we figure out which piece goes where, we are surely reasoning – but with pictures in our minds rather than with words.

On the other hand, if we have a reason for thinking something or doing something, then words are a most valuable tool for explaining, ie. making plain, our reason to others or even to ourselves.

If, indeed, you need to convince other people that your reason is a good one, then words seem almost essential. That was certainly the view of some of the ancient Greeks. They employed special teachers to teach them or their children the art of logic – how to reason well with words.

Logic and education

One of the most famous Greek philosophers, Aristotle, (384 - 322 bc) actually published some rules of logic that were part of formal education right up till the 19th century.

Logic is no longer taught as a subject in schools. Part of the answer may be that in the 19th and 20th century other subjects, such as science and geography, grew very quickly and logic was squeezed out.

Yet at the very time when Aristotle's rules were going out of fashion, Edward Venn, an English clergyman, devised a way of picturing them that made them much easier to understand and also made it obvious why logical thinking is still fundamental to good thinking.

It is not just that logical thinking is straight thinking that avoids bad mistakes of reasoning. It is also because Aristotle's rules of logic reflect the variety of relationships between the categories we use to order our thinking about the complex world in which we live. These relationships are effectively mapped out by Venn Diagrams, which therefore play a major part in this short course in logic.

Part A: Avoiding the mistake of rash reversing

One of the easiest slips to make is thinking we can 'reverse' a sentence when in fact it cannot be done. A simple example would be the following:

1. *If you get a cold, then you get a runny nose.*

This argument seems sound enough. Experience tells us that colds are often accompanied by runny noses. Indeed, this is so common that if a person did not have a runny nose we would doubt whether they had a proper cold.

This connection between colds and runny noses is so strong in our minds, however, that we can easily try to reverse the argument as follows:

2. *If John has got a runny nose, then he must have got a cold.*

If people see someone with a runny nose they do, in fact, often jump to the conclusion that they have a cold. But this is not necessarily a correct conclusion. A runny nose can also be due to hay fever, for example, or to cold of another sort – cold weather. It is simply mistaken always to suppose that the reverse of a true argument is itself true. Arguments like this do not have to be expressed in the form of *If... then*. They could take the form:

3. *You have got a cold. So (or therefore) you have got a runny nose.*

Or they could take the form used by Aristotle when he was drawing up his 'rules of logic':

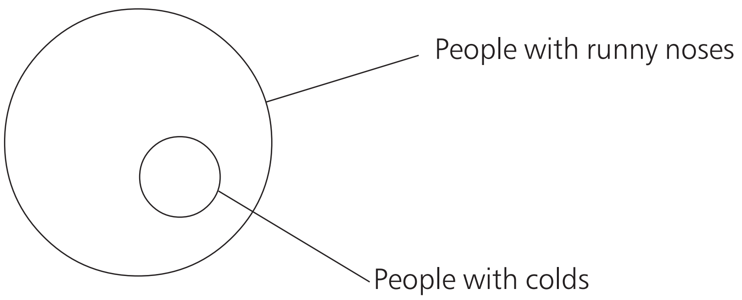
4. *All people who get a cold are people who get a runny nose.*

This may seem a rather long-winded way of saying

5. *Everyone who gets a cold gets a runny nose.*

It has been found, however, that putting the argument in the Aristotelian form, *All ... are ...*, is a good way of clarifying the categories or sets of things (or people) in the argument. Moreover, since the 19th century, thanks to the English clergyman Edward Venn, we have been able to show the argument in a diagram that we may describe as 'the fried egg':

Note Here it is very clear that the set of people who get a cold forms a subset of the set of people who get a runny nose but not vice-versa. The relationship between the sets is not reversible. In 'fried egg' terms, the white surrounds the yolk; the yolk does not surround the white!



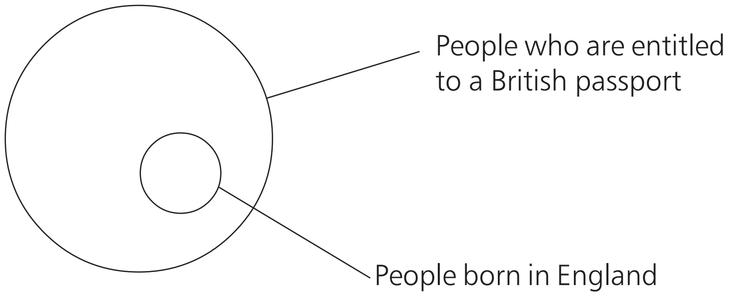
Before we move to some more challenging examples, here are two exercises to help your class become familiar with putting arguments into Aristotelian form, and sketching the Venn Diagram that represents them.

Exercise A1: Getting our thoughts in order

On a piece of paper each member should 'translate' each of the following arguments into the form *All ... are ...,* and then sketch a Venn diagram to represent the argument, labelling the circles clearly.

For example, *Everyone born in England is entitled to a British passport* translates into *All people born in England are people who are entitled to a British passport* and is represented by the diagram

Note It might seem unnecessary to repeat the word 'people' in this example, but strictly they form part of the label for the second set. If you can find a shorter way of labelling the same set, so much the better. For example, instead of *people entitled to a British passport* you could say *British passport-holders*.



Now try these statements

You may alter the following statements however you like, provided you keep the sense the same and end up with the correct form, *All ... are ...* You may even draw and label the diagram first if that helps you get the correct form clear in your mind. Compare answers to see if there are any interesting differences.

1. Doctors are trained in the art of healing.
2. Every breed of dog is descended from wolves.
3. Any friend of yours is a friend of mine.
4. The UN soldiers were targets for militiamen.
5. Everyone in the new shopping mall had a smile on their faces.
6. If you have won a lottery prize you must have bought a ticket.
7. Those who have bought a ticket may now take their seats.
8. This is a meteorite. So it must have come from outer space.
9. Anyone entering this area is putting themselves at risk.
10. They are all hungry because they have not eaten for days.

Reverse the arguments in your minds or on paper, just to check that they are not reversible. This would prove particularly useful in preparation for the section, which deals with a special sort of sentence that is, in fact, reversible.

Part B: Getting our definitions clear

Some statements beginning with *all* are reversible. Here are some examples:

1. *All oaks are trees that grow from acorns* – which is true. The reverse of this is: *All trees that grow from acorns are oaks* – which is also true.

2. *All aeroplanes have engines and wings to help them fly* – which is true. As in some cases above, this one has to have a little translation before it can be reversed: *All aeroplanes are machines that have engines and wings to help them fly.* 'The reverse, then, is: *All machines that have engines and wings to help them fly are aeroplanes* – which remains true.

What is it about these statements that makes them reversible? You can probably figure this out for yourselves, but in short the answer is that they are both **definitions**.

What are definitions?

It is worth just spending a little while considering what makes them work as definitions. Notice that they both have the same structure: *All x's are y's that ...* Logicians or mathematicians would express this in the form *the set of x's is a subset of the set of y's.* But there are other equally good ways of saying this: *an x is a sort of y*, for example, or *if it's an x, then it must be a y.*

Of course, if this was all that was being said, then it could be represented by the fried egg diagram, just like the previous examples.

What makes the definitions special is the extra bit, beginning '*that...*' This is the part that says what is special about the x's (oaks or aeroplanes, in our examples) that distinguishes, ie. separates, them from other y's (trees or machines).

Distinguishing features

Oaks are trees distinguished by the fact that they grow from acorns (no other trees do that). Aeroplanes are machines distinguished by the fact that they have engines and wings to help them fly. Any other machines that them must also be aeroplanes.

Two final points before developing your understanding in the next exercise. One is that the extra bit does not have to start with '*that ...*' You can express the *distinguishing factor* however you like. A common way of doing this is to describe the special function or job of the thing being defined – for example *Thermometers are instruments for measuring temperatures*.

The second point is that your definition must be wide enough to include all x's, but not so wide that it includes other things that are not x's. For example, *All beers are drinks that are made from hops* is too narrow a definition, because it does not include beers made from other plants, such as ginger beer.

On the other hand *All beers are drinks made from plants* is too wide, because it would include squashes and other drinks made from fruit, including wine. It is not so easy to define things accurately as you might think. (How exactly would you define beer?) But, of course, if we are not clear in our definitions, we are not likely to be clear in our reasoning.

Exercise B1: Definitions

Individually or in small groups, see if you can complete the following definitions. When you are satisfied with your efforts, compare them with other people's. Be critical of each other (in a friendly way)! If you think hard you may be able to give examples to show that certain definitions are too narrow, or too wide. You should also aim for definitions that are not too long.

1. All wristwatches are timepieces that ...
2. All giraffes are animals that ...
3. All hammers are tools for ...
4. All cameras are machines for ...
5. All fish are creatures ... (with?)
6. All magazines are ...
7. All fruits ...
8. All nurses ...
9. All sports ...

Part C: Avoiding the mistake of not looking for alternatives

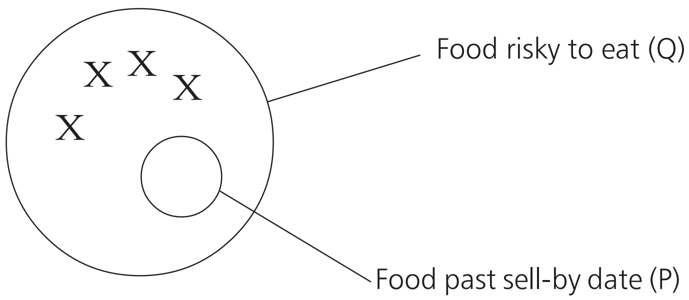
We have already noted that it was a mistake to reverse sentences such as *All p's are q's* or *If p, then q* unless they are definitions. In this section we note another common mistake, which is really just a development of the one above. It is to jump from the same statement to the conclusion that if something is not a case of p, then it is not a case of q.

An example is needed to bring this to life. Suppose someone said *All food that has passed the sell-by date is risky to eat*, and then you picked up some food that was not past the sell-by date. You might reason to yourself that it was not risky to eat. Would this be sound reasoning?

It would not! Going past the sell-by date is not the only thing that would make food risky to eat. Leaving it open to the flies is one amongst a number of alternatives that could make it risky.

The mistake in the reasoning arises because the person assumed that the reverse of the sentence was true, namely that if the food was risky, then it would have passed the sell-by date. It hadn't passed that date, and so the person felt safe to eat it.

The following picture may make the mistake of logic even clearer. The inner circle (labelled P) represents food that is past its sell-by date, and the outer circle (labelled Q) represents food that is risky to eat. The crosses represent examples of food that is not past the sell-by date (P) but is risky to eat (Q). How many such examples can your group think of, apart from food that is left open to the flies?



The effort to picture the sets as a Venn diagram is one way of taking care to think the situation through. Another way is just to pause and check if there is an **alternative** to your immediate way of thinking. For example, you could ask: ‘Are there any other reasons why food could be risky to eat.’

Yet another way is to become more alert to the difference between the use of the word *if* and the expression *if and only if*, as in the next exercise.

Exercise B1: Sorting 'only' from 'not only'

Introduction

Firstly, let's look again at that key sentence, *All x's are y's*. We know very well now that, except in definitions, it does not follow that *all y's are x's*. Another simple way of proving the point is to agree that *all x's are y's* but to say that *not only x's are y's*. For example, all oaks are trees, **but not only** oaks are trees – there are plenty of other (alternative) trees.

Compare this case with that of a definition, such as *All MP's are entitled to vote in the House of Commons.* It happens that the only people who are entitled to vote in the House of Commons are MP's. So, to be clear in our thinking, we should use the expression *All and only MP's' are entitled to vote in the House of Commons.*

Procedure

Individually or in pairs, rewrite the following sentences, adding either and only or but not only as appropriate. Wherever you add but not only, give one or two alternative examples.

1. All food that has passed the sell-by date is risky to eat
2. All Olympic medal winners deserve praise.
3. All parents have children.
4. All hospitals are places where the sick are nursed.
5. All puppies are baby dogs.
6. All people who cannot walk are paralysed.
7. All robbers are thieves.

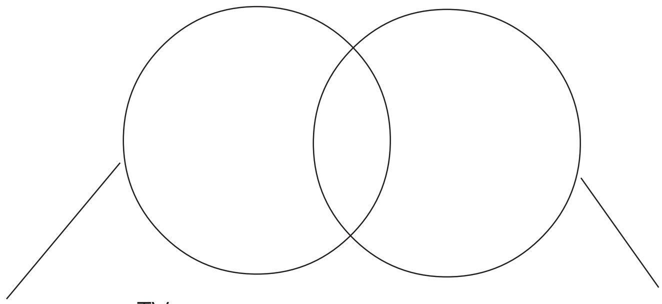
If you finish before others, you might go a step further and translate the same sentences into the form: *If x, then y*. Then check that the *and only* sentences translated into *If and only if x, then y.*

Part C: Avoiding the error of gross generalisation

The previous sections looked mainly at sentences beginning (or translating into) *All x's ...* These are called 'universal' sentences because they refer to all members of a set or 'universe'. They are important as they form the basis of how we classify or order the world about us, but they are certainly not the only sort of sentences there are.

Using the word 'some'

In our ordinary conversations, we more often speak of **some** members of a class than all. And in our ordinary judgements we normally distinguish between some members of a class from others. For example, we might say: *Some programmes on TV are awful* – from which we would normally conclude that some are not. Such a judgement can also be represented in a Venn Diagram, (which we call 'the butterfly') as follows:



Unfortunately people are not always so careful and balanced in their judgements. Most of them have a tendency to over-generalise.

Over-generalising

An over-generalisation is when something maybe true once, or on **some** occasions, but we judge it to happen more often, or more generally, than it does. We may even go so far as to say that it is true **all** the time.

For example, we may get fed up with the rain and say 'It's always raining'. Or we read headlines about teenage pregnancies and think that they are more frequent that ever. Or we have an awkward experience with some people from a different group and form a bad opinion of all people in that race.

Prejudice and stereotyping

This last example would be a case of prejudice or stereotyping – the words are commonly known, though their origins may not be. Prejudice means judging in advance or too quickly, and stereotyping means taking someone or something to be typical when it is not. That is exactly what we mean by 'over-generalising'.

Well, how often it happens in your own mind is for you to judge! But the following exercise is designed to show how easy it is to fall into the trap.

Exercise C1: Keeping generalisations in check

Divide into smaller groups of three or four people. Each group considers one of the following examples and decides how much over-generalisation is going on. They should also:

- consider whether the generalisation is totally unjustified or reasonably understandable
- try to come up with similar examples from their own experience
- share experiences with the whole group
- discuss how people could be educated to avoid bad over-generalisation.

Over-generalisation?

1. A head teacher hears a loud noise coming from a classroom and tells the whole class off.
2. A disc-jockey hears a loud record by a new group and assumes they are a heavy rock band.
3. A famous football team is reported to have had a drunken party, and the coach says ‘They're just young men. What do you expect?’
4. You offer to do the washing-up one day when you have nothing better to do. From then on you are expected to help out every day.
5. There is a bad-tempered atmosphere in the shop one morning. ‘I'm not going there again,’ says one of the customers on leaving.
6. A train is late and a businessman misses a vital connection. He decides to go back to driving everywhere.
7. You go shopping on a Saturday morning and have a hard time with the crowds. You conclude that the world is getting overpopulated.
8. Two different neighbours win some money on the lottery. You try to persuade your parents that buying a ticket next day would be a good bet.
9. A friend of yours gets a low score in a maths test and says: ‘I’m useless at maths. I should just give up.’

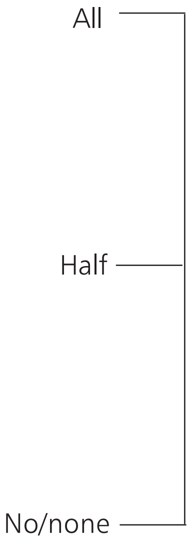
Exercise C2: Making 'some' more precise

There is a large range of words and phrases that cover the gap between *all* on the one hand and *no* or *none* on the other. The more familiar we are with these words, the easier it should be to express our generalisations accurately.

Procedure

The organiser should start off by drawing a tall vertical line on the board and putting markers (horizontal lines) at the top, bottom and middle. Next to these markers should be entered the words *all*, *no/none* and *half* respectively. The remaining words or phrases below should either be written separately on the board or photocopied for each member.

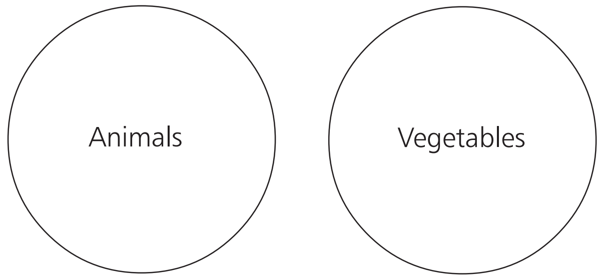
The exercise can continue as a whole group activity or in small groups or as individuals, the business being to enter all the words or phrases onto the 'ladder'. If there is some doubt as to where a word should go, it should be set aside for later whole group discussion.



a few	not many	lots of
most of	the majority of	one
thousands	millions	all but one of
several	a fraction of	very few
next to none	almost all	virtually all
certain of	a small number of	a large majority of
more than one	not a few	a large number of
precious few	one or two	a couple of
a handful of	almost none	a minority of
loads of	a small minority of	a quantity of
the vast majority of		

Part D: Avoiding the mistake of class confusion

There are some basic categories we use to sort out the many 'things' in our world. Animals, vegetables and minerals are three of these main categories, but there are many categories of abstract (untouchable) things as well like colours, sounds and tastes, for example, or numbers, decisions or promises. Often these categories are quite separate from each other and we do not confuse them. Animals and vegetables are a clear example. The relationship between these two categories is simply expressed by the sentence, *No animals are vegetables*, and can be shown by a diagram that we may call the 'binoculars'.



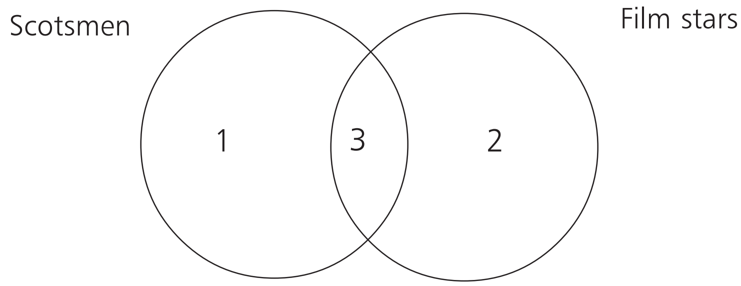
It is obvious from this diagram that sentences of the form *No x's are y's* are reversible: if no animals are vegetables, it must equally be true that no vegetables are animals. You probably realised in the last section on generalisations that the same is true of categories that overlap, expressed in the form, *Some x's are y's*. If some Scotsmen are film stars, for example, it is equally true that some film stars are Scotsmen.

As a matter of fact, categories overlap more often than not, and this can lead us into confusion. That, in turn, can lead to other mistakes in our reasoning. In the *Newswise* section, for example we explore how the categories of drugs and medicines overlap. Are all medicines drugs? If we thought so, we might make a mistake in banning all medicines. Or perhaps all drugs are medicines? In that case we might be tempted to legalise all drugs. But if the answer is neither, then we clearly have to face the question: when is a drug a medicine and when is it not?

Logical thinking does not necessarily lead to agreement in answering such questions, but it does discipline us into treating the question in a systematic – ordered – way. The following exercises practise this discipline.

Exercise D1: making the boundaries more precise

This exercise can be done individually or in small groups or as a whole group. For each of the pairs of sets or categories below a 'butterfly' diagram should be drawn to represent the relationship between the two sets, and the set names should be written on the outside, and the numbers 1, 2 and 3 on the inside, as in the example below.



Under each diagram a specific example for each area of the diagram should be written, as follows:

1 - a member of set 1 that is not a member of set 2 (for example, Gordon Brown, who is a Scotsman but not a film star)

2 - a member of set 2 that is not a member of set 1 (for example, Julia Roberts, who is a film star but not a Scotsman)

3 - a member of set 1 that is also a member of set 2 (for example, Sean Connery, who is both a Scotsman and a film star) If it turns out that there is no example for 3, then the diagram should be redrawn in 'binoculars' form.

singers, songwriters

TV presenters, women

paints, oils

foods, drinks

soldiers, sailors

buildings, homes

musical instruments, industrial waste

knives, weapons

wild animals, domestic animals

vegetables, fruits

games, jobs

sports players, professionals

sports persons, Americans

Part E: Coping with complexity

Aristotle started his investigation of logical thinking by observing that most basic arguments have three parts. They consist, in his words, of a couple of 'premisses', or basic statements, which are put together to make a 'conclusion'. (You could say it's like 'putting two and two together to make four'.)

Of course, people's conclusions are not always correct, and Aristotle observed that this might be for one of two reasons: either one of their premisses is incorrect, or the person's reasoning is incorrect (or, in his words, 'invalid').

Premisses and conclusions

Here is an example of an argument based on an incorrect or false premiss:

Premiss 1 *My newspaper today said that some extraterrestrials have landed.*

Premiss 2 *Everything you read in the newspapers is true.*

Conclusion *It must be true that some extraterrestrials have landed.*

Explanation

We probably do suppose that newspapers give us the truth most of the time, but hardly anyone thinks they give the truth all the time. So, the argument above does not persuade us, because we doubt the premiss: *everything you read in the newspapers is true.* We should note, however, that the first premiss might be true. And some might even argue that the conclusion is also true. The point is that to prove it they would have to do more than just quote the newspapers. Some other, correct, premiss or evidence would be needed.

Note It would be useful to demonstrate this is an active way with a group by asking them wether the conclusion might ever be true and, if so, what alternative premisses would be more convincing

Making sure your premisses are correct is obviously important. But what interested Aristotle even more was making sure that the reasoning was also correct. For he noticed that even if you had two correct premisses, you might still have a false conclusion – if the conclusion did not 'follow' from the premisses. For example:

Premiss 1 *All squirrels are rodents*

Premiss 2 *All rodents are mammals*

Conclusion *So all mammals are squirrels*

Here, the two premisses are both correct, but the conclusion is (obviously) false. It certainly does not follow from the premisses. Anyone who put this argument would have confused the categories involved – squirrels, rodents and mammals. On the other hand, the conclusion *All squirrels are mammals* would not only be true but would also be a valid conclusion because it follows from the premisses. The categories would have been properly sorted out.

In most simple cases like the ones above, people can see which conclusions follow from which premisses and which do not, without knowing Aristotle's rules. But for centuries Aristotle's rules seemed the best way of sorting out more complicated arguments and categories: thousands of students learnt them and no doubt their thinking was sharpened as a result.

Today, thankfully, we do not have to learn a lot of rules in order to think as clearly and sharply as Aristotle and his students. The 'logical' relationships between categories, which form the basis of much argument, are more simply shown by Venn diagrams. The

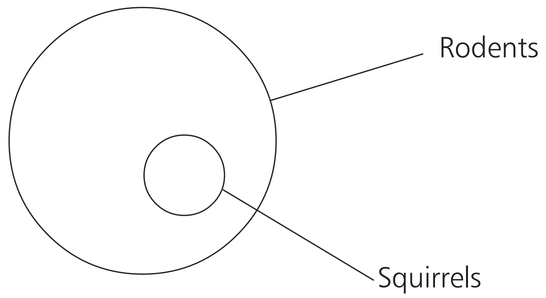
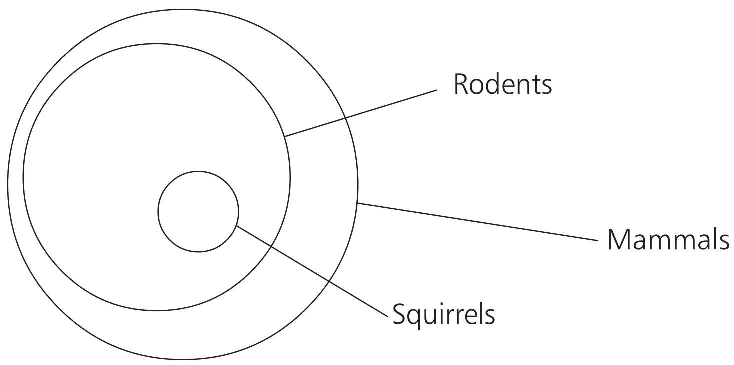


diagram to represent the first premiss, *All squirrels are rodents* is this:



When the second premiss, *All rodents are mammals*, is added we get the following picture:

Exercise E1: Gaps in the arguments

From this it can be seen at a glance that it would be correct to conclude that *All squirrels are mammals*, and incorrect to conclude that *All mammals are squirrels*.

Use your common sense to work out the gaps in each of the following arguments. (But also sketch a Venn diagram to see if that helps you think it out.)

Premiss 1 *All his friends are rap fans*
Premiss 2 *All rap fans are word-lovers*
Conclusion *So all his friends are …*

Premiss 1 *All squares are rectangles*
Premiss 2 *All … are quadrilaterals*
Conclusion *So all … are quadrilaterals*

Premiss 1 *All ostriches are …*
Premiss 2 *All birds are egg-layers*
Conclusion *So all … are egg-layers*

Premiss 1 *All … are bops*
Premiss 2 *All bops are …*
Conclusion *So all bips are bups*

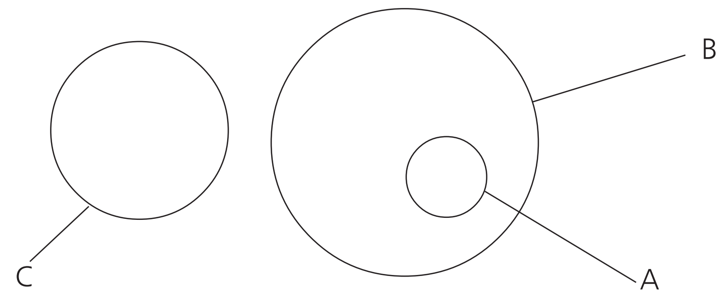
Premiss 1 *All students in this class are people who plan to be doctors*
Premiss 2 *All people who plan to be doctors are persons who like to heal the sick*
Conclusion *So …*

Premiss 1 *All films shown before 9 p.m. are supposed to be suitable for family viewing*
Premiss 2 *All films that are supposed to be suitable for family viewing are films without violence*
Conclusion *So …*

Exercise E2: Finding more logical relationships

Introduction

In exercise E1, the relationship between all the sets involved is the same as the one between squirrels, rodents and mammals. But there are other relationships between three sets – for example:



The valid argument that this diagram represents is:

Premiss *All A's are B's*

Premiss *No B's are C's*

Conclusion *So no A's are C's*

See if you can draw another diagram to represent the following valid argument.

Premiss *Some F's are G's*

Premiss *All G's are H's*

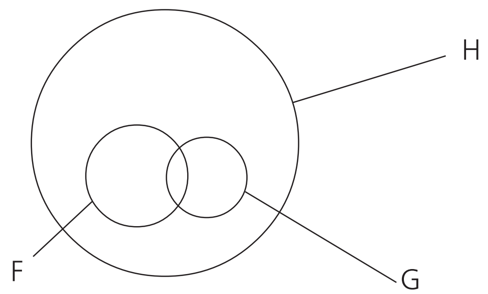
Conclusion *So Some F's are H's*

If you compare your diagram with other people's you may notice that there are two possible diagrams to represent the two premisses here.

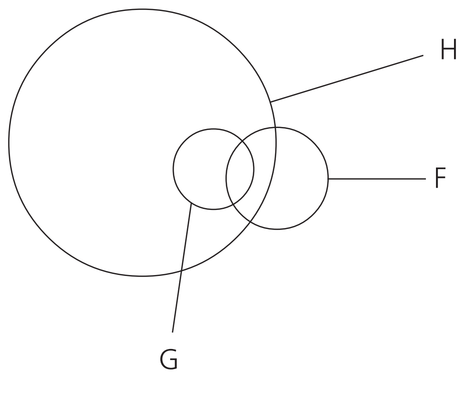
Explanation Strictly, you could argue that only the second diagram correctly represents the full argument, because the conclusion is only that some F's are H's, not that all of them are. But other people might argue that if you draw all F's as H's, then certainly it would be true that some F's are H's - so that diagram is not incorrect after all.

In the end, that discussion is not so important as to realise that you cannot actually conclude that all F's are H's from the original two premisses. And the reason for that is because the two premisses guarantee only that all the F's that are G's are also H's. This is not the same as simply saying that all the F's are H's.

1



2



When logical argument gets to this point, of rearranging letters and circles, some people become more fascinated by it, whilst others recoil in horror. It has to be admitted that the following exercise is more likely to appeal to the former group! But before others turn off completely, it may be worth their reading at least the next couple of paragraphs.

Logical relationships in life

As humans grow older, not only does their range of experiences grow, but so does their range of ideas. Already by the age of 10 most humans carry in their minds thousands of ideas, most of which are related to each other in very simple ways: like the circles in Venn diagrams, two ideas can be quite different from each other (binocular-style), or similar in some ways and different in others (butterfly-style), or almost exactly the same (fried egg-style).

256 combinations of circles

If we only ever discussed two ideas at a time, we might rarely disagree with each other, since the relationship between the two ideas could be sorted out in just such simple ways. But the moment we bring a third idea into the argument, things can get complicated very quickly. We won't go into the mathematics of it now but, believe it or not, there are 256 different possible arguments involving just three different ideas and the basic words 'all', 'some', and 'no' – of which only 19 turn out to be sound' or valid arguments. It was to separate the 19 from the other 237 that Aristotle made up his rules.

Fortunately, there are not 256 combinations of circles representing those arguments! There are in fact only 13 different 3-circle relationships. Practice in examining these relationships will stand learners in good stead for dealing with arguments in the future. They do not need to struggle through the rules. Just trying to be clear about the relationships between ideas will improve their chances of arguing well.

Procedure

Taking a pencil and some blank sheets of A4 paper, spend 5 minutes doing small freehand sketches of different 3-circle combinations, as in the diagrams above.

When you have drawn as many as you can, compare with your neighbour to see if you have all 13 different 3-circle relationships between you. If you have a little time to spare you might even try and bring the diagrams to life with examples of sets that fit them.

Question chain

Is all reasoning logical? Is all logic reasonable?

1. When you reason about what to have for lunch, or what to do with your friends, do you ever use the words 'All', 'Some' or 'No/none'? If so, give examples.
2. If you are discussing with your parents which film to see, do you use classification words such as 'thriller', 'action', ‘romance’ or 'comedy'? If so, do you make judgements about members of these classes/sets, with words such as 'most' and 'last' or 'good' and 'useless'?
3. Can you give examples of judgements about sets as a whole rather than just individuals in sets? Do you think most of your judgements are about individuals rather than sets?
4. Is your judgement affected at all by knowing that each individual is a member of one set or another, eg. the set of boys, or teachers, or postmen, or apes, or spiders?
5. Can you reason about anything without taking account of sets?
6. What do people usually mean when they say that someone's reasoning is 'illogical'?
7. If we say something is reasonable, do we mean that there are good reasons for it?
8. What do we mean by saying that a person is reasonable?
9. Is having an irregular heartbeat a good reason for going to the doctor? If so, what makes it a good reason?

11. If you have a good reason for going to the doctor, is it 'logical' to do so?
12. If someone reached a 'logical' conclusion but based on a bad reason, would we say that they were being illogical, or just unreasonable?
13. Is there any important difference between saying that a course of action is reasonable and saying that it is logical?

Activity

Judging good reasons

In pairs or small groups decide whether the following reasons are good, bad or 'not sure'.

1. Abraham decides to go to the city *because* he wants to get away from it all.
2. Brenda decides to become a vegetarian *because* her best friend is a vegetarian.
3. Colin decides to go to a football match *because* his friends are all going.
4. Dot decides to stay in bed *because* it is raining.
5. Elijah decides to help wash up *because* he needs some more pocket-money.
6. Frances decides to scream *because* she feels like it.
7. Gurinda decides to have day's silence *because* he doesn't feel like talking when he wakes.
8. Hannah decides to have a day's silence *because* she wants to do something for deaf people.
9. Ian decides to stop this activity *because* he thinks you don't have to have a good reason for everything.
10. Jessica decides to tell Ian off *because* she thinks that's not his real reason.

Activity

Logic roleplay

Rolepaly in pairs or threes can be a good way to practice logic. One person takes the role of the 'subject' – the person who makes a logical mistake. Another tries to explain the error. The subject should not understand the mistake to quickly but instead try to push the explainer into several different explaining strategies. Venn diagrams may even need to be drawn! Here are some scenarios to try out, though it is worthwhile challenging groups to make up their own based on parts of this logic course.

1. A parent wants his daughter to be a nurse but the daughter is not keen. To back up his argument, the parent says: 'Nurses are caring and I know that you are caring. So you should be a nurse – you have the most important quality to be successful.'
2. A boy had a bicycle accident and was taken to hospital. A few weeks later he is fully recovered but doesn't remember what happened to cause the accident. He says to his father: 'I can't understand it. You keep telling me that bicycles with faulty brakes are dangerous. But I checked the brakes before I set off. I really did!'
3. John and Mary are disagreeing about whether lying is always wrong. Paul says: 'arguments are conflicts and conflict is wrong so I think arguing is wrong. You should stop the argument. Anyway, arguments never get people anywhere.' Mary, disagrees. What would she say to Paul's about his argument?