

Critical Thinking and Practical Reason

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The material that is included here is for classroom use and the distance education programme by the University of Ghana only.

Also contained in Units 8, 10 and 12 are examples compiled by work previously contributed by Charles L. Gesheker, Emeritus Professor of History in the State University of California who served for a decade as a member of South Africa's Presidential Advisory Panel on AIDS, and a co-member with one of the authors of this text, of the Board of the Scientific Group for Rethinking AIDS. Prof. Gesheker consents to the use of this material in the classroom and for distance education and for any educational purpose by the University of Ghana. This material appeared initially in Chapters 2-4 in Vol. I of *History and Philosophy of Science for African Undergraduates* (2003) Ibadan: Hope Publications and in the forthcoming *Reclaiming the Human Sciences and Humanities through African Perspective* (2010) from Sub Saharan Press, Accra.

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General Overview

Dear Student,

Welcome to the world of Critical Thinking and Practical Reasoning!

We who created this workbook and course reader for you have designed it in such a way that you can master all the material required to do well in this course just by relying on all the readings, exercises, activities, practice drills, and discussion questions provided here. We suggest textbooks where this sort of topic is treated at the end of the book, but all you really need to do is to study each unit very well, and to ask questions with your tutor or the lecture of the course.

There are three types of activities through the Units

1. Short answer items
2. Thinking exercises and drills
3. Research exercises
Discussion options

Suggested answers are provided at the end of the module for the short answer items only. Thinking exercises, research drills, and discussion options may be assigned by your lecturer in your continuous assessment.

Any questions or counterparts of the same style may appear on examinations.

Anything which is unclear in the book would be a good place to start asking questions that you should bring to lecture or to tutorial or to your lecturer during office hours.

Not all written material is clear; you can help the teacher asking honest questions. Critical thinking begins with asking honest questions.

By the end of this course, you will have accomplished our main objectives if you are able to:

1. See when there is a need for making language clearer;
2. Use specific techniques to make the use of language clearer;
3. Appreciate various approaches to gaining knowledge of different types in different subject areas;
4. See the difference between distinct types of argument and reasoning that logicians have categorised;
5. Identify types of problems that you meet in everyday life;
6. Apply the respective types of solution to these problems recognised by cognitive psychologists.

Each unit in this workbook is designed to cover a particular topic that is treated in this course over thirteen weeks of lectures. If you are attending lectures then everything in the workbook will be covered in the two hour lecture or in the one hour tutorial held each week.

If it is not covered in one or both places then you should read the material and raise questions yourself about it. Some of the topics are very straightforward and you can learn them by yourself, provided you ask what you need to be sure you understand the exercises and activities.

If you are a distance education student then you will have covered all the material dealt with in the course if you read everything thoroughly and ask your tutor online specific questions, referring to specific page numbers from the text or the exercises or both. Ask everything you want to know. Especially ask if something written in the explanations is not clear to you. That shows you are working hard and that you are thinking and reading critically.

OVERVIEW OF THIS READER

In a way, there is nothing new here in this book except terminology or special labels for the sorts of things you do in your head automatically without realising it. Every person who speaks a language is already using logic. What sometimes makes it tricky to study these rules is that you follow them automatically, and it may take some extra concentration to learn the labels and categories used to talk about what you do as a speaker of a language.

Another reason why this course material may seem awkward at first is because we are using language to study language. We are thinking about our thoughts and other people's thoughts that are expressed in language, but the only way to think about our thoughts is by creating more thoughts! In geology, for example, the subject matter, is the rocks and formations on the earth's surface and underground; and the technical instruments and tools required to examine this subject matter are totally distinct: you observe your subject matter through microscopes and survey equipment, draw maps and propose theories about how these physical formations and crystalline structures came to be as you observe them. When we reflect upon our own thoughts, there is no way to separate the tools used to observe and describe what we see from the objects under investigation. This means that at the end of the day you may find that the vocabulary used and the categories drawn are often grossly inadequate for the job we are doing. But in this inquiry, realising the limitation in the categories we've drawn will count as progress!

OVERVIEW OF THE UNITS

In Part I of this course, UNITS 1-3, you will learn to look at your thoughts and other people's thoughts as they are expressed in language. The basic unit of most thinking is a sentence. Different types of sentence represent different kinds of thought or different actions accomplished using language, called 'speech acts'.

Language gets used for different purposes. There are certain techniques we can apply to classify what people are doing and thinking when they talk or write. We will discuss how to interpret what someone is doing when they use sentences in various ways. Then we can decide if for a given purpose or use, the language that has been used or the thoughts being expressed need to be made clearer.

We can look at different ways of demanding and fulfilling the need for logical clarity—that means demanding a clearer use of language to express our thoughts. While we practice doing this we will gradually, over the weeks, come slowly to understand what is meant by “logical clarity.”

In part ii, units 4 and 5, you will discover what sorts of logical tools are required in different subject areas of knowledge, also called modes of inquiry. Everyone on the campus or in their homes is studying subjects or disciplines that contrast with each other—the methods used in the arts and humanities are not the same as those taught in natural sciences or social studies. You will come to see how different patterns of logical relation between thoughts constitute the differences between the subject areas taught in distinct faculties.

By sketching what we call the Map of Knowledge, you will get some insight as to why theology and mathematics (normative sciences) are approached differently from psychology and sociology (empirical sciences), and why the study of ethics has more in common with mathematics than it does with sociology. This contrast between normative and empirical studies illustrates the differences between reasoning called deductive and reasoning called inductive.

In part three, units 6-10, we will look more directly at the fundamental differences between deductive and inductive reasoning, but we will always keep it very practical. You will learn basic patterns of logical reasoning only insofar as you need to apply them as tools to identify elementary flaws in the thinking that may lead us to hold on to a particular belief or point of view for the wrong reasons.

In part four, units 11-12, you will be introduced to strategies for everyday problem solving; these will help you to maintain your own personal and professional discretion in the face of peer pressure and mob mentality, when confronting the challenges and moral dilemmas we all face in our everyday lives both within the university and beyond.

A FINAL WORD BEFORE STARTING

Throughout, this course is practical. You need to be spending time practicing the skills and doing the homework exercises on your own. The theory is very simple but if you don't practice you could fail the exam even though you understood everything while listening to the lecture. But be careful: Driving a car is not difficult conceptually; people learn and then they do it sometimes while falling asleep, it's so easy when you learn how.

BUT “watching somebody drive a car while you sit in the passenger seat is not sufficient to ensure you can drive it yourself. *WORK HARD*. Don't just come to lectures or read through the module.

Never be afraid or hesitant to challenge anything that you read here—or anywhere. It is quite likely that if you are not satisfied by a given explanation, or if a contrast is being drawn that seems to you as not very reliable or accurate or adequate, then there is a good chance that your concerns are well founded on philosophical grounds or on experiences you have had of which others are ignorant. In any case it is always correct to take seriously your own concerns with

incoming information and to raise these objections and challenges that are worrying you. That is what critical thinking is all about.

In a more advanced course in philosophy or in another subject area in your future studies, either in a formal course or on your own, you will be free and encouraged to explore these concerns and see whether they are well founded or not. But the time to start asking questions and raising objections and posing problems is now. That tendency to raise questions and point out the need for elaboration or further explanation is the mark of a true scholar and intellectual, and that is what your role should be in civic society wherever you work and in whatever you do, to contribute to a strong and vibrant nation.

Unit one: Thoughts as Objects Scrutiny

Introduction

Logic is a useful tool, but not always. It can be abused to deprive people of their entitlements; it can be used as a verbal stick of oppression to bully and silence people.

And it's not in every situation where logic is useful; there are many uses of language to which rules of logic do not apply. For instance people use language to create an effect: to impress an audience, the Master of Ceremonies might speak of a newly wedded couple in beautiful verse, to intentionally exaggerate their virtues; to be overly concerned about the truth of what he is saying misses the point of why he is talking in the first place. Or someone might be engaged in playing a fictitious character in a play, or reciting poetic verse or telling a vivid story, or giving someone consolation, or spiritual inspiration, or just to express strong feelings. In all these situations, applying logical analysis would at best give the impression that you are trying to make a joke or to express disdain for the proceedings or the speaker. Or it might seem that you are grossly at fault for missing the intentions of the speaker or of the text.

So our first job in learning to use logical tools is to recognize those statements to which they apply. This requires recognizing different forms of linguistic expression.

This unit will cover the following topics

Section 1 Distinguishing types of sentence-shaped thought

Section 2 Recognising sentence (thought) fragments and expressions of feeling

Section 3 Identifying different types of declarative statement

Objectives for treating thought as an object of study

Upon completion of this unit you should be able to

1. Contrast

- (i) directives or imperatives,
 - (ii) questions or interrogatives,
 - (iii) declarative statements.
2. Observe sentence fragments and emotive expressions—components of thought that are incomplete sentences
 3. Identify different types of declarative statement:
 - (i) factual judgments,
 - (ii) value judgments (moral and non-moral),
 - (iii) definitions;
 4. that is, recognise when there is a call to establish:
 - (i) the accuracy of a factual judgment,
 - (ii) the credibility of a value judgment,
 - (iii) the quality of a definition.

SECTION 1 DISTINGUISHING TYPES OF SENTENCE-SHAPED THOUGHT

Introduction

In this section we will learn to examine and classify sentences into different types of action using language: a sentence might serve to ask a question in order to gain information, or to issue a directive or request to get something done, or to make a statement or declaration to convey information.

Objectives

Distinguish these categories of speech act

- interrogatives (questions to gain information)
- imperatives (directives, commands, requests to do)
- declaratives (fact statement, value judgment, definition of a word)

Interrogatives are questions and they are spoken to get information. A question in itself cannot be true or false; a question may be successful or not, depending upon whether or not it attracts a correct answer.

Imperatives are also called directives or commands, and they are requests to get someone to do something. Just like a question, a command or directive will be successful if the result is that the desired effect is brought about. Sometimes a command can be made in a polite way, as if it were a question demanding information. So we have to be aware that a sentence may have an explicit interpretation and an implicit meaning at the same time.

If I want to be polite and you are busy but I need you to tell me the time, I might say “Please, do

you know what time it is?” We would call this question a coven command or imperative, since I am not actually asking for information: I really am asking you to do something (to tell me what time it is)

Similarly in certain circumstances if I say, “can you open the window?” What I say has the form of a question, but I am not actually asking the question to find out what you *can* do; it’s rather that I intend to get you to actually do it. So it would be correct to categorize this question as a directive or a request

(an imperative). Of course it could succeed or fail—you may refuse to open the window, or it might be stuck shut—but we would not say what you have asked is true or false.

Declarative sentences also called propositions or statements convey information of different kinds; so there are three different sorts of declaratives that we will learn to distinguish. These are: statements of fact, value judgment, and definitions. We study these alone in Section 3.

ACTIVITY 1.1

Contrasting factual statements with imperatives

Rephrase sentences (1-4) so that you turn the following declaratives into imperatives:

1. Kofi closed the door.
2. Kwame is going to town.. :
3. Afua wants to take this book back to the library.
4. Joshua needs money.

ACTIVITY 1.2

Contrasting factual statements with interrogatives

Rephrase the same sentences (now 5-8) so that each is a genuine question (make an attempt with words to get information).

5. Kofi closed the door.
6. Kwame is going to town.
7. Afua wants to take this book back to the library.
8. Joshua needs money.

ACTIVITY 1.3

Contrasting factual statements with imperatives

Identify for each of the numbered items (9-15) which of the following interpretation applies:

- a. a request for someone to do something (a polite or indirect command)
- b. a request for information (a direct question)
- c. a statement expressing information. What label should you use for each? Is it possible for a question to be overtly a request for information and covertly a request to get something done? Could any of these questions serve possibly two functions?

Sometimes you will find a statement expressing information but also implicitly giving a directive. We say this statement has an implicit meaning and an explicit meaning. We will discuss this further in future sections.

9. Sir, we are the only ones here. Are you going to close the library at 5 p.m.?

10. Is today the deadline for submission of these documents for signature?

11. Can you tell me the way to get a reimbursement for this purchase?

12. Is there any time other than 2-4 tomorrow when I can book an appointment to see the Hall Master?

13. Is this teller window open for cash withdrawals?

14. I am looking for a place to buy coins.

15. This matter is going to be tabled for discussion at the next meeting.

SUMMARY

In section 1 we distinguished three types of sentence-length acts of communication:

- A speech act to get information is called an interrogative (question)
- A speech act to get someone to do something is called an imperative (directive or request or command)
- A speech act to convey information is called a declarative.

SECTION 2: RECOGNISING SENTENCE FRAGMENTS AND EXPRESSIONS OF FEELING

Sentence fragments

Some expressions do not express complete statements, so they cannot have logical relations with other expressions. A sentence fragment is a sentence with a missing part: either the subject or the verb (predicate) is absent. This may convey information, but much the way a signboard conveys information, or in an abbreviated way.

Examples:

1. Rice and stew
2. 31st December Women's Movement
3. Taking the lead
4. Unless tomorrow
5. Education of the girl child

Although sentence fragments can be very communicative, the information conveyed depends very much upon the circumstances—for instance:

If you see a sign “Rice and Stew” it won't be informative except as it might be situated where food is being served.

Or suppose I say. “Oh, as for the current president. . .” If you are looking at my face, then from my expression you can tell whether I am expressing an approving value judgment or a disapproving one. But it won't necessarily be clear in what respect I approve of the president, except with reference to the rest of the discussion. A sentence fragment therefore depends too much on circumstance and prior supplementary knowledge of the listener, or the relationship between speaker and listener, to be evaluated for its logical properties as a reliable vehicle of truth. So a sentence fragment is generally not regarded as a reliable object for analysis as a vehicle of truth.

Activity 2.1

Constructing declarative statements

For each of these expressions, add words to write a complete declarative.

1. Rice **and** stew
2. 31st December Women's Movement
3. Taking the lead
4. Unless tomorrow
5. Education of the girl child

Constructing questions and commands

Activity 2.2

Now take each of the same expressions (itemized for this activity as (6-10) and create an *imperative* or an *interrogative*. Indicate which type of speech act you have constructed for each case.

6. Rice and stew
7. 31st December Women's Movement
8. Taking the lead
9. Unless tomorrow
10. Education of the girl child

Emotive expressions

Another way of conveying information without expressing a complete sentence is called an *emotive expression*. This is a use of language which does not have any logical characteristics: from such expressions any other thought may follow and any thought might precede such an expression. They are what we call 'subjective' and have no basis for evaluation except they are either genuine and authentic, or they are disingenuous and insincere. The information is conveyed in the way we do by shouting, smiling, crying, hugging, waving ones arms and singing, and so on.

Examples:

11. Hallelujah
12. Hey! Who do you think you are?
13. Oh, how?! Are you crazy?
14. That Michael; he is the best man in the whole world! I just love to watch him.
15. Can you believe that? I can't stand the way she's dressed. It's disgusting.

It is important to realise when someone's speech activity does not lend itself to any rational evaluation. An emotive expression simply reveals the feelings or reactions of the speaker.

There is no reason to reject or to attempt to refute the way a person feels if all they do is express their feeling. They may be inappropriate or illegitimate or misguided in their reaction or feeling, but it would require a further speech act to find out why the person has the emotion they are expressing. Just the expression or feeling or subjective opinion in itself is not in itself susceptible to critical evaluation.

The point here is that when someone engages in this kind of speech activity, there is no point in arguing or in agreeing with him or her. These expressions are insignificant from a logical point of view.

Activity 2.3—Thinking exercise

Create your own examples of emotive expression.

Summary

In section 2 we distinguished two types of speech act that cannot be subjected to logical analysis or critical evaluation:

Sentence fragments—function like signboards or placards

- Sentence fragments—function like signboards or placards
- Emotive expressions—function like making faces, hugging, poking, kicking, shouting, fighting (with words)

These contrast with:

- Propositions (declarative statements)
- Interrogatives (questions)
- Imperatives (directives, requests, commands)

Activity 2.4

Distinguishing types of speech act

A. From the following list of speech acts, pick out which of them are declarative (propositions). Which are sentence fragments (incomplete sentences, idiomatic expressions or phrases)? Which are emotive utterances? Which are interrogatives? Which are imperatives?

Remember: a given sentence in English can function in more than one capacity. Sometimes the meaning of the sentence is implicit in the context of its use, e.g. a polite interrogative may be couched as a question.

B. Choose three of the fragments above and add or delete something to make them full propositions.

C. Choose three of the propositions above and reword them to make each one an interrogative.

D. For each emotive utterance, change it so that it expresses a proposition.

1. Report for class early (before 9:30) on the day of the class test.

2. Will you please close the window?

3. Is there a train running at this time of night?

4. If only he can get transport

5. Excuse me; *do* you know what time it is?

6. Students must register for each course they want to take with the department.
7. Where is Kwesi?
8. Kwesi is in the dining hall where he normally studies.
9. President Flight Lieutenant J.J. Rawlings and the charming FirstLady.
10. Let there be light.
11. Let us pray.
12. The best football player of all time.
13. Running for JCR president.
14. Everyone adores Weah of *Liberia*;
15. Weah for President!!! .
16. The most popular girl in Volta Hall.
17. Education of the girl-child.
18. There are 500 people enrolled in UGRC 150 this semester.
19. Red red and beans.
20. He is so tribalistic! I hate that!
21. What a gorgeous and talented man.
22. What are you doing for supper tonight after the Inter-Hall football match?
- 23 You must never tell lies.
- 24 Oh what should I do? It's terrible I have no money for the child's medicine.
- 25). Students must register for every course if they want to receive credit.
26. Do you know where the Balme Library is, please?
27. We're about to close; unless tomorrow.
28. Ghana was the first African team to qualify for the next level in the World Cup in 2009.

SECTION THREE: IDENTIFYING DIFFERENT TYPES OF DECLARATIVE STATEMENT

Introduction

Three different types of sentence can be easily identified as being either true or false. In English Grammar these are declarative sentences. In logic we call these 'statements' or 'propositions.' Each type of statement will give its own sort of information, and so we will determine how to find out if the statement is true or false depending upon the kind of information it is trying to give us.

Definitions: A declarative sentence is said to be a definition or true by definition, either because it states the correct meaning of a word or because it follows logically from another statement which is a definition (or because it contradicts some definition).

Example: A square is a four-sided geometric figure in a plane whose sides are equal in length, so that its height is the same as its width.

The next unit 2 is all about definitions,

Factual judgments: (factual statements): A declarative sentence is called a factual if its being true or false depends upon whether or not it accurately describes the way the world is. A factual statement is not necessarily true; it is supposed to be true, but may fail to be, and then the factual statement would be false. E.g. 'Lagos is the capital of Nigeria.'

The contrast between definitions and factual judgments sometimes can be very tricky to see, since our use of words and their correct meanings depends upon what we know to be true about the world (our knowledge of the facts).

Often when a sentence is giving the meaning of a word it is very obvious. For example:

A 'sibling' is a biological brother or sister.

But very often the only way to determine the difference between a definition and fact is by referring to the context of the sentence that is the way it is being used. For example:

Water is H₂O.

Activity 3.1

Contrasting definitions with factual statements

Directions: Determine which of the following items are factual statements, which are definitions, and which are neither factual statements nor definitions.

1. My sister's name is Ann.

2. If Ama's only sister were to marry her husband's father, then Ama's brother-in-law would also be her father-in-law.
3. Ama has four sisters.
4. A sister is a female sibling.
5. I just love Ama's youngest sister Caroline! It makes me happy just to see her! I wish I could marry her one day.
6. There are no sisters in my father's family.
7. Africa must unite!

Value judgments: A declarative sentence is called a value judgment if it conveys the way something should be or how someone in the world ought to behave, or the way things *or* people should not be, rather than describing the way people and things in the world are actually found to be. Sometimes it is very obvious when a statement is expressing a view about how people ought or ought not to be.

Moral and non-moral value judgments I

There are two types of value judgement: moral value judgment and non-moral value judgments, it is easy to see the difference by use of some examples:

- 1) He shouldn't plant the corn too early.
- 2) He shouldn't shout at his wife.
- 3) That knife has a really good edge.
- 4) That woman has a really good conscience.

Sentences (1) and (3) are called non-moral value judgments; whereas (2) and (4) are moral value judgments.

Metaphors as an expression of value judgment

Sometimes we express our values of approval or disapproval or other assessment of a thing or a person using a metaphor. A metaphor is a statement that shows how two things which are unlike in most respects have some striking similarity. Usually a metaphor is not intended to be a declarative factual statement. The meaning of a metaphor will be missed if it is interpreted literally. It must be interpreted by thinking of the sorts of qualities or characteristics that the suggested analogy or image brings to mind. We will encounter metaphors in more detail in Unit 3 Section 2.

Activity 3.2

Distinguishing factual statements from value judgments

Sometimes it is obvious when we are looking at a factual statement, or instead a sentence that expresses a value judgment. Some statements convey both types of judgment: a statement that is implicitly judgmental and expresses a value, also is explicitly stating a fact.

Can you tell which of these are obviously value judgments, which are simply factual statements, and which could be both?

1. Those boys are setting fire to that cat.
2. It is wrong for those boys to set fire to that cat.
3. Most Ghanaians do not approve of abortion.
4. Abortion is evil.
5. Idi Amin was over 6 feet tall.
6. Idi Amin treated his people with no regard for their basic human rights.
7. But in other cases a statement might express both a value judgment and a factual judgment. We can then say the statement has an explicit and an implicit meaning. This will be discussed in a later section.
8. Robert Mugabe is a present day Idi Amin.
9. The British press do not treat the President of Zimbabwe with the due respect they show presidents of G8 countries.
10. The BBC commentator for the World Cup 2010 persistently asked fans in a South African drinking spot, with apparent incredulity, whether and why they were proud that Robert Mugabe was coming to visit the games.
11. Where there is smoke there is always fire.

Unit summary

In this unit we have distinguished factual statements about the way the world is, from value judgments that depict how the world should be or something that is wrong about the way the world is; and we contrasted both of these declaratives from definitions which focus on the meaning of a word or concept as their subject.

We observed that these contrasts are not always easy to make. This is because; sentences can fulfill more than one purpose on a single occasion of its use.

- a statement can express both a fact and a definition at the same time.

- a statement can express a fact (explicitly) and also a value judgment (implicitly) at the same time.
- a statement can express a value judgment and an imperative at the same time.

Unit one Revision Activity 1

Classifying types of declarative statement

In the following list of speech acts, distinguish:

- (i) which ones are definitions (or which can you decide are true or false just by looking, since you know the definitions of the words in the sentence);
- (ii) which are factual statements,
- (iii) which are value judgments (moral or non-moral);
- (iv) which items are not declarative statements at all?

(That is, which are sentence fragments or emotive expressions)?

1. The World Cup 2010 is the first global football tournament played on the African continent.
2. The World Cup 2010 is like a shower of gold from God gracing Africa's future.
3. A whale is the largest mammalian creature that lives predominantly in water.
4. Most plants require chlorophyll to produce energy from the sun.
5. The substance in this beaker is contaminated with DDT.
6. Education for all.
7. Environmental protection Of Ghana's wetlands is critical for the future of the nation's economy.
8. Oil drilling off the coast of Ghana may impact the eco-systems associated with Ghana's coastal wetlands in the region surrounding Ada.
- 9 When you reach the junction you must turn left to get toOkponglo; look for the signboard after that and you will reach the hotel: but you must hurry; the organiser is waiting for you.
- 10.The most toxic pesticide use in recent years in this part of the country is DDT.
- 11 You must never tell lies.
12. DDT is a white chlorinated hydrocarbon used as insecticide (abbreviation for dichlorodiphenyltrichloroethane).

13 -Water' is a colorless, transparent, tasteless, odorless compound of oxygen and hydrogen in liquid state convertible by heat into steam and by cold into ice: any liquid consisting chiefly of this in seas, streams, lakes, rain, tears, sweat, saliva, urine, serum.

14. Every mammal needs Water to live.

15. A 'mammal' is a class of animal having a milk-secreting organ in the female for nourishment of the young, and usually quadruped with hair or fur.

16. Lord have mercy; Christ have mercy.

17. The 31st December Women's Movement was begun under the PNDC regime, and continues to this day to be a politically active organ during campaigns of the NDC.

18. Praise ye the Lord; the Lord's name be praised. Know ye the Lord, He is God.

19. Running for president.

20. Unless tomorrow.

21. You must always treat others as you would have them treat you.

22. Don't you just love these exercises? I'm having so much fun!!

Unit 1 revision activity 2

Past questions

Consider the following alternatives and classify them as

- Definition or a statement that is 'true by definition'
- Value judgment (distinguish moral from non-moral)
- Factual judgment
- Sentence fragment
- Emotive expression
- Imperative
- Interrogative

A. It is terrible to see Reggae music commercialized for profit by corporations.

- B. No Reggae musician ever cuts his hair.
- C. We need more rain; otherwise the grass will be very dry.
- D. Whenever the grass is very dry we cannot weave mats.
- E. There has been no rain for three months.
- F. Grass mats or grass baskets.
- G. It is going to rain unless it is not going to rain.
- H. Education of the Sahelgirl child.
- I. Emancipate yourself from mental slavery; only you can free your mind.
- J. Most of the hens in our yard are sick and will stop laying eggs next month.
- K. A hen is a mature female chicken.
- L. A rooster is a male chicken.
- M. The hen may know before the cock when dawn will come, but it is the cock who crows.
- N. No hens are roosters.
- O. These hens have not laid any eggs in the last month.
- P. Abiemo likes Bob Marley's music so he must like Reggae music.
- Q. All Reggae music was banned in Jamaica until the 1980s.
- R. Neither a borrower nor a Sender be.
- S. Reggae is a West Indian style of music with a strongly accented subsidiary beat.
- T. Reggae ROCKS!
- U. If you want to go to Madina for less than one cedi, then wait here for a tro-tro to come.

UNIT 2: DEFINITIONS

Introduction

The meanings of most words as we ordinarily use them are easy to grasp from the context of the sentences and situations in which the words are used.

But in public debates, in political discussions, in policy making, situations, in theological disputes, in theoretical articles and speculative discussions, in protest speeches and letters, petitions, and campaigns of all kinds, in cross-cultural descriptions and economic development planning, in phone-in talk shows and in general addresses, speakers often assume too much from their listeners about the meaning of particular key words they use. The result is that sometimes you can't completely understand what a person is saying, or the person is actually not saying anything important at all, even though they seem very insistent that you take them very seriously. Or people may wind up in an endless argument simply because they are attaching different meanings to the words they are using. Sometimes a very flawed proposal will be passed because the consequences or implications of the policy have been described in a misleading way, due to the unacceptable degree of vagueness or carelessness tolerated in the use of key words.

In all these situations the first step in critical thinking requires realising when there is a need to demand for clarification of the meaning of key words.

This unit discusses when it is appropriate to seek a definition, by demanding of others and ourselves clarification of specific words. It is important to know how to make this demand effectively. So we will review the different types of definition for this purpose. Depending on the purpose or situation in which more information is required about a word's meaning, one type of definition rather than another will be appropriate.

This unit will cover the following topics:

Section 1	Six types of definition
Section 2	'Well-defined' words
Section 3	'Open-textured' words
Section 4	Problems arising with definitions

Objectives

Upon completion of this unit you should be able *to*

1. Recognise six different types of definition and understand how they relate to each other;
2. Apply the method of searching for a 'real' or 'essential' definition to explore key concepts more deeply;
3. Appreciate what it means for a word to be well-defined;
4. Understand what it means to say a word is open-textured;
5. Diagnose when a definition is too narrow, too wide, vague, circular, question-begging.

A PREFATORY NOTE ABOUT WORD MEANINGS: THE CONNOTATION AND THE DENOTATION OF A WORD

A definition presents the meaning of a word. But what is the 'meaning' of a word? Just for our purposes in this course of assessing the quality of a definition, it will help if we distinguish two aspects of a word's meaning: the word's connotation and the word's denotation.

The connotation is the characteristics or features or properties of something which are associated with the word that refers to that sort of thing. For example, consider the word 'chair'. The standard connotation of the word chair is: a type of furniture that is produced for one person to sit upon with a back support.

Given this connotation, the denotation of 'chair' is collection of all the things in the world that have ever existed and which exist now and which will exist in future which are correctly picked out by this word 'chair. You can sit on a member of the denotation of the word 'chair'. You cannot sit on its connotation, instead you can describe its connotation; you can look it up in a dictionary; you can decide how to make it more precise or more general. It is the connotation of a word's meaning that typically is spelled out as its definition.

Most words have more than one connotation, and each connotation is usually associated with a distinct denotation. For instance the word 'chair' has other connotations: a chair can be the leader of a unit or department or agency in an institution; it can also be the person presiding as the authority who directs or controls what happens during a meeting. Another connotation for 'chair' is the activities of directing proceedings of a meeting or leading a group, i.e. to chair a meeting. The denotation of the word 'chair' will vary accordingly.

We use this contrast and the relation between these two aspects of the meaning of a word in order to assess the quality of a definition, as you will see in Section 5.

SECTION 1: TYPES OF DEFINITION OBJECTIVES

To recognise six different types or categories of definition

- to see how the categories are used
- to see how the categories are related to each other
- to recognise problems arising with each category of definition

Introduction

A standard definition is a statement which has two parts: the subject of the statement is the word being defined (called the definiendum), and the rest of the sentence (called the definiens) which gives the word's connotation.

There are several different sources from which definitions derive, and the different types reflect this variety of sources of and methods for creating definitions. Six different types of definition are introduced here, depending upon how the definition is created or where it comes from.

The purpose or situation requiring the clarification of a word's meaning will determine which type of definition is appropriate to supply.

These six types of definition are not mutually exclusive categories. One definition can belong to more than one category, because the sources of definitions for words shade into each other and depend upon each other, as you will see from the explanations and examples that follow. We talk about the different types to help you find the sort of information needed in different situations to make a word's meaning clearer.

1. LEXICAL (DICTIONARY) DEFINITION:

A dictionary is the most obvious and familiar place to look for a definition. A dictionary that is restricted to a particular branch of knowledge; hence a lexical definition is the most common and simplistic source of information about the meaning of a word.

The dictionary definition describes the connotation(s) of a word. For example: the word 'water' has this connotation, quoted from a dictionary: "a colourless, odourless, tasteless fluid that is the chief constituent of streams, lakes, springs, rain, tears, sweat, urine, semen, saliva due to appetite, and amniotic fluid."

Most words have more than one connotation—so we find different connotations for one word. These will be numbered in a list in the dictionary. You might find four or five definitions of 'chair' in the dictionary.

This is very common, and usually it does not create any problem. Most of the time you can tell from the way a word is used in a sentence, which of its different meanings is intended for that sentence. When this is not possible, more information is required in order to correct what is called the ambiguity of the word on that particular occasion of its use.

But often the dictionary definition presented for a word is vague for a particular purpose; or it might also be too narrow because it is reflecting the common usage of the word only by people who live in the society where the dictionary was produced.

In fact dictionary definitions are often flawed or inadequate. This is because dictionary definitions are simply huge collations of the most common way a word is used, usually in popular publications or in people's everyday conversations. So any dictionary can offer no better than the conventional or common connotations associated with a word; and the conventional or common way of using many words is often too vague for a critical thinkers liking.

Activity 1.1—Thinking exercise

Recognise the inadequacy of dictionary definitions

1 Look up in a dictionary the word 'bucket' *or* 'machete' or any other common noun describing an everyday object.

2. Now look up the word 'blue' or 'glossolalia' or 'chocolate' or 'download'.
3. Contrast the definitions for 'bucket' and 'machete' with the definitions for 'blue' and 'chocolate' and 'download'. Are they equally useful?
4. Look up some key words that you find in one of this week's newspaper editorials. Is the dictionary definition giving you all the information you need to feel comfortable using the word?

2. OSTENSIVE DEFINITION

Some commonplace definitions cannot be found in dictionaries because they cannot be written down. The meanings of some words can only be demonstrated face to face. An example is colour words. Consider the word 'red'. Words really don't help to capture its meaning; it's best to point to an object which is red.

Words that describe actions are sometimes also difficult to define using other words, for instance 'pounding fufu' and 'agbadza'. It is best to point to people engaged in these activities in order to literally show what they mean. A definition that is provided by a demonstration in real life, not by using other words, is called an ostensive definition. 'Ostensive' comes from the French 'ostendere' which means 'to show'. It is easy to remember if you know what it means to say that someone dresses ostentatiously, which means they dress in a showy way, to call attention to themselves.

To give an ostensive definition is to literally show or to point out what in real life is referred to by the word being defined.

For example, if you ask me for the definition of prime number, and I list some: "1, 3, 5, 7, 11, 13, 17, 19, 23" then I am giving an ostensive definition. Or if you ask me for the meaning of 'pop star' and I point to one standing in the street, or if I list some names of pop stars: "Beyonce, Michael Jackson, Reggie Rockston, Obrafour, Praye, Wutah, Traffic" then I am giving you examples of what the word means, which again count as ostensive definitions. When you give an ostensive definition you are directly using one or more members of the denotation of the word, bypassing the connotation of that word.

The drawback to this kind of definition is that it can be too limited. For instance there are very many shades of red besides the one we are looking at in the situation where I point at someone's shirt to ostensively define the word red. Also, in order to use this kind of definition you already have to know something about the word's use before you can make sense of my definition. For instance you have to know that the word red refers to a shade or hue of a colour, otherwise when I point to an example of a passerby's clothing which happens to be a very dark or bright red, you might mistakenly think that 'red' is another word for 't-shirt' or that it means 'very bright colour' or 'very dark colour' or that it means 'a man who is walking in casual wear'.

There are very many words for which an ostensive definition would be inadequate.

Activity 1.2—Thinking drill

Give examples of ostensive definitions

1. Choose a word that can be defined ostensively.
2. Then analyse why the definition might be inadequate.
3. Describe a situation where someone might not fully understand or be mistaken about the word's meaning if all there was to go on was the ostensive definition that you have just given.

3. OPERATIONAL DEFINITION

Another way of demonstrating the definition of a word is to give a list of instructions or to describe a sequence of steps or an operation or procedure which, when followed, will reveal or demonstrate how the word is used correctly. This type of definition is most often used in the natural sciences.

For example in chemistry, the operational definition is given for 'water soluble' in this way: (1) Take a clean beaker. (2) Add 50 cc of unsaturated water at room temperature. (3) Add 14 teaspoon of the substance to the beaker. (4) Stir five to ten times. (5) If the substance dissolves, then it is called 'water-soluble'.

This type of definition is very helpful when you are working in a situation where the meanings of words can and should be made very precise and exact. But there are many fields of knowledge and many uses of language where this is not only impossible, it would not be suitable. For instance, imagine trying to explain the meaning of the word 'faithfulness' by giving an operational definition. Will it be adequate? Why not?

Later in this Unit, in Sections 2 and 3, we will discuss how different fields of knowledge require different types of word meaning (precise vs. open). Later in Units 4-5 we will consider in more detail why different modes of inquiry and different fields of higher learning require that we rely on words' meanings differently.

Activity 1.3—Thinking exercise

Create your own example of an operational definition.

For this exercise choose an activity or topic in which you are very familiar with the way words are used. For example: If you know cooking, give an operational definition for the word 'banku'. If you know football, give an operational definition for the word 'penalty-shot'. If you know weightlifting, give an operational definition for the word 'bench-press'.

Now consider a word whose meaning is not very clear at all, but you are quite sure it is meaningful, and you use the word yourself quite often. This may not be easy to do; you have to think a long time about the words you use; we don't normally do this, if ever.

It may help to scan a newspaper, or listen to a news broadcast or watch a soap opera or a movie

and listen to the words people emphasise to each other in the course of a conversation. If no word comes to mind, use the word 'God' or 'Onyame' for this exercise.

Once you have selected a word that suits this description, explain why an operational definition would not be suitable. Write a brief paragraph or two on the limitations of operational definitions using this example. Or, discuss this in your study group.

4. THEORETICAL DEFINITION:

Many of the definitions that are in the dictionary (lexical definitions) and which we commonly use are based on meanings that come from theories that have been accepted in specific fields of scientific knowledge, and from social studies or the humanities.

The use of these definitions is based upon the theory achieving general acceptance. For instance the definition 'Water is H₂O' presupposes the existence of a theory in chemistry that is the basis for notation of molecules built up from physical elements. The symbol for oxygen is O, and H is the symbol for hydrogen. Modern chemistry teaches the principle that atoms combine together in specific structures to form molecules, and that huge numbers or moles of molecule constitute the substances we can observe in their liquid, solid and gaseous states of observed materials. This theory of substances changing states due to changes in their molecular behaviour is the basis for using the acronym H₂O that stands for two hydrogen atoms that are bonded to one oxygen atom, to represent one molecule of water. So we call the definition 'Water is H₂O' theoretical.

All the disciplines that we study in university generate vocabulary that depends upon theories that, in the main, have been accepted in that discipline. Some definitions are controversial within a discipline. Examples include the notion of 'development' in economics, and 'analyticity' in philosophy. Controversies about the meaning of theoretical terms is the subject of section 3 (open class concepts) in this Unit.

If the theory is faulty or if the theory is not reliable in every situation where it is supposed to apply, then there will be problems in depending upon the standard meaning of words that are dependent upon the general acceptance of the theory.

Activity 1.4

Identify the general source of a theoretical definition

1. For each of the following words or phrases, name the subject area of study where you would find the theory that is the source of its definition.

Nuclear family, Superego, **Inflation, phonetic, proletariat class**, sedimentary, semi-conductor, Higg's boson, Oedipal complex, bipolar disorder, antibody, reverse transcriptase, iambic pentameter, viral load, red-dwarf, drug resistant strain

Activity 1.5—Discussion option

Identify the general source of a theoretical definition

1. If you have never seen the word or phrase, or if you have seen the word before but you are unsure of its meaning, then look it up in a good collegiate dictionary. Or if it is a phrase then look up each of the words in the phrase. From the dictionary definition, can you tell from what field of knowledge or theoretical knowledge the definition is likely to be drawn?
2. Which if any of these definitions seems to you to be culture-specific, and therefore might require revision?

5. STIPULATIVE DEFINITION

For the purposes of debate or analysis or policy making, it can be useful to establish explicitly that you agree upon a specific definition for the course of the exercise or discussion or the project. Or as an author writing a long essay or thesis you can establish a stipulative definition by fiat. To further a debate it is good to find a stipulative definition by deliberation and agreement or through consensus.

For instance the standard dictionary definition for ‘earned income’ is ‘any taxable wage earnings that issue at a rate determined in advance for a fixed duration under a labour contract.’

But in many communities—perhaps most people outside Accra and even throughout the big cities—the majority of people are not earning a monthly salary at a given rate per time period; nor do they earn income under a labour contract. Yet they are still bringing income to the home on which they and their family depend. So to do any serious thinking about earned income in Ghana, a stipulative definition probably must be proposed in place of or as a supplement to the dictionary definition. This way when you use the phrase earned income it will include in its denotation the ways people here actually support themselves and their families where no monthly wage salary or paycheck is coming in.

6. IDEAL DEFINITION:

There are some situations where people involved in a dispute may not be able to agree finally on the meaning of a key word that is central to their discussion. These people may decide to adopt a stipulative definition as described above, in order to pursue their discussion about the more substantive question of what the concept ‘really’ or essentially stands for.

We use this type of definition as a philosophical method for investigating vague or poorly understood concepts which are very important to us. The essential definition need never be discovered but in searching for it, we may arrive at a deeper understanding of the subject matter under investigation. In the dialogues he wrote that featured his teacher Socrates as a hero, Plato used to demonstrate Socrates definitions following the Socratic method of conceptual analysis by pursuing necessary and sufficient conditions for correctly applying a word demanding essential definitions from the citizens of Athens as a means of confronting them with the inconsistencies and inadequacies in their everyday thinking and their behaviour.

For example, some people insist that glossolalia (speaking in tongues) is a very crucial capacity of every true Christian. That is to say, some people insist that the ability to speak in tongues, and

the practice of speaking in tongues very often, is a necessary feature or a deciding characteristic of faith in Christ, separating those who are true Christians from people who profess the faith but do not really count among those who have been ‘chosen’ by the Lord. Others very vigorously disagree and regard speaking in tongues as a learned skill and even a distraction from the true meaning of Christian faith. These two groups of people have what is called a substantive disagreement about what the ‘essence’ of Christian faith involves. They may never agree about the ‘essential’ or ‘real’ meaning of Christianity, but if they use the idea of seeking a ‘real’ or ‘essential’ definition of Christian faith as a tool or method to guide their debate, this technique of analysis of a concept can help them get a better understanding of their own position and see more clearly exactly where their views differ, and why.

To identify the ‘essence’ of a word’s meaning is very difficult. It should be regarded as a goal that need never be reached but it still is a useful way to review and reflect upon our intuitions and the collection of notions we have about the use of a word or the concept that it stands for.

Ideal or essential definitions are only achievable for words that are ‘well-defined’ as we will discuss in the next section of this Unit.

This type of ‘ideal’ or ‘essential’ definition is also called an eliminative definition. This label comes from the idea that if one has an eliminative definition, then the definiendum could be eliminated and replaced by the definiens in every context of the word’s use. This is because the definiens provides all those features and only those features of a thing correctly called by that word. The eliminative definition provides just the necessary and sufficient conditions for using the word correctly. For example, here is an eliminative definition of even number

An ‘even’ number is a whole number that is divisible by 2.’

This definition is called ‘eliminative’ because in any true sentence where the definiendum ‘even number’ appears, it could be eliminated and replaced by the definiens: ‘whole number that is divisible by 2’ without changing the truth of the statement.

Activity 3.1—Discussion option

Discover how difficult it is to find *an* ideal definition of an everyday word.

Consider a very simple word like ‘table’. Think about one connotation of the word. (‘Table’ has several connotations: it is a type of furniture, it is a format for presenting information, a summary of data in a long published work, it is an administrative action that results in a topic being treated during a meeting.) Try to discover all the necessary conditions and all the sufficient conditions that make it correct to denote something by that word according to that connotation. If you are able to do this, you have created an ideal definition of that word and then you can say the word is well-defined. But it is hard.

Sample discussion

A. What is a necessary condition of being a table?

- i. Is it necessary that a table be made of wood?
- ii. That it be 35 cm. above the ground?
- iii. That it has four legs?
- iv. That it be rectangular?
- v. That it be used routinely to write upon?
- vi. That it ever be used for any reason at all?

Replies to A: None of these conditions are necessary:

- i. there are objects called tables that are not made of wood— tables are made of aluminium, formica, plastic, stone, concrete
- ii. some tables are 2 or 3 metres high, some are 4 metres high, the height of a piece of furniture is not essential to its being a table etc.
- iii. some tables have three legs, six legs, or just one leg
- iv. there are tables that are circular, elliptical, kidney shaped, diamond shaped
- v some tables are only used as a work bench for drafting or for carpentry work, or for eating
- vi some tables have never been used for any purpose because they are made arid kept for decorative purposes only, or built as stage scenery or props, or placed behind glass, or redundant in a room full of many tables

B. What is a sufficient condition of being a table?

- i. Is it sufficient that an object be sat near and written upon to be a table?
- ii. Is it sufficient that an object be a piece of furniture whose flat surface is raised above the ground, in order to be a table?

Replies to B: Neither of these conditions is sufficient:

- i. Someone might sit near a big cardboard box and eat or write on the flat surface, or near a wooden crate, or a fallen tree trunk; or a countertop, or one might sit next to a bed or another chair that one writes upon or puts things on.

So this condition is not sufficient for something to be table rather than a crate or a bed or a counter or a chair- although you might say you are using the chair, bed, crate, tree trunk as if it

were a table. But this implies it is not a table.

ii. A bed, a chair, a lectern, a sofa, a book shelf, are all articles of furniture where the flat surface is raised above the ground; yet they are not correctly called tables. So this condition is not sufficient for fixing the denotation of the word table.

Summary

We have discussed six types of definition: dictionary (lexical), ostensive, operational, theoretical, stipulative, ideal (essential).

- We reviewed problems and drawbacks that emerge with each type.
- We noticed that some of the types overlap:
 - In particular, theoretical definitions often appear as dictionary definitions.
 - A stipulated definition might be derived directly from the dictionary; so it could also be classed as a lexical definition.
 - Some operational definitions are also theoretical (e.g. Chi square test; prime number).

SECTION 2: WELL DEFINED TERMS

Introduction

If we can successfully provide an ideal or essential definition for a word then we call it well-defined. A word is well-defined just in case its definition makes completely clear which objects or individuals or properties are correctly called by that word W.

For example, the term ‘even’ number’ introduced in section 1 is well-defined because given any whole number it is possible to tell from the definition whether or not that number should be called even. If the number is divisible by two without remainder then it is an even integer, and not otherwise.

Objectives

- To understand what it means to say a word is ‘well-defined’;
To see why this is useful in some fields of study.

Almost all the terms of mathematics are all well-defined. So we can say in this case that the definition of ‘even’ is both operational and essential. Typically, only words that are well-defined are allowed in mathematics, unless they are introduced explicitly as ‘primitive’ or ‘undefined’ terms, e.g. the word ‘point’ in geometry has no definition, it is one of the few words that is accepted without definition, as a ‘primitive term’.

But outside of pure sciences like mathematics, it is difficult to find well-defined words. In fact it is not very often that you can decide precisely what are the necessary and sufficient conditions

for using even the most ordinary words that we use in our everyday lives.

Summary

Words that have ideal or essential definitions are called well defined. Outside of the pure sciences, these are rare. A science called 'pure' if all its basic elements of knowledge can be collected together in a system of axioms and proven theorems using deductive rules of inference. We will discuss such a method of deriving knowledge in Unit 6.

SECTION 3: OPEN CLASS CONCEPTS

Introduction

Psychology and history and economics are often cited as prime examples of subject areas that contain many key terms that cannot be well-defined. In Unit 4 we will consider whether this is a reason to locate these disciplines on a borderline between science and art.

But as you just discovered if you worked on the summary exercise for section 2 on the previous page, surprisingly many familiar words cannot be well-defined. In public and personal life maybe most of the words we use regularly cannot be well defined: patriotism, terrorism, justice, piety, fidelity, beauty, intelligence, ethnic identity, democracy, love.

Objectives

To understand what it means to say a word is 'open-textured' or 'essentially contestable'
To realise how this can be a useful feature of key words in some fields of study

OPEN TEXTURED WORDS

These are the words that represent open class concepts. This category is also called "essentially contestable" concepts. As we considered in section 1, the deeper or broader implications of a word's meaning (for example, 'justice', 'intelligence', 'equality', 'democratic process', 'national development', 'life'). In the case of getting a clear understanding of the meaning of these words, a dictionary definition is not good enough. As we noticed, a dictionary is merely a huge compilation of the common usage of words. Because the ordinary or commonsense use of a word is often vague and unclear, (the dictionary definition is usually only the starting point to seek further specification and elucidation of a word's meaning.

Here are examples of words (or concepts) that are essentially contestable:

Income, Family, Intelligence, Development, Justice, Democracy, Rural, Orphan, Fidelity, Normality, Equality, Ethnicity, Modernity, Corruption

This label is derived from Alasdair MacIntyre's "The Essential Contestability of Some Social Concepts," *Ethics*, 84 (1973-74): 1-9.

The purpose of creating ideal or essential definitions is therefore to function just as a heuristic, to guide us in the process of exploring meanings that we hardly understand adequately. If you want to look deeply in the whole tangle of intuitions and associations associated with a word that is important to you, then it helps to have a systematic method, and this is how the notion of an ideal definition or essential definition is used—as a model. Socrates in Plato’s dialogues is famous for using the ideal of an ideal definition as a methodical way of interrogating his fellow citizens about important concepts including justice, piety, the state, love, wisdom, freedom, truth, beauty.

For many words, perhaps most words, essential definitions do not exist. Like other virtues, the well-definedness of key terms as presented here is an ideal that we might aspire to in the social studies and humanities but usually do not achieve.

Summary

As you will discover, for some vocabularies it is not even desirable as a goal to pursue an essential definition. For some concepts. We need our understanding of the meaning of the word that stands for that concept to remain ‘open’ to many interpretations. This characteristic of well-defined words in one vocabulary and open-textured words in another vocabulary has sometimes been used as a way of distinguishing the natural and pure sciences from social studies and the humanities, as we will examine in depth later, in Unit 4.

Summary exercise 3.1—Discussion option

Try to create an ‘ideal’ definition for one of the words on the list of open class concepts presented above activity 2.1 in the previous section 2. Report and discuss your experience.

SECTION 4: DIAGNOSING PROBLEMS WITH DEFINITIONS

Introduction

In this final section of Unit 2 you will learn some vocabulary to help you recognise and remedy flawed definitions.

Objectives

To identify flaws in definitions as

- too vague
- too narrow .
- too broad
- circular or begging the question

To be able to realise when a statement masquerading as a definition is actually expressing an opinion or a value judgment

Any of the six types of definition presented in section 1 may be flawed in one or more ways. Below we have different categories to diagnose why a definition is poor. These categories overlap. In other words, a given definition may be flawed in more than one way.

Problems arising with definitions

(a) too narrow(the definiens does not cover all the things that correctly belong in the extension or denotation of the word)

(b) too broad(the definiens covers things that don't belong in the denotation of the word)

(c) vague(the definiens does not specify adequately to determine what belongs to the word's denotation)

(d) circular(the definiens repeats the definiendum); also called *begging the question* (when the definiens contains words that are just as obscure as the one being defined)

Explanations and examples:

To easily understand these labels for assessing the quality of a definition, think of the meaning of a word as having two aspects— the denotation and the connotation. The definiens might be correct or too broad or too narrow depending upon whether it captures the connotation of the dimension. Think of the connotation as a box which should be exactly the right size to contain all the members, and only the members, of the word's denotation. The denotation is the collection of all the individuals or instances in the world that are denoted or picked out or designated by the word being defined.

(a) When a definition is too narrow.

The dictionary definition for 'earned income' is a good example of a definition that should be criticised as too narrow:

(i) 'Earned income' is 'any taxable wage earnings that issue at a rate determined in advance for a fixed duration under a labour contract.'

If this definiens were used to specify the dimensions of a box containing all the individual instances of earned income in the world, then the box would not be big enough to contain many earned incomes: those of self-employed artists and craftsmen, self-employed caterers and cleaners and service providers that earn only as and when they have customers, performing artists like dancers and musicians who wait for functions when they are needed and do other odd jobs in the meantime to support themselves and their families, subsistence farmers and herders whose income is seasonal and not always paid monetarily but might be provided in kind goods or services, anyone in the informal sector who is a petty trader, or who is providing services from streetside kiosks or who are completely mobile, or those producing commodities in their backyards and selling in their frontyards. All these ways of supporting oneself and others are

correctly called earned incomes and constitute over half the commercial economy in Ghana, but they would be left out of the denotation according to the connotation of 'earned income' described by the dictionary definition cited above. This shows that the dictionary definition of earned income cited above is too narrow.

(b) When a definition is too broad.

On the other hand, to stipulate the definition of 'earned income' by revising it to contain the wide range of cash or kind relations that an agrarian economy depends upon, then we might stipulate a definition like this:

(ii) An earned income is any acquisition that benefits the recipient.

Commentary: If (ii) were accepted as the definition then it would destroy the important and familiar distinction between acquiring something as earned income and acquiring it as a gift, as purchased services, as an inheritance or a legacy, as a constitutional right, as stolen property, as graft, or as a prize or donation that supplements what is correctly called one's earned income. The definiens of (ii) allows too many things into the denotation of 'earned income' which do not correctly belong so we say it is too broad. Here is another example of a definition that is too broad because in a container of this description we will be able to fit too many things that don't really belong in the word's denotation.

(iii) Love is a powerful emotional response.

Commentary: While statement (iii) is true, it is a flawed definition of love because if you were to create a box that contains everything which is an emotional response, it could include jealousy, hate, envy, fear, resentment, rivalry, ambition, pride, vanity. Because all of these are powerful emotional responses but none are correctly denoted by the word love we say that the definition in (iii) is too broad.

(c) When a definition is *vague*.

This is a criticism that applies to a definiens that is so imprecise that it is not clear what sort of things are being denoted by the definiendum.

(iv) Democracy is freedom for all.

Commentary: One might ask: all what? What sort of freedom? Are we talking about people (is anyone on holiday denoted by the word democracy?) or insects (is the Brownian motion of molecules that are constantly and arbitrarily changing location in any compound when in a liquid or gaseous state, correctly referred to by the word democracy?) or unpenned domestic animals (does democracy denote free range chickens or wild dogs moving freely in packs?)

This definiens simply doesn't give enough information of what type of entity it is which is being referred to as universally free. We don't know what at all is meant to fit into the box, from this

connotation. So we say it is too vague.

(d) When a definition is circular or begging the question:

A poignant example is the definition of AIDS offered by the Centers for Disease Control (CDC) based in the USA. This definition is “responsible for much of the obstruction in the scientific appraisal of the AIDS situation. . .” Quoting Serge Lang further:

The CDC definition of AIDS is circular. It involves a list of 24-29 diseases (depending on the year), about 60% of which have to do with immunodeficiency (including TB), and 40% of which have to do with other types of diseases, including . . . cervical cancer. These diseases are called AIDS (acquired immuno-deficiency syndrome) only when the antibodies test indicates that HIV may be confirmed or presumed to be present. If a person tests HIV negative, then the diseases are given another name. Statistics based on such a definition are very misleading, because the definition assumes the correlation

To put this critique in context, what follows in italics is one version of the official and complete CDC definition as it existed for public perusal on the internet in 2010 at many internet locations, including <[http://www.cdc.gov/mmwr/preview/mmwrhtml/00018871 .htm](http://www.cdc.gov/mmwr/preview/mmwrhtml/00018871.htm)>

CDC definition of AIDS:

AIDS defining clinical conditions is the terminology given to a list of diseases published by the United States government run Centers for Disease Control and Prevention (CDC). This list governs the U.S. government classification of HIV disease. This is to allow the government to handle epidemic statistics and define who receives US government assistance. In 1993, the CDC added pulmonary tuberculosis, recurrent pneumonia, and invasive cervical cancer to the list of clinical conditions in the AIDS surveillance case definition published in 1987 and expanded the AIDS surveillance case definition to include all HIV-infected persons with CD4+ Tlymphocyte counts of less than 200 cells/uL or a CD4+ percentage of less than 14. Considerable variation exists in the relative risk of death following different AIDS defining clinical conditions. According to the US CDC definition, a patient has AIDS if he or she is infected with HIV and presents with one of the following: A CD4 + T-cell count below 200 cells/pi (or a CD4+ T-cellpercentage of total lymphocytes of less than 15%) or the patient has one of the following defining illnesses:

- Candidiasis of bronchi, trachea, or lungs
- Candidiasis esophageal
- Cervical cancer (invasive)
- Coccidioidomycosis, disseminated or extrapulmonary
- Cryptococcosis, extrapulmonary
- Cryptosporidiosis, chronic intestinal for longer than 1 month
- Cytomegalovirus disease (other than liver, spleen or lymph nodes)
- Encephalopathy (HIV-related)
- Herpes simplex: chronic ulcer(s) (for more than 1 month); or bronchitis, pneumonitis, or esophagitis

- Histoplasmosis, disseminated or extrapulmonary
- Isosporiasis, chronic intestinal (for more than 1 month)
- Kaposi's sarcoma
- Lymphoma: Burkitt's, immunoblastic or primary brain
- Mycobacterium avium complex
- Mycobacterium, other species, disseminated or extrapulmonary
- Pneumocystis jiroveci pneumonia (formerly Pneumocystis carinii)
- Pneumonia (recurrent)
- Progressive multifocal leukoencephalopathy
- Salmonella septicemia (recurrent)
- Toxoplasmosis of the brain
- Tuberculosis, disseminated
- Wasting syndrome due to HIV

People who are not infected with HIV may also develop these conditions; this does not mean they have AIDS. However, when an individual presents laboratory evidence against HIV infection, a diagnosis of AIDS is ruled out unless: the patient has not undergone high-dose corticoid therapy or other immunosuppressive/cytotoxic therapy in the three months before the onset of the indicator disease OR been diagnosed with Hodgkin's disease, non-Hodgkin's lymphoma, lymphocytic leukemia, multiple myeloma, or any cancer of lymphoreticular or histiocytic tissue, or angioimmunoblastic lymphadenopathy OR a genetic immunodeficiency syndrome atypical of HIV infection, such as one involving hypogammaglobulinemia AND the individual has had Pneumocystis jiroveci pneumonia OR one of the above defining illnesses AND a CD4+ T-cell count below 200 cells/ul (or a CD4+ T-cell percentage of total lymphocytes of less than 14%).

Sometimes a statement is presented as a definition when in fact it is an emotive utterance or a value judgment, not a definition at all. For example:

- (v) Hip life music is trash,
- (vi) Abortion is an evil act.

Commentary: Sentence (v) might be regarded as vague also, since all manner of things are correctly categorized as trash, except that it is used here as a negative or pejorative description. It could therefore be called question-begging, except that an opinion is being clearly expressed, so it is not a definition at all, even if there were no question arising. Similarly, (vi) categorizes abortion on moral grounds but does not indicate what define it. So it is a value judgment, not a definition.

Notice that a faulty definition can be correctly criticized as having more than one type of fault. For instance it is not contradictory to say that the following faulty definition is both too narrow and too broad; and it could be criticized in other ways as well:

- (vii) Spirituality is a characteristic exhibited by a person who attends some form of church service or: a regular basis

Clearly this is too narrow since many people who are religious go to mosques, temples, or noninstitutionalised service at all. But it is also too broad as a definition because people who attend regular worship services may not all claim to have spirituality as a characteristic or as an interest or aspiration. They may practice the ritual of church attendance because it is their duty, or because it is socially advantageous, or because it is the custom of their family, or because they are afraid not to follow the convention. The definition seems to presuppose rather than spell out what spirituality means. So it could also be said to be begging the question. And since it fails to provide a definition of the connotation adequately it might be criticized as not a definition at all, but a covert form of imperative (i.e. if you claim to have spirituality then you should be attending a church service regularly). Or it could also be said to be expressing a value judgment (i.e. spirituality should entail going to a church service on a regular basis).

Activity 4.1

Identify problematic definitions

In the following list, consider each statement for its qualities as a definition. Classify the problem faced by labelling it as:

- i. Too narrow
- ii. Too broad
- iii. Vague
- iv. Circular or question begging
- v. Not a definition (identify what it is instead)

Notice that some of the sentences may not count as a definition.

1. The meaning of evil is, for example, murder.
2. To be courageous is to have courage.
3. A dinosaur is a pre-historical creature.
4. Violence is forcing someone to do something against her or his desires.
5. An identity is the sharing of identical features by two or more things.
6. Morality is the doing of what is morally right.
7. Philosophy is the study of the works of Plato.
8. Love is an emotional response.
9. Learning is a form of intellectual stimulation.

10. Dancing is the repetitive motion of the whole body or limbs.
11. All Volta ladies are snobs.
12. Religion is the opiate of the masses.
13. Terrorism is the greatest threat to civilisation of our time.
14. A terrorist is any enemy of the American way of life.

In the Answers section at the end of the book you will find some suggestions for interpreting the problems with the definitions above. They are not definitive. You may have an alternative assessment which may be legitimate; have you got reasons for your way of labelling the definition's fault? It may not be inconsistent with the answers suggested at the end of this book, but still your assessment may be correct—it depends upon how you explain your answer.

Summary

In section 4 we have reviewed various ways that definitions can be criticized. Each label reflects a failure of the definiens in a definition to capture the correct connotation of the word, using the image of a container for the denotation:

- If the container allows too many things that are not proper members of the denotation of the word, then the definition is too broad.
- If the container described by the definiens does not allow things that belong to the denotation to fit in the container it describes, then the definition is too narrow.
- If the definiens does not give enough information to tell what sort of things are being referred to at all, or if the words it uses are so obscure that it can't be located what the word designates, then the definition is called vague or begging the question.
- If the definiens contains cognates of the definiendum then it is called circular.

More than one category of criticism can apply to the same faulty definition.

These categories are not mutually exclusive.

TIP: Critical thinking requires original thinking. Don't strive to memorize a list of applications of these labels or any of the categories you learn in this course. Instead, find a paradigm example that you can remember as a prototype, and then rely on your own judgment and reasons for criticizing future definitions and words in use.

Summary exercise

Consider your results of Activity 4.1: can you find other ways of evaluating what is wrong with each of the sentences presented as definitions?

1. Review and redo all the Activities in this Unit that you had difficulty with, and raise any questions you have with your tutor or instructor.

2. Pay close attention this week to the editorials and opinion columns in the newspapers. Or listen to a favourite phone in talk-show or debate on the radio. Look for uses of words that require further clarification of their intended meaning by the speaker or writer. Look each of these words up in the dictionary. Is a lexical definition going to solve the problem you encountered with how the word was used? Form a study group to discuss the result of your critically reading and listening to editorials, phone in talkshows.

Unit summary

We say that a word is essentially incontestable, or open-textured, or that it stands for an open class concept if it is unlikely to gain universal consensus. People's lives and experiences are very different throughout the many regions where an international language is used (English, French, Spanish, Portuguese are examples of languages that are international in Africa). So it is that many key terms in the human sciences have connotations that do not fix absolutely their denotations. See Unit 4 for a more thorough treatment of this point about the human sciences (social studies). It is actually necessary that key words in the social studies and humanities are not precisely definable (not well-defined) and which are meaningful to us even though their meaning can diverge widely depending upon our backgrounds.

In this unit you learned:

- when and how to call for different types of definition;
- two aspects of the meaning of a word, which are captured correctly
- by a good definition: the connotation and the denotation of the word;
- when to expect words to be well-defined, and when to expect words
- to be open-textured, standing for open class concepts that cannot be and should not be precisely defined;
- when to use the method of searching for a 'real' or 'essential'
- definition as a technique for exploring our beliefs and intuitions about a concept;
- when and how to criticize a definition which requires revision to capture a meaning of a word.

UNIT THREE: CONTRASTING TYPES DISCOURSE

Introduction

In Units 1 and 2 you were introduced to techniques for studying the meaning and different uses of individual sentences. But most of the time when we gather information we do not think about individual sentences one at a time in isolation from each other.

In this Unit you will apply these same techniques to scrutinize batches of sentences working together—in written passages and spoken conversations, where sentences are ordered in distinct ways for different purposes.

When we formulate, or defend, or revise, or refute our own opinions or other people's opinions and beliefs, we need to analyse statements in organised sequences. It is the relations that exist within a batch or sequence of statements which are the chief focus of logical thinking and critical reasoning.

Sentences usually convey more than single bit of information or a single level of meaning at a time. We need to assess what is communicated both implicitly and explicitly, indirectly as well as overtly, in order to make correct evaluations and to draw correct conclusions from what we hear and read as critical thinkers and good practical reasoners. We also need to know when critical analysis is inappropriate, and when instead we need to employ more subtle forms of interpretation of meaning.

This unit will cover the following topics:

- Section 1 Distinguishing verbal disputes from substantive disagreements
- Section 2 Bracketing metaphorical and proverbial language
- Section 3 Correcting ambiguity, vagueness, and equivocation
- Section 4 Recognising types of discourse revealed in passages
 - Argument
 - Narration
 - Instruction
 - Rhetorical polemic

Objectives

Upon completion of this unit you will see where logical analysis belongs because you will be able to:

- distinguish between a verbal dispute and a substantive disagreement
- appreciate the deviations from literal interpretation required by metaphor, allegory and proverbial discourse
- recognise when ambiguity, vagueness, and equivocation require correction
- identify when a passage contains an argument rather than a narrative, a set of instructions, or self-asserting rhetorical polemic

SECTION 1: VERBAL DISPUTES VS. SUBSTANTIVE DISAGREEMENTS

Introduction

A verbal dispute is a disagreement which rests upon an inconsistency in the way the disputants are using the same words. Usually this is not a fruitful kind of disagreement. Once the meaning of key words is clarified so that both sides of the dispute are relying upon the same meanings, then either it becomes clear that there is no real difference of opinion, or it becomes clear instead what is the nature and quality of their disagreement. So coming to an agreement about the use of words will allow progress towards the goal of discussion, which is to reach greater understanding of a problem, or to articulate a point of view about the problem and to give good reasons why it should be embraced.

Objectives

- To discover how correcting inconsistencies in the use of words can help to fix a disagreement that is steeped in confusion.
- Correcting a confusion does not always mean we can wipe away a disagreement by resolving people's conflicting views.
- Correcting confusion may involve instead forwarding the discussion to a productive level, either making clearer what the disagreement is about, or reaching a deeper, wider, or more complicated level of the disagreement.
- Substantive disagreement is a good thing. Or we can learn how to make it so.

THE NATURE OF DISPUTES

As just described in the introduction, some conflicts are based on confusion. We call these disputes merely 'Verbal' if they are the result of inconsistency in the use of words. In contrast, a substantive dispute is one that exists because each side of the disagreement has in view different facts or subscribes to contrasting values. Substantive disagreements can be pursued fruitfully on logical grounds. Life is full of disagreements, especially academic life. It is out of disagreements that we come to a better understanding of the world and ourselves and each other.

Another basis for disagreements is the constant divergence and shifting tide of our feelings and opinions and reactions. Different reactions and feelings are stirred up in each of us over any given topic and usually our feelings and reactions change over time. Subjective reactions are in constant flux, and feelings vary between and within people depending upon our varied backgrounds, circumstances and experiences.

Asserting yourself in polemic or rhetorical or emotive exclamations while I do the same does not yield a divergence of views that add up to a logical inconsistency. This too is only an 'apparent' argument that cannot reach resolution or make any advance in understanding of the objective world, although we can learn a lot about each other and ourselves by listening to each other expressing our feelings. When people voice their subjective reactions, their sentences need to be recognised as emotive utterances.

Such sentences tell us about the speaker. This is why they are called subjective utterances. When people are voicing their subjective feelings then this is just a part of the fabric of social reality

and normally it does not warrant any further diagnosis. As the saying goes, ‘people are entitled to their opinion’.

It is very important to know when someone is doing this. Because very often, people’s personal preferences or feelings are mistaken as a legitimate basis for making policy. Sometimes if an individual wields a lot of political or financial or professional or social power, his or her subjective opinions get confused with the facts, or with a good logical reason for accepting what he or she says. It is important for critical reasoners to realise the difference between an objective fact and an individual’s subjective opinion.

In order to realise whether a statement constitutes a disagreement that is merely verbal, or polemical, rather than a substantive difference in viewpoint, you must pay very careful attention to what is being said or written, and then ask the following four questions in any given situation of discursive conflict.

Activity 1.1

Distinguish verbal disputes from substantive disagreements

- 1 Will the disagreement be resolved by all parties accepting a stipulative definition? If so, then the participants in the argument were engaged in a verbal dispute. (Recall the notion of stipulative definition introduced in Unit 2).
2. Is the proposal of a stipulative definition likely to be resisted by one or more of the parties in the dispute? If so, then there may be a substantive disagreement between the participants.
3. Suppose a stipulated definition of key words is accepted by everyone involved in the discussion. Once agreement is reached about the use of key words, is there still unfinished business and unresolved conflict of opinion? Do the participants have good logical reasons for their different viewpoints? If so, then again we say they are engaged in a substantive disagreement.
4. If a disagreement prevails, but there are no reasons available, then the difference may be just between subjective points of view. If the statements are actually emotive expressions, then they cannot contradict each other because they are neither true nor false except as facts about the different speakers (one loves A, the other hates A). Expressing different opinions or feelings is an important part of social interchange, and is to be expected because people have very different experiences and reactions to the world. But these interchanges are unlikely to be a fruitful focus of logical analysis and critical assessment. ‘People are entitled to their own points of view’.

Apply the questions above to each of the snippets of conversation below. Read the commentary that follows each conversational fragment, as a way to inspire your own insights about what the conversation is meant to illustrate.

1. That woman is not a real Christian because she does not speak in tongues. No, she really is a Christian since she was baptized and confirmed in the United Methodist Church.

Commentary: These people clearly disagree about what is essential to having Christian faith. The participants in this debate might not be able to arrive at a stipulative definition for Christian unless they realise it is only a means to get at the deeper issues about which they disagree. But it is not obvious that these sentences are correctly understood to be emotive expressions. This is likely to be a substantive difference in matters of faith, but it is not resolvable using critical analysis alone. For there are many ways to experience belief in Jesus Christ; perhaps all are legitimate. Or, perhaps there is only one way to interpret the Bible. Tolerance of varied interpretations of biblical text is called ecumenism. Single-minded interpretation is called fundamentalism. These and other ways of interpreting the Bible are vigorously disputed among some Christians. Similar theological disputes obtain among devout Muslims reading the Qu'ran, committed

Buddhists reading the Pali canon, and pious Hindus reading the Bhagavad Gita. One has to study theology to make progress with understanding the objective implications of this sort of substantive disagreement.

2. That man is playing a wooden flute and the other musician is playing the apentemma.

-No; I am sitting closer and I can see that one of them is playing a clarinet and the other is playing on a fontomfrom drum.

Commentary: In this case, the person sitting closer probably has a better view of the instruments and the players, so here the disagreement can be resolved by appeal to the facts. It is also possible that the first speaker needs to learn what the words 'clarinet' and 'fontomfrom' mean. So the first speaker can be corrected in his use of the words 'flute' and 'apentemma' by learning that he has misapplied them on this occasion. The second speaker has resolved their dispute by giving a report of the facts, or by providing an ostensive definition of 'clarinet' and of 'fontomfrom', or both. So the original disagreement can be said to have been merely verbal.

3. Kpanlogo is a traditional folkloric dance that our Ga ancestors used to dance only at funerals for hundreds of years.

— No; Kpanlogo is a neo-traditional popular dance that the dance-bandleader Otoo Lincoln and his group created in Bukom Square, Accra, around 1962. He relied on the old funeral dirges to build up a versatile form of popular dance which suits every occasion nowadays, including funerals.

Commentary: Here again is a case where more knowledge of the musical history of Ghana's popular music forms can correct the first speaker's use of 'Kpanlogo'. Since the correction of what the word means resolves the disagreement, we can say that this was merely a verbal dispute.

4. African Americans are really American.

—No, African Americans are really African

Commentary: Among Americans it is highly charged and significant where people originally come from since the whole society was created by and has been comprised of immigrants, except for the indigenous Native Americans most of whom were killed in a few generations through systematic genocide.

This conversation reflects a deep dispute that reveals the shifting politics of identity. It is possibly similar in its content to the conversation in item 1, although probably much more emotionally charged because of the role Africans have played in the development of American society. How to resolve the question of one's social or ethnic identity for some people invites hugely substantive disagreements; this is not a verbal dispute.

5. The Head of State is not really a Ghanaian since he's half Scottish.

-No, he is a Ghanaian since he is our leader and he is a Ghanaian citizen with a Ghanaian passport.

Commentary: This is likely not to be just a verbal dispute about what it means to be a Ghanaian citizen. This discussion may rather display indirection to avoid open and blatant criticism of a high official, particularly a head of state. Openly criticising a head of state may be regarded as committing a serious offence or might be regarded as very bad taste or as unpatriotic. At times when past presidents have been the focus of disapproval, their nationality has been challenged, rather than voicing openly a complaint about their performance. Once a stipulative definition is agreed upon about what are the requirements to be a Ghanaian citizen, then possibly the underlying objections to the individual in question or criticism of his performance might emerge if the discussion is continued and circumstances allow candid disagreement.

6. You are not properly registered as a resident of this Hall; yet you are occupying a room, and this is illegal. I will have to take the appropriate actions against you.

-That's not fair! I'm not doing anything wrong! Legon Hall is my Hall, and I'm only perching here! Everybody is doing it.

Commentary: Here we have a definite example of the second speaker applying a persuasive use of words to try to encourage a point of view. Occupying a room illegally, without being registered for it, is what 'perching' means in the Legon community. But to call a practice 'illegal' usually highlights its ignoble nature and typically indicates disapproval—except in rare cases where the morality of the law is being challenged. The hall official is expressing his disapproval. The student is using a euphemism that underlines the fact that the same action is widespread and conventionally or covertly accepted. The following questions arise about what these two disputants are saying, although they are not asking these questions explicitly: Does the fact that an illegal practice is being indulged by everyone and is covertly tolerated make it ethically acceptable? Is the fact that something is illegal to do a sufficient basis to penalise one individual—if the practice is tacitly condoned as a widespread, makeshift response to an untenable housing problem?

The verbal disagreement concerning how to refer to the action of living unofficially in a residence hall is only a superficial cover which deflects from the real and substantive questions

about the ethics of this action, and the ethics of sanctioning one person for meeting his needs according to an established convention. So this is a substantive disagreement which has yet to be spelled out.

7. These US army personnel are helping Iraqi citizens because their presence maintains a peaceful and secure environment, thanks to the sacrifices they are making in their effective peace-enforcement strategies.

-These US soldiers are imposing martial law and have orders to target civilians, so they pose a threat to Iraqi citizens and their belligerent presence increases the danger of freely moving in the city. Their presence is provoking terrorist attacks where none occurred before they came.

Commentary: Here are two sentences describing the same activity, both of which are exhibiting the persuasive use of words. The first person chooses words that make the U.S. instigation of war in Iraq sound like a noble venture. The second sentence describes the same military initiative in a way that condemns it and thus expresses severe disapproval. It seems that these value judgments may not be reconcilable. More of the discussion would have to be revealed in order to see whether exploration of facts on the ground in Iraq would bring this disagreement to a close.

8. The reason the environment is degraded and the people stay so poor in Northern Ghana is that the population density is increasing too rapidly; in other words they have too many children; and the environment can improve only if people change their sexual behaviour.

— No, if you look more carefully at the way government money is borrowed and now policy is set to determine how little is spent in Ghana on social services, you realise that the increasing poverty and environmental degradation in Northern Ghana results from low infrastructure investment, few road networks, minimal or no support for subsistence agriculture, degraded policies in education and health care, employment options dwindling, date back to the development bias that favoured the southern coastal regions by the British colonial administration.

Commentary: This is an example of two conflicting explanations for environmental degradation in Northern Ghana. This disagreement should be resolved through analysis of further facts presented by the second speaker, which seemed to be overlooked by the first speaker.

Summary of Section 1

In this section we learned to recognise verbal disputes as inconsistencies in the use of words, giving rise to confusion that results in disagreements. But inconsistency in the use of words is the most superficial and easily corrected source of confusion and disagreement. If people are still having a disagreement which cannot be resolved by improving their access to the facts or by making more explicit the meaning of their words by appeal to a dictionary, or by appeal to a relevant theory, or by a stipulative or ostensive definition, then we call their dispute a substantive disagreement.

Summary Exercise 1.2

Return to any of the conversations in Activity 1.1 recorded above where a substantive disagreement is underlying the apparently verbal dispute. Continue the conversation yourself by writing two or more lines of further dialogue for each of the speakers. Write declarative statements that clearly convey each speaker's value judgment or factual judgment about the topic, so that the disagreement between them becomes clearer and more explicit than it was before you came to meet their conversation.

SECTION 2: BRACKETING METAPHORICAL AND PROVERBIAL LANGUAGE

Objectives

- To classify for special treatment sentences that have to be interpreted for their variety of meanings and layers of symbolism
- To appreciate that some kinds of discourse are not the proper focus of ultra-literal, explicit and objective logical analysis

Introduction

Some declarative statements cannot be interpreted literally in the way we understand straightforward factual statements. If they are interpreted literally, the entire meaning of these sentences will be completely lost. Among these are metaphors and proverbs.

A metaphor or a proverb, like a parable or symbolic allegory, is an intentionally and purposefully vague use of language which carries many associations. This multiplicity of indefinite meanings is the value of metaphors and proverbs: they are generally used to make an indistinct open-ended impression or to have an affect on listeners which is flexible and relevant in a wide range of situations, subject to each individual's own personal and unique point of view and experience. Metaphors and proverbs are among the many types of sentence that can carry more than one meaning simultaneously, and which also have different functions, depending on the circumstances.

This section stresses the limits to the tools of logical and critical analysis which are taught in this module. There are uses of language that require a more elaborate, intricate, more flexible and sensitized study of meaning than can be engaged using just the skills introduced in these lessons. Analysis of metaphor and proverbial discourse requires the advanced techniques used by critical literary theorists, by speculative, creative analysts who study oral knowledge traditions, by commentators who accentuate the aesthetic appreciation of drama, of music and fine art, by interpreters of poetry, and by theologians dedicated to the exegesis of sacred texts.

Metaphors and proverbs can be used to express a value judgment or to describe the way the world is and also to give instructions on what to do, all at the same time, the way a painting or a sculpture can communicate meanings of different types simultaneously.

To be very clear in conveying information it is usually best to avoid metaphors, proverbs, poetic and literary indirection.

But to inspire, motivate, advise, to speak on topics that are socially powerful and highly charged, metaphors are very useful. These multi-purpose speech acts should be reserved for special contexts where critical reasoning must be applied in a specialized and amplified way.

Examples:

- (i) Juliet is the sun. Her eyes are deep, fathomless pools.
- (ii) We are like sheep.
- (iii) Though we journey through the valley of death, we are not alone.
- (iv) The Lord is my shepherd; I shall not want.
- (v) Be ye like the lilies of the field.

These statements are not literally true. But (i) conveys the speaker's feelings about Juliet. Perhaps (i) is a way of expressing the speaker's love for, or dependency upon, Juliet. Statements in (ii-v) inspire and instruct us to live our lives more spiritually and less materialistically. They teach us to find security and build faith beyond what is evident in this material world. But they do so in a practical way, by making reference to very material and manifest things: valleys, shepherds, sheep, lilies, fields, loneliness. Thus metaphors and proverbs can be used to advise listeners on how to behave or what attitude to take towards other people or about a particular subject which is very important and therefore uncouth to speak about directly. Depending upon the situation where a proverb is used, it can have many different meanings.

We consider proverbs therefore to be a type of speech act which is not suitably subjected to simplistic reductionist logical evaluation. A proverb cannot be taken literally. It can be a way of advising, reprimanding, directing, guiding, inspiring, motivating, reassuring, subduing, impressing, mentoring, the listener, but it must be understood as a symbolism for something else besides what it literally says, whether the statement is literally true or fanciful.

The hen also knows when the sun will rise; but only the cock crows.

This proverb may be a value judgment or an imperative that women should not speak in public or express their opinions too forcefully. In a certain context it might be used to chastise an individual or to prescribe behaviour: Don't speak your opinions freely if you are a woman.

Sometimes a metaphor can be interpreted to convey information about the way the world is, in order to advise a correct course of action. Similarly, proverbs can be interpreted in a way to describe the way the world is and at the same time advise an attitude that will bring about success.

Example: No one can lick their own elbow.

It is a matter of fact that because of the body's structure, this statement is true. But it is not only a

true factual statement; it is better understood as an imperative advising the listener that it is necessary to rely on other people; that one cannot do everything oneself; that co-dependency is not just necessary but it is a good and sensible thing; that humility is appropriate; that there are limits to what is feasible to do on one's own and that hubris is ill-advised; to avoid attempting ludicrous ventures, one should not pursue impossible goals. So the same sentence is functioning as an imperative and as a value judgment with multiple messages.

Although rich as prescriptive imperatives, metaphors are generally not a reliable way to convey information because so much depends upon the situation and mood and reception and background knowledge or preparedness of the listener, to appreciate and interpret the meaning of a metaphor. They cannot be relied upon to convey a single objective meaning.

If a declarative statement is intended, It is usually a good idea to find a more explicit way to express one's thought.

Evaluating metaphors

If we are to assess the quality or usefulness of an analogy or a metaphor, we need to consider the ways in which the two items being compared are similar and the ways they differ. Then we can decide if the similarities outweigh or over-ride the differences in any illuminating or insightful way. If the answer is yes, then the metaphor is a good one. If the answer is no, then we might criticize the metaphor as based on a bad analogy. For example: in the metaphor 'life is a game' the subject is 'life' and the focus word of the predicate is 'game'. One way that these two things are very different is that usually the end of a life is highly significant and its termination normally is not within our control; whereas it is of little or no consequence when we have to end a game and we can do so at will. Another difference is that once a life is terminated then it is over forever in the form that we have known it—whereas a terminated game can be resumed; or another session of the game can be started as and when we wish.

One way that a life and a game are similar is that both require strategies to succeed. Both are meant to be enjoyed. Both involve elements of chance.

Activity 2.1

Interpreting metaphors and proverbs

For each of the following sentences, first interpret each sentence by deciding and spelling out literally what the things being compared are, and whether a proverb is using them to perform a value judgment or a directive, or an instruction.

Secondly, for each sentence contrast the two things being referred to, by mentioning at least one way that they are unlike each other. Then look for one or more ways in which the subject and the focus of the predicate are similar.

Thirdly, describe in a straightforward way the factual or value judgment that the metaphor is intended to express,

1. Life is a game.
2. Life is war /bra ye ko [Akan]
3. Love is a journey
4. Life is a journey bra yeakwantuo [Akan]
5. Juliet is the sun.
6. Peter is the rock of the church
7. John is an Einstein.
8. Charlie is a cesspool.
9. No man is an island. .
10. The crooked and gnarled tree will never be cut down for timber.

When you should not use a metaphor

What we will consider now are situations where metaphors are misapplied. We have already observed that metaphors are usually inappropriate when supplying a definition of a word. This is because a metaphor presupposes or requires an understanding of the literal meaning of the words involved. Recall from Unit 2 in Section 4 Activity 2.4

(i) Religion is the opiate of the masses

We observed that if this sentence is offered as a definition of 'religion' then it is faulty because it is begging the question of what 'religion' ordinarily means, rather than providing an answer to this question which is what a definition is supposed to do.

We need to examine this as a value judgment, but still it compels us to ask more questions than it can answer. An analogy is being drawn here, famously by Karl Marx and Sigmund Freud, between religious observances and the use of drugs. But if you don't already know what is involved in religious observances and the effect they have on people, then you cannot appreciate why Marx and Freud suggest that the institutions of religion in society function like narcotic influences upon the thought and behaviour of a person: a narcotic temporarily blunts a person's awareness of surrounding reality, making the person relax or calmed down, artificially relieving stress by manipulating the person's reactions rather than treating the source of his stress in the environment. This is a temporary and superficial solution to people's dissatisfaction in life, and that is what the statement is implying about religion: it is being characterised negatively as a superficial and inadequate means of manipulating people's responses to their environment, rendering them as socially and politically ineffective agents.

But unless one already subscribes to this negative opinion of religion one is unlikely to be convinced that this statement depicts religion accurately. As a metaphor, it is a vague depiction of religion, because the statement does not provide any reasons or evidence to support or elaborate this caricature of religion. Advocates of religious observance have no basis for changing their view, they will simply reject this analogy as a distortion or misrepresentation of religion. So we don't actually learn anything about religion from this statement; we rather learn something about the speaker's feelings about religion.

Metaphors are good lead-ins to motivate thoughtful discussion and to provoke controversy. When you need language to act as a magnet to pull together many associated thoughts and intuitions that require further investigation, then metaphors are a very helpful starting point. Their drawback is that their interpretation is open-ended and indecisive and so they do not serve very well to describe the world in a testable, rigorous way.

Summary

In trying to present an objective support to defend a value judgment or a factual belief, appeal to metaphors usually are not helpful. Metaphors, to be effective, require that their source already enjoys authoritative recognition. One might say that metaphors only 'preach to the converted'. Unless your audience already shares the value judgment being conveyed, it may not be appreciated at all or its validity might be challenged by people who do not already share the view of the speaker.

However, proverbs have many other useful and important functions in communication about practical reasoning and decision making, because metaphors and parables and proverbs can elaborate, inspire, motivate, and counsel. Analogies also have important roles in science to explain natural and social events, as will be introduced briefly in Units 4 and 8 of this module.

SECTION 3: VAGUENESS, AMBIGUITY AND EQUIVOCATION

Objectives

To recognise three common vices of declarative speech which require correction. The goal of declarative speech is to be as explicit and clear as possible in describing, prescribing, generalising and predicting the states of affairs in the world.

Introduction

This section will introduce how to diagnose and improve the use of language when it is designed to describe and explain the real world as clearly and objectively and explicitly as possible. This is a use of language that avoids symbolism.

This is the domain where ambiguity, vagueness and equivocation have little or no productive role to play. This is the limited but strictly monitored arena where logical tools of critical thinking apply.

VAGUENESS

When the meaning of a sentence is objectionably vague, it is usually because the choice of the component words has not been carefully considered. This can be problematic when the sentence is supposed to state something factual and specific about the way the world is, or if it expresses a value judgment about what should be the case, or if it conveys a directive about what precisely should be done.

The use of a word is vague if not enough information is conveyed so there is no way to tell exactly what in the world the word is referring to. Technically this means that words are vague when their intended denotation is indeterminate.

Example:

1. Forcing a girl to have sex is like showing her you are a real man. *'real man' in this context is vague. What behaviour demonstrates that? Why?*
2. Every graduate who cannot find a job is not looking hard enough, 'looking hard enough' is vague
3. Traditional beliefs should be discontinued. 'Should be discontinued'—how are beliefs which have been in the system for indeterminate periods of time ('traditional') discontinued?
4. The University is undermining the students' political power bloc. *'Undermining' and 'students' power bloc'—what is actually is the activity taken by the institution being referred to here? What is the students' power bloc?*

Activity 3.1

Locating the source of vagueness

Decide for each of the following items 1-5 where to locate the source of the vagueness.

1. A breakdown in morality is ruining our youth and corroding the society.
2. The former Vice President of the World Bank, Mr. E. Jaycox, told the *African Farmer* in 1993 that without structural adjustment policies, Sahel girls would have never learned to read.
3. The economy is growing day by day.
4. The Millennium Development Goal number 7 requires integrating the principles of sustainable development into country policies.
5. The Millennium Development Goal number 3 mandates that we empower all women by 2015.

Activity 3.2

Correcting vagueness

For items 10-16, identify the words or phrases that are responsible for the vagueness. Discuss how to correct the vagueness. Rewrite each item so that the vagueness is eliminated.

6. He said he will be here any moment from now.
7. We are sorry to say that we are looking for a younger person for the job.
8. Temporarily out of service. We are unable to dispense money at this time.
9. This practice counts as cruel and unusual punishment so it should be banned.
10. This ritual is a Vandal tradition so you have no right to object to our culture.
11. We need to protect these creatures since they are an endangered species.
12. The way these students disrespect and protest all the time is becoming a threat to the very fabric of society.
13. Ours is a developing country so what do you expect?
14. Our citizens are dying of AIDS because the youth have no sense of right and wrong and indulge all the time in inappropriate behaviour.
15. We demand equal pay for equal work.
16. The government provides adequate social services, so what is your problem?

Ambiguity and Equivocation

The use of more than one connotation of a word in the same context without any signal of the shift with the intention to manipulate or to persuade is called equivocation. As a rhetorical ploy, equivocation will be criticised in Unit 10. Here we will focus upon a feature of some words that the tactic of equivocation depends upon: this feature is called the ambiguity of a word's use. If the intended meaning of a word seems to shift back and forth between two or more distinct connotations without warning or indication then the use of the word is said to be ambiguous. A quicker way of saying this is to describe the word as ambiguous. But this shorthand way of speaking is misleading, since almost every word has more than one connotation (look at the definitions on a page of a dictionary; notice that most entries list more than one meaning for the word). Having more than one meaning is not enough for a word to be criticized as ambiguous. We reserve this critical label for when a word appears in a given sentence and the context leaves it unclear which of two or more of distinct known connotations are intended. Then the word is said to be ambiguous. Sometimes this is due to the syntax of the sentence, or the lack of good structure. For example:

I've always wanted to apply to get into a post graduate studies programme, and now I finally have.

This could mean either that I have now finally applied, or I have now finally gotten into one. The ambiguity would be resolved if the last phrase were completed:

and now I finally have applied to one.
or... and now I finally have been accepted into one.

When ambiguity is very obvious, apart from sometimes being amusing, it can be instructive: it can illustrate that different ways of organising and structuring a sentence can make your intended meaning more or less easy for a reader to understand:

Example: Disappearing into a hole, I saw a mouse.

This is grammatically correct but misleading. Does it mean that I was disappearing into a hole as I saw the mouse? Or does it mean the mouse was going into the hole as I watched from a stationary position? The ambiguity here would disappear if the phrases are rearranged and one of these meanings was clear:

I saw a mouse disappearing into a hole.

By using more than one function of words in the same sentence, ambiguity is created for a little humorous effect: Here we find ‘flies’ used as a subject and as a verb in the same sentence. Also ‘like’ is used first as a relative pronoun (qualifying or describing how time flies) and later as a verb (what fruit flies do):

Time flies like an arrow but fruit flies like a banana.

These are cute word jokes. But when ambiguity is responsible for misleading from premises to a conclusion, the effect stops being funny and becomes dysfunctional, leading people to draw false conclusions and to take ill-founded decisions. This is the case where passages move from premises to a conclusion, or conversations where a dispute is maintained, on the basis of ambiguous words. These are cases of equivocation.

Example of Equivocation:

Speaker A: - Discrimination against homosexuals is a violation of people’s basic human rights: we have to campaign to change the sodomy laws that exist in many countries still, because these laws that turn into a crime a minority group’s sexual orientation are a breach of those individual’s constitutional rights, sometimes in the same country. This is the case in Ghana. These laws that ban homosexuality are immoral. No one should be turned into a criminal simply because their private conduct deviates from a social norm.

Speaker B: - No, brother, you’ve got it all wrong. Homosexuality is an abomination because it is a violation of God’s law which defines our essence and God’s purpose for us. Just see what it says in the Bible or in the Qur’an if you are in any doubt about it. The criminal code of Ghana is a reflection of God’s law and should be maintained.

Commentary: The substantive disagreement here about homosexuality is based on an ambiguity of the word ‘law’. Notice that speaker A is using the word ‘law’ in one sense, as it connotes man-made civil and criminal laws. Statutes recorded in law books are made by legislators and are relied upon to determine whether citizens should be sanctioned or punished for doing something illegal. The second speaker B is using ‘law’ in three other senses or connotations of that word.

The second speaker moves between (i) the meaning of ‘law’ as it connotes theological doctrines (what is written in sacred scriptures, “God’s purpose for us”) and (ii) the first legislative or man-made connotation of law (e.g. Ghana’s criminal code) and (iii) the sense of ‘law’ that connotes a

moral principle (“Violation of our essence and God’s purpose for us”). Speaker B is thus equivocating which is misleading and improper, whether intentional or not, and needs to be corrected.

This is not to say that Speaker A is correct. It is to say that Speaker B’s refutation has not provided good reason to think Speaker A must be wrong. The topic remains open for further consideration. The discussion might progress and be illuminating of the real or substantive points of disagreement if these vacillations (swinging back and forth) between different senses of law are brought under control. Five different senses of law will be discussed in detail in Unit 5.

Activity 3.3

Identifying the root of equivocation

Consider this passage describing a court trial. Decide which word is occurring in the passage whose ambiguity is being exploited by the defendant’s lawyer, who could be criticized for equivocation.

The judge said that the law could only hold sane people as fully responsible for their criminal actions. Therefore, the foreigner Johnston was not going to be sent to prison because it was shown by the report from the psychiatrist that at the time Johnston committed the offence he was mentally disturbed. Instead the judge ruled that Johnston should be extradited to his own country on the grounds that he needed psychiatric help and the state could not afford to provide it for him here in Ghana. Other than that if he wanted to avoid deportation he should seek psychiatric help which he pays for himself, and prove to the court that he is undergoing treatment. The defendant’s lawyer stood up and argued that he would appeal this with all due respect to the court, because he could see that if Johnston was not responsible for the act then he should not have been arrested and tried in the first place.

Activity 3.4

Diagnosing ambiguity

Each of the following sample newspaper headlines can be read in two ways because of the ambiguity of word meanings. We deal with phrases to focus specifically upon the shift between meanings, but the same skill can be applied to full passages.

- (i) Discuss or write out for yourself two different interpretations using other words
- (ii) Identify the words responsible whose ambiguity is responsible
- (iii) Rewrite the headline as it might have been intended to avoid ambiguity

1. Drunk gets nine months in stolen laptop case

2. Military head seeks arms.

3. Prostitutes appeal to pope
4. Teacher strikes delaying WAEC candidates
5. Police squad helps rabiddog bite victim
6. Enraged billy goat injures farmer with cutlass
7. Miners refuse to work after death
8. Juvenile court to try shooting defendant
- 9 Stolen jewels discovered by tree
10. Two American oil tankers collide in the Gulf of Guinea;’ one dies
11. Two sisters reunited after 18 years in market stall

SECTION 4: TYPES OF DISCOURSE REVEALED IN PASSAGES.

Introduction

In this context ‘argument’ does not connote conflict or altercation necessarily. Argument in the logical sense is the structure of statements relating to each other as premises leading to or supporting the truth of a conclusion. There is no need for a fight or disagreement. As we will see in Units 7-10, arguments are used to support hypotheses in the sciences; arguments are the form that a scientific explanation or prediction takes. Argument is used to justify or help draw a decision about what needs to be done.

Objectives

To distinguish passages that contain:

- Arguments, narrations of events, sets of instructions, verbal self-assertions using rhetoric or polemic.

A narrative is a passage which reports a sequence of events in order of their occurrence; the passage may also contain comment upon the episodes recounted by making empirical claims that can be established as true or false based on documentation or evidence. The sentences are ordered according to time.

Example

The students went to the Ministry of Education with their proposal to cut down on fees. But they

were sent back to the school to discuss with the school authorities. They were told it was an oncampus concern. So they went back to the school administration. The administration told them that they would have to petition the Ministry of Education because that is where the decisions on the budget are finally made. Then someone had the idea of approaching the Ministry of Finance, so the Secretary of the SRC will make an appointment to see the Director of the Budget next week.

A passage that gives instructions describes as process or sequence of things to do in a specified order; it also might provide a list of directives to follow to accomplish some desired effect, like a prescription.

Example

Before beginning to swim at speed it is important to stretch: bend your head completely forward, then slowly all the way back, then left and to right, then roll your head in both directions. Lean over slowly to stretch your back, hold the stretch for a few moments; stretch also your triceps and biceps; also rotate your shoulder cuff rotator muscles by moving in large circles ten times in each direction. This will all prevent injury.

A rhetorical polemic is a passage that communicates (usually strong) feeling or persuasively vents an opinion.

Example

I hate running these lab tests. Every time I am exposed to the diseased plants I fall ill. I'm sure they hate me, or they are punishing me or something; it's disgusting how I get sick so often.

A structured argument is a passage that contains a single conclusion that is presented as a logical consequence of reasons stated in one or more premises.

Example

If I want a mobile phone, then I have to use my school loan when it comes. But if I use the school loan up on the phone, I will not be able to return my mother's money for the tuition. If I don't return my mother's money she will not pay for my tuition next year. I cannot afford to pay tuition next year unless my mother helps with the tuition. But I have to pay tuition next year. So I cannot buy a phone.

Identifying arguments in passages

Arguments can be recognized sometimes—although not always— by the 'cue' words that introduces explicitly the premises or the conclusion. Often these cue words are implicit

Here are some words that indicate premises and conclusion of an argument. But remember that arguments sometimes do not include any of these words. You must read carefully to be a critical thinker.

Some premise indicator words are:

Because, in light of, since, given that, considering, from the fact that, if, provided, the research findings are, hence, therefore, consequently, it follows that, so, as a result, we can conclude that, clearly, then, thus.

Activity 4.1

Identifying arguments in contrast with other types of discourse

Decide for each of the following passages whether it contains:

- an argument form (premises providing a good reason to believe the conclusion) or instead a narrative or report of events or instructions or an opinion expressed emotively or rhetorically

1. I simply don't understand what the administration thinks it is doing with these constant increases in school fees. Where is the money supposed to come from? Students are paying enough already. The University wants to squeeze us dry, while they, the fat cats, are sitting on lots of money they refuse to spend. We should call a boycott and refuse to pay anymore.

2. When the accident occurred there were no witnesses. Without witnesses you cannot claim insurance. Without insurance you have to pay for the repairs yourself. So I will have to pay for the repairs myself.

3. We went to the clinic and waited until four o'clock for the military officer. The military officer never came. So we went home with the sick child.

4. On Saturday, the military officer never comes to the barracks. He is busy at the hospital all day Saturday. So if you need to see a military officer, then do not go to the barracks on Saturday. Since I need a military officer and it is Saturday, I won't go to the barracks.

5. The politicians want votes. You can see they are corrupt. So don't trust any politician.

6. Either I took the book to the library or I've left it in my room. I can't find it anywhere in my room. So the library must have the book.

7. This formula milk sold 90,000 more cans this year to mothers than any other brand. So it must be the most nutritious brand available.

Summary

The beginning of critical thinking is careful reading and scrupulous listening. We need to study

sentences in relation to each other to appreciate when reasoning is well grounded. Sentences relate to each other in different orderly ways for different purposes.

In this section:

We studied the connection between statements in time, and discovered the category of narrative discourse. We studied the connection between statements that indicate a process of things to do, and discovered the category of instructive discourse.

We studied the connection between statements that support or provide a good reason for believing a conclusion, and discovered the category of argumentation.

Assignment 3.1

Study your favourite daily newspaper for a week, or your favourite weekly over a series of three weeks. Watch in particular the commentary columns, the opinion articles, the letters to the editor, the editorials, and the advertisements.

1. Look for the following, and pick out good examples of the following flaws in declarative discourse:

- Vagueness of statements, Ambiguity in headlines, Rhetorical or polemical discourse to motivate belief in a point of view

2. Find an example of a narrative.

3. Recount a set of instructions

4. Record a metaphor or analogy that appears in place of an objective factual statement or a value judgment. Rewrite the intended meaning of the metaphor in plain declarative style.

Assignment 3.2

Consider each of the following passages: it may be either a narrative which reports a sequence of events in order of their occurrence and may also comment upon these episodes by making empirical claims that can be established as true or false based on what is documented. Another possible type of passage gives instructions of things to do in sequential order, or a list of directives to follow to accomplish some desired effect. A third type of passage is one that exhibits polemical rhetoric which expresses a strong feeling or persuasively vents an opinion, a fourth type of passage provides a structured argument containing a single conclusion that follows logically from reasons given in one or more premises. For those passages containing an argument, decide if it is a good argument whose premises provide a good reason for believing the conclusion is true, or a bad argument where the premises fail to provide adequate evidence or a good reason for believing the conclusion is true.

1. Of the 15 Commonwealth Hall students who took part in the destructive mob action in September 2003, 12 were indicted for criminal behavior by the authorities and four were punished with suspension for two years, while others were expelled from school. More recently

in March 2006, non registered students came to the Legon campus and carried on a rampage to express dissatisfaction at the election results for the SRC for the coming academic year. So again the police were called to come and patrol the campus in order to prevent further vandalism and related criminal activity. In all there have been more police interventions on the Legon campus in the last ten years than there have been in the previous forty years since the University was first established.

2. On a simplistic model of urban development that is widely accepted in the global arena, towns and cities grow big because they are centres of industrial productivity. But if all commercial development depended upon industrial manufacturing base, then Ghana would have to copy the European model of capital accumulation in order to increase its GDP. But both in ancient and modern times the records clearly indicate that building up a heavy machinery industrial base is not the only way to build up strong urban economies. For instance the geographer Jacob Songsores has observed that in Northern Ghana and the forest belt between the 8m and 15th centuries, settlements and state structures developed in tight interdependence with long distance trade initiatives and commerce-related activities, to protect and control trans-Saharan trade from Cairo to Morocco. And in more modern times, India has increased its GDP rapidly through a service-oriented business sector responding to an already existing need in the electronic computer and telecommunication sectors, rather than manufacturing products which are then distributed by creating markets worldwide. So it is clear that there are many different ways for Sub-Saharan African nations to build up their economic prosperity; they do not need to copy the European industrial model.

3. Some of the hijackers who forced the planes into the World Trade Centre were known to be members of the al-Qaeda network. All of them were known formerly to have professed their faith in Islam. The same holds for the people who blew themselves up in order to cause havoc in London on the public buses and underground tube. So that just shows you that basically all Muslims have no respect for human life, their own or that of others and that their faith predisposes them to support terrorism.

4. I am sick and tired of hearing all this wahala from these so-called revolutionaries. All they do is say how they are going to make everything better. But what have they done except talk? In fact, all the criticism they put into the newspapers and on the radio does nothing more than run down the government. Where is their patriotism? Where is their sense of national pride? I wish someone would shut them up so we could move on in peace.

5. There is a big football match today and Kwame always watches the matches whenever he can. But this is the only day Kwame is able to do his laundry. So Kwame will either be watching the match or he must be doing his laundry. He is not doing his laundry; so you will find him watching the match.

6. All the students had their questionnaires filled out after the village survey and they were all ready to go home.

But they had to wait for the bus. They were arguing the whole time whether they should have taken public transport rather than rented the bus. After waiting half an hour the bus didn't come. So someone suggested hiring a taxi. After giving reasons for and against the taxi, they decided it

would be too expensive because of the long distance. So then someone suggested calling the bus station where they rented the bus. But they could not make the call unless they could find a phone and they could not find a phone. Finally they located a police station where they could use the phone. It took an hour to get the phone number of the bus station. Finally the bus came along, but it was two and half hours late. The students were all arguing with the bus driver, because they wanted to get their money back and the driver was saying they had no right because he got them to the place on time. On the way home they wrote a letter explaining why they should be refunded half the money. Later the bus company refused; they claimed the bus had broken down and was delayed by servicing. The students decided to take another bus company the next time they planned a field trip. The following month the field trip was scheduled and the transport came and left with them on time.

7. Sexual infidelity is prevalent these days, sad to say. Even though people know it's wrong, they often have sex outside their marriage. No surveys have been conducted, but it is known to be true that men with many wives are more likely to have sex with women outside marriage. It's very unsafe and irresponsible. Men just don't care about the women who care for them and love them, that is what it shows you—men are really selfish. Sexual infidelity is abhorrent in many respects, but the traditional priests and the church pastors do nothing about it. Some of the worst offenders are the pastors; everyone knows it. What should be done? Infidelity is truly a great blight on society

8. A cold (catarrh) or flu (influenza) is an infection caused either by a virus or by a bacterium. If the cold is caused by a virus then there is no cure for it, so you should take an analgesic to make you feel better, and antihistamine to dry up your nose. You can try some cough mixtures if you are coughing, to suppress the cough. A flu infection caused by a virus lasts no more than two weeks. If you are still sick after two weeks then the infection might be a bacterial infection, such as pneumonia. To treat it properly you need to go for tests to be sure what type of bacterial infection is causing your illness. To interpret the test results, you then need to see a doctor. Don't just go to a chemist. If one doesn't get rid of cold symptoms after two weeks, you should see a doctor.

9. In Ptolemy's time in the 9th century, it was believed that all the planets are perfect spheres, and can move only in perfect circles around the earth. When Mercury was discovered, it seemed to move forward and then reverse its direction for some months, and move forward again. This was known about Mercury even a thousand years ago. The Ptolemaic system explained it in terms of epicycles, or little perfect circles ('perihelion') that some planets were assumed to make as they proceeded around the Sun. In the mid 16th century, Kepler claimed that all the planets but Mercury could be predicted by using his laws of planetary motion. About 1939, we discovered nine planets in all. Not until the first decade of the 20th century, when Einstein's theory of relativity was tested could anyone predict the elliptical path of Mercury with accuracy. And in the last twenty years many more planets have been discovered. Since we put a telescope in outer space for the first time in 1995, and can see the galaxy much more clearly, it has been a matter of debate among astronomers exactly how many planets exist in our solar system.

Unit Summary

In unit 3 you learned

- how to distinguish a verbal dispute and how it may be covering over a substantive disagreement
- what a metaphor is, and how to classify proverbial discourse, allegory and analogy for special treatment
- what the difference is between ambiguity and vagueness
- how to locate the source of vague discourse
- how to locate the ambiguous words that is the basis for equivocation
- how to recognise when a passage contains a set of premises supporting a conclusion
- how to distinguish a passage that contains an argument from a narrative, a set of instructions, or rhetorical polemic

UNIT FOUR: SURVEYING THE MAP OF KNOWLEDGE

Introduction:

Knowledge is classified into different types or subject area underlying patterns of reasoning to develop and sustain it. In Section 1 of this Unit, we see how different subject areas are classified into different faculties: the Faculty of Arts, the Faculty of Social Studies, and the Faculty of Science.

In Section 2, we look at the broad characteristics that distinguish natural sciences from social studies (human sciences) and from arts (humanities).

In Section 3, we will consider briefly the historical development of human sciences in contrast with modern philosophy of the natural sciences in the 17th century.

Lastly in Section 4 we will look at the following different possible reasons why social sciences seem to contrast with the physical sciences.

1. Semantic differences (the meanings of key concepts different)
2. Distinct kinds of question are asked in the different disciplines
3. Methodologies are different when doing social studies and

Maybe the subject matter in social studies is totally unique and so requires a totally different approach from the way subject matter is studied in the natural sciences.

And yet researchers in the social sciences and physical sciences all aspire to accumulate knowledge about the world around us scientifically. To examine this paradox, we will look more carefully at what it means to think ‘scientifically’ about the empirical world – this will be a focus to come in units 7 and 8.

To explain the contrasts listed as 1 and 2 above we need to study the meaning of words and how they are established: so we will use principles already introduced in Units 1-3.

This unit will cover the following topics:

Section 1 Classifying academic disciplines

Section 2 Contrasting different types of knowledge

Section 3 Historical development of social science

Section 4 Distinguishing social studies from natural sciences

Objectives

Upon completion of this unit you should be able to:

- Identify which area of knowledge your subjects of study belong
- Understand why we have different faculties for different areas of knowledge
- Characterise differences between the natural sciences and social studies
- Contrast the humanities (liberal arts) and social studies
- Appreciate the historical development of social studies as a reaction to the biases of the new natural scientists of 17th century Europe.
- Contrast social studies and the natural sciences from different standpoints (semantic, methodological metaphysical)

SECTION 1: CLASSIFYING ACADEMIC DISCIPLINES

Introduction

For our reflections to be useful and not just vastly overstated and simplistic, in this section we will confine ourselves to the study of how knowledge and skill acquisitions are categorised in universities, and why these classifications are maintained in universities all over the world, including in the universities of Ghana.

Objectives

- Identify what accounts for the contrast between faculties of arts, of social studies, and natural sciences
- provide a nominal ostensive definition of each faculty
- distinguish the arts & humanities from scientific disciplines
- distinguish the social sciences from natural sciences

Activity 1.1 -Thinking drill

Chart the basic subject areas in the geography of the university

- Make a survey of all the subject areas in which you and your friends and acquaintances are enrolled.
- Study the University of Ghana Undergraduate Handbook to see which subject areas you have overlooked in your first-hand survey.
- Which subject areas in your list are grouped as humanities or liberal arts subjects?
- Which are grouped as social studies disciplines?
- Which of the faculties does your subject cluster belong to? What does each of the departments belonging to one faculty seem so have in common with each other that they do not share with departments in the other faculties?

We are not looking here at the way all knowledge that we gain throughout our lives is acquired—that would be too vast a subject to cover even in the most rudimentary way. We are thinking here about how knowledge is acquired in university. Is it all acquired in the same way? What are the major differences? What explains these apparent differences?

In this Unit we are going to focus on just three basic classifications of knowledge:

- Faculty of Arts (also called Humanities)
- Faculty of Social Studies (also called Human Sciences) and
- Faculty of Science (also called Natural Sciences or Physical Sciences).

The fact that we focus on these particular faculties, of the several that exist in most universities (including University of Ghana, KNUST, UDS, UW, and Cape Coast) does not mean that these three groupings are more important than other combined domains of knowledge. We narrow our

focus this way in order to make our charting of the world of knowledge manageable. But everything we say about subjects taught in the Faculties of Arts, Sciences and Social Studies also apply to what is taught in:

4. The Faculty of Agriculture and Consumer Sciences
5. The Faculty of Law
6. The School of Medicine
7. The School of Engineering
8. The School of Nursing
9. The Business School

Each of these areas of specialized skills and accompanying knowledge have their own defining characteristics yet the department in these faculties 4-9 run courses that feature the basic subject areas offered in the Arts, Sciences and Social Studies. These professional faculties 4-9 combine and apply methods and questions to develop a training programme for those engaged in specific professional career tracks that require specialized technical skills. But in the main, the learning in professional arenas of studying for certification and licensing to practice. Largely depends for its theoretical foundations, scholarship, and research, upon what is taught and the ways it is taught in the academic faculties listed as 1-3 above.

Activity 1.2 - Research exercise

Chart the professional subject areas in the geography of the university

1. If you are an agriculture student or a medical student or a law student or nursing student or a business student, look at some of the courses offered in the departments you will be enrolling in for study. You may use the Undergraduate Handbook or other resource tool for this activity.
2. If your chosen subjects are located in one of the basic academic arenas (Arts, Social Studies, Sciences), then imagine you are a student in one of the professional disciplines that are located in the faculties named in items 4-9 above.
3. Which of these departmental subject listings overlap with courses taught in the social studies faculty?
4. Which courses that are not offered in the Faculty of Science still count toward a BSc (Bachelor of Science) degree?

5. Do any of the subject areas studied within the Faculty of Agriculture overlap with subjects taught in the Faculty of Arts?

Summary

We have just considered most of the domains of knowledge that are taught in university – both basic academic discipline and professional training programme. We have looked carefully at the way these subject areas are classified. These existing classifications of subjects are the data about which the rest of this unit will be speculating in order to explain.

Section 2 Contrasting Different Types of knowledge

Introduction

Now we want to ask: Why are the areas of university study organized in this way? Could it be better if it were organised otherwise?

In the future if knowledge were perfected, might all the departments belong to one big faculty? Is all knowledge acquired in basically the same way? If not, should it be?

In this section we will consider some broad characteristics that distinguish the learning of Russian and Chinese, from the study of prostitution among tourists in Cape Coast, from the analysis of chemical compounds involved in purifying plant germplasm to create herbal remedies.

What is the difference between an Arts subject and a subject in Social Studies? Is the History Department (in Social Studies) expecting their students to write essays in the same way as the English Department (in the Arts)?

For example: When you write an essay about Akan beliefs for the philosophy department (for lecturers belonging to the Faculty of Arts) is it supposed to follow a different standard and a different method of exploring truth from the essays you write for African Studies (for the Faculty of Social Studies)?

For another example: What is difference between doing a research report of your results into studying the sociology of religious beliefs as exhibited in a community in BrongAhafo and writing a philosophical treatise investigation Akan metaphysical beliefs?

Objectives

To understand what the difference is between social studies and natural sciences.

To understand what distinguishes subjects in the Arts (humanities) from social and the natural sciences.

Why do we call it the faculty of social studies and not social sciences?

Later in Section 4 we will consider that there are features of our theories about human experience and the products of human existence which cannot be tested in the way we can test our theories about inanimate objects. But if testing a theory is the one feature about a set of statements that separates science from doctrine and dogma, then this feature of our beliefs about societies today and throughout history is a reason to refrain from calling sociology, or history, or economics, or psychology a science. Instead these are referred to without provoking any controversy social studies. In some ways, as we will consider in Section 4, the methods we use are different from those techniques that are learned for doing chemistry, physics, biology, botany, zoology, medical research.

Another reason is historical: before WWII social science was associated with social engineering, that is, some Europeans were engaged in what was called social science, which involved manipulating the way people live and the way they grow. Eugenics, for instance, was pursued with vigour as a means of perfecting the species of homo sapiens by selective reproduction, the way botanists and zoologists would cross-breed special species of plants to increase their crop yield, or the way zoologists would control the reproduction of livestock and domestic animals in order to experiment with pedigree strains and lineages to create the best race horse, or to study how much pain a mammal can endure. So too, social scientists were engaged in contributing to perfecting the course of human evolution. This programme grew out of an 18th century idea, popular in Europe, that all of humankind is advancing along a single trajectory of progress from a primitive state of being to an advanced state of existence.

Various systems of philosophy along these lines were developed and seemed to ratify lending a hand to help along the development. From this doctrine arose justifications for the colonisation of Africa, and for the extermination of certain ethnic or social groups in Europe regarded as contaminating the purest race of human being

In consequence many scholars resisted vigorously the close association of social scientific disciplines with these social engineering programmes. So it was important to cluster the study of human beings for benign purposes, without any political agenda, as Social Studies.

Activity 2.1 - Thinking drill

Create a nominal (verbal) ostensive definition of 'social studies'

1. Make a list of all the departments in the Faculty of Social Studies.
2. Examine the list and see if you can find a common characteristic.

What are social studies about?

Activity 2.2 - Thinking drill

Discover the 'social' in social studies

1. Look at the room you are sitting in. Then think of the area outside the room. Now think of the whole campus of Legon. Next think of your home town.

2. What is there around you that would exist if human beings didnot? For example: trees exist without humans. What else?

Activity 2.3-Thinking drill

Contrast aspects of the world that constitute different kinds of subject matter. Consider these two groups of features of the world around us. Decide what group A items have in common with group B items.

Group A:

Trees, ocean, stars, gravitational force, different soil structures, bird songs, pressure, heat, friction, effects of fire, animals in the bush, sea shells.

Group B

Herbal medicine, funeral, shop, argument, prison, nations, arguments, musical drama, cooked foods, jokes.

Consider what all the features of group A list have in common with the feature of group B list, and whether this is a basis for contrasting the physical sciences and the social sciences.

All the departments in the Social Studies focus on aspects of reality that would not exist if human beings did not exist.

This is a helpful suggestion, but it will not suffice if we are trying to capture what the social studies have in common that is exclusive to those areas of learning alone. Recall that human beings are also subjects of study of the natural sciences.

If you study the height, weight, blood type of a human body, or the acceleration rate of that body if it is dropped from the roof of a high rise building, if you study its susceptibility to disease, percentage of water, chemical constitution, necessary temperature range to continue survival, biological processes of growth and decay, chromosomal make up, neuro-physiological features—then you are studying a human being as a physical entity. And human beings exist in the physical world so they have physical characteristics; so human beings are important objects of inquiry in biology, physics, chemistry, medical research, genetic engineering, evolutionary genetics, and so on.

So what is the difference between subjects taught in the Faculty of Science and the Faculty of Social Studies?

Further, when you look at the disciplines grouped together in the Arts Faculty, (Modern Languages, Linguistics, English Department, Philosophy and Classics, Performing Arts, Study of Religions, African Studies and others) all of them also treat aspects of reality that would not exist if human beings didn't exist.

So what is the difference between subjects taught in the Arts (Humanities) and in Social Studies (Human Sciences)?

To answer this last question right away, let's consider that in the Arts and Humanities courses, *you are taught how to do things*. Consider for instance your African Studies courses or anything going on in the School of Performing Arts. There you learn how to put on a play, how to create costumes, how to act and direct how to play a musical instrument, how to dance. In learning how to do something, you learn how to appropriate new values and you acquire new taste, new powers of discrimination. You may learn traditional weaving or sculpture, and in so doing you learn how to value the different qualities of kente cloth, of architecture of a specific cultural tradition. You learn how to see the refined and nuanced skills of dance in a specific tradition, or in comparative traditions and cultures.

3 Activity 2.4 - Thinking drill

Contrast skills learned in the arts and questions answered in social studies

Consider the list comprising the column on the right hand side in Activity 2.3 above. Ask a question that would capture how that topic or class of things would be treated in a social studies discipline. Then choose how the same topic or class of things might be treated as a subject of some Arts or Humanities discipline.

Example I: flower arranging

As a topic in the Arts: Learning to find plants that have medicinal powers. As a topic in Social Studies: How is Chinese traditional medicine taught in contrast with the transmission of knowledge of herbalists in traditional Akan society?

Example II: funerals

As a topic in the Arts: Learning to interpret the meaning of different funeral dirges. As a topic in Social Studies: Why are most funerals very public occasions in West African societies and very private events in technocratic societies?

Activity 2.5 – Research exercise

Create a nominal (verbal) ostensive definition of the Humanities by learning the subjects studied in the Arts Faculty.

Create a complete list of the subject areas that you are taking or that you would take if you studied a subject in the Arts Faculty. You can do this easily by copying out the departments listed in the Undergraduate Handbook or use course outlines handed out at Legon or that you find online posted by any university. You can browse textbooks on the open shelves in the relevant sections of the Balme Library that covers your subject areas, or look at tables of contents of relevant textbooks advertised on the internet.

As we just noted above, in the Arts and Humanities you learn new values and you acquire new tastes. You acquire and then increase your capacity to judge the quality and skill of what others do and produce. You develop by practicing a sensitivity to the nuanced ability in doing and producing things very well, according to criteria of excellence that you learn as your subject, be it choral singing, or composing songs, or writing poetry, or engaging in debate, or dancing in court, or probing a philosophical question, or developing a mathematical proof. In part, learning to appreciate what others do involves learning and practicing skills of critical observation and listening: in the English department you learn how to interpret the meaning of a novel or a poem and oratory; in Theatre Arts you learn how to criticise dramatic performance, costume design and stage production.

What about comparative religion? You learn exegesis of a sacred text. You learn to appreciate different kinds of religious experience. What about linguistics? You learn how to master the phonetics and other key structures of a language, and you learn how to classify languages on the basis of these structural distinctions. What about Modern Languages? You learn fluency in one or more languages other than the one you already have mastered. Through this mastery you learn how to appreciate different modern cultures expressed through these languages. What about philosophy? You learn how to engage in a logically valid sequence of thoughts; you learn how to pursue a fundamental issue or problem. You learn how to clarify a fundamental question of perennial importance to humans which is often poorly understood. You learn to challenge and question assumptions everyone usually takes for granted.

Activity 2.6 - Thinking drill

Discovering the nature of the Arts and Humanities

Take one by one the departments that you have listed in your ostensive definition of the Humanities for Activity 2.5. Using imagination, helped by course descriptions or course outline choose, spell out one thing you would learn to *do* or a value that you would learn to appreciate by studying in each of these departments, by the activities you would be involved in when prompted by Activity 2.4.

Summary

Arts (Humanities) subjects have been distinguished here as fields that teach you how to do things, and that train you to critique others doing things: this means learning as a skill, how to critique other people's performance and productivity. The Arts and Humanities cultivate in their scholars and students an appreciation of acquired values and tastes in assessing and interpreting people's advanced cultural activities, or in performing these activities themselves.

In contrast, the Social Studies (Human Sciences) and Natural (Physical) Sciences are disciplines that teach you facts and theories and explanations of events, and methods to study the way things and states of affairs are given to be in the world. We have yet to define a fundamental and definitive contrast, if there is any, between the social studies and the natural sciences.

The contrast that was proposed in this section so far between social sciences and physical sciences was that the subject matter of social sciences would not exist if human beings did not exist.

However, we noted that this poses a problem for our classification project: because human beings themselves are the subject matter of many physical sciences. So we have yet to find an adequate basis for distinguishing social studies from the natural sciences. The pursuit of this distinction will occupy the rest of the sections in this Unit.

SECTION 3: HISTORICAL DEVELOPMENT OF SOCIAL SCIENCE

Introduction

The sciences we call today 'natural' or 'physical' started centuries earlier than those studies we classify as 'social'. The social sciences were developed as an intentional fully fledged critique of the European New Scientists of the 1600s who supposed that the only true modern science could only be about the physical world.

Objectives

- To appreciate the history of the social sciences which were originated by European philosophers who stood in conceptual opposition to the prejudices of the New Science advocates during the seventeenth century European Enlightenment.

Strictly speaking, the starting point of the modern scientific tradition has no single date nor can it be located in any single geographical or cultural location. Typically the origin of modern methods of natural science are attributed to seventeenth century European Enlightenment thinkers and experimental practitioners, evidenced by the iconoclastic public statements of Galileo Galilei, and later the treatises of Francis Bacon (the most famous published from 1620 onwards), the rationalist treatises and physico-mathematical theories of Rene Descartes, and other contemporaries who pronounced themselves pioneers of a New Science.

It is an important fact that other scholars and natural philosophers of other cultural traditions, some of whom were based throughout the African Sahel and in the Middle East, developed the principles known as modern scientific deduction and experimental method before Europeans formulated them explicitly. One relatively unknown precursor of the European Enlightenment's New Science was Ibn'Hayham who lived in the eleventh century Basra, present day Iraq. He wrote the first known Book of Optics whose principles anticipated Newton's Optics written five hundred years later. But in this course and module we will not dwell at all on the fascinating history of physics and other natural sciences.

instead we will look very briefly at the development of the social sciences, which in Europe originated as an explicit refutation of Descartes' theory of knowledge and the vanguard of self-identified New Scientists' of his day. Descartes famously propounded that:

“Only through clear and distinct ideas could certainty be attained about the foundations of the physical world. Its content and structure could be established only by deductive inference from mathematical first principles. Francis Bacon advocated an inductive arrangement of thought following from the results of experimental research. We will study this contrast further in Unit 6. Descartes and his rationalist colleagues believed that the world as God made it could not be revealed to humans through the senses, because we are fallible creatures and steeped in bias. Descartes was convinced that to the extent we have any interest and investment in states of affairs, our conclusions must be held suspect. So he stressed mathematical principles and logical rules of inference as the means of achieving a complete picture of physical reality which must be geometric and mechanistic in its structure; anything less cannot be presumed to be a true depiction of reality. Descartes regarded the historical narratives of his day as a confused collection of contradictions, illusions, storytelling and folkloric fables, a trumped up version of common uneducated people's superstitions and old wives' tales.

In reaction to this mainstream view of the Enlightenment, a radical philosopher was Giambattista Vico (1668-1794) who was barely read until the mid-1800s by Wilhelm Dilthey in Germany and the mid-1900s by the British natural philosophers Croce and Collingwood. In *La Scienza Nuova* (1730) Vico sternly criticised Descartes understanding of why mathematics yields indubitable results through the construction of proofs. Vico understood mathematics to be useful and reliable only because it is a wholly human construction, the meanings of its terms completely stipulated and arbitrary. Mathematics is completely consistent because it is like a sophisticated game. Vico disagreed with Descartes' conviction that rationalist philosophers were providing an indubitable image of physical reality by demonstrating with logical proofs their conclusions. Descartes posited that the detachment and disinterestedness with which humans contemplate the foundations of the universe provide the insurance that our inferences about the physical structure of the cosmos will be objective and reliable. But in contrast Vico argued that humans have no chance of penetrating the truths of the physical world.

Precisely because it is distant from our experience andimmediate interests; Vico emphasised that the physical world is relatively alien to us. At best we can learn to imitate copy nature through experimentation; we can only presume to know the truth of physical reality to a qualified degree by drawing inferences about it through pure inferences starting from mathematical first principles.

Vico was critical of Descartes for overlooking art, law, history as proper domains for accumulating knowledge systematically. Contrary to Descartes' skepticism about these discourses as being hopelessly confused and illusory, Vico said that these are the very topics which humans can know best, because humans have a more intimate, instinctive capacity to grasp the circumstances of social reality than they can imagine what conditions are like on a distant star in outer space.

Vico was one of the first of the Enlightenment thinkers to treat history as a discipline as important as physics. He complained that previous prominent writers about human nature (Hobbes, Pufendorf, Grotius) thought of it as fixed, static and unchanging. But in fact they were projecting their own views on others because they relied (as Descartes prescribed) upon a priori reasoning from first principles. Vico insisted this was the wrong method for doing history.

Vico is one of the first thinkers on record in the European tradition of modern scientific method to recognise a fundamental contrast between knowledge of things in the human world, as the products of human invention and will, vs. knowledge about the physical world, which is external to man and therefore investigation is less likely to yield warrantable results.

Vico's contrast was later picked up and concretized by the romanticist philosopher Wilhelm Dilthey (1833-1911) in the mid-nineteenth century, who coined the terms *Geisteswissenschaften* and *Naturwissenschaften* to represent two fundamentally different approaches to building knowledge. Dilthey insisted that in the understanding of human experience and intentional actions we are more preoccupied with a model of part-whole; whereas in the natural sciences our explanations are restricted to the linear model of cause and effect.

This course is not a place where we can pursue an adequate study of the history of sociology, for which it would be important to pursue the lasting and divergent influences of Auguste Comte and Herbert Spencer and Georg Simmel. Dilthey introduced the notion of 'understanding' or *verstehen* in his native German, which means empathising, or trying to stand in the shoes of one's subject—appropriate for explaining social events of history but absurd as a method to explain combustion, electro-magnetism, or the movement of the planets. Later, the influential 20th century sociologist Max Weber relied very much on this notion of *verstehen*.

For our purposes here, it is sufficient to observe that the inception of social science (history, sociology, psychology) was motivated with the explicit intention of introducing a new and distinct model of scientific explanation and with it a methodology that stood their own ground in opposition to the methods of natural science that had been laid down and were well established

already for a century in Europe, and several centuries in the Middle East and in Western Africa during the Abbasid Empire (9th to 13th centuries) and afterward. It is important to note that just because social studies began with a self-conscious introduction that completely different methods are necessary in order to study physical and social reality, it doesn't follow that this must be the case. Generally even if the ideals of scientific understanding are presumed to be uniform for pursuing all sorts of knowledge objectively and systematically, it is accepted that such an ideal is impossible to achieve. Whether it is worthwhile to pursue such an ideal remains an open debate. So there remains an inherent tension throughout the social sciences whether human events should be explained using the criteria, the models, and the methods that are relied upon to explain physical events. This tension becomes most palpable in the disciplines of history and economics, where experts may either pursue or revile statistical analysis, for instance, in the development of theoretical explanations of data. We cannot pursue the details of these internal social scientific debates about methodology here.

For our purposes, we need to get a basic feel for what is meant by methods and standards being scientific. This will be the focus of Units 7-9. It is incumbent upon us, as critical thinkers and practical reasoners, to be conversant with the basic principles of scientific reasoning so that we can be critically literate consumers of policies and theories that are packaged in scientific discourse. We also need to know when such methods are being inappropriately or inadequately applied within our discipline.

Although we cannot deal with this topic in this module, it is important to be aware that social studies have developed cultures and locations outside Europe. For instance the critical study and reflective description of social relationships and problems has developed among Ghana's opinion leaders and social activists before independence.

Summary

The social sciences did not grow up with the physical sciences; the fields of history, psychology, sociology, economics, law, as we study them today, grew out of a protest in reaction to the prejudices of the early New Scientists in the 17th century. The rationalists of the early modern scientific era in Europe and the Middle East favoured the study of mathematics and physics because they thought the natural world could be known more perfectly than the messy, complicated and complex world of human affairs.

But human beings might be said to understand ourselves best of all, since we live in the social world, it is what we know first hand and directly.

It remains an open question how best to understand subject matter that talks and sometimes explains itself, and if we can really and fully attain self knowledge of the human condition at all through the methods of the natural sciences. This is what we will study in the remainder of this Unit. See Max Assimeng (1996) Chapters 1 -3. Abridged and reprinted in H. Lauer and K. Anyidoho, eds. (2010).

SECTION 4: DISTINGUISHING SOCIAL STUDIES FROM NATURAL SCIENCES

Introduction

Further ways in which social sciences appear to contrast from the physical sciences will be explored. In Units 1-3 we learned some principles and vocabulary which will help with the first of these contrasts, and the considerations reviewed in this unit so far will help us appreciate the last two:

- The kinds of question that are asked in the social sciences are different from the physical sciences
- The social sciences exhibit a predominance of open textured words,
- The sorts of methodology that can be employed to evaluate claims in the natural sciences are not available in the social sciences
- There may be something unique about certain aspects of being human which disqualifies us as ideal subject matter for scientific inquiry

Objectives

To be able to articulate what it means to be a scientific discipline

To be able to see contrasts between scientific study of humans and other subject matters

To understand why open textured concepts are characteristic of vocabularies in social studies but not in the natural sciences

What makes a subject of study scientific?

So far we have distinguished social studies from other knowledge domains as the examination of all things that would never exist if human beings did not exist (e.g. architecture, the history of chieftaincy, world economics, political systems, the nature of the state, religious institutions and doctrines, theories of psychological disturbance, cognitive development).

Does this mean we can say that the Faculty of Science studies all those aspects of reality that would exist if human beings never existed? (That is, astronomy, weather patterns, geological formations, the animal kingdom, insects, oceans, the plant kingdom, biological life, chemistry, physics, crystallography).

Drawing this contrast requires some care. As was observed in the summary of Sections 2 and 3, human beings themselves are part of the natural world; human beings are also the subject matter of many disciplines in the natural sciences, including biology, food and nutrition science, medicine, biochemistry, physics, genetics, and other research agendas.

The very same object, a human being, can be a focus of different kinds of science. It all depends upon the kinds of question you want to ask, as we considered in Activity 3.1 of the previous Section.

Activity 4.1 - Thinking drill

Contrasting questions that are appropriate to subject matter that explains itself.

We observed in Section 2, we can ask questions about a human being treated as a physical entity in the natural world; and we can ask questions about a human being as a core member of the social world. To see that the method of *verstehen* might be appropriate when answering some kinds of questions about a human being and not other kinds of questions, consider what questions you might ask about the following blocks of characteristics.

Which characteristics could be queried and answered using the method of ‘getting inside the shoes of’ the subject matter? For which questions would this be inappropriate to do, in order to find an acceptable answer?

Contrasting characteristics of a human being

Height, weight, blood type, age, chemical composition, basal temperature, physical endurance, religious affiliation, job opportunities, educational background, number of languages spoken, political party allegiance, marital status, dietary and nutritional intake

Differences between the vocabularies of social studies and the physical sciences

“Essentially contestable concepts” or ‘open textured’ words characterize our study of human collectives. Recall from Unit 2 Section 3 how many words used to describe social reality are dependent for their meaning upon the beliefs of the people who comprise a society. Recall how a currency works, or how your ethnic identity is dominated by other people’s recognition of the legitimacy of the labels you use for yourself. Social reality is created in part by what the majority of a social group believes. So for example what gets counted in the denotation of a legitimate: family, church, or marriage, depends upon what the majority of people in a community recognise as norms of family structure, what a religious institution properly set up *ought* to look like, or how a marital relationship should be organised. But these are all value judgments that are the result of how one has been brought up. Such beliefs about norms change necessarily because of disagreement and debate, or because economic constraints and political changes impact upon the majority’s beliefs in a given social environment.

Many of the key words that are used to describe human group and individual behaviour require appreciating the role that local beliefs play in shaping not only how reality appears but how reality is for the people who live or work in that locality.

Activity 4.2 - For discussion

The role of local community beliefs to determine meaning

1. Find a brief account of what happened in Rwanda in 1994, or in Cote D'Ivoire in 2001-2002.
2. In light of the episodes that are highlighted in these periods by news briefs, answer these questions: What does it mean to be Rwandan? Ivorian? Are civil statutes or a legal definition sufficient to determine the denotation of these terms?
3. Can you think of other more immediate Situations where your neighbours have to recognise you as such otherwise a label does not apply?

Many theories and doctrines in the social sciences (and also the humanities) depend upon phrases which are composed of words that are called 'open textured' or 'essentially contestable'. These are words that attract many interpretations and carry many meanings that vary from culture to culture because their use must depend upon people's varied beliefs and experiences in different cultures. Using the technical terms we learned in Unit 2, these are words whose connotation we may share but the denotation of the word may diverge for different speakers living at different times or in different cultures.

For example, consider the phrase 'good wife'. The connotation of this phrase may be universally appreciated: a good wife is a woman whom you would regard as desirable and would wish to marry, or the type of woman you would wish to become when you grow up or the type of woman you would groom your daughters to become in order to get married to an ideal husband. But although we may all agree upon some synonym in our own language for 'good wife' we call this term 'essentially contestable' because the shared connotation does not fix the denotation. There may be no agreement on the denotation of the phrase from culture to culture or depending upon your own social class or ideological perspective, or religious beliefs. So, if you are a Taliban ruler, the denotation picked out by the phrase 'good wife' is very likely to differ in some crucial respects from the denotation that would be picked out by Michelle Obama. There is no way to find a 'typical case' for all societies of what to pick out as the full range of behaviours characteristic of a good wife. So there is no 'normal' use of the word.

Its use always depends upon the beliefs of the people who are using the word, and these may change. So they are said to stand for concepts that are 'essentially incontestable' or 'open textured' or 'open class' concepts.⁴ It is likely to be impossible to find any essential definition for these words. And yet they are crucial to descriptions of what we meet in social reality, in the things people intend to do and the relationships and institutions that people maintain over generations and throughout history. This is typical of very key terms used in the social sciences.

The ideal of transparency of meaning in the natural sciences

Let's consider now why this 'essential contestability' or the 'open textured' feature of the meaning of words is not duplicated in the natural sciences, in the natural sciences, from time to time researchers and theorists do also debate the meanings of the key terms they use. A recent and famous example is the controversy among astronomers that arose with re-opening the official Royal Astronomical Society's stipulated definition of the word planet. This global debate about what should be the denotation of planet was provoked by a change in technology of telescopic photography, and with it a drastic and abrupt improvement in resolution of photographs taken of deep space by instruments mounted in outer space and sent by satellite back to earth. The earth's atmospheric conditions no longer interfere with what we can see through our telescopes. It appears that planet-type objects revolve around our sun in all shapes and sizes; there may be hundreds, not just nine.

However, once the debate amongst modern astronomers is resolved, if only by convention or fiat, then the connotation of planet will certainly have changed, but it will also once again be fixed; and the new connotation will determine universally a denotation of the word planet, which all properly trained astronomers will come to learn how to use as part of their training. Thus in the natural sciences, knowledge is not contoured by, nor relative to, cultural beliefs.

This is because in the natural sciences, the model of vocabulary admitted into a discipline is that each word must be operationally defined. Recall from Unit 2 what an operational definition provides: it is a list of instructions to follow in order to tell whether the word being defined applies in a given situation or not. The list of instructions can change as a science develops, and it often does. (Fifty years ago the term 'gene' was a theoretical concept. In a microbiology textbook today, you are shown photographs of genes; it is now an observation term.)

But essentially the connotation will fix the denotation, as we just recounted has happened with the changing concept of 'planet'. In the natural sciences, variations in local beliefs are not essential to determine an ever shifting denotation, required for the use of a word. Presumably, if there is such a virus as HIV, then it exists whether or not anyone in this generation knows about it or has yet to discover it. Similarly, the meaning of AIDS should be established globally once and for all populations: the fact that AIDS means one thing in California and something else in Accra is a breakdown of scientific rigour that is typical of the whole HIV/AIDS research and pharmaceutical industry.

By the same token, suppose thanks to a redirection of research funding, the local understanding of the pathology of AIDS develops to such an extent that the earliest notion of 'HIV' which dominated medical research since the 1980s, will become outdated, as researchers get a clearer understanding of what causes immune systems to break down in African climates under the added pressures of inadequate sewage, simultaneous illnesses, poor nutrition and inadequate medical care.

Then what is regarded as the AIDS virus will have turned out to be mistaken, even if the scientific community and pharmaceutical public relations engines abroad continue to use this terminology.

A word's use in science is not a function of local beliefs; it may be rejected as inadequate. This is what happened to the word 'phlogiston' that referred to a firelike element in the 1600s. It was supposed that in order for burning to take place, an element in flammable objects was released, accounting for the lighter weight of objects after they have turned to cinders or otherwise burned out. Subsequently it became clear to chemists that there is no such substance given off when a substance burns. The process of burning is now understood differently, as the result of three elements being available: a heat or ignition source, fuel and oxygen. This development does not mean that phlogiston did exist for the scientists of the 17th century. It means that the scientists in the 17th century were wrong. Key terms in the natural sciences do not depend upon the beliefs of the community of speakers that use them.

Similarly if a planet is defined as any object that circles the sun in an ellipse regardless of its size, then there may exist planets smaller than our Moon even though we do not know whether they exist, and even if we refuse for practical reasons to use the term planet in this way, until future evidence forces us to change the way we use the word. Similarly, the Higgs boson particle may exist in sub atomic space, or not, regardless of what scientific experts believe today. This is how people can come to discover something totally new about physical reality which no one anticipated before. Words may or may not have the reference they do, depending upon how the world is, not depending upon our beliefs about the world.

But fascinatingly this sort of objective detachment of the meaning of words cannot hold when describing social reality. In order for certain words to have the meaning they do in our social worlds, and in order for social reality to exist as it does, people have to hold the beliefs that they do.

For example, consider the meaning and the authority of military officer, or local currency, or political party, or electoral victor, or policeman, or husband. Unless people maintain certain beliefs, these terms cannot function, to guide our behaviour towards each other as they do. Were it not for the beliefs we hold about what these words denote, they would cease to refer to the things that they do. We need examples to make this point clear

Consider the meaning of Ivorian, or Rwandan. What did it mean in 2001-2002 in Cote D'Ivoire, or in 1994 in Rwanda, to be a member of these classes of people? Is membership of a nationality dependent upon civil statutes alone? Legal definitions may define who you are, but your neighbours also have to recognize you as belonging to the denotation of the label, otherwise the label doesn't apply to you. People's beliefs are essential to the functioning of some words that describe the social world, and these beliefs are subject to external influences.

This is why it became so critical in Rwanda during the 1990s to sanction against radio broadcasters inciting negative connotations to the word 'Tutsi'.

Nor is the contestable or manipulative nature of certain words that function to describe social reality and identities a function of low level of education of the asses or certain tempers attributable to certain people accused of being 'tribalistic'. What does it mean to be tribalistic? Who is tribalistic?

Consider the word 'terrorist'. It simply doesn't function in newspapers or in the international arena of diplomacy today as it did twenty years ago. Similarly for the words 'security threat', 'enabling economic environment', 'genocide', 'freedomloving people', 'family values', 'corruption', 'crime against humanity'. Much of the discourse in the global arena is a function of who has the power to distribute information via satellite media, and for what purpose, and in whose interests.

As critical thinkers we need to be alive to this feature of words that describe social reality 'scientifically'. The meaning of key terms in social studies are circumstantially determined in a way that the terms used in the physical sciences are not.

Activity 4.3 - For discussion

Essentially contestable concepts affect the nature of a question

Determine for each of the following questions, whether it contains terms whose connotation can fix the word's denotation for all future instances, of whether the connotation of the word can be shared but particular instances will remain debatable.

- In other words, which of these questions contain essentially contestable 'words'?
- In consequence of this feature, which of these questions is characteristic of social studies? Which is characteristic of the natural sciences?

1. Is this object a planet?

2. Is this substance a metal?

3. Is this a married couple?

4. Is this woman your wife?

5. Does this child have your DNA?

6. Is this child your heir?

7. $P = T/V$ is Boyle's Ideal Gas law. Is this how a gas ordinarily behaves?

8. Kepler's second law of planetary motion describes that a planet's orbit sweeps out equal areas over equal times as it orbits the sun. Is this how every planet always behaves?

9. According to Freud's theory of the psyche, the ego mediates between the id and the superego and the external world, constantly seeking a balance between primitive drives and reality's demands. Does this also apply to a man who has become a paramount chief and in the process gives up his personality to become a channel for the ancestors and his people?

10. Is this the head of household?

Finally, some metaphysical reasons for the difference between the physical sciences and social studies:

The purported uniqueness of the subject matter of human sciences—namely, the nature of human beings ourselves—is regularly cited as a reason why the study of human beings is necessarily unique. Here are some aspects of the human condition and experience that are drawn upon to explain why humans cannot be studied with complete adequacy using the same methods and techniques as we study rocks, plants, trees biological organisms.

1. Mature humans generally have free will; and this is taken to mean they are spectacularly unpredictable, even more so than the weather or seismic activity of the earth's crust. So we can never hope to predict or explain fully the way human beings behave.

2. Consciousness may be a unique aspect of social reality if only human beings have it. Perhaps being conscious or aware and able to formulate plans and intentions necessarily carries with it limitations as a focus of successful objective study by beings who are conscious.

3. Maybe self-reference has its limitations. Perhaps human beings cannot fully understand themselves because it is impossible to completely depict the picture of social reality of which our understanding is a part. This might be because the social activity of understanding ourselves thoroughly and exhaustively is itself a part of the understanding we wish to achieve. After all, the production of knowledge is in itself a very critical part of our social landscape. So of course the achievement of having fully explained ourselves, or having completely depicted our picture of social reality, is an important part of the social reality we need to depict, in order for our picture of social reality to be completely exhaustive. And so perhaps the process of depiction or explanation of social reality necessarily can never be completed.

To consider the first point about human free will, return to the two lists of characteristics of a human being presented above in Activity 4.1. If there is one feature that the characteristics in the right hand column presuppose that the features in left hand column do not, it is the fact that human beings have the capacity to choose what they do; people can act for their own reasons; they can make choices about whether to build their faith, or marry the partner chosen by their parents, or to motivate and create their own plans that need not be programmed by their innate

biological make up nor dictated by their political rulers. And so humans can do things in society that are unpredictable. Whether or not the nature of human free will is something that can be explained using the same principles as provide us with causal theories of other phenomena is a topic in philosophy that we cannot pursue here.

Considerations 2 and 3 are further metaphysical reasons for regarding the subject matter of human sciences as unique. Again we cannot penetrate these provocative philosophical questions in the compass of this course. But they underlie the controversy surrounding the question whether human sciences must diverge from natural sciences, requiring different research methods and producing a different kind of knowledge of the world in which we live.

Summary

In the natural sciences the beliefs that people happen to share at a given time and place *do not* determine the reality they describe. So people's beliefs at a given time and place are not essential to the meaning of key words use a in natural scientific descriptions and explanations.

But for systematic study of social reality, knowing what people believe is required not only to describe what they think they are doing but also, therefore, to construct an explanation that will be relevant to the way they function in their given circumstances. Certain terms depend for their meaning upon what those who use those words in a given community believe them to mean. Such terms must therefore have an 'open texture'.

Open textured terms are key in explanations and theories proposed in social studies. This is because the way people understand the words that they use not only captures their social reality as it appears to them; the way people use words in part determines what their social reality is.

Assignment 4

Discussion exercise

Consider the following terms. Would it be possible to find a typical case for each word that would represent for all societies world wide what belongs to the denotation of that word?

The reason that there is no typical case of these classes of people is because these words require that the people who use them must maintain certain beliefs determining their application. There are no authorised rules, no body of experts that can determine once and for all time in any society, let alone for all societies globally, what these words should denote.

Chief, Military officer, Bonafide pastor, Political party, Official congregation, Religious behavior, Currency, Elite, Family, Spiritual devotion, Freedom fighter, Student leader, Head of society, Terrorist, Marital fidelity, Wife.

What would happen if we try to provide an ostensive definition of these words, since there may be no ‘typical’ or universally representative case that we could rely upon? How should we go about defining these words?

Unit summary

We have canvassed the different areas of knowledge and skill training that are covered in university life.

We’ve considered what distinguishes the purpose and goal of liberal arts and humanities courses as distinct from social studies subjects.

We’ve learned something about the history of social studies and why there is a preference for the title social studies rather than social or human sciences even though both labels refer to the same collection of departments and subjects.

We’ve looked at different reasons why the natural sciences require different kinds of training than social studies: the vocabularies of these two areas of knowledge are different, the sorts of questions asked tend to be different, and the methods used to find answers to these questions also tend to mark a contrast between natural sciences and social studies.

For our lives:

We also noted while examining the nature of social studies vocabulary that some features of social reality require a debate and a subsequent change in people’s beliefs in order to result in the desired transformation of their community. This is why Kwame Nkrumah emphasised the importance of consciencism, the term he used for people’s need to change the beliefs that they hold about themselves and about the causes of their social and economic limitations, in order for the material conditions of those limitations to shift. This principle was later popularised in the lyrics by Bob Marley in his immortalized “Redemption Song.”

In Units 11 and 12 we will consider why this transformative exercise may require you on occasion to think independently of what the majority of your friends or work colleagues believe. We will look at how to accomplish this life skill of thinking and problem solving independently.

UNIT FIVE: THE NORMATIVE AND THE EMPIRICAL

Introduction

In this unit we will reflect upon: Five distinct meanings of the term ‘law’ and its cognates (universal hypothesis, rule, axiom, a priori knowledge, necessary truth, apodictic certainty).

This will prepare us to understand later, in Units 6-10, a broad contrast between two (interdependent) types of reasoning that are typically invoked to support general claims of two kinds: normative principles—which indicate how things must be or how they should be—vs. empirical generalisations—which supposedly report how things are in fact.

But many statements in the human sciences and social studies contain implicit and explicit meanings: many statements convey both a factual judgment as well as a value judgment.

It is extremely important in a course on critical thinking to become sensitized to this feature of the disciplines in the social studies where you are dependent upon textbooks that are produced in a distant culture and when you are learning theories and research assumptions that are developed in the international language of a former coloniser’s knowledge tradition. As we observed in Unit 4, this feature of certain disciplines to reflect the values and norms of imperialist or globalising societies, when they are explaining social norms of people in currently or formerly colonised societies can be misleading. The same problem does not arise to the same degree in the physical sciences. In this Unit as in the last, we will continue to examine why.

This unit will cover the following topics:

- Section 1 Six senses of ‘law’.
- Section 2 Contrasting facts and values
- Section 3 Explicit and implicit meanings of statements

Objectives

Upon completion of this unit you should be able to

- Identify different notions of law presupposed in statements
- Distinguish statements that express facts vs. values
- Recognise the implicit and explicit meanings of statements

Section 1 Six Senses of ‘Law’ Introduction

These contrasts were introduced already when we discussed ambiguity and equivocation. To avoid being fooled by switching connotations without indication, the differences should be clear to you as a critical thinker.

Objectives

We will contrast the notions of

Natural law, Civil law or statutory law, Customary law, vs. cultural norm, social rule, convention, moral law, logical law, mathematical law, divine law.

NATURAL LAW

Where this is understood to be statements expressing the laws that scientists are striving to discover, the statement expressing a law of nature is called a scientific law. These are statements that aim to describe; regularities or uniformities in the patterns of event or features of things we observe around us. The statement expresses an expectation that we have which is based on past experience: it is supposed that the statement will meet with no exceptions. It is in this sense that the statement is supposed to be law-like. But there is no way to be absolutely certain that the statement is true. So it is called law-like, in case it turned out someday to be false. For example:

(1) Every planet moves around the sun in an elliptical orbit.

Suppose that we someday did discover a planet that did not orbit the sun in the path of an ellipse. Then we would not propose that the planet be incarcerated or accused of a wrong motion. We would be obliged to check our data, review our observations. If it turned out that indeed the planet newly discovered was not really some other kind of celestial body but really was a planet that did not have an elliptical orbit, then we would have to say (1) is false.

In this respect, statements depicting scientific laws are predictions in disguise that may turn out to be false someday.

Example: Consider this 'low-level' law like statement: All metals expand when heated. This is a disguised prediction in the sense that it means: If this object is a metal and if it is heated then it will expand.

It may not be obvious why this statement is recognised as true even though some day it might turn out to be false, and we know that even now, yet we still accept it as very probably true. We will discuss why law-like hypotheses like this one in the example come from later and at length in Unit 7.

Scientific laws always depend upon evidence; they are predictions based on summary reports. They may turn out to be false. We call such statements 'law-like'; the statement *might* recount a

law of nature that exists, or it might not. With our limited experience we have no way of telling for sure.

Examples of statements that are necessarily true because they are theoretical definitions (recall Unit 2):

(2) A molecule of water is H₂O.

(3) A force operating upon a moving object is equal to its mass times its acceleration.

(4) The atomic weight of gold is 12.

Activity 1.1

Recognising the close connection between necessary truths and definitions.

For each of the statements (2) - (4) above, explain why each can be regarded as a law of nature, but also a definition.

CIVIL LAW AND STATUTORY LAW

This type of law is man-made; it reflects the legal instruments that governments have to control behaviour of citizens. These laws have been intentionally created through due process in accordance with the procedures set up for creating legislation. These laws are backed by force and they have sanctions attached. Constitutional laws are obligatory on the government to obey. Examples of manmade laws include commercial law, tax laws, tort, contract law, constitutional statutes, land tenure regulations, family law, labour laws, rules for electoral process, media laws, laws for starting a business, licensing a building for commercial use, criminal laws in response to stealing, murder, manslaughter, assault and battery, human rights laws, laws protecting the rights of prisoners, arrest and detention procedures, laws protecting against perjury, libel, intestate law, traffic laws, procedures for certification to register certain property or to engage in certain services for commercial purposes.

If a citizen breaks these laws, and is caught and summoned to court to determine their guilt in violation of the law, then there may be penalties. A citizen may choose to break such a law, or do so unwittingly, but the consequence of violating a law in this sense does not invalidate the law. Rather the violation may entail inconvenience or loss of freedom through imprisonment or capital punishment leading to loss of life. The threat of punishment in principle provokes people to obey laws that are man-made.

There is an important contrast between the idea of natural laws first described above, and the idea of criminal and civil laws that are man-made. It would be a confusion to say that the laws of psychology force a person to act in a certain way, or that the laws of planetary motion *compel*

planets to move a certain way, on pain of punishment if they violate the law. If we learn about a planet that does not follow (1), then we reject (1) as false. We don't punish or deride the planet. Similarly for so-called psychological laws. Human behaviour is extremely complex and multi-determined, and for whatever reason it is difficult for psychologists to discover statements about human individuals that have no exceptions whatsoever unless they are; very banal truisms, like 'All people deprived of liquid to drink for over twelve hours seek to quench their thirst.' Even this sentence is likely to be false if we took hard enough into places where fasting recluses are seeking spiritual development and are totally immune to the demands of even their own bodily need to replenish fluids, or someone who is determined to make a point and is on a hunger strike.

CUSTOMARY LAW

In some countries two parallel legal systems or more are sustained simultaneously. But the man-made nature customary law, are closest to civil law. Indeed customary law is civil law, and is practiced despite the impression that customary laws may have been superseded by another subsequent system that is enforced by a central state apparatus. Violations of customary laws are thus sanctioned in accord with the system of authority that is organised to sustain them.

CULTURAL NORM, SOCIAL RULE, CONVENTION

These contrast with laws, in that these norms influence people's behavior usually without any formal public or community arrangements or procedures which follow their violation. To break these types of code of conduct will likely have a more diffused negative consequence; unacceptable behavior often attracts covert approval within sub-groups of society (there is always a clique for eccentrics and rebels to seek support and recognition). Very possibly breaking social rules will yield no public response or effect at all. So it is not always that you will find the purported disincentives to breaking social rules and conventions. In this respect, social customs and mores fall short of being binding in the way laws are understood to carry specified sanctions. Examples of cultural norms and conventions include wearing of certain kinds of apparel in certain public and private circumstances, dietary rules, worship behaviour, observance of holy days and public ceremonies, and a host of other rules guiding conduct and relationship that are detailed lovingly by sociologists and anthropologists.

Another kind of code of conduct is specific to situations: for instance there are codes of conduct for playing football, or for attending university. Each institution can create codes and procedures that are followed if a member violates the procedure.

MORAL LAW

The authority of morality is usually presumed to be universal. If stealing is wrong morally, then that means it is wrong whoever you are, wherever you come from, whatever your religious beliefs or social customs. So moral principles are called 'laws' in that they bear no exceptions; otherwise it is not laws that constitutes the difference between moral law and cultural norm except that there must be a difference, otherwise there would be no way to complain and debate on moral grounds on whether a cultural norm is ethically right, e.g. serial divorce, or extra marital sexual relations. Morals are certainly understood to be more binding than conventions, but there is obviously variation in views worldwide about what is moral behaviour so exactly what moral universality amounts to is not at all obvious. Moral imperatives (for instance: do not steal) are readily distinguished from what is legally prohibited, or behaviour required by legislation (for instance civil disobedient Black South Africans intentionally broke pass laws in apartheid South Africa prior to 1994 and were thereby acting with great moral courage and rectitude. Nelson Mandela's activities landed him in Robben Island Prison for thirty years because he was violating legal statutes but in doing so he was acting as a moral hero).

There must be some contrast between moral law and criminal law, or between moral law and cultural norm, however difficult it is to articulate, otherwise it would be impossible to complain about the injustice or immorality of some cultural conventions and norms, and there would be no sense to regarding Nelson Mandela a hero during the fight against apartheid because he broke the pass laws of South Africa. In other words if saying an action is morally good means exactly the same thing as saying that the action is recognised as a cultural norm, then there would be no way to criticize any cultural norm as being immoral.

People do challenge the morality of legislation and of cultural practices all the time and they are not contradicting themselves. For instance some people criticize as immoral, and other people defend as morally innocent, the cultural norm of women being paid to waitress or to dance while wearing practically no clothes in a public drinking venue; other people will defend this practice as morally innocent and acceptable on cultural grounds. That debate could not make any sense if there were no difference in our understanding between moral principle and cultural norm. Another example is where people within one culture object to the social toleration that exists for serial marriages or serial divorce (that is, getting married to one woman, getting divorced from her and remarrying another) because they regard such behaviour as unethical. Again this complaint could not arise, that is the challenge would be incoherent if there were no distinction between the sense in which we understand something to be a cultural norm and the sense we intend when we say that something breaks a moral code or moral law. It's important to remember this when the topic comes to moral relativism.

Similarly, if being calling an action legal meant the same as saying that the action is morally commendable, then there would have been no way to challenge apartheid law on moral grounds prior to 1994 whilst it was the official system of legislation in South Africa. Correlatively, there would be no way to *break* apartheid law on moral grounds, if obeying a civil law means the same thing as obeying a moral law. And yet as we observed above, there are many famous examples of people doing exactly this: breaking a law on moral grounds, and being punished by the state for doing so, and so being regarded as heroic on ethical grounds because of it.

Since it is plain to everyone that the thirty years Mandela spent for breaking apartheid laws and for advocating armed rebellion against the legislation of apartheid in South Africa was an outstanding example of moral rectitude and heroism, everyone clearly recognises two different connotations of law when they speak of moral law and of civil law, even though spelling out exactly what constitutes moral authority is extremely difficult. So we speak of two connotations of law when we regard moral law and civil legislation.

We might also consider a different situation, to understand that indeed there is a stark contrast between moral Tightness and legality. Many people object on moral grounds to the trial and incarceration of the esteemed Tsatsu Tsikata, former chief executive of Ghana National Petroleum Company. Legally the rules and statutes for due process of putting someone on trial and incarceration may have been followed, but the motivation and causal factors leading to these legal proceedings have been challenged in that some think a moral injustice was committed by setting in motion the whole legal process from the beginning. Now, whether you agree Tsatsu was properly incarcerated or not, the point here is to recognise that the debate and your own view about whether the Tsikata's case and the judge's decision were moral cannot be formulated if you do not distinguish between man-made legislation and the sense in which people pass judgments upon the moral Tightness and wrongness of actions. But clearly there is such a debate. And clearly you may or may not hold a view about it. So we do indeed recognise a contrast between, what is legal and what is morally right and commendable.

Activity 1.2—Thinking exercise

Recognising the contrast between the sense of law connoted by state legislation vs. moral laws.

Think of an example where someone is criticizing on moral grounds the legitimacy or justness of a civil statute or a law. Then write a sentence to describe the conflict between something that is an accepted practice on legal grounds but is regarded as unacceptable on moral grounds. Explain in your own words how this example illustrates that there must be more than one sense we attribute to the notion of law.

Activity 1.3—Research exercise

Contrasting moral law and cultural custom or norm

Find a cultural norm or social custom either in your own society or someone else's which you find morally objectionable. Write your value judgment in one statement.

Write down whether your judgment supports or instead contradicts this relativist view of morality: what is morally right and morally wrong is nothing more than a construction of each society, so that morality is relative to each culture or society.

LOGICAL LAW

These principles have no content or subject matter. They are rules for thinking that are required in order to move from statements that are accepted as true, to further statements which by all means will necessarily also be true since they follow from, that is they deliver in a different way the same information as, the premises that were assumed to be true from the outset.

The relation in a valid argument between premises and conclusion holds only because logical laws have governed the inference, regardless of the subject matter. In this respect, the laws of logic are universal.

Example: If all As are Bs and every B is a C then every A is a C.

Deductive laws of logic guarantee that if your starting point (your assumptions or premises) are true then your final conclusion that will also be true. If we follow the laws then we will never be led from a true assumption to a false conclusion, in this respect a rule of logic has no exceptions: it is foolproof, no matter what the subject matter. Why this is so will become clearer in Unit 6.

But in the formation of arguments every day by human beings, mistakes are often made; the laws of logic are not always applied, just as traffic laws are routinely disobeyed. It should be emphasised that logical laws are not *empirical*. Laws of logic are not empirical summaries of how people do think. They are not psychological overviews: these laws are not a record of psychological regularities. Deductive laws of logic are normative: they capture how we should think, not how we actually do think. Rules of logic are not always followed faithfully by living human beings. People commit logical fallacies. How people actually reason about a problem or a decision about what to do is flawed; we violate these logical laws.

Although people make mistakes in their reasoning and fail to follow rules of logic, this is not a refutation of the laws of logic. Even if in certain situations people deviate very often, or if certain cultural frameworks encourage people to disregard laws of logic, this also does not refute the laws. The force of these rules is not relative to culture.

Ultimately the laws of logic are derived from the fact that reasoning productively is impossible without them. And you cannot prove that this is so, without employing some rules of logic. But that is a weak explanation of the authority of logical laws, because it assumes that we can sit back and judge when reasoning is productive or not. This would require some goal or purpose of reasoning, and some content or subject matter about which the reasoning is performed; only then can we decide if the reasoning is fruitful or not. Yet the laws of logic are supposed to be binding independent of all subject matter. We will explore further the significance of laws of logic in Unit 6.

Activity 1.4—Discussion option

Showing logical laws are not empirical laws.

Come up with an example of a mistake in reasoning that violatesthis logical law:

(5) All As are Bs, and this x is an A. So this x is a B.

Does your example invalidate this law?

Example: Let A = Dogs, B = creatures that bark

All dogs bark. This creature is not dog, so it cannot be bark.

Commentary: This person is confusing modus ponens, since there are creatures that bark who are not dogs; seals bark, for example. But the rule would stay the same nonetheless, since All As are Bs does not mean all Bs are also As. And suppose you have a case where there is a dog that doesn't bark. My dog lost his voice in a car accident. He cannot bark. Still if it were true that all dogs bark then the conclusion would follow, so the rule is not violated in either of these apparent counter-instances. One contrary case is due to confusing modus ponens reasoning and committing a fallacy, the other is due to the premise being false about all dogs. Neither case means the law is no longer valid.

MATHEMATICAL LAW

We can separate these into rules for mathematical practice:

(6) Never divide by zero.

And descriptive laws that summarise the results of mathematical practice for all time:

(7) Every even number is the sum of two primes.

If the Laws in mathematics are established as the conclusion or theorem derived as the last line of a proof. We will give an example of a proof for (6) above in the last section of Unit 6.

A proof is a list of statements that is constructed by using rules of logic to move from one or more statements in the list to construct subsequent statements in the list. Therefore one might assume, as mathematicians and philosophers have supposed for hundreds of years that the certainty of mathematical laws depend ultimately upon laws of logic.

But this assumption turns out to be mistaken. Because in any symbolic language that can exhibit all arithmetic truths, it will always be possible to find a true statement which cannot be proven, nor will its denial be proven false.

So it is not clear what justifies in an ultimate sense our certainty about mathematical laws. But we can recognise that their status as an exception-less law follows from our constructing a proof for it. The difference between proving a statement as a theorem from first principles and confirming a statement as a law-like hypothesis on the basis of evidence is the topic of the next Unit 6.

DIVINE LAW

This is a theological concept. The content of such laws depends upon which doctrine is embraced for first principles.

For instance, at different times and in different religious and cultural conditions, the following manifestos and beliefs have been claimed to derive as divine law:

- God's will was supposed to justify the laws of segregation prior to the 1950s in USA
- Legal sanctions against miscegenation and all forms of racial segregation in the USA's public and private institutions are still regarded in some communities as directed by divine law
- Apartheid laws in South Africa prior to 1994
- Discrimination against homosexuals is regarded as ordained by divine law
- Laws against abortion and against contraceptives regarded as ordained by God
- Divine rule of kings justified the monarchies in Europe until the 18th century French revolution challenged this doctrine
- Rule of the Vatican in Roma dominated Europe up to the 15th century by appeal to a Divine Order
- Activities of the Ku Klux Klan in the USA are always ratified by the conviction that white supremacy is ordained by God's law

It should be clear from the list above that there is no way to judge amongst all the mandates that have been claimed to be divine will and therefore carries the authority of a supreme law. If there is a supreme law whose author is a divine will, its contents completely open to speculation. For all we know, divine law decrees that we all must wear red hats on Wednesdays; and this edict has yet to be discovered by some prophet who will in future realise the true message of the First Cause through a revelatory dream.

Different interpretations of various Scriptures prevail. The meaning of any written text including sacred scripture depends upon the time and context of the authorities reading it. So even if there is such a thing as divine law the content of its directives cannot be established through reasoning. There is no way to establish indubitably that one interpretation of the Bible or the Qu'ran is more revealing of divine will than another.

Activity 1.5

Identifying two different types of normative statements: Law-like hypotheses vs. theoretical definitions

a) Which of the following are true because they express a uniformity or regularity of nature which is established by observing the empirical world. This is an empirical or *factual* generalisation, or a law-like empirical hypothesis. Its truth would be confirmed through experimentation or field work research.

b) Which of the following are true because of the meaning of the words comprising the sentence? This is called a theoretical definition. Its truth could be determined by consulting a dictionary or lexicon.

c) Which of the following could count as both a definition and a law-like empirical hypothesis?

1. NaCl is water soluble.
2. 'NaCl' is the chemical abbreviation meaning sodium chloride, commonly known as table salt.
3. A single Y chromosome is a rod-like or thread-like structure occurring in pairs in the nucleus of animal and plant cells, carrying genes which determine the inherited characteristics of an individual.
4. Every metal expands when heated.
5. It is necessary but not sufficient to have an x-ray taken to determine if a tumour is malignant.
6. No human being is borne with feathers.
7. A substance is water soluble if it dissolves in an unsaturated solution of H₂O at room temperature and normal barometric pressure.

8. The substance in this beaker is water soluble.
9. Exposure to light is a necessary but not a sufficient condition for most green plants to grow.
10. Fufu is a dumpling made from boiled and pounded tubers, including cassava and usually plantain or cocoyam.
11. A homo sapien is a featherless biped with the most developed neo-cortex among the family of mammals.
12. A whale is a mammal.
13. Every mammal needs water to live.
14. A mammal is a class of animal having a milk-secreting organ in the female for nourishment of the young, and usually is quadruped with hair or a fur coat.
15. A biological sister is a female sibling.
16. The green colour in a plant is due to the chemical called chlorophyll in its cells which makes photosynthesis possible, the compound necessary to transform light into energy for the plant to grow.
17. A floating currency is a currency that uses a flexible exchange rate as its exchange rate regime, and is contrasted with a fixed currency.
18. A newton is a unit of force, acting for one second on a mass of one kilogram, giving a velocity of one meter per second.
19. The most famous Newton died in 1727, and was born the year that Galileo died, 1642.
20. Any substance contaminated with DDT has to be treated as a lethal poison.
21. DDT is the most toxic pesticide used in recent years in this part of the West Africa.
22. DDT is a white chlorinated hydrocarbon used as insecticide (abbreviating dichlorodiphenyltrichloroethane)

Summary of this section

We have examined distinct senses (connotations) of the word law. We have distinguished the sort of necessity connoted by scientific laws as dependent upon the way the world appears to be. So it is possible to discover that what we took to be a law-like hypothesis that described a regularity of nature after all does not have a universal validity—because one day we find counterexamples that defy the statement. Then we don't say that the things we've discovered should be punished because they broke the natural law.

Rather we say that what we took to be a law-like hypothesis is actually false, because it doesn't describe a uniformity of nature after all. Either we revise the statement in light of the new evidence or we reject it. That is the way statements that describe scientific or natural laws work. They are very different from every other sense of law that we explored.

Divine laws are also unique in that they are not universally valid, only for those who subscribe to the doctrine or creed from which they originate.

Mathematical laws are recognised as absolute because they can be proven; so their strength is dependent upon the proof theory that supports these logical demonstrations.

Logical laws are accepted as rules, without which we cannot distinguish being right from being wrong, being true from being false.

Moral laws are meant to carry a universality that transcends or supersedes civil laws and theological laws. But it is controversial how to justify moral laws.

Civil laws are man-made and can be changed: violators might be punished if they are caught, put on trial and found guilty. This does not follow as a consequence of other kinds of law.

SECTION 2: CONTRASTING FACTS AND VALUES INTRODUCTION

In this section we consider and practice in more detail a contrast that was introduced in Unit 1: the difference between statements expressing factual judgments and those expressing value judgments.

Recall this difference that we drew in the previous Unit: Statements that describe the world as it is in fact are called factual statements. These can often be distinguished readily from value judgments, which are statements that describe the world as it ought to be or ought not to be.

But in many cases, we state what we think to be the case and implicitly what we say reflects what we believe should be the case.

Objective

- To be able to distinguish a statement which describes a fact that can be tested with an experiment, survey or field work.
- Statements that describe the world as it is in fact can often be distinguished readily from statements that describe the world as it ought to be or ought not to be.

Example of a factual statement:

1. Those boys in that yard are setting fire to that cat.

Example of a value judgment

2. It is wrong of those boys to set fire to that cat.

The two examples above provide a clear cut contrast between factual statement and value judgment: sentence (1) is clearly a report of an episode of behaviour. A photo snapshot could verify the fact conveyed by the statement. But sentence (2) does more than records an event using words as neutrally as a photograph takes a picture. (2) describes what is going on by evaluating it, in this by condemning the action as wrong.

But in many cases, we state explicitly what we think to be the case and implicitly what we say reflects what we believe should be the case. Such statements convey both a fact and a value judgment; this is not a contradiction nor is it a confusion. We say such a statement has an implicit meaning and an explicit meaning. The explicit or overt claim might be factual, while the implicit or covert significance of the statement might be a value judgment.

Example of a statement explicitly factual and implicitly a value judgment

3. “Without IMF policies imposed on the Ghanaian population, Sahel girls would never learn to read.”

Statement (3) above is a quote from the World Bank President for Africa, Jay Wilcox, and was published in the Washington DC magazine *African Farmer* in 1993, in an interview feature article titled “Has Structural Adjustment been a success? Yes.” This statement is explicitly a hypothesis about the influence of recent social and economic history, but it is also an implicit value judgment which conveys that the Structural Adjustment Programme was good thing, essential to progressive educational reform in the country. It also implicitly assumes that Sahel girls should learn to read, and that they would be worse off without the impact of the World Bank.

The contrast between factual and value judgment distinguishes what is testable from what follows deductively from moral principles. In the case of a factual claim, there is some way of investigating the world and its states of affairs in order to tell if it is true or false, whomever you are. We will study the way that factual judgments are tested using inductive reasoning in Unit 7.

A value judgment depends for its certification not only on observations of the world around us, but also upon principles of morality in the case of moral judgments, or on criteria of worth or utility in the case of non-moral judgments.

There are two types of value judgment: moral and non-moral. Non-moral judgments are more objective: these statements can be testable as well. For instance,

Examples of a non-moral value judgement

4. This car provides the best mileage for its price.

This is a value judgment but is not about moral goodness. Best in this sense can be tested by experiment. In contrast, consider

Example of a moral value judgment

5. This is the most virtuous sacrifice the SRC president has ever made.

Here we are looking at a moral judgment, because we are talking about virtue and sacrifice, which are characteristics or personality traits that normally has moral or ethical connotations.

There are many ways of understanding the meaning of moral value judgments. This would involve an analysis of what makes a personality characteristic a moral trait. We will not study these theories of moral goodness and evil in this course. We are only concerned here with recognising when a statement is expressing a value judgment.

Activity 2.1

Distinguishing factual statements from value judgments

Decide which of the labels apply to each item. This exercise provides an opportunity also to identify when an expression is a definition, and when it is not a declarative statement: neither a factual statement nor a value judgment nor a definition.

1. Guinness The Power.

A. Definition

B. Factual statement

C. Value judgment

D. Sentence fragment

2. Anyone who thinks it is acceptable to use stem cells in research must not respect human life as God intended us to love and preserve it.

A. Definition

B. Factual statement

C. Value judgment

D. Sentence fragment

3. The most vile crime still accepted as a socially desirable practice in some cultures is female genital mutilation.

A. Definition

B. Factual statement

C. Value judgment

D. Sentence fragment

4. Every mammal needs water to live.

A. Definition

B. Factual statement

G. Value judgment

D. Sentence fragment

5. Mammal is the name of the class in the animal taxonomic family of creatures having a milk-secreting organ in the female for nourishment of the young, and is usually quadruped with hair or fur covering some or all portions of the skin.

A. Definition

B. Factual statement

C. Value judgment

D. Sentence fragment

6. Too many people have died in the barrage of aggressive attacks over these endless two weeks.

A. Definition

B. Factual statement

C. Value judgment

D. Sentence fragment

7. 1,354 people have died in the 40 air strikes over the last two weeks.

A. Definition

B. Factual statement

C. Value judgment

D. Sentence fragment

8. “Iraq has turned from a brutal dictatorship and sworn enemy of the United States into the only true Arab democracy in the centre of the Middle East and a friend of America.

A. Definition

B. Factual statement

C. Value judgment

D. Sentence fragment

Summary of this section

In this section we have observed the difference between value judgments and factual statements, and realised the tight dependency between universal factual statements (empirical law-like statements) and definitions.

SECTION 3: EXPLICIT AND IMPLICIT MEANING OF STATEMENTS

Objectives

- To recognise the two meanings conveyed simultaneously by some statements
- To appreciate the interdependence between fact and value in the social sciences

Introduction

There exists a failure to comply with the standard dichotomy between knowledge that is recognised as normative and information presented as empirical. This lack of clear demarcation between fact and value results in a peculiar characteristic of the social sciences most notably. Statements explicitly reporting facts about individuals or social groups may implicitly cast value judgments about their subject matter.

Becoming conversant with this contrast between factual statement and value judgment will allow us to become sensitive to the academic reality on the ground, which is that the conventional contrast between what counts as fact and what is regarded as a value is neither fixed nor well defined in any branch of knowledge.

Some key words that we use to express our values are useful to us precisely because they are *not able* to be well-defined nor can they be defined in terms of strictly observable characteristics: ‘successful’, ‘virtuous’, ‘development’, ‘tradition’ and ‘modernity’, ‘fairness’.

In other words, whether it is appropriate to demand that a term be well-defined or operationally defined depends on the context of the term's use. And this is not surprising, since *all* meanings of words depend to a greater or lesser extent upon the context in which the word is being used.

Value judgments are an inherent or essential feature of the meaning of these words. They function in this scientific descriptions that are proposed as factual judgments about social reality. And this is how factual statements in the social sciences come to carry value judgments implicitly

Example:

A. Even though the school gave her the opportunity of talking with a counsellor over some weeks, Jasmine has clearly taken the easy way out and chosen to compromise her integrity by going for an abortion by the end of her fourth week of pregnancy.

B. After three weeks of the school's statutory counseling that students are entitled to when they feel the need for it, Jasmine has made a difficult decision and chosen to terminate her pregnancy at the end of the fourth week.

C. After three weeks of the school's statutory counseling that students are entitled to when they feel the need for it, Jasmine has chosen to terminate her pregnancy at the end of the fourthweek.

The statements above A, B, C all report the same incident. But B and C import descriptive words that implicitly cast a value judgment in the course of reporting Jasmine's behaviour: A is a very strong condemnation and makes it clear that the decision made is an immoral one; B casts some modest support for the decision and may imply (in a much milder way than the opposite judgment was conveyed by A) that the decision was morally right; C in contrast is a straightforward factual statement which introduces no value judgment into the meaning of the report.

Activity 2.2—Discussion option

Recognising implicit meaning and distinguishing it from explicit meaning

Consider the following five statements. Discuss or reflect upon i-vi below.

- i. Decide which of them is conveying value judgment on the social event being described.
- ii. Is there any statement in 1 -5 that is purely factual?
- iii. Are they all factual?
- iv. Do they all describe the same event?

v. How do changes in the words used to describe the social event change the picture and the implications of what happened?

vi. How do changes in the words used to describe the event change your impression of the people involved in the event?

1. A young woman purchased a mild sedative on the advice of a pharmacist.

2. An inexperienced woman was advised by a pharmacist to buy a mild sedative drug.

3. A pharmacist increased his sales by advising an inexperienced young woman to buy a sedative from him.

4. A rich pharmacist increased his market by persuading an inexperienced young woman on her own that she should spend her hard-earned money on a widely advertised sedative drug which has habit forming risks.

5. A young and attractive woman convinced an older man who was a pharmacist to give her access to habit-forming drugs.

Summary of this section

In this section we have discovered how two contrasting kinds of judgment—factual and value judgments—blend together or synthesize in individual statements whereby one and the same sentence can explicitly or ostensibly report a fact while also implicitly or covertly casting a value judgment.

Assignment 5.1

Directions: Identify which of the following statements are definitions (i.e. refers to a word as its subject), and which are factual (i.e. refers to something outside of language as its subject or reference class).

a) NaCl increases the symptoms of hypertension.

b) NaCl is sodium chloride, commonly known as table salt.

c) A single Y chromosome contributed by the male parent is responsible for the sex of a human offspring.

d) A chromosome is a rod-like or thread-like structure occurring in pairs in the nucleus of animal and plant cells, carrying genes, which determine the inherited characteristics of an individual.

e) 'Kpanlogo' is the name of the dance that the people over there are performing.

- f) My sister's name is Ann.
- g) All of Kofi's four sisters are studying medicine.
- h) A sister is a female sibling.
- i) One of Kofi's sisters answered the phone when I called last night.
- j) A newton is a unit of force, acting for one second on a mass of one kilogram, giving a velocity of one meter per second.
- k) Newton died in 1727, and was born in 1642, which is the year that Galileo died.
- l) Objects that are moving close to the speed of light do not obey Newton's laws of motion.
- m) The substance in this beaker is contaminated with DDT.
- n) Any substance contaminated with 5 mg. of DDT is lethal if ingested.
- o) The most toxic pesticide used in recent years in this part of the country is DDT.
- p) DDT is a white chlorinated hydrocarbon used as insecticide (abbreviation for dichlorodiphenyltrichloroethane).
- q) 'Water' is a colourless, transparent, tasteless, odourless compound of oxygen and hydrogen in liquid state convertible by heat into steam and by cold into ice; any liquid consisting chiefly of this in seas, streams, lakes, rain, tears, sweat, saliva, urine,
- r) Every mammal needs water to live.
- s) A mammal is a class of animal having a milk-secreting organ in the female for nourishment of the young and usually quadruped with hair of fur.
- t) A whale is a mammal.
- u) A 'whale' is a marine mammal of order Cetacea.

Assignment 5.2

- (i) Which of the items below express value judgments, and which express empirical (factual) judgments?
- (ii) Some statements are explicitly empirical statements, and implicitly suggest a value judgment. Which of the following items fall into this category?
- (iii) Which of the statements below can be characterized as both a value judgment and an empirical statement? Do these belong to category (ii) above? If not, why not?

(iv) Which of these statements, if true, are true strictly by definition of the component terms? Is the presupposed definition correct in each case?

(v) Which statements appeal to some sense of law? Which sense of law?

1. It is worse to destroy a human life than it is to do any other wrong action.
2. IMF policies imposed on the Ghanaian population amount to economic genocide.
3. Without IMF policies rescuing the Ghanaian population, the country would have deteriorated into Civil War like the rest of West Africa.
4. The reason Structural Adjustment policies have deleterious effects on the majority of people in West Africa is due to the corruption and ineptitude of West African statesmen and administrative officials in government.
5. Hitler was a short man.
6. Hitler was an evil man.
7. Abortion is illegal in this country.
8. Abortion is the worst criminal action any human being can commit
9. The practice of euthanasia is an example of how new technologies are corrupting the customs and values of this society.
10. All the talk about AIDS and making condoms available so readily everywhere you go is breaking down the fibre of society, making the youth fall into loose and uncouth behaviour.
11. Environmental degradation in the North is Nature's way of punishing people who have too many children and allow their population to increase without self restraint.
12. AIDS is God's way of punishing promiscuous people.
13. All citizens must be given access to free education.
14. All governments must preserve the economic rights of their own citizens, and not sacrifice their citizens social welfare to the capital interests of foreigners.
15. Every planet must circle the sun in an elliptical orbit.
16. All salts must dissolve in water or some other liquid.
17. Every metal must expand when heated.
18. It ought to rain later today.

19. You ought to save money to buy your books and class materials.
20. All humanity must respect human life.
21. All mammals must have oxygen to live.
22. There is no such thing as marital rape. 'Marital rape' is a contradiction in terms.
23. All citizens must pay taxes.
24. Every Hindu Brahmin must give alms.

Unit summary

In this unit you learned

- How to recognise distinct notions associated with the word 'law'
- How to distinguish an empirical law-like statement from a definition
- How to realise when a statement is true both because of the meaning of the component words as well as because of the way the world is found to be through experimentation or survey
- How to avoid being misled by equivocation on the word 'law'
- How to distinguish value judgments from factual judgments
- How to recognise when statements exhibit both a value judgment and a factual report.

UNIT 6: DEDUCTION VS INDUCTION

Introduction

For general purposes and widest application, it is best to think of human reasoning as a process with two aspects. One aspect concerns the form or pattern of our sequences of thought, independent of whatever it is our thoughts are about. Thoughts that are formed into sentences have a structure defined by a small set of fixed operations that comprise different types of sentences, which are organised in packages called arguments. The validity of an argument is determined by how the shapes of its constituent individual thoughts fit together. A valid argument, also called a demonstration, or a proof, indicates a conclusion of a certain form will be true if its supporting premises are true. The principles or rules governing the form of thoughts fitting together are called DEDUCTIVE.

The other equally important aspect of our declarative thoughts concerns how they reflect the world around us. We call this side of reasoning INDUCTIVE.

Each aspect requires different principles and techniques to evaluate whether the reasoning has been executed well or poorly. All actual reasoning that humans do (practical, aesthetic, spiritual, philosophical, moral, and scientific) except for very specialised situations is both inductive and deductive.

Reasoning is always about problem solving. Disciplines that construct knowledge—philosophy and many liberal arts and social studies and physical sciences—begin with a problem or question that prompts a quest for solution or a satisfying answer, using both deductive and inductive patterns of thinking.

From a cognitive, psychological point of view (concerned with how we actually think and survive) the two cannot be isolated from each other. Yet they can be distinguished, like all interdependent things must be distinguished, in order for their reciprocal dependence to be seen clearly.

In this Unit we will learn to tell the difference between deductive and inductive reasoning, even though they can rarely be separated altogether as meaningful categories in isolation from each other (think of the biological categories male and female, or the physics of night and day). We need to distinguish induction from deduction because we need to evaluate each type of reasoning using different principles of dependability and credibility.

This unit will cover the following topics:

- Section 1: How to contrast and how not to contrast deductive and inductive arguments
- Section 2: Some simple deductive argument patterns (four valid syllogisms)
- Section 3: Three syllogistic fallacies

Section 4: The notion of a valid argument as distinct from a true statement

Section 5: Some famous samples of deductive proof

Objectives

Upon completion of this unit you should be able to

- Appreciate what is wrong with a standard way of contrasting induction and deduction
- understand that deduction is topic neutral, while induction is dependent upon subject matter
- Identify four types of deductive syllogism
- Discriminate these four valid syllogisms from fallacies that parody them
- Enjoy two examples of applying deductive proof to justify a commonplace arithmetic truth and a familiar arithmetic rule

Section 1 How to Contrast and how not to Contrast Deductive and Inductive Arguments

Introduction

This course is in part a research course. This means you should learn to use the library as a source of information about the topics covered in the syllabus. Any library can be used to practice, because there will be at least one logic textbook in the library that you have access to.

You can equally well use the internet to do research for this course, because there are lots of websites devoted to information about introductory practical reasoning, and exercises for 'informal' logic courses online. Use a search engine and type in topics on the syllabus, and see what comes up.

It may be easier sometimes to go to the City Campus library or the Balme Library, (either the circulation section and the SRL (Student Reference Library) Reading Room on the second floor and use the logic section to browse the book indexes for the key terms in the syllabus, and see what you find. At the end of this module you will find a list of useful books all available in the Balme, upstairs on reserve and downstairs in circulation, the department library, and in the Hall libraries too.

But you must always be careful when you rely on research materials; sometimes what you find in elementary publications or on the internet is not altogether true. A critical thinker is always prepared to cross check and improve upon or update or deepen what is presented at an elementary level in publications, what is circulated in the public domain, and what most people take for granted.

Elementary level treatments and textbooks are by nature incomplete. You will find for instance that the Oxford Learner's Dictionary leaves out many words that you need for your studies in university. This module is also incomplete; for instance it leaves out almost all the important contributions of elementary formal symbolic logic.

Objectives

- define 'argument' in a technical sense
- recognise counterexamples to a standard way of contrasting induction and deduction
- distinguish reference class from attribute class of a statement
- distinguish particular from general statements based on the reference class of the statement
- understand that the quantity of things or the type of things referred to by the premises and the conclusion have nothing at all to do with whether or not the conclusion follows deductively from premises

What is an Argument?

In the technical sense we use for this course and module, an argument is a set of statements with premises and one conclusion. This was the sense of the term introduced in Unit 3.

Arguments in this sense need not involve altercation or heated conflict or differences of opinion. Deductive arguments are used to demonstrate that a given conclusion must be true provided linestarting points that led to it logically are all true. Such a deductive conclusion is sometimes called a theorem.

Arguments are also used to explain events or processes observed in nature.

Arguments are used to defend a value judgment. They are used to defend the application of a rule.

They are used to correct our deepest intuitions and convictions.

Rational argument can help us progress beyond our fallible sense of what must be true, which getwarped by the limitations of our experiences in the world.

In this Unit we will study the structure or anatomy of some deductive arguments. And then we will look at some famous ways that deductive arguments have been used to accomplish some of the things listed above.

Activity 1.1

Identifying the conclusion and the premises of an argument

Return to Unit 3 Activity 4.1. For each passage that you identified as an argument, discern which statement expresses the conclusion.

All the recommended logic textbooks at the introductory level are likely to contain some brief description of the difference between induction and deduction, and they will give you examples. You should do some research to see whether this is actually happening in the textbooks or online in elementary logic web pages: look at more than one of the textbooks available to you and compare treatments as your activity assigned along with this section.

Sometimes textbooks are misleading. Some textbooks and elementary presentations of deduction vs. induction claim that the difference between induction and deduction is dependent upon the premises and the conclusion being particular or general.

What is the difference between particular and general statements that appear in almost every argument?

To understand this mistaken way of drawing the contrast we need to first appreciate the difference between particular and general statements.

Identifying the reference class and the attribute class of a statement

This contrast between particular and general statements depends upon the reference class of the statement (also the grammatical subject of the statement, in many cases). This is to be distinguished from the attribute class of the statement.

For example, in the statement:

(i) *Joshua and Kofi are reading in the library,*

The reference class is ‘Joshua and Kofi’, while the attribute class (assigning them an action or property) is ‘reading in the library’.

The reference class in (1) is finite because you can count the number of individuals in this reference class—there are two people referred to by the sentence. So we say that the statement (1) is particular.

In the statement,

(2) *All freshmen are reading in the library when they are not in lecture.*

The reference class here is ‘all freshmen’ and that is a universal or infinite number of individuals, so (2) is called a general statement. In fact we call it a *universal generalisation* because it refers implicitly to each thing in the universe, and says that if this thing is a freshman, then it is reading in the library when it is not in lecture. The attribute class is ‘reading in the library when not in lecture’.

Activity 1.2

Recognising what makes a statement particular

In the following list of statements (1-8), identify the reference class and the attribute class. Then explain why each of these is a particular statement. Later when we study inductive arguments in Unit 7 we will return to this exercise and we will be referring to one kind of particular statements as evidence and as verifiable statements.

1. This student is reading Philosophy.
2. That man is the Dean of Arts.
3. The water in this person’s bucket is finished.
4. That table is green.
5. This stone is not a real diamond.
6. None of the students in this class have registered.
7. The fourth and seventh samples of the meat consignment were infected with the lethal bacteria.
8. All the voters interviewed said they would prefer a recount of the ballots

Activity 1.3

Recognising what makes a statement general

In the following list of statements (9-18), identify the reference class and the attribute class. Then explain why each of these reference classes is not finite but is rather infinite (the number of individuals has no definite limit). Thus each of these is a general statement. Later in Unit 7 when we study inductive arguments, we will be referring to one type of general statement as an hypothesis and as confirmable.

9. All metals expand when heated.
10. Planets move in elliptical orbits around the Sun.
11. Every heavy smoker has a carbon film on his lung tissue.

12. Green tables are costly these days.
13. Meat from England is infected with e-coli bacteria.
14. No student registers unless forced.
15. All 100 level students must take UGRC 150.
16. 80% of all retailed stones are not diamonds.
17. Few Ghanaians are allergic to pineapple.
18. 75% of those who contract the human equivalent of mad cow disease die from eating the infected beef.

A mistaken way of distinguishing induction from deduction1

Let us return now to one very common but misleading way to contrast deduction and induction. Some textbooks tell you that:

(A) An inductive argument moves from particular premises to a general conclusion;

Whereas:

(B) A deductive argument always moves from general premises to a particular conclusion.

This is sometimes true but not always, so it fails to provide a good definition of the difference between induction and deduction.

In fact some valid deductive arguments, just like inductive arguments, move from general premises to a general conch or from particular premises to a particular conclusion:

Example 1. All reptiles are cold blooded: and no cold blooded creature is a mammal; so no reptile is a mammal.

Example 2. Amy is older than Patience; and Patience is older than Ama. So Amy is older than Ama.

Both example 1 and 2 are deductive arguments, for reasons we have yet to discuss. Notice that the two premises in example (1) are general. And so too the conclusion is general. So we call this a counterexample of claim B, which says to be a deductive argument the conclusion should be particular while the premises are general. Similarly, in example (2) the premises and the conclusion are all particular. So this is another counterexample to the definition that is a standard given at the elementary level for deductive arguments. Many such counterexamples can be created. This means the definition is faulty.

You have yet to be given a good definition of what makes an argument deductive. We will come to that by providing you an ostensive definition (giving you examples) in the next section of this Unit.

The correction of this misleading characterisation of the contrast between induction and deduction is made in other textbooks for instance by Merrilee Salmon Introduction to Logic and Critical Thinking (1983) p. 55. Used with permission of the author and publisher for classroom distribution and for inclusion as chapter 21 in volume II of History and Philosophy of Science for African Undergraduates (2003) ed. H, Lauer Ibadan: Hope Publishers.

Meanwhile, we can find easily inductive arguments that move from general premises to a particular conclusion just as deductive arguments do

Example 3 95% of the students in Annex B have contracted headache, fever and painful joints in the last month. 80% patients presenting headache, fever and painful joints at the clinic were tested for malaria parasites and were diagnosed with malaria. So the doctor concluded that Yaa, who is residing in Annex B and has a headache and fever and painful joints, has malaria.

And some inductive arguments often move from general premises to a general conclusion:

Example 4.95% of the students interviewed preferred free access to a computer services instead of kitchen facilities. So we conclude that students coming to Legon will welcome the installation of computers instead of cooking pantries in the new residence blocks.

Activity 1.4

Analysing the quantity of reference class in premises and conclusion

Look at example 3, which is an inductive argument. We will discuss why it is an inductive argument in Unit 7. For now, identify the following features of the argument:

- a) What is the conclusion?
- b) What is the reference class of the conclusion?
- c) Is the conclusion particular or general?
- d) What is the reference class of the premises?
- e) Are the premises particular or general?
- f) Is this a counterexample to the definition of an inductive argument given in A above?
- g) Go through the same exercise following steps (a-f) for Example.

So what is the correct way to describe the difference between deductive reasoning and inductive reasoning? The answer is this:

In a valid deductive argument, the conditions that ensure the truth of the premises require that the conclusion will also be true. That is, it would be a contradiction to assert the premises and deny the conclusion in a valid deductive argument. In a valid deductive argument the truth of the premises proves or guarantees or requires or contains the truth of the conclusion.

Now these are all metaphoric terms (guaranteeing, requiring, containing) and we have yet to get a clear picture of what makes an argument deductively valid, in this course we will provide a definition by ostension, giving examples of valid arguments. This is merely introductory and will leave you dissatisfied. But it will suffice for the purpose of contrasting deductive arguments with inductive arguments, which is all we can accomplish in this overview course.

But in a good inductive argument, the premises provide a good reason to believe the conclusion will be true. The premises do not prove the conclusion to be true. The premises rather confirm the likelihood of the conclusion being true. That means there will be no logical contradiction between the premises being true and finding the conclusion to be false.

This contrast has to be spelled out in more depth by making clear what inductive confirmation amounts to, and what deductive validity involves. This will be the focus of the rest of this Unit and the next Unit 7.

What is the correct way to contrast deductive and inductive arguments?

To study deductive arguments we pay no attention to the subject matter or content of the statements, we just look at the logical connectives within and between the statements. When we study inductive arguments, we have to look at the content of the statements to examine the quantity and the sorts of things described in the premises and the conclusion. This is why we separate the study of deduction and induction, even though in real life and thinking they complement each other.

Although you may not have thought about forms of argument before, the term ‘form’ in the sense used here is not unfamiliar to you. You probably have been concerned with structures in many real-life situations. Most secondary-school students are required to take a civics course in which various forms of government are discussed.

For example, in Ghana and Nigeria, the governments are now constitutional republics. Both would be characterised today as democratic, whereas in Zimbabwe today the government functions as an ‘authoritarian’ democracy. The former apartheid South Africa was a totalitarian state; in 1990 its form changed to a constitutional democracy. In the United States, the democratic constitutional form of federal government is composed of executive, judicial, and legislative branches, whose respective powers are also outlined in a constitution.

The republic form of all these governments stresses their independence from any foreign power. But both Nigeria and Ghana, for example, follow in part the legislative and judicial structure of the British form of government which is a constitutional monarchy, in that both Nigeria and Ghana have a Parliament whose members are elected as well as a judicial branch whose members are appointed. However, the British monarchy features a crowned King or Queen, who—except in cases of abdication—holds his or her office for life. In contrast, the chieftaincy system in Ghana functions parallel to the state; the chiefs' military strengths are nominal, and ostensibly, disloyalty to the Asantehene (Asante King) is no longer legally punishable by military force. Yet it does not follow that chiefs in Ghana are not defended by force, nor that the form of governance called chieftaincy is outmoded and merely ornamental. Another contrast is that the head of government in Britain is the Prime Minister, but unlike the President of Ghana or

Nigeria or South Africa, the British Prime Minister is not the head of state. The powers and responsibilities of the various branches of the British government are defined in various acts of Parliament, traditions and customs. In Ghana, all the powers and functions of branches of government are outlined in the constitution while the allocation of a chief's powers is sustained by oral tradition, customary knowledge and the system of common law, which function parallel to the state judiciary and legislative systems, not unlike the way the traditional health care system functions parallel to the western hospital system. Ghana practises a unitary system of government in contrast with the federal system in the United States, whereby judicial and legislative powers and functions are balanced between two territorial levels, the central government and fifty-one subsidiary state governments. In Russia, the former Union of Soviet Socialist Republics comprised a very different form than the current Federation of Russia, and prior to that, the Czar of Russia was the head of a monarchy, which no longer exists even vestigially. In some ways, monarchies are recounised by political scientists generally as more stable than the other forms of government mentioned above.

When we study forms of government in this way, we learn something about these various forms of government in a rather abstract way, without taking particular notice of the individuals who fill the positions determined by the form of government at any given time. We learn about their parts and how these parts are (or should be) related to one another. Similarly, when we study forms of arguments, we will learn something about their parts and how they relate to one another. To discuss how the parts of a government should function is to analyse it normatively. In contrast, when we give a descriptive account of that government we focus on how it actually does function under the circumstances of a certain period of history, by a particular group of individuals.

The distinction between normative and descriptive analysis carries over to arguments: when we discuss the general forms of argument independently of their content, we engage in a normative discussion of the structure of scientific reasoning. If we reconstruct the steps in reasoning that led someone to a certain discovery, then we are engaged in a descriptive or a psychological account of human inference.

On the standard or 'received' view of scientific theorising, the context of justification is distinguished from the context of discovery. This distinction is highlighted again in Part 11 where it is stressed that the techniques used to justify causal hypotheses should not be misconstrued as a general prescription for the discovery of causes.

In a valid deductive argument, the conditions that ensure the truth of the premises have nothing to do at all with the quantity of things referred to in the premises and the conclusion. Deductive reasoning is not reliable because of the content or subject matter of the statements involved; it is rather the form of the statements or thoughts that they comprise which determines whether or not the premises, if true, can guarantee the conclusion will also be true. That is, it would be a contradiction to assert the premises and deny the conclusion in a valid deductive argument. But the necessity that true premises will result in a true conclusion is not a result of what or how many things the premises and the conclusion refer to.

Deductive validity is preserved in our thoughts because it is all that prevents us from contradicting ourselves. This is what is involved when we say that in a valid deductive argument the premises prove the conclusion.

But in a good inductive argument, the premises provide a good reason to believe the conclusion will be true. The premises do not prove the conclusion to be true. The premises rather confirm the likelihood of the conclusion being true. That means there will be no logical contradiction between the premises being true and finding the conclusion to be false.

This way of understanding the contrast between proving a conclusion deductively, and confirming a conclusion inductively, is troublesome because it begs the question: What is a contradiction, such that to avoid committing one we are compelled to embrace the conclusion of a valid argument?

The best way to explain this will be by example. We will study such examples for the rest of this Unit.

Example of a deductive argument

There is a big football match today and Kwame always watches the matches whenever he can. But this is the only day Kwame is able to study in the library. So Kwame will either be watching the match or he must be in the library. But he is definitely not in the library; his mates saw him leave there two hours ago. So you will find him watching the match.

In the passage above, we learn first that for any day when football matches are played, if Kwame can watch then he will. We then learn from the premises a disjunction: either Kwame is in the library, or he can watch the match. And he is not in the library. So the conclusion is, by disjunctive syllogism, that he is watching the match.

Example of an inductive argument

75% of the football matches played over the last year were attended by Kwame. Normally if he is not in the library when a match is played then he will watch the match. Today the library is closed, and there is a big chance. So Kwame is probably watching the match.

In this argument, we learn that based on his behaviour over the last year, there is a 3 out of 4 chance that if a big match is being played Kwame will be watching it. He tends to be there if he is not in the library. But we don't know this as an absolute regularity with no exception. So if the premises are true then it may not be true that Kwame is watching the match, but in the absence of further information these premises give us good reason to believe that the conclusion is true.

Activity 1.5

Contrasting deductive arguments with inductive arguments

Look at the passages in this list carefully, and see if you can discern by reading their contents which premises provide a guarantee that if they are true then the conclusion will necessarily be true—these are deductive; contrasted with passages where the premises might be true while the conclusion is discovered to be false and there would be no contradiction in such a discovery, since the premises give you good reason to believe the conclusion is likely to be true, but no guarantee that it must be true—these are inductive.

1. In a sample of 20 patients who ate meat infected with the lethal bacterium, and who contracted the human equivalent of mad cow disease, 15 of the patients died of eating the infected meat. The study shows that 75% of people contracting the human equivalent of mad cow disease will die from eating infected meat.
2. Eighty of the one hundred rats fed on burnt meat developed brain tumours. So charcoal-burnt meat is carcinogenic in rats.
3. Every time I date a Commonwealth Hall boy I wind up spending a lot of time waiting for him to keep his appointment and then getting disappointed. So I am not going to date this Commonwealth Hall boy who has asked me out. Because he will just stand me up and I will get hurt.
4. All *clacks* are *quacks*, and all *quacks* have *smirkishsublaveensin* in their anterior *postuly*. So all *clacks* have *smirkishsublaveensin* in their anterior *postuly*.
5. When the accident occurred there were no witnesses. Without witnesses you cannot claim insurance. Without insurance you have to pay for the repairs yourself. So I will have to pay for therepairs myself.

6. If I want a mobile phone, then I have to use my school loan when it comes. But if I use the school loan up on the phone, I will not be able to return my mother's money for the tuition next year. I cannot afford to pay tuition next year unless my mother helps with the tuition. But I have to pay tuition next year. So I cannot buy a phone.

7. The politicians want votes. You can see they are corrupt. So don't trust any politician.

8. In my first and second years I only dated Commonwealth Hall boys. Every time I spent a lot of time waiting for the guy to keep his appointment and then I would be disappointed. So I am not going to date this Commonwealth Hall boy who has asked me out. Because he will just stand me up and I will get hurt.

Summary of Section

We have covered a good deal of vocabulary that we will need for the next Unit on inductive arguments as well as putting us in the right frame of mind to study deductive argument patterns in the rest of this Unit. We learned:

- A common way of contrasting deduction and induction is false; because it requires judging the size of the reference class of the premises and the conclusion of the argument, making this a central feature of being inductive rather than deductive.
- A statement is particular if its reference class is finite; a statement is general if its reference class is infinite.
- The difference between deduction and induction has nothing to do with the subject matter described by the statements' reference and attribute classes at all.
- We will see what deduction involves later in this Unit by example, and we will see what induction involves in the next Unit.
- Deductive arguments, when valid, guarantee their conclusions being true if their premises are true.
- If you do not accept the conclusion of a valid pattern of reasoning deductively then you will be contradicting yourself.
- Inductive arguments, when good evidence is provided, give a reliable reason to believe the conclusion is likely to be true; but this is no guarantee of the conclusion's being true. So you could embrace the premises as true and the conclusion false, and this would not result in your contradicting yourself. It would result in people wondering what you might know that is keeping you from depending upon the evidence cited in the premises which seems to suggest that the conclusion stated is likely to be true.

Section 2: Some Simple Deductive Argument Patterns (four Valid Syllogisms)

Introduction

In a valid deductive argument, the conditions or interpretation that determine the premises will be true, ensure that the conclusion will be true as well. This is what it means to say that in a valid deductive argument the truth of the premises prove the truth of the conclusion.

Objectives

- to recognise the hidden conditional pattern 'if _____ then _____' in universal affirmations and universal negations
- to recognise 4 different syllogistic patterns
- to interpret passages that contain these 4 syllogistic patterns

A note on universal affirmations (generalizations) and Universal negotiations Consider the universal generalization.

All As are Bs, example: all cats are mammals.

This should be understood as a conditional: If (x is A) then (x is B) In this example, if x is a cat then x is a mammal.

In this sentence, (x is A) is called the antecedent and (x is B) is called the consequent.

In section 1 unit 5, it was suggested that we think of this as a prediction, a conditional statement of this form: If x is A then x is B. We learned that 'x is A' counts as the antecedent placeholder of any 'if (_____) then (_____)' or conditional form of sentence, and 'x is B' is called the consequent.

So to continue our example:

All cats are mammals. My pet is a cat; so my pet is a mammal.

Take a moment here to consider also the universal negation pattern:

No As are Bs (that is, every A is not B) This means 'if (x is an A) then (x is not a B)'

In our example it would read No cats are mammals that is, if x is a cat then x is not a mammal.

Now you are ready to study four types of syllogism: A syllogism is a simple pattern of relations that always hold between two or three classes - we can call them A, B, C, or P,Q, R:it doesn't matter. These letters simply represent the reference classes and the attribute classes described by two premises and one conclusion. There might be two or three such classes.

Consider this syllogism:

Premise 1: all As are Bs.

Premise 2: This individual is an A

Conclusion: Therefore this individual is a B.

Suppose now we interpret A as the class of all birds.

And B is the class of all flying creature.

Then the interpretation that makes the premises true will ensure the conclusion is also true. So for example:

All birds are flying creatures, and this individual is a bird therefore this individual must be a flying creature.

This is one of the four syllogism patterns we will study in this course. It is called MODUS PONENS (also called Affirming the antecedent)

Modus ponens (Affirming the antecedent) always has this form:

Example:

All As are Bs, and this individual is an A, so this individual is a B.

All my friends are Ga. This lady is my friend, so this lady is a Ga.

A second type of syllogism pattern is called MODUS TOLLENS (also called denying the consequent)

Modus tollens (denying the consequent) always has this form:

Example:

All As are Bs and this individual is not a B, so this individual is not an A.

All my friends are Ga. This lady is not a Ga, so this lady is not my friend.

A third category of syllogistic pattern is called HYPOTHETICAL SYLLOGISM (this is because every line is a hypothesis—if ___ then)

Hypothetical syllogism always has this form:

Example:

All As are Bs., and All Bs are Cs. So all As are Cs.

All these freshmen are tall. All tall people are good at racing. So all these freshmen are good at racing.

The final category of syllogism we will study in this course (there are 25 or so) is called DISJUNCTIVE SYLLOGISM (this is because one premise is a disjunction—either ___ or ___)

Disjunctive syllogism always has this form:

Example:

Either A is true or B is true, but A is false. So B is true.

Either I will live in Volta or at home; but I cannot get a room in Volta; so I will live at home.

Teaser

Looking at examples of syllogistic arguments with universal negations

Here are examples of the four syllogistic patterns taking the negative universal. See if you can turn each universal negation into an if _____ then _____ statement to observe the syllogistic form. See if you can complete the syllogism yourself.

Modus ponens

None of the students in this class needs to fear deductive logic.

Kofi is a student in this class. So . . .

Modus tollens

No Legon Hall gentleman has ever felt comfortable looking like a fool. That student dancing around naked doesn't feel uncomfortable looking like a fool. So . . .

Hypothetical syllogism

All of the goats in that truck are for sale now

Nothing which is for sale now is headed for Tema. So . . .

Disjunctive syllogism

Either none of my friends from my home town are in my courses or none of them have started attending lectures. But I know one of my friends has been attending lectures since the beginning of the semester very regularly. So . . .

Answers:

Modus ponens conclusion—Kofi doesn't need to fear deductive logic.

Modus tollens conclusion—That student can't be a Legon Hallgentleman.

Hypothetical syllogism conclusion.—None of the goats in that truck are headed for Tema.

Disjunctive syllogism conclusion—None of my friends from my home town are in my courses.

Activity 2.1

Symbolizing arguments to reveal valid patterns of thought

Identify the type of syllogism that each passage contains by following these 3 steps:

1. Substitute letters for the reference and attribute class in the conclusion: then find the reference classes and attribute classes of the premises, using the same names for crucial classes as and when possible;
2. Rewrite or symbolise the argument as a pattern of symbolised class relations;
3. Identify which syllogistic pattern you are looking *at*

Example:

1. Every herbivore is easy to breed. All goats are herbivores. Therefore all goats are easy to breed.

Working:

Step 1: The reference class of the conclusion is Goats = G. The attribute class is 'easy to breed': = B. In the first premise G is the reference class and the attribute class is Herbivores = H. That is all the relevant classes in the argument.

Step 2: All Hs are Bs. All Gs are Hs. Therefore all Gs are Bs.

Step 3: This is a hypothetical syllogism. The two premises can be in any order; the pattern of thinking is the same.

Now try the rest. Answers are at the end of the book.

2. This creature is a herbivore. All herbivores are easy to breed. So this creature is easy to breed.

3. All goats are herbivores. The creature in the shed eats meat. So the creature in the shed cannot be a goat.

4. No goats require vaccinations. Creatures that require no vaccinations are not expensive to breed. So goats are not expensive to breed.

Activity 2.2

Recognising deviations from the deductive ideal

For each of the following passages in italics, determine which of these four syllogism patterns (also called rules of inference) is characterised by the passage.

If the passage does not represent any of the patterns you have been introduced to, then it may be a fallacy. We will discuss kinds of fallacy in the next section.

The argument may be valid and represent a syllogistic pattern, but the conclusion is false. This means that the argument is not sound. Section 4 we will deal with the difference between arguments being valid and conclusions and premises being true.

1. All the wild mushroom varieties in this forest are poisonous. If a vegetable is poisonous then it could kill a small child. So all the wild mushroom varieties in this forest could kill small children.

2. Anyone who is registered for this course should use the Course Companion Reader and also do research from textbooks. Kofi is registered for this course, so Kofi should use the Course Reader and also do research from textbooks.

3. If you try hard then you can get an A in that course. Joseph tried hard, so he must have gotten an A.

4. All graduates who want to become lawyers are very smart. And all those who are very smart are dishonest. So any graduate who wants to become a lawyer must be dishonest.

5. All graduates are virtuous; all pastors are virtuous; so any pastor must be a graduate.

Activity 2.3

Recognising syllogistic arguments

Each of these passages requires a premise to be a valid syllogism. Since it is missing a premise we call it an enthymeme (ENTH-ehmeem).

Choose which of the following would provide the premise to make the passage into a valid syllogism, following these steps (a, b, c).

a. Try each of the options A, B, C as a premise and decide which sentence if any helps to complete the passage in italics as a valid syllogism.

b. Use your own choice of letters to capture the reference and attribute classes in the italicized passage and your chosen premise, and determine from the resulting pattern which type of syllogism your choice has helped complete.

c. if none of the options will create a valid syllogism, then mark the passage as invalid. Can you find premises of your own that will create a valid argument linking the given premises with the conclusion?

i. *All cats are mammals. So all cats need oxygen,*

A. Oxygen is given off by trees in the process of photosynthesis.

B. All cats have fur.

C. All mammals need oxygen.

ii. *All the people sitting in this room are taking the Mature Students Examination. So Kofi cannot be sitting in this room.*

A. Kofi is not taking the Mature Student exam.

B. All the Mature Students candidates are required to take an examination.

C. Kofi is a Mature Student candidate taking the exam.

iii. All mammals have at least two legs (unless they are deformed or amputees). Therefore all mammals have fur or feathers or hair.

A. Two legged creatures are able to run but not as fast as four legged creatures.

B. Some mammals have fur.

C. All creatures with at least two legs have fur or feathers or hair.

iv. The occupation of the Gaza Strip will not end unless the military withdraws. So the terrorism will continue in Gaza.

A. The terrorism will continue in Gaza until the occupation is over.

B. The military is going to pull out.

C. The purpose of withdrawal of settlers in the Gaza Strip is to promote peace.

Summary of Section

- Universal affirmations (All As are Bs) are disguised conditionals.
- Universal negations (No As are Bs) are also disguised conditionals.
- A conditional has two components, the antecedent and the consequent.
- The syllogisms we discussed here are very common rules of inference: modus tollens, modus ponens, disjunctive syllogism, hypothetical syllogism.
- A valid argument may not have true premises, the conclusion then may be true or false.
- An argument with a missing or suppressed premise is called an enthymeme.

Section 3 Three Syllogistic Fallacies

Introduction

Careful attention to details is required otherwise we will be confused by passages that look like syllogisms but aren't really. These similar but faulty patterns are called fallacies.

Objectives

Recognise the difference between valid syllogisms and fallacies that are parodying the real thing.

Syllogistic Fallacies

—they look like the real thing but aren't really.

False hypothetical syllogism

All As are Cs. All Bs are Cs. So; All As are Bs.

This conclusion does not follow from these premises because the class C can include very many other individuals besides members of A and B. In any case, being a member of C, according to the premises, does not entail you are a member of BOTH A and of B.

Example 1: All the women in this room are enrolled in UGRC150. All the men in this room are enrolled in UGRC150. So All the women in this room are men.

Examples 2: Every lawyer needs to be intelligent. Every doctor needs to be intelligent. So every lawyer needs to be a doctor.

Fallacy of affirming the consequent

All As are Bs. This x is a B. Therefore this x is an A.

Again the conclusion cannot follow the premises because not everything which is B must be an A. Bs include other individuals besides As.

Examples: 1 All the women in this room are enrolled in UGRC150. That student is enrolled in UGRC 150. So that student must be a woman in this room.

Example 2: Every cat is a mammal. My lecturer is a mammal. So my lecturer is a cat.

Fallacy of negating the antecedent.

All As are Bs. This x is not an A. So this x cannot be a B.

Again because the class of B can contain many more kinds of individuals other than As, the fact that something is not an A doesn't mean it cannot be a B.

Examples 1: All the women in this room are enrolled in UGRC150. That student is not a woman. So that student cannot be enrolled in UGRC 150.

Example 2: Every cat is a mammal. My lecturer is not a cat. So my lecturer is not a mammal.

Activity 3.1—Thinking drill

Demonstrate fallacies of syllogistic form

Choose your own classes A, B, C. Write three passages in English using your classes as the reference or attribute classes so that you have three demonstrations of the three types of fallacies labelled in this section.

Example: A = Vandals, B = Vikings C = Legon students

Writing an illustration of false hypothetical syllogism:

All Vandals are Legon students, and all Vikings are Legon students; so all Vandals are Vikings.

Activity 3.2

Identify fallacies of syllogistic form

For each of the following, symbolise the passage as a syllogistic fallacy and identify it by name.

1. The Vandals' student leaders are always making trouble. This student leader is not a Vandal. So surely he will not make any trouble.
2. Anytime he goes to town he passes by my mother's house first. Today he passed by my mother's house. So definitely he is going to town.
3. On last year's examination we did not see this question. If a question appears on the examination this year, then it follows that it did not appear on the examination last year. So this particular question will by all means come on the examination this year.
4. I am looking for a job. Anytime I have no luck with my job hunting, then I visit my girlfriend. This morning I have to visit my girlfriend. So I can expect that later today I will have no luck when I job hunt.
5. All his friends are from Nigeria. All the Muslims in this room are from Nigeria. So all the Muslims in this room must be his friends.
6. All the forensic medical experts I know make over 5,000 Ghana cedis a month. All the lawyers I know make over 5,000 Ghana cedis a month. So all the forensic medical experts I know are lawyers.

Summary of section

Syllogism fallacies bear close resemblances to the syllogistic patterns which are valid. Often a fallacy is committed when the antecedent of a conditional is confused with the consequent, and then a parody of the inference drawn from conditional forms can occur.

So, when you negate the antecedent of a conditional rather than the consequent, then you commit a fallacy. And if you assert the consequent of a conditional instead of the antecedent, then again a fallacy is committed. If your conclusion reflects the antecedents or only the consequents of two hypothetical conditionals, then again you have committed a fallacy. This is because when you change the pattern of the thinking, the premise being true will no longer guarantee that the conclusion will be true.

Take a simple example: You can see it is valid to say that

All Vandals are men and my classmate is a Vandal, so my classmate is a man. If it is true that all Vandals are men (it is true now, it might not always be) then this conclusion must also be true. So affirming the antecedent is a valid pattern of thinking. But if you affirm (assert) the consequent and say that my classmate is a man, then it would not follow that my classmate is a Vandal. Lots of men are not Vandals, even if all Vandals are men. So affirming the consequent commits a logical fallacy.

Section 4: The Notion of a Valid Argument as Distinct from a True Statement

Introduction

One of the important distinctions we need to make is the difference between truth and validity. A valid argument may not result in a true conclusion. Example:

(1) All elephants can fly; my lecturer is an elephant. So my lecture can fly.

The problem in (1) above is that the premises were false, so the conclusion need not be true just because it follows the premises using a valid rule of inference. In the case above we have a modus ponens syllogism which is valid, but it is unsound. It is not sound because it does not have true premises.

In another peculiar situation, a conclusion might accidentally be true even though it generates from false premises. So the validity of the argument again is not sufficient to provide a good logical reason to believe the conclusion, even if it is true. Example:

(2) All corrupt politicians are over fifteen years old. Any creature over fifteen years old is dishonest to some degree. So all corrupt politicians are dishonest to some degree.

In (2) above, the conclusion may be convincing, that is, the conclusion might well be true. But clearly the premises cannot possibly give a good reason for believing the conclusion is true; the conclusion is believable despite the ludicrous premises, not as a logical consequence of those premises, even though it is a logical consequence of those premises—a valid one at that. This is a hypothetical syllogism. But it is unsound. Again, the premises are false so the argument is not sound, even though the conclusion may happen to be true.

Activity 4,1 — Thinking drill

Create your own syllogisms to reflect valid but unsound arguments.

Choose any interpretation for the classes A, B, C. Then fit these reference classes and attributes of your own choosing into each of the valid syllogistic patterns.

Example: Let A = x is an Australian rhinoceros

E = x is a member of an endangered species

U = x is a member of a union

All Australian rhinoceri are unionised. All unions are endangered species. So all Australian rhinoceri are endangered species.

Here the conclusion may well be true, but the premises give no reason to believe that it is, since the second premise is absurd, unless the sentence is understood as a metaphor, indicating that nowadays it is difficult to organise labour under neo-liberal economics policies (which is true). But in this sense the second premise has nothing to do with either the first premise or the conclusion, and would render the passage a fallacy of equivocation, best interpreted as a joke.

Write a passage in completely grammatical English that houses these syllogistic patterns using your chosen classes. Does your interpretation result in a valid argument but does not result in a true conclusion? Or is the conclusion true but the premises turn out to be false under your interpretation, so that the premises do not supply a sound reason to support the conclusion?

SECTION 5: FOUR FAMOUS EXAMPLES OF DEDUCTIVE PROOF IN ACTION

Introduction

Strict deduction can be used for many purposes. One is to provide the proof for truths we take to be self-evident. For instance we all ‘know’ that $2+1 = 3$. We learned to accept this in primary school. We believe it because we were well motivated to accept what we are told at that formative age; to reject anything so basic in that context so early in life would have had severely negative consequences for our future and our acceptance in society.

But the question arises inside the critical thinker, I know why I have always believed this statement of arithmetic—it would be crazy not to believe it. But what justifies this statement? Why is it crazy not to believe it?

The answer is: a deductive proof exists to show that $2+1 = 3$ must be true. This formula follows necessarily from the definition of the counting numbers that place 1, 2, 3 and many more within our grasp as a tool for organizing experiences around us and well beyond our experience, for that matter. So if you accept that definition, you are stuck with the belief that $2+1=3$.

If you want to reject the counting number definition we all use, then go ahead and give us a different theory of how to count. And in your alternative system, if it does as good a job as the one we already have, then indeed $2+1$ does not have to equal 3. But if we accept the standard meaning of 1, 2, 3 then this arithmetic sentence must be true. We provide the proof as Number 1 in this section. It's easy.

Another use of deduction is to justify rules. You know you cannot divide by zero. You know the motivation for obedience to this rule: early in life the consequences of not dividing by zero might be the shame of a poor mark on a test, maybe even a beating in school, discouraged parents or guardians, ridicule of class mates

But WHY should we never divide by zero? What is the justification for this strict rule in arithmetic?

The answer is also a deductive proof: we provide it in section 2. It's also easy. The style of this proof varies from the one to show why $2+1=3$. This style of proof is called reduction ad absurdum or reducing to absurdity or indirect proof. It carries the message: 'Believe P because if you don't your beliefs will degenerate into complete absurdity.' The indirect method of proof is relied upon to prove a statement P is true by showing that if you try to prove the statement P is false, then step by step by relying on rules of inference you will wind up deriving such ridiculous further beliefs that you are forced to concede that P was never a good idea to reject in the first place. By being forced to admit P cannot be false, you are compelled to accept that P must be true.

Actually, this style of proof has come in for some serious, if radical and eccentric, controversy. If it makes you uncomfortable or wary, you are on good philosophical grounds for refusing to accept it. But most of mathematics depends upon this style of proof, so it is useful to realise how it works and get the feel for why it is supposed to be convincing. We cannot delve into the deep logical reasons why some 'intuitionistic' and 'constructivist' philosophers of mathematics argue that most of classical mathematics is based on very shaky logical ground since it depends upon indirect proofs such as this one. We give this lovely proof as our No. 2 in this section.

Deduction really is a very powerful tool, so effective it can vanquish dogma, no matter how entrenched. But you must be careful. You can deduce your way right into jail or the gallows. Galileo Galilei almost did. Through deduction he was able to show that standing doctrine of 1500 years acceptance in Europe were actually rubbish. He got sent to jail for exposing the contradiction within Aristotle's ancient explanation of the motion of all bodies near the earth in free fall. He was charged with treason and heresy; because he was right, and it disturbed the political powers that prevailed. His indirect proof of gravitation is legend; we look at it briefly as number 3.

In this final section of Unit 6 we will consider yet another use of deductive proof: to explore the unknown terrains of reality beyond our senses. We hold very deep, spiritual convictions about how the world must be, and yet we may be wrong. Deductive reasoning can lead us to realise our firmest convictions are totally wrong, and our reasoning mind can help us correct our deepest intuitions. Through deduction our mind can grow and learn about reality where no experience can take us.

Objectives

We look here at some classic examples of deductive reasoning in living action, which made tremendous impacts in the history of pure science. These are tasty preserved treats of reasoning that are part of your intellectual heritage to savour and enjoy for their beauty and gratifying elegance, and because they are fun.

- A direct proof of why necessarily $2+1=3$.
- An indirect proof of why you should never divide by zero.
- Galileo's famous proof that refuted Aristotle's theory of free fall by reducing it to absurdity.
- Pythagorean's indirect proof of the existence of irrational numbers.

No. 1

Here is a 'direct' proof that $2+1 = 3$. We begin by laying down some definitions as our starting assumptions about what the symbols 1, 2, 3 mean. This means we accept 4 of the 5 Axioms of Arithmetic (spelled out by Giuseppe Peano, published 1889):

Axioms of counting (natural) numbers.

1. 1 is a natural number.

2. For every natural number n , $S(n)$ is a natural number. 'S(n)' reads as the 'successor of n'. $S(n)=n+1$.

3. For every natural number n , there is no number that precedes 1. 1 is the first natural number.

That is, for every number n , $S(n) \neq 1$, (1 is not the successor of any other number. It's the first natural number)

4. For any two natural numbers m, n if $S(m)=S(n)$ then $m=n$. That is to say, every natural number is the successor of one and only one number. Or: every counting number n has one and only one successor.

If one accepts these four features of the definition of natural number then one must accept as well that $2+1=3$. Like this:

Proof that $2+1=3$

1. 1 is in the set N of natural numbers (by Axiom 1)
2. So $1 + 1 = S(1)$ is in the set of natural numbers, (by Axiom 2)
3. A handy notation for $S(1)$ is 2.
4. So 2 is in the set of natural numbers. (from 2, 3 above)
5. But then $S(2)$ is in the set of natural numbers, (by Axiom 2)
6. That is, $2+1 = S(2)$ is in the set of natural numbers.
7. A handy notation for $S(2)$ is 3.
- 8 So $2+1 = 3$ which must be in the set of natural numbers.

Deductive proofs are used to demonstrate why obvious truths are true, as we just did.

Deductive proof is also used to justify rules and regulations.

The next proof you will read is convincing provided you accept the definition of counting numbers proposed above in Peano's axioms. In that scheme, if $1+1=2$, then $1+1$ is not equal to 1. In other words, 2 is not equal to 1. This follows from Axiom 4. In other words, if you accept a starting assumption which leads you to conclude that $2=1$, then that is absurd; and so you have demonstrated that there must be something wrong with the starting assumption that led you, step by step, to deductively draw such an absurd conclusion. Indeed you will have shown (by indirect proof) that the starting assumption was false.

No. 2

An indirect proof of why you should never divide by zero.

1. Suppose you *can* divide by zero. (Assume this for reductio ad absurdum)
- 2 Let $a = b$ assume a, b are two whole quantities whereby
3. $a^2 = ab$ by multiplying both sides of equation in (2) by whole quantity a .
- 4 $a^2 - b^2 = ab - b^2$ by subtracting both sides of (3) by positive whole b^2

5. $(a-b)(a+b) = b(a-b)$ by factoring both sides of (4).
6. $(a+b) = b$ by dividing through by $(a-b)$. * Note from 1, $a-b = 0$
7. $2b = b$ by substituting equals for equals, from line 2
8. $2 = 1$ by dividing through by whole number b .

But this is absurd! 2 cannot equal 1!

9. So line 1 must be false. You CANNOT divide by zero.

Detail of 5-6:

If $a-b=0$ Then $(a-b)(a+b) = b(a-b)$

$(0)(a+b) = b(0)$

$0 = 0$

But since we have agreed to allow $(a-b)$ to figure into our algebraic operations. Then if we divide through by $(a-b)$ we get

Then $(a-b)(a+b) = b(a-b)$

$(a-b)(a+b) = b(a-b)$

$(a-b)(a-b)$

So $1(a+b) = 1(b)$

$b+b = b$

No. 3

Galileo's refutation of Aristotle's Theory of gravitation using inductive and deductive methods

The premier example of a scientist utilising both of the approaches described above to support his theories was Galileo (1564-1642) of Galilei in Italy. Galileo is celebrated as the first and perhaps the most famous of modern scientists who withstood ridicule, accusation and life-threatening condemnation for contradicting received official dogma. His living practice inspired both Descartes' and Bacon's written theories about the methods of the New Science.

Among Galileo's most revolutionary precedents (and worst offences in the eyes of the Inquisition) was to present in a court of law evidence derived from a strange, new gadget—designed apparently through sleight of hand to dupe the most dignified authorities—which he called a telescope.

He had used the telescope and discovered moons revolving around the planet Jupiter, contrary to the received doctrine concerning the pristine nature of celestial spheres, each of which was supposed to move in perfectly uniform symmetry over the stationary earth with no peculiar irregularities. Today, astronomy could not proceed without telescopes, but at the time Galileo introduced the first copy of its contemporary prototype into public discourse, the contraption was ruled as an outrageous insult and its architect was deemed a dangerous trickster guilty of heresy in Europe.

Galileo employed the two complementary styles of reasoning (advocated by Descartes and by Bacon) to refute key principles of Aristotle's doctrines. This was the point that so outraged the authorities: Aristotle's doctrines were established by fiat for centuries as truth, the only truth. In the particular case dramatized here, Galileo was attacking Aristotle's theory of gravitation. Aristotle had lived 1,500 years before Galileo his doctrines were accepted by the Vatican. No one ever questioned them.

Very briefly, Aristotle said: each and every existing thing has a distinct essence, comprised of a characteristic combination of the four basic elements of substance: earth, air, fire, and water. Each entity tends towards its natural place strictly in accord with its essence. Things with a predominantly earthy essence such as rocks or lead cannonballs fall toward their natural place of rest faster than objects whose essences are less earthy. Things with very little earth element and a predominance of air (e.g. bird feathers, flower petals, lamb's fleece, clouds) are things that float easily in the air which is their natural resting place; they likewise fall to earth with great reluctance because moving toward the earth is contrary to their essence.

Galileo argued deductively against the Aristotelian account of gravitation by demonstrating that Aristotle's theory yields a contradiction. Consider a thought experiment involving a 10-kg cannonball called A, and a 2 kg cannonball called B.

According to Aristotle's view, A will fall to earth faster than B because its essence contains more earth element. Now suppose A and B are tied together; call the resulting system C. By virtue of B's airier, lighter essence, it resists falling. So B retards A's fall when they are tied together in system C. Hence A falls faster than C. S. Drake (1976) p. 264.

But the cumulative density of C is 10 kg plus 2 kg. So C which is 12 kg will fall faster to earth than A which is only 10 kg.

Therefore if you embrace Aristotle's principles of motion and trace their logical consequences, you are obliged to deduce that A falls faster than C and also that C falls faster than A. But this is a contradiction. To say that C falls both faster and slower than A is an absurd conclusion; it cannot be true. Yet it follows by valid rules of deductive inference from Aristotle's assumptions about the motion of bodies. So there must be something false in Aristotle's assumptions about the motion of bodies.

This is Galileo's *reductio ad absurdum* of Aristotle's theory of motion. It is a *deductive* form of argument: the truth of the premises guarantees that the conclusion is true (the conclusion here being that Aristotle's theory contains some false precept).

Galileo started by accepting Aristotle's starting principles and then moved step by step to consider the logical consequences of these principles until he discovered a contradiction. He thus demonstrated by pure inference that embracing Aristotle's assumptions about gravitation must be mistaken since jointly they lead one to conclude a blatant absurdity. No further considerations can detract from this validly deduced conclusion that something must be wrong with Aristotle's assumptions since they have led to a contradiction. Either the set of principles thus reduced to absurdity needs to be revised, or it needs to be rejected altogether if a better theory can be offered which is free of inconsistency.

No. 4

Deductive proof that **there** must exist irrational numbers (**Indirect proof**—*reductio ad absurdum*)

2,500 years ago the Pythagoreans subjected their own metaphysical theory and spiritual doctrine of numbers to deductive scrutiny, and thus discovered a mistake in their understanding of the cosmos, whose essence they took to be rational numbers.

We next give the oldest and most famous example of indirect proof in mathematics, the Pythagorean indirect proof of the existence of irrational numbers.

Historical note: The historical evidence of the use of *reductio ad absurdum* as a method of deductive proof goes back well over two thousand years, to the earliest records of Hellenic mathematics in the 6th century BC. Pythagoras, as well as other famous pre-socratic philosophers constituting the pinnacle of ancient Western abstract thought, had journeyed to Africa (Egypt) as students and studied with Africans (Egyptian priests) in order to develop their highly coveted and widely celebrated results in abstract mathematics—notably geometry. Thus the roots of Western mathematical abstraction and logical reasoning are chronologically traced to ancient African culture. This is neither controversial nor contested fact, and well documented.

To appreciate the significance and power of deductive reasoning, you need some background and context in which this discovery that not all numbers can be rational was made.

Historical and conceptual context of the Pythagorean proof of the existence of irrational numbers. What remains important about the ancient Greek practice of pure speculative reasoning in mathematics and cosmology is not the content of their speculations but rather the methods by which they went about achieving and justifying their insights.

To say a scientist's method is 'pure' means its results are axiomatisable; it does not in general mean that the individual scientist harbours virtuous intentions or that he pursues his work in any particularly laudable manner—although science for the ancient Greeks was indeed an extension of fervent religious devotion, chastity, righteous living, and a pious dedication to universal harmony.

The ancient Greeks who engaged in cosmological speculation were doing what we now call metaphysics and meditation—pure contemplative reflection of the logical consequences of basic starting principles accepted as self-evident. Rival theories of cosmology, for instance, were judged by their relative coherence, simplicity, proportional beauty and elegance. Hypotheses were inspired not from the results of empirical experimentation, as in Bacon's later notion of science, but rather from contemplative meditation upon the pure basic geometrical forms—now referred to as the Platonic solids: the perfect sphere, cube, tetrahedron, hexagon, octagon, dodecahedron and so on. These foci of contemplation wholly absorbed the mind in the perfect symmetry and ideal balance presumed to reflect the ultimate orderliness and harmony of the Divine 'kosmos' (meaning 'creation' in Greek). From the ancient Greek's and modern scientist's point of view, creation is so mysterious and awesome that nothing is impossible in principle, not even the possibility that one's strongest convictions may be proven false.

A leading teacher of this methodology was Pythagoras (572-490 BC). He was the head of an esoteric order, a religious brotherhood that lasted for centuries until it was banned in 415 AD. The Pythagoreans were priests who regarded the cosmos as governed by a divine mathematical lawfulness. Man's reason reflected in numbers—or ratio—was presumed to be a microcosmic mirror of the divine order. To worship the divine it was necessary to cleanse the mind of preoccupations with worldly distractions. By refining and stilling oneself through ascetic rules for diet and daily discipline, together with meditating on pure forms and the essence of rational numbers, one brings the mind to a state of serenity and receptivity to the divine order, which is in essence mathematical. The foundations of reality for the Pythagoreans were rational, proportions, and rational numbers expressed these proportions. Thus rational numbers were regarded as the basis of all things.

Justice, reason, opportunity are all modifications of rational number. Contemplation of rational numbers, i.e. the study of mathematics, was the ancient Greek technique for knowing God.

To appreciate the cognitive significance of deductive methods in mathematics even in its very earliest use and interpretation, it is important to realise the depth of this conviction with which the Pythagoreans believed that 'number' *means* what we now still define as the 'rational numbers'. Their conviction about the structure underlying the observable world was on a par with contemporary convictions about the existence of gravitation and a monotheistic God. It was just such a deep intuition that the Pythagoreans recanted by the light shed through followingsystematic deduction. They used indirect proof.

They so trusted in the method of deductive reason that when they recognised a contradiction follows from assuming that all numbers are rational, they renounced and corrected their deepest conviction about the very foundation of the cosmos, and countenanced the existence of numbers that are not rational. This is strong faith indeed. It distinguishes faith in reason disciplined by scientific method from fundamentalist faith in a dogmatic creed.

In conclusion, here is the Pythagoreans' proof of the existence of irrational numbers (6th century BC). It has the form of a *reductio ad absurdum* proof. To prove that $\sqrt{2}$ is irrational (using *reductio ad absurdum*)

Line

0. Definition:

A rational number is a ratio m/n where m, n are integers $\{1, 2, 3, \dots, 9\}$ which are reduced to lowest terms. This means that m, n have no common factor other than 1. This definition is central to the main crux of the proof.

1. Assume that $\sqrt{2}$ is rational. So assume the definition at line (0) holds of $a/\sqrt{2}$.

2. $\sqrt{2} = m/n$ by definition of 'rational'.

3. $2 = m^2/n^2$ by squaring; both sides of the equation.

4. $2n^2 = m^2$ by multiplying through by n^2 in equation on line (3).

So m is even, since its square ($m \times m$) in equation on line (4) is divisible by 2. So:

6. $m = 2p$ where p is some integer less than m . So:

7. $m^2 = 4p^2$ by squaring both sides of the equation

8. $2n^2 = 4p^2$ by substituting into step 7 from line (4);

9. $n^2 = 2p^2$ by dividing through the equation by 2 on line (8).

10. So n is even, since $(n \times n)$ is equal to some whole number times 2, so $(n \times n)$ is divisible by 2.

11 -But by steps 5 and 10, m/n is not reduced to lowest terms (m, n share 2 as a common factor). And from step 1, m/n is reduced to lowest terms.

12. So 2 is both NOT rational and rational, by the *definition* assumed at line (0) plus step 11; this is a contradiction; it cannot be true!

13. Thus the assumption at step 1 must be false, because the falsehood (line 12) was derived by valid rules of inference from step 1. It is *not* the case that 2 can be rational, contrary to assumption 1. We conclude that there exists at least one number that is not rational, i.e. rational numbers must exist.

Summary of Section

Deductive proofs have played an essential role in the development of our human legacy of knowledge about the world that we can never see but are obligated to understand to the best of our ability. Our understanding is constantly open to improvement through revision and augmentation using basic patterns and rules for creating deductive proofs.

Assignment 1

Recognising arguments containing syllogistic structures.

a) Some of these passages in the list below are not arguments; some are. Determine which are arguments.

b) Some of the arguments below are simply representations of a single syllogistic argument pattern. If so, can you identify it? Use alphabet letters to identify the key reference and attribute classes, and illustrate the syllogistic pattern.

c) Other arguments go beyond one simple syllogistic form, and so they contain one or more of these patterns and they contain statements that may not directly count in any pattern. For those you can recognise, spell out the type of syllogism(s) that each reveals

1 Charles is a conceited snob. *He* is a penny-pincher, he is aggressive, and he is a bully, in addition, he steals other people's belongings and he doesn't work.

2. If Paul leaves the door open again I will complain to the house management. If he leaves the door open he is letting in mosquitoes every night. If mosquitoes get in we can catch malaria, and these days if you want to cure malaria you have to go to the hospital. We want to avoid going to the hospital, so the door must be kept closed as much as possible.

3. All the candidates in my District are interested in helping private schools settle in the area. But as a school teacher I know this will destroy the public school system. And the district needs a good public school system, since education is the only way to end the cycle of poverty. I want to do whatever I can to prevent the public school system from being destroyed.

So if the candidates change their platform and offer some resistance to the influx of private education entrepreneurs then I will vote for them.

4. If Kofi comes early to take over my post, then I will leave here and go to the farm before the sun goes down.

5. We need to do the weeding more than once a month. If you only weed once a month, then the weeds grow. The weeds take most of the nutrients because they grow faster than the tomato plants. Whenever the weeds get too much the tomatoes don't get nutrition from the soil. If they don't get nutrition the tomatoes will die. We need the tomatoes to live so we can take them to market. So we have to move the weeds out more than once a month.

6. Goats who eat wet grass always get sick. Since you allow your goats to graze after the sun goes down instead of bringing them in early, your goats will get sick.

7. The internet communication is down again, so I cannot read any of my mail.

8. Everyone who was invited to Georgina's party must come. She went to a great deal of trouble making all the decorations, cooking, making a new dress and looking very pretty, and she is looking forward to receiving gifts. So everyone should make every effort to attend.

9. Today is very hot and sunny. I am climbing the hill. Anytime you reach the top of a hill and the sun is bright and shining, the sun's powerful rays bounce off the surface of the pavement sharply, at the same angle that it refracts off the surface of water. You get an optical illusion or a mirage, and you think you are looking at water. So as I approach the top of the hill I will think I see a puddle.

10. It is raining and the sun is shining. A rainbow is the result of light being dispersed into distinct wave length frequencies by refraction off the surface of raindrops. This occurs when sun hits rain drops of sufficient size. So we will probably see a rainbow.

11. Stars look as if they are twinkling, but they actually emit a great steady light. But because they are very far away, the light coming from stars is disturbed and interrupted by objects and particles in the earth's atmosphere which may periodically block the light on its great distance to reach our eyes.

12. Now that the meaning of the word 'planet' has changed, there is no consensus anymore about how many planets compose our Solar System.

13. Very few young people are actually interested in the problem of global climate change, according to a recent poll.

14. You cannot pass the test early on Monday morning if you do not study. You only have today left and tomorrow. But today is an important football match and you are the only member of the team who is not injured and who is trained as a goal keeper, so you cannot study today. Therefore you will have to study very hard tomorrow.

15. You and your friends are nothing but a bunch of thieves. You just take people's property without their knowing anything about it, and you don't ever give it back. That's what thieves do: they take other people's property. You're a bad sort. I am going to tell my friends not to mix with you.

16. None of these candidates running for office can be trusted; I won't vote for any of them. Everybody knows that power corrupts, and that all politicians are corrupt even before they get elected. They are corrupt by nature otherwise they would never become politicians.

17. Some of the people from my senior secondary school are politically concerned and active. And given that every politically concerned and active person is very intelligent, it shows that some of my former classmates are very intelligent.

18. Anywhere you go these days in the cities you find unemployed young people vandalising and begging on the street. Young urban dwellers who take recreational drugs tend to vandalise and to beg for money to buy more drugs. But if young people had access to credit then they could start up their own businesses and be gainfully employed. Youth who have created their own jobs for themselves become responsible and don't have time to involve in drug abuse. So if there were credit schemes for young adults, the street begging and vandalism would decrease.

19. There has been a sudden increase in criminals, gamblers and drug sellers on the campus. This is probably because SRC recently built a new Gaming Centre for students to congregate, which is open to the general public. The SRC wants the general public so they can make some money from the Gaming Centre. But a UGRC 150: Critical Thinking and Practical Reasoning Unit6: Deduction and induction Centre for Distance Education, 36 University of Ghana, Legon place where people relax, eat, drink and play games also tends to attract drug dealers, gamblers and criminal elements of society.

20. I really can't stand people who spend all their time playing computer games. They are just idle and ignoring their responsibilities. They are boring too. They don't care about anybody except the fake people in the computer.

21. What's the point of even talking to you? You don't pay any attention to anyone who disagrees with you.

Assignment 2

Some of the passages below are arguments.

(A). Identify the passages which are *not* clearly premises leading to a conclusion.

(B). Recognize the difference between arguments that are DEDUCTIVE and INDUCTIVE.

(C). Which of the inductive arguments do not seem to be well substantiated by the premises?

1. If you want to get an A it is necessary to study two hours at least for each lecture hour. Kofi is not able to study for each lecture period. He just goes to class and collects notes, but does not do any other work. So Kofi will not get an A in the course.

2. All goats are mammals. This creature that he keeps in the yard is a goat. Therefore he is keeping a mammal in the yard.

3- All the goats in my neighbours yard have contracted stomach flu. They have been eating scraps from the kitchen. So anytime a goat feeds on kitchen scraps it is likely to contract stomach flu.

4 All the people who bought diesel fuel pickup trucks over the last decade and imported them into Ghana up through 2009 were able to avoid the customs and excise tax on importing an automobile—none of them paid custom duty. Jackson was forced to pay the custom charge on the vehicle that he imported in July 2010. So it appears that he did not buy and import a diesel-fuel pick-up truck.

5. Of the 15 Vandals who took part in this demonstration, 12 were caught by the authorities and four were punished with suspension for two years, while others were expelled from school. So Legon students should be aware that they are not entitled to demonstrate because they likely will be punished by the authorities or rusticated and lose their place in university.

6. If he wins this lottery then you know he is a lucky man. Since he is known to be a very lucky man, so it follows that he must win this lottery.

7. To say a number is even means it is divisible by 2 without -remainder. 7,008,956,784 is even. So it is divisible by two without remainder.

8. The Volta Hall girls are conformist; they are generally willing to do what they see most of the other Volta Hall girls doing. 85% of Volta Hall girls so far have registered to take part in this church function. Mary is a Volta Hall resident. So Mary will register to take part in this church function.

9. There is a big football match today and Kwame always watches the matches whenever he can. But this is the only day Kwame is able to do his laundry. So Kwame will either be watching the match or he must be doing his laundry. He is not doing his laundry; so you will find him watching the match.

10. If Guinness is willing to sponsor a Hall Week for millions of cedis, why doesn't someone convince them to help the students to buy a big bus? What about asking Guinness, or Coca Cola, or Lever Brothers, *or* any of the regular sponsors to help improve the water situation on campus? The transport problem and the water problem really worry students year after year. Can't we ever plan for the future of the University? All students only think about their own personal welfare, the rising costs of their 'user fees', and finding their personal avenues to success. Does anything matter to BA students besides grabbing a quick and easy degree while conducting a promising social life?

11. Protozoa are microscopic life forms that lived under water. The first five rocks from the hills of Obuasi studied show evidence of fossilized protozoan life. The sixth and seventh rocks have no such fossils, but the eighth, ninth and tenth rocks studied from Obuasi also had fossils of protozoan life. When these fossils are carbon tested, they are found to be four million years old. So the rocks in Obuasi must have been under water at least four million years ago. 12. 98% of the Pro-Vice Chancellors in African universities are male, and 95% of the Directors of institutes of African Studies attracting meritorious awards at universities within and outside of Africa are also male. So at the University of Ghana, Legon, Professor Akua Dplphyne (a former Pro-Vice Chancellor) and Professor Yaa Odotei (a current Director of the Institute of African Studies) are both males.

13. Eight of the ten rats fed charcoal-burnt meat developed brain tumours. So 80% of all rats fed on charcoal-burnt meat develop brain tumours.

14. In a sample of 20 patients who ate meat infected with the lethal bacterium, and who contracted the human equivalent of mad cow disease, 15 of the patients died of eating the infected meat. 75% of people contracting the human equivalent of mad cow disease will die of eating infected meat.

15. Anyone who is registered for this course should use the Course Companion Reader and also do research in textbooks. Kofi is registered for this course, so Kofi should use the Course Reader and also do research in textbooks.

16. You can get an A in that course only if you try hard. Joseph tried *very* hard, so he must have gotten an A.

Unit summary

In this unit you learned:

- How to contrast induction and deduction
- How to locate the reference class and the attribute class of a statement to distinguish particular from general statements.
- How to recognise four types of deductive syllogism
- How to differentiate some valid syllogisms for the fallacies that pretend to copy them
- Some examples of how deductive reasoning is used to expand and correct our understanding of the world

Unit 7:INDUCTIVE REASONING IN THE SCIENCES AND EVERYDAY LIFE

Introduction

In Unit 6 we studied how to test the validity of a deductive argument. You did this using a rudimentary version of symbolic logic: First you symbolized the reference and attribute classes of the premises and the conclusion to get rid of everything in the argument that was not a logical operation. You eliminated all the semantic content (non-logical meaning) of the statements in the argument. Then you studied the logical structure or pattern (called the logical scheme) of the statements in relation to each other to see how the truth of the premises might be able to guarantee the truth of the conclusion in every case of thoughts having these shapes or structure.

Your study of validity was independent of and separate from the content or subject matter that these arguments originally carried before you took out the content and substituted letters as class variables. You paid no attention to what these statements were about. You just looked at the structures or patterns of the statements and compared them to patterns fixed and known in advance that apply as a standard to all thought sequences regardless of what the thoughts are about.

In contrast, in this unit you will study inductive reasoning in a different way altogether. The connection between the premises and the conclusion of an inductive argument does not depend solely upon the logical structure or patterns shaping the premises in relation to the conclusion. Now you have to study meaning content of the statements—you have to examine the quantity of things referred to, you have to decide whether the information called ‘evidence’ given in the premises really adds up to a good reason for believing the hypothesis, which is given as the conclusion, is likely to be true. An inductive argument does not provide the structure of a logical-proof; it doesn’t follow a fixed pattern that holds for all thoughts. The premises provide evidence that confirms the likelihood of the conclusion of the argument— which is why it is called a hypothesis, a well-founded conjecture. There is no certainty with this kind of reasoning, only degrees of probability that the conclusion of the argument is a true conjecture. When we make predictions about the world in the sciences, we can never do so with absolute certainty. The logic of induction is the logic of qualified conjecture.

In this respect, inductive reasoning is much harder to evaluate because it is not mechanical. There is no automatic test to apply that always works for testing or evaluating all inductive arguments. You need to use common sense, general rules for evaluating evidence provided as information about a sample, or experimental results, and then you need to think about what the conclusion is claiming about a whole population or cases outside the ones that were tested in the sample.

This unit will cover the following topics:

Section 1: The contrast between verifiable premises (evidence) and confirmable conclusion (hypothesis)

Section 2: Statistical hypotheses have less predictive power than law-like hypotheses.

Section 3: Three examples of enumerative induction: CONFIRMATION IS NOT PROOF

Section 4: Uncertainty as a virtue and the principle of testability in science

Objectives

Upon completion of this unit you will be able to understand:

- why inductive reasoning never yields certainty
- why inductive premises ('the data') are verifiable or directly testable
- what it means to say hypotheses are confirmable or indirectly testable
- what the structure is in an enumerative induction
- the contrast between law-like and statistical hypotheses
- how statistical hypotheses can also be used as evidence
- why statements in social studies and natural science and liberal arts must be testable

SECTION 1: CONTRASTING VERIFIABLE AND CONFIRMABLE STATEMENTS

Introduction

To evaluate inductive arguments, you cannot eliminate the semantic content or the non-logical meanings of the statements involved, because it is just the semantic content or the non-logical meaning of the premises that provides the basis or support that confirms the conclusion. You have to read each argument and evaluate it separately to see if the premises provide a good reason to believe the conclusion is likely to be true.

You have to assess the quality of the data provided in the premises. You have to evaluate the quality and size of the sample, that is, you need to consider the quality and range of evidence provided in the premises and see whether in light of these findings, the conclusion seems convincing. You will learn the basic principles of this in the next Unit 8.

In this section you will learn to tell the difference between premises and conclusion, and recognise what it means for premises to confirm a conclusion. This means that to evaluate an inductive argument as good or bad, you cannot symbolize the classes involved and just look at the logical operations linking them up. You need to examine the content and size of the reference class and the attribute class of the premises and compare them to the conclusion.

Objectives

- recognise when a statement is verifiable
- recognise an inductive conclusion as confirmable
- understand how the projection of an inductive conclusion goes
- beyond the truth of the premises

Examples of verifiable statements or data, evidence, test results, observation reports, research findings.

Recall from the last Unit 6 Section 1, Activities 1.1 and 1.2. We distinguished the finite reference class found in every particular statement from the infinite reference class that is the mark of a general statement.

Recall these examples of particular statements:

1. This copper strip expanded when it was heated to 120°F.
2. That man is the Dean of Science.
3. This person's passport has expired.
4. That table is green.
5. This stone is not a real diamond.
6. As of today, none of the students on this list have registered for this class.
7. The fourth and seventh samples of the meat consignment were infected with the lethal bacteria.

8. All the voters interviewed said they would vote for the incumbent candidate.

In the statements above, each reference class is finite (the class described by the subject is fixed or limited in number, or we might call it a closed class). So in principle a test could be run to see if the sentence is true or false; or a specific observation whose effect could be measured, and it could be repeated to establish 'directly' in one or a few episodes, to verify that the sentence is true or false. This is what is meant by saying the statement is verifiable. It is able to be verified 'directly' through experience on one or just a few occasions.

We rely on this kind of statement to report what is called evidence or data, or research findings, or experimental results or observation statements

In an enumerate inductive argument, these are the premise. We call this type of argument 'enumerative' because we are enumerating, or counting up, the instances in favour of a hypothesis which is presented as the conclusion of the argument. The evidence is said to confirm the likelihood of the conclusion. The more instances in its favour, the stronger the confirmation

Activity 1.1

Identify the finite reference class of verifiable statements

For statements 1-8 above, explain why each reference can be directly testable. Explain in particular for statements 6-8 how you can tell the reference class is finite.

Compare the verifiable statements 1-8 above with the following confirmable statements or hypotheses that all have reference classes which are infinite, examples 9-18 below. To say the reference class is infinite means the statement refers to uncountably many members belonging to a class that may exist at anytime and anywhere. There is no way to count them all, therefore no way to perform any observation that will eventually determine directly whether the statement is true or false. Hypotheses are therefore not directly testable. But to be scientific, a statement should be confirmable i.e. indirectly testable—testable in the way described in the next section.

Examples of confirmable statements or hypotheses:

9. All metals expand when heated.

10. Planets move in elliptical orbits around the Sun.

11. Heavy smokers have a carbon film on their lung tissue.

12. Mammals require oxygen for life and mammary glands to feed their young after birth.

13. No student registers unless forced.

14. All voters prefer a recount of the ballots.

15. Some cow meat from England is infected with lethal bacteria.

16.80% of all retailed stones are not real diamonds.

17. Few Ghanaians are allergic to pineapple.

18.90% of those who contract the human equivalent of mad cow disease die from eating the infected beef.

Activity 1.2

Identify the infinite reference of confirmable statements

1. In statements 9-18, explain why the reference class cannot be directly testable.

2. Among statements 11-18 some do not include the words 'all', 'each' or 'every'; explain how it is you can tell that the reference class is infinite.

Summary

We have observed that some statements are verifiable, that is, able to be tested directly in one or a few episodes of controlled observation and measurement. We use the word 'Verified' in this technical sense of the word. This requires that the sentence is an observational report, again this means that the attribute reported is measurable; it can be determined by one or a few episodes of investigation, whether the attribute applies to the individuals referred to in the reference class; the statement can be determined or verified as true or false.

Verifiable statements can function as evidence to support hypotheses.

We have observed that some other statements which are not verifiable are instead confirmable, that is, they are able to be tested indirectly. Confirmable statements are determined as likely to be true or false indirectly by other statements. Verifiable statements which are directly testable provide the information that supports or rejects those that are indirectly testable. To be testable means the truth or falsity is determinable by anyone with appropriate training. To be testable means it is possible for someone to learn what to do to tell if the statement is true. To be testable means there is something to look out for, to tell whether or not the attribute described in the statement applies to members of the reference class.

Statements which are not testable in this way do not properly belong to natural science or social studies. They are called pseudo-scientific. We will look at these in the last section of this Unit. In the next two sections we will examine the relation between directly and indirectly testable statements as the relation between the premises and conclusion of an enumerative inductive argument.

Section 2 Why Statistical Hypotheses Have Less Predictive Power than Law-Like Hypotheses

Introduction

The reference class of any hypothesis is infinite. But a law-like hypothesis admits of no exceptions. A statistical hypothesis always admits of some percentage of exceptions. So a statistical hypothesis is more likely to be true than a law-like hypothesis. But if true, a law-like hypothesis has more predictive power than a statistical hypothesis.

Objectives

- To contrast law-like and statistical hypotheses

Law-like Hypotheses vs. Statistical Hypotheses

Below are reprinted the statements in the list 9-18 that we presented in Section 1 above as confirmable statements.

9. All metals expand when heated.

10. Planets move in elliptical orbits around the Sun.

11. Heavy smokers have a carbon film on their lung tissue.

12. Mammals require oxygen for life and mammary glands to feed their young afterbirth.

13. No student registers unless forced.

14. All voters prefer a recount of the ballots.

15. Some cow meat from England is infected with lethal bacteria.

16.80% of all retailed stones are not real diamonds.

17. Few Ghanaians are allergic to pineapple.

18.90% of those who contract the human equivalent of mad cow disease die from eating the infected beef.

The first six in the list are what we call law-like hypotheses. They have the form:

All Fs are Gs (i.e. Each F is a G) or No Fs are Gs (i.e. All Fs are non-Gs)

Whereby F is the infinite reference class named by the grammatical subject of the sentence, and G is the attribute class, indicating the property being attributed to all members of the reference class. For example in item (12) the reference class is infinite—all mammals—and the attribute class is the requiring of oxygen and mammary glands.

This is why these statements are called law-like. Each hypothesis is a prediction that 100% (all Fs, each F, every F) have G, or that 0% of the reference class F (no F, none of F) belong to the attribute class G. In other words, a law-like statement is trying to attribute the property G to every individual F without any exception whatsoever. That is to say, it is absolutely a law of nature that each and every F will have G. This means it is a regularity without any deviation at all.

Remember that in Unit 5 Section 1, when we introduced the notion of a scientific law or natural law, we said these universal negations and affirmations can be understood as disguised predictions. Restated, each of these hypotheses (9-12) can be read as follows:

9. If x is a metal then x will expand when heated.
10. If any x is a planet then x follows an elliptical path around the Sun.
11. If x is a heavy smoker then x has a carbon film on his or her lung tissue.
12. If x is a mammal then it requires oxygen and must provide milk for its newborn.

Activity 2.1

Every hypothesis is a disguised prediction

1. Read statements 13 and 14 and translate each into a conditional, as done above for 9-12.
2. Create your own law-like statement; then translate it into a conditional to reveal its hidden predictive value.

Statements 15-18 are statistical hypotheses, such that some percentage less than 100% and more than 0% of the reference class has the property described in the attribute class. The percentage may not be mentioned explicitly, but instead referred to vaguely by the terms 'hardly any', 'few', 'occasionally', 'some', 'most', 'many', 'typically', etc. Restated as predictions, these could read:

15. Of all the consignments of cow meat imported here from England, some of the consignments will contain carcasses of meat infected with lethal bacteria.
16. Of any ten retailed stones, only two will be real diamonds.

17Activity 2.2

Translate statistical hypotheses as predictions

1. Do the same as above for items 17 and 18 in the list.
2. Create your own statistical hypothesis. Translate it into a condition to show the hidden prediction that it will express.

Predictive power and falsifiability

In order to appreciate the difference between the results of inductive reasoning (confirmation) and deductive reasoning (proof), we have to understand the difference in predictive power between a true law-like hypothesis which admits of no exceptions, and a true statistical hypothesis, which has exceptions built into the expectation built into the expectations it gives us.

Consider the contrast between

- (i) All Legon Hall residents play football once a week,
- (ii) Legon Hall residents play football at least once a week.

Each of these is a prediction (i) is what we call a law-like hypothesis, telling us that if an individual x is a Legon Hall resident then x will play football once a week.

(ii) Is a statistical hypothesis, and it tells us that for every 100 Legon Hall residents, 40 will play football at least once a week. In other words (ii) makes the prediction that if x is a Legon Hall resident then the chances are 4 out of 10 that x will play football once a week or more than once a week. Or, of any 100 Legon Hall residents, x will be in the group of 40 with the attribute of playing football at least once a week.

Now consider something very peculiar:

Which of these statements is more likely to stay true, as you encounter Legon Hall residents one at a time and check to see if they have this attribute? Clearly, (ii) is more likely to be true; because if you encounter a Legon Hall resident who does *not* play football at all, then (i) will be proven false—because (i) admits of no exception: for prediction (i) to stay true, every single Legon Hall resident must play football exactly once a week. This is a very strict condition for being true. If even one Legon Hall resident doesn't play football at all, or plays twice a week, then (i) will be false. But (ii) will stay true; because the truth conditions for (ii) are much more relaxed. Hypothesis (ii) is making a weaker prediction.

Read it again: (ii) is telling us that some L/H residents won't play football at all 60% don't, according to (ii), or any of the 40% L/H residents who do play football will play more often than

once a week — hypothesis (ii) doesn't even specify how often they will play. So lots of scenarios are consistent with (ii) being true. That is, (ii) being true tells us much less than (i) does about what to expect concerning the football habits of Legon Hall residents. That is because there is far less opportunity for hypothesis (ii) to be false, than for hypothesis (i) to be false. The truth of hypothesis (i) is very restrictive: (i) will turn false provided even one L/H resident fails to play football less often or more often than once a week. If even one L/H resident doesn't play at all, (i) will also be false, (i) is far more likely to be false than (ii): (i) is far more dependent upon the way the world is for its truth than is (ii). Therefore if (i) is true, it gives a far more detailed impression of facts that obtain in the world than does (ii).

There are fewer situations that will make (ii) false than will make (i) false, but those situations could exist, (ii) will be false if less than 40% L/H residents don't play football, and (ii) will be false if less than 40% play less than once a week. Many other situations obtaining will make (ii) false. But all these situations will also make (i) false. So we say that (i) is more falsifiable than (ii).

Indeed (i) is very likely to be false. There are students in L/H who have suffered polio and stay away from the football field altogether. Some students don't know how to play football some know how but don't care to play. Many of the women at L/H who are residents might know how to play and want to, but have no opportunity to play once a week. Given all these conditions (ii) might stay true but (i) would be false.

If (i) is actually true, then a very specific and detailed state of affairs must obtain; and so if (i) is true and you are told about it then you can make a very exact prediction about Legon Hall residents' football playing behaviour than if you are told (ii).

Both of these hypotheses may be true but law-like statement (i) is more valuable as an empirical hypothesis if it is true, because it is more vulnerable to being false. Ironically, if both these statements are true, then law-like hypothesis (i) is more valuable to us, providing us with more information about the way the world is than does the statistical hypothesis (ii), because (i) is less likely to be true than (ii).

Read the two statements (i) and (ii) again. Hypothesis (ii) can lead you to make predictions but the result is vague compared to the hypothesis suggested by (i): for instance the statistical hypothesis (ii) will be true no matter how many times over one week the Legon Hall group of footballers play. And from (ii) you know that out of any 10 or 5, how many will likely play, but you don't know which ones it will be. That is, for any individual resident, there is no way to tell from the truth of (ii) whether this individual belongs to the group that plays at least once a week or whether this individual belongs to the larger group that does not play once a week.

Further, from (ii) you know that 40% of the residents play at least once a week, but (ii) does not tell you exactly how often in fact they play, (ii) doesn't tell you about any one particular individual at all, actually.

So (ii) gives you much less information, if it is true, than would hypothesis (i). If hypothesis (i) is true, then it gives you a specific bit of information about every single Legon Hail resident. So (i) has more empirical content than hypothesis (ii). Hypothesis (i) has more predictive power than hypothesis (ii). But this is precisely because hypothesis (i) is less likely to be true than is hypothesis (ii). More things could happen that would undermine the truth of (i) than of (ii). (ii) is more certain to be true than (i). The conditions that make (ii) true are far more liberal and varied than the conditions required for (i) to be true. The truth of (ii) is more impervious than (i). We say (i) is more falsifiable than (ii), and therefore it has more empirical content and more predictive power than (ii). And for that reason (ii) is also less valuable than (i) as an empirical hypothesis. In the natural sciences, in social studies, and in creative liberal arts scholarship, uncertainty is a virtue.

Summary of this section

Statistical hypotheses are more likely to be true than law-like hypotheses, but law-like hypotheses, if true, have more empirical content than statistical ones. Particular, verifiable statements are less likely to be false than hypotheses, but they tell us far less about the world generally; particular observation statements are verifiable and their truth can be tested directly, but they carry no predictive power at all.

Hypotheses are disguised or implicit predictions. This is because every hypothesis, be it statistical or law-like, can be framed as a conditional [if ____ then ____] statement. So empirical content can be understood as predictive power. The more likely a statement is to be false, the more predictive power it has. In Section 5 of this Unit we will explore this in even more depth.

In the next section we will consider the relation of evidence to these hypotheses as the relation between the premises and the conclusion of an inductive argument where the more evidence accumulated in favour of a hypothesis, the more the premises confirm the probability of the conclusion's being true.

SECTION 3: THREE EXAMPLES OF ENUMERATIVE INDUCTION: CONFIRMATION IS NOT PROOF

Introduction

Hypotheses are constructed in relation to evidence. To appreciate the support that evidence provides for an hypothesis, we need to understand the type of reasoning called 'enumerative induction'.

Objectives

- To appreciate that the type of support given by evidence to an empirical hypothesis is not the same as the support of premises that prove a conclusion deductively, thanks to rules

of inference and independent of the statements' contents. Thus we speak of inductive reasoning.

- To understand the way an hypothesis 'goes beyond' the evidence. Thus we speak of inductive reasoning.
- To see why supporting evidence confirms but does not prove the truth of a hypothesis. This is the key distinction between deductive and inductive reasoning, as introduced in Unit 6.
- To recognise that an inductive argument based on a statistical hypothesis confirms but cannot prove the conclusion

Here is an illustration of Enumerative Induction where the conclusion is a Law-like Hypothesis.

Consider the basis for conjecturing statement (9) in Section 1.

In the following argument, the premises (i-vii) are directly testable or verifiable.

Premises (i-vii) are called data, evidence, findings, research results, observation reports, experimental outcome, and in this argument, these premises do support the conclusion. So the conclusion is said to be confirmed by the premises. Recall that another name for a conclusion in an inductive argument is the hypothesis.

Because the conclusion is going 'beyond' the sample of individuals where tests can be conducted (either it is referring to a future case or an infinite class of cases) we say that the conclusion is indirectly testable.

Premises (evidence):

- i) This silver spoon was heated to 400°F and expanded.
- ii) This copper wire was heated to 120°F and expanded,
- iii) This iron bar was heated to 800°F and expanded,
- iv) This mercury was heated to 100°F and expanded,
- v) This aluminium pot was heated to 350°F and expanded.
- vi) This gold ring was heated to 500°F and expanded.
- vii) This tin strip was heated to 275°F and expanded.

viii) Summary of data: All the metals that were tested expanded when heated.

Conclusion (hypothesis): All metals expand when heated.

Statements (i-vii) constitute individual observation reports or test results. The statement (viii) is a summary generalisation of all these observation reports. Notice that above the solid line all the statements have reference classes that are finite (in summary generalisation (viii) as well: 'all the metals tested is a finite collection of metals) and they are all verifiable. The conclusion beneath the solid line is a hypothesis: notice its reference class is infinite (it refers to all metals for all time, past and present and future, anywhere). And so it can only be confirmed (never proven) by the evidence presented in the premises above the solid line. To prove the conclusion we would have to know it must always be true without any exception. And although this may be the case, we cannot know this from the premises given. The data or the evidence provided only gives us a very good reason to believe that this conclusion is very likely to be true. And there is no evidence to the contrary, according to this argument. So if we assume this evidence is complete, in that it leaves out no relevant data, then we have evidence that confirms the hypothesis to a very high degree of probability.

It is worth reviewing intuitively why confirmation does not provide an absolute proof of the truth of this conclusion, but rather provides a degree of certainty of the likelihood that the conclusion is true. Getting any number of metallic substances to expand by heating them certainly cannot prove in the sense of providing a guarantee that all metals everywhere at any time must expand when heated. Thousands of successful trials cannot rule out the logical possibility that some future test result will yield evidence of a metal somewhere at sometime in future that fails to expand no matter how much it gets heated. This is why empirical test results are not treated as deductive proofs of the hypotheses that they confirm.

As it happens, there are synthetic metals that have been produced which are called superconductors and never absorb energy, so they remain at absolute zero when energy is introduced; they never expand. So in fact this hypothesis is false. But it is confirmed by this evidence. According to this data, the hypothesis is in fact likely to be true, although in fact (as we can learn later, or as states of affairs change) it is in fact false. For a good inductive argument, therefore, there is no logical contradiction between the premises being true and the conclusion being false. Inductive reasoning is quite different from deductive reasoning.

Enumerative induction will confirm a statistical hypothesis more often than a law-like hypothesis.

Recall the list of statements-9-18 appearing in Section 1 of this Unit and earlier in Section 4. The statements 15-18 on that list are statistical hypotheses, such that some percentage less than 100% and more than 0% of the reference class is claimed to have the property described in the attribute class.

Examples of confirmable statements which are statistical hypotheses:

15. Some cow meat from England is infected with lethal bacteria.
16. 80% of all retailed stones are not real diamonds.
17. Few Ghanaians are allergic to pineapple.
18. 90% of those who contract the human equivalent of mad cow disease die from eating the infected beef.

Statistical hypotheses can also be the conclusions of enumerative inductive arguments following the same form of argument as you just observed in this section. Statistical hypotheses more regularly reflect the prediction that is supported by a body of evidence.

Consider two examples where statistical hypotheses are more faithful to the data than a law-like hypothesis:

Two further illustrations of enumerative induction where the conclusion is a statistical hypothesis.

First example of evidence supporting a statistical hypothesis—

Premises:

1. The first rat fed with charcoal-burnt cow meat developed a brain tumour in 200 days.
2. The second rat fed with charcoal-burnt cow meat did not develop a brain tumour.
3. The third rat fed with charcoal-burnt goat meat developed a brain tumour in 215 days.
4. The fourth rat fed with charcoal burnt pork did not develop a brain tumour.
5. The fifth rat that ate the charcoal burnt-pork developed a tumour in 180 days.
6. The sixth rat ate the charcoal burnt cow meat and got a tumour in 63 days.
7. The seventh rat ate the charcoal burnt chicken meat and got a tumour in less than two weeks.
8. The eighth rat got a tumour in 250 days after starting on the charcoal-burnt cow meat.
9. The ninth rat eating charcoal-burnt mutton had a brain tumour after 90 days.

10. The tenth rat fed with charcoal-burnt meat developed a brain tumour in one year.

Summary of data: Eight of the ten rats studied developed brain tumours.

Conclusion: 80% of all rats fed on charcoal-burnt meat develop brain tumours, (that is, charcoal-burnt meat is carcinogenic in rats.)

Second example of evidence supporting a statistical hypothesis

Premise:

In a sample of 20 patients who ate cow-meat infected with the lethal bacterium and who contracted the human equivalent of mad cow disease, 18 of the patients died shortly after eating the infected beef.

Conclusion: 90% of people contracting the human equivalent of mad cow disease will die of eating infected meat, (that is, the human equivalent of mad cow disease usually is fatal.)

In the second example, the premise above the solid line is a summary generalisation of observation reports; it is verified by cross-checking each of the test results or repeating the experiments that it summarises. In both examples, the conclusions below the solid line are statistical hypotheses referring to any group (of rats and of people, respectively) under the specified conditions, and attributing a property that will be found in a high percentage of cases (cancer and death, respectively). These hypotheses are said to be confirmed by the evidence reported in the premises above the solid lines. They are not proven in the sense that deductive proofs provide a guarantee of mathematical theorems.

Arguments based on statistical hypotheses

It is not always that inductive reasoning starts with particular statements and ends with a general statement. We observed this in a general way in the first section of Unit 6. In section 1 and 2 we focussed on the structure of enumerative inductive reasoning, where you add up from an accumulating collection of individual observation reports describing data; the more verifiable observation reports provided in the premises that support the conclusion, the likelier the concluding hypothesis is of being true.

However sometimes arguments include hypotheses in the premises. You can project from a statistical hypothesis to draw an inductive conclusion about a particular future case.

Consider the following argument where the evidence cited in the premise is itself a statistical hypothesis.

Premise 1: 90% of Legon Hall residents play football at least once a week.

Premise 2: Jonathan is a LegonHall resident.

Conclusion: Jonathan plays football at least once a week. Notice that these premises do not guarantee the conclusion will be true. This is because Jonathan might be in the 10% for whom the attribute of playing football at least once a week does not apply.

But because of the very high percentage of Legon Hall residents who do have this attribute, we have a good reason to believe that the conclusion is likely to be true. This is therefore an inductive argument. The conclusion is a prediction that goes beyond the premises.

Contrast this argument with the modus ponens deduction that emerges if the hypothesis in the first premises were to be law-like:

Premise 1: All Legon Hall residents play football at least once a week.

Premise 2: Jonathan is a Legon Hall resident

Conclusion: Jonathan plays football at least once a week.

Here you have a valid deductive syllogism! From the law-like hypothesis in the first premise, if it were true, then necessarily the conclusion must follow. So you can see that the predictive power of a law-like hypothesis is quite different from that of a statistical hypothesis. The law-like hypothesis is more likely to be false, as we discussed in Section 1 of this unit. But if it is true, then we can know much more about the sporting habits of Legon Hall residents than we can learn from a statistical hypothesis on the same topic.

The contrast between using a statistical hypothesis as premises of an argument and a law-like hypothesis as the premise of an argument marks the difference between confirming a conclusion inductively and providing a statistical hypothesis on the same topic.

Contrast the difference neatly using syllogistic form:

If the X percent stands for all (100 percent) or none (0 percent) F s are G s then the conclusion is called a universal generalisation or law-like hypothesis. When x percent stands for more than 0% and less than 100%, F 's (for instance some, few, many, most) then we call the conclusion a statistical hypothesis or a statistical generalisation. It follows that we can show schematically two examples of general hypotheses functioning as premises to draw particular inductive conclusions.

In the two argument schema below, F stands for the reference class of the statement; G stands for the attribute class of the statement; a denotes some particular person, entity, event, or class:

- (i) Statistical argument form: 80% of all Fs are Gs. A is an F. So A is G.
- (ii) Law-like argument form: 100% Fs are Gs. A is an F. So A is G.

Summary

Recall we considered in Unit 4 that in social studies, we rarely are able to arrive at law-like hypotheses that are not trivial. It may be noted that the human sciences pursue particular statements based on evidence or upon statistical hypotheses. So the results are not very steady or certain as they can be in physics or other statements that can operate on law-like hypotheses as their first principles. But that is not a drawback of social studies. Sweeping generalities tend to be uninformative about human behaviour.

Arguably, social studies researchers are in most cases looking for explanations of differences between societies, between cultures, between historical cases of revolution for example. Social scientists rarely seek law-like statements at all, for they are not interested in the uniformities and absolute regularities of human experience—these are largely truisms and commonplace. Law-like generalities that hold true of human beings are banal. Rather, it is the uniqueness of distinct human situations, the peculiar features of this revolution, not what is true of all revolutions, for instance, that are of interest. This may be another way of accounting for the differences we witness in the methods and the models of explanation that distinguish the human from the natural sciences, as we began to survey in Unit 4.

SECTION 4: UNCERTAINTY AS A VIRTUE AND THE PRINCIPLE OF TESTABILITY IN SCIENCE

Introduction

We saw in Section 4 that, in general, the more falsifiable a statement is, the more predictive power it has, and the more empirical content it has, so the more valuable it is in giving us a picture of how the world is. The more likely a statement is to be false, the more information its truth provides us about the world, if in fact it is true. We saw this in Section 4 by comparing two statements: one was a law-like hypothesis, the other a statistical hypothesis.

But this is a counter-intuitive and very peculiar fact about empirical knowledge so we will spend this section spelling it out.

The ideas in this section of the Unit are amazing. They are perhaps the most unexpected features of knowledge that you will encounter in this whole course. If you don't get it right away, read it again. Read it again tomorrow. Expect really interesting ideas to take a while to understand.

Objectives

- To recognise the connection between a statement's being falsifiable and its having empirical content and predictive power
- To appreciate that a statement which can never be false is empty of empirical content
- To understand what it means to call a statement a pseudo-hypothesis

The relationship we just witnessed in Section 4 between degree of falsifiability and predictive power leads to a very unexpected feature of empirical knowledge in the humanities and in social studies and in the natural sciences, but this does not mean as scholars and scientists that we seek absolute security that everything we claim to know can never be contradicted and must never be questioned.

It means rather that as a critical thinker you should never be shy of controversy. You should question and challenge what people say, especially people presented to you as experts and authorities. If someone is incapable of robust controversy over something they take to be true, then their knowledge base is not resilient and unlikely to be worthy of your serious consideration as an intellectual in any walk of life.

Surprisingly, the more certainty we can claim about a statement, the more we have no reason to wonder if the statement is true, the less useful it is in telling us about the world encountered through our systematic, carefully recorded experience and inquiry.

That is to say, as we just saw in the last section, for any statements you compare that describe the way the world is, the one that is providing the most information about the world (the one that has the most 'empirical content' and the most 'predictive power') will be the statement that is the most vulnerable to being false. This is because a statement that provides a lot of detail about the way the world is will be a statement whose truth requires that the world be a certain way—the more detail the statement describes, the less its truth can admit of deviation from a particular state of affairs. If this is puzzling or hard to understand, don't be surprised! It is not at all what you would expect. We will witness this odd feature of truth through examples in the next exercise.

Certainty about our descriptions of the world as scholars and scientists is an odd sort of virtue. Although desirable, certainty is not actually a direct goal of research in any empirical science or social studies subject area or liberal arts discipline that you will pursue in university.

As scholars and scientists, we try to formulate hypotheses and claims about the world, hoping these claims will be true, but we must ensure that the claims we make are able to be false:

otherwise the empirical hypotheses or statements we produce will not be not saying anything about the world.

If we propose a thesis about human society or human personality or economics or cultural geography or geography or an exegesis of sacred scripture, or an interpretation of a poem, which is certain to be true and about which there is nothing that anyone would disagree, your supervisor is likely to tell you that the thesis is uninteresting. The way the world is must make some difference to the truth or falsity of an interesting thesis that you propose.

As an empirical scientist or humanities scholar you need to propose hypotheses or theses that are testable, that is, there should be something to look for, some experiment that can be conducted or an investigation to pursue, or a debate to engage in whose results will indicate whether your thesis is likely to be true or likely to be false. If there is no way at all for the thesis to be false, then there is nothing in particular about the world that we can learn from its being true. If a statement remains unassailable no matter what happens, then its being true is not revealing anything about the way the world actually is, rather than how it might be. Such a statement contributes nothing to explain or predict the occurrences and states of affairs that we are likely to observe. It has no explanatory nor predictive power. We call such a claim a pseudo-hypothesis.

Let's look at examples of this oddity, that an empirical description which can never be false, which can be embraced with complete certainty, fails to tell us anything about the way the world is in fact.

(Notice when we make this demand that a statement must be falsifiable to be useful, we are talking only about descriptive statements referring to the empirical world, not about statements of mathematics or rules of logic or principles of morals.)

For example, suppose that when you ask me what the weather is like outside, I tell you:

(i) 'Either it is raining or it is not raining.'

Although what I have said is unassailably true, true no matter what is happening with the weather, it is thereby vacuously true, empty of empirical content, because it doesn't give you any anticipation of what the weather will be like when you get outside. Similarly if I reply to your query:

(ii) 'If it is raining, then something outside this building will get wet;'

Then again I have told you something which is empty of empirical content, in the sense that whether or not it is raining outside, my statement will be true. My statement will be true if it is raining here and not raining over there; it is true if the sky is sunny; it's true if it is snowing, if we are in a drought. No matter what the weather is like, my statement will be true.

It is not able to be false. So again I haven't given you any information in answer to your query, although what I have said in reply is unassailably true. Indeed for that very reason, what I have said is useless to you because you wanted to know about the weather outside now, and what I have told you could never be contradicted by any experience you might have under any weather conditions. So what I have told you gives you no reason to expect the weather to be one way rather than another; my statement (ii) has no predictive power.

To satisfy your query, the sort of reply that is required will be true only under certain weather conditions and false under all others, e.g.

(iii) 'It is raining directly outside this building now.'

Then by accepting this statement as true, the report (iii) supplies you with a set of expectations about the weather outside now—if those conditions do not prevail, (iii) is false. So if (iii) is true, your believing it provides you with expectations which amount to information about the weather conditions that do in fact prevail. In contrast, (i) and (ii) are not able to be false; so their being true gives you no expectations about the weather now because their truth is not dependent upon any particular conditions prevailing.

So knowing (i) and (ii) to be absolutely true is to know nothing about the weather as it is now. This is why (i) and (ii) are said to be empty of empirical content. An unfalsifiable descriptive hypothesis of this kind is useless in science; it is called a pseudo-hypothesis ('pseudo' means 'fake' in Greek).

The capacity or ability of a true descriptive or explanatory statement to be false is so crucial to its value in any empirical science that falsifiability has been used as the central standard for a statement to be suitable for scientific discourse or for entry into rigorous social studies. This was a principle recognised by the logical empiricists known as the Vienna Circle in the 1930s and was later popularised by Karl Popper in the mid-twentieth century.

We can take the point a step further and appreciate that there are degrees of predictive power that can be discerned by comparing the degree of falsifiability between statements. That is, the more falsifiable a statement is the more empirical content it provides.

Contrast (iii) above with the following statement:

(iv) Every third Friday it rains outside this building.

Now, consider that the reference class of (iv) is infinite (it refers to an unlimited number of Fridays). If (iv) were true it would tell us a great deal more about the weather than does (iii). But (iv) is very likely to be false. It would take only one future episode to contradict (iv). If we wait three weeks from Friday; then if it does not rain, (iv) will be false. But (iii) would be true, insofar as the statement made by (iii) refers to the weather outside this building at the time it is uttered, that is, today.

What happens three weeks from now is of no significance to the truth of this particular statement. We can see therefore that (iv) is more falsifiable than (iii). Therefore (iv) provides more predictive power than (iii), exactly because (iv) is more vulnerable to being shown false. Therefore so long as it is true, it is more valuable as an empirical statement than (iii).

Contrasting degrees of empirical content

Activity 5.1

Compare the scope of reference of these statements and see how the greater the scope, the greater the falsifiability, and therefore the greater the empirical content (or predictive power) of the statement.

1. The Earth's orbit around the sun is elliptical.
2. All the planets that were discovered by Kepler before 1620 AD have elliptical orbits.
3. All planets have elliptical orbits.

Activity 5.2

Examining degrees of falsifiability

1. Which of the following statements is the most falsifiable?
 2. Which is not falsifiable at all?
 3. Which gives the most precise information if it remains true in light of tests or new evidence?
 4. Which is the least able to be false (which remains true in the face of the widest range of experience)?
- A. 80% of the seedlings planted in the laboratory last month have developed mould around the pistil and stamen.
- B 80% of seedlings planted in sandy soil treated with 'ROTRAID' pesticide will develop mould around the stamen and pistil
- C. The seedling I placed in the last row of this plot has *no* mould around the stamen.
- D. The insecticide 'ROTRAID' causes mould in flowering plants.
- E. Either 'ROTRAID' causes mould in flowering plants or it does not.
- F. 'ROTRAID' causes mould in flowering plants only if it has mycotic (i.e. mould-producing) properties.

G. 'ROTRAIID' will produce mould within ten weeks of germination of seedlings, somewhere on the stamen, pistil, root or stem of the plant.

H. 'ROTRAIID' will produce mould between the 56th and the 63rd day after germination, and then only on the stamen of any plant's flower to which it has been applied.

For another, non-trivial, illustration of the contrast between a pseudo-hypothesis and a falsifiable hypothesis, compare Darwin's theory of evolution (D) with the following expression of the Creationist account of our origins (C).

(C): The universe as we perceive it now was created in 168 hours, 6,066 years ago.

(D): The origin of life occurred in the oceans millions of years ago in such a way that:

- i. The many species we witness today developed from very few types of single-cell marine organisms.
- ii. The different species developed very gradually in a seamless continuum of incremental change accumulating over millennia.
- iii. Species continue to develop always in response to environmental pressures that affect genetic mutations. So if an individual is able to survive long enough to reproduce its genetic endowment, then it produces offspring with characteristics similar to those that allowed the parent to compete successfully in changing environmental conditions.

A point should be made about the contrast between Darwin's evolutionary theory and the Creationist paraphrase from Scripture. Recall what we learned from Unit 1 that different statements serve different purposes: observation reports and empirical hypotheses describing and explaining the world as it appears through rigorous and systematic investigation are serving a different purpose than statements aimed at expressing value judgements or statements intended to provide spiritual inspiration or instruction or guidance. Not all important discourse in our lives is susceptible to the same type of logical analysis. Not all statements should be regarded on a par; some statements are not suited to compete with empirical hypotheses because they serve a different, equally important purpose in our lives.

We do many things with language besides report the way the world appears and build explanations about why it is the way it seems to be. The mistake some people make — sometimes very learned and highly prestigious people with influential jobs — is to confuse statements as theoretical or empirical claims when in fact they are not standing in contradiction at all with theoretical or empirical claims — because they are not falsifiable, they do not count as scientific in the first place. So they cannot contradict scientific claims. In other words by defending (D) in this exercise, we have not invalidated nor have we undermined or belittled the significance of (C).

A statement such as (C) above is susceptible to varied interpretations — it may be an allegory, a metaphor; it may express the ultimacy in value of the Divine as that which came before everything else and without which nothing else could come to pass. (C) surely is an example of a statement with multiple implicit as well as explicit meanings.

This is the domain of humanities imaginative speculation, literary theory and scriptural interpretation. This domain is governed by varied points of view, each of which is defensible with more or less success by appeal to competing first principles, to varied evidence, and careful deductive reasoning. Even when we stop parading (C) as a pseudo-hypothesis, it need not be treated as an inert, fixed and immutable component of dogma. When we cut off from the many layers of meaning a statement might have, we lose our capacity to access our own insights available through deeper reflection on our own experiences; and we lose the great opportunity to learn from other people with experiences different from our own.

Summary

Scientific and empirical knowledge generally has to be vulnerable to being false; it must be susceptible to constant revision in the light of new evidence. This is what makes it possible for knowledge to grow. This is where the metaphor of a Tree of Knowledge comes from. We have very little use for a statement that can never be false when building a faithful and informative picture of the world. The pictures we paint with descriptions and explanations in the natural sciences and social studies must be always in the process of updating.

In social studies as well as the natural sciences, we are always ready to revise or reject an hypothesis in the light of new evidence that shows us our initial expectation was wrong. As students of the natural sciences and social studies, we must constantly challenge and test the theories we are presented by authorities against our first hand experience and against contrary views we gain in the course of life outside the classroom. This is the only way to make substantive contributions to our favourite discipline. This is the making of world-class scholarship and scientific discovery.

And this is the way we should live our personal lives. To be sealed mentally inside a dogma, or to be dependent upon a single leader or group or fixed tradition by which we learn what to believe, means to be stuck with prejudices and limitations that we are never free to change. It means to give up the ability to grow by thinking critically and reasoning practically on one's own.

Assignment 7—Thinking exercise

Look for non-falsifiable claims that are presented as scientific hypothesis. These might turn up anywhere (in radio call-in discussions, newspaper editorials, and in your textbooks!) Explain in terms of their invulnerability to being false why these claims have no predictive and no explanatory power.

Unit summary

In the study of logic, it is important to keep separate in your mind the truth of a conclusion from the strength of an argument. Bad or weak arguments may turn out to have true conclusions, and good or strong arguments may turn out to have false conclusions. In inductive logic, the standards for strong arguments are designed to make it probable that if the premises of the argument are true, the 'conclusion will be true as well, if we adhere to these standards, conclusions that are based on true premises will usually, but not always, be true.

In this unit you learned:

- The difference between verifiable and confirmable statements
- The way evidence supports a hypothesis in an enumerative induction.
- The way a statistical hypothesis can be relied upon as evidence.
- The way law-like statements are more valuable because they are more vulnerable to being false than statistical hypotheses.
- The reason why descriptive statements that are always true are regarded as pseudo-scientific.
- The contrast between inductive confirmation and deductive proof.
- The value of uncertainty in building an accurate representation of the world.

UNIT 8: ARGUMENT BASED ON SAMPLING AND ANALOGY.

Introduction

In Unit 7 you learned one reason why enumerative inductions can only confirm (but never prove) an hypothesis. Another reason is as follows: Within inductive arguments, the premises (reports of evidence) usually refer to a sample (a finite subset) of a population, and the conclusion (the hypothesis supported by this evidence) refers to the whole population (an indeterminate collection) or to some arbitrary member of an indeterminate population. Since the premises in an inductive argument refer only to the finite sample; the conclusion refers to the whole infinite population or to some member of that population outside the scrutinised sample, then facts established about the sample have to be inferred to apply to individuals in the population. But this inference is not foolproof. It cannot be guaranteed that what holds for the sample must hold for the whole population.

The facts established by examining the sample are facts about just a subset of the whole population. It is a matter of assessment whether the sample represents faithfully the whole population. But this ideal is difficult to fulfill in fact, and in any case even more difficult to discern through an evaluation, for many reasons.

It must be supposed therefore that whatever is true of the sample might not hold be true of the whole population; we can only try to achieve a sample which is a microcosm of the population. But in our reasoning we must presume this may not be the case. That is why conclusions based on evidence derived from a sample cannot be taken to be proven but is only confirmed to some degree of likelihood.

This unit will cover the following topics:

Section 1 Sampling a population

Section 2 Criteria for judging the quality of a sample

- Sufficiency
- Representativeness
- Completeness
- Relevance

Section 3 How changes in a sample can weaken or strengthen the probability of a hypothesis

Section 4 Arguments based on analogies

Objectives

Upon completion of this unit you will be able to

- distinguish a sample from the population it represents.
- understand basic principles for evaluating samples.
- recognise what is wrong with failures to fulfill the criteria of a good sample.
- understand the structure of arguments from analogy.
- appreciate the different ways analogy helps in scientific explanations.
- appreciate the weaknesses of arguments from analogy.

Section 1 Sampling a Population

Introduction

A sample is a subset of the whole population. What is true of the sample may not be true of the whole population, but it is supposed to be. In general, across subject matters, samples can be evaluated on very basic principles for their adequacy in support of any hypothesis about a specified population. A good sample increases the likelihood that what is true of the sample will be true of the population. Use of a sample of a population cannot provide absolute proof that a hypothesis about that population must be true.

Objective

To understand what ‘population’ means in an inductive argument

A population usually connotes a collection of people comprising a society or country. But in this context a population is generally the infinite reference class of a hypothesis.

The reason that you need to take a sample is that statements about a population cannot be verified; only confirmed by appeal to a finite subset of the whole infinite class.

For instance, even if your hypothesis is about an actual human population refers now to a finite number of individuals —say, all Ghanaians, as the reference class of an hypothesis the sense of ‘population’ intended will still be infinite, because the hypothesis normally refers to all Ghanaians for all time—past and future as well as present.

Activity 1.1 – Thinking drill

Understanding the technical sense of ‘population as an infinite class.

Refer again to the confirmable statements we have been examining in previous Units. Identify the population referred to in each of these hypotheses and establish that each is an infinite class.

9. All metals expand when heated.
10. Planets move in elliptical orbits around the Sun.
11. Heavy smokers have a carbon film on their lung tissue.
12. Mammals require oxygen for life and mammary glands to feed their young after birth.
13. No student registers unless forced.
14. All voters prefer a recount of the ballots.
15. Some cow meat from England is infected with lethal bacteria.

16. 80% of all retailed stones are not real diamonds.

17. Few Ghanaians are allergic to pineapple.

18. 90% of those who contract the human equivalent of mad cow disease die from eating the infected beef.

SECTION 2: CRITERIA FOR JUDGING THE QUALITY OF A SAMPLE

Introduction

To count as good evidence, information about a sample depends upon the sample itself. The collection of individuals from the sample must be sufficient in quantity, complete in the factors surveyed and recorded that are relevant to the hypothesis, the types of individuals in the sample must be unbiased, and the qualities reported about them must be relevant to the attribute of the population under scrutiny.

In each field there are specialist techniques to fulfill the standards specific to different sorts of subject matter, which you learn when you study research methods in the various disciplines of social studies and natural sciences, and in the empirical fields of liberal arts. You need to use different standards for studying the behaviour of chemical elements, for instance, from when you study the behaviour of crop plants, or the effects of a floating currency. And botany, chemistry and economics will involve standards for selecting a sample from a population that are different again from sociology of religion, and from cognitive psychology.

Despite the specialist techniques of each empirical discipline, samples in any research field are evaluated according to rudimentary principles that are accessible even to non-experts; these very basic criteria that apply across the board in every area of research are presented in this section.

Objectives

- To understand what it means for a sample to be sufficient in size, and to appreciate the fallacy of hasty generalizations based on samples that are insufficient
- To know how to see that a sample fails to be representative that is, the sample is biased with reference to the overall population
- To understand what it means to demand that evidence about a sample is relevant to the hypothesis
- To understand what it means to say the evidence is complete
- To analyze faulty samples and be able to spot which of these types of shortfall is to be blamed for its inadequacy

Criteria for good sampling

A body of evidence based on a sample that fulfils the three basic criteria of a good confirmation for a hypothesis about a population is likely to feature:

- A sample which is representative of the population from which it is selected. This means the sample is **UNBIASED** in its standing in for the population.
- A sample that is **SUFFICIENT** in size relative to the population.
- The information collected about the sample must capture all the crucial factors that pertain to what is said about the population in the hypothesis. We say that the evidence must be **COMPLETE**.
- The individuals in the sample and the information collected about the sample should not deviate from the reference class of the hypothesis and from the attribute postulated in the hypothesis. We say that both the sample and the evidence must be **RELEVANT** to the hypothesis.

Here is a brief illustration of what happens when each of these criteria is not fulfilled.

The sample must be sufficient in size

The correct number of items comprising a good sample is dependent upon the subject matter and the conventions in the field of inquiry. To establish or confirm by experiment chemical properties (e.g. melting, freezing, and boiling points) of known compounds, one of two samples is adequate, because the whole infinite population of the compound is homogeneous and defined by these very properties. All pure gold for instance has the same atomic weight and the same melting point. But if a hypothesis is offered about the opinion of all 8,500 students at Logon, or instance, and it is confirmed by a poll that includes only three students, then this sample would be regarded as insufficient and thus fails to provide reliable evidence for a hypothesis referring to the whole student body.

The fallacy of insufficient evidence goes by different names: hasty generalisation and jumping to a conclusion. We will meet these labels in Unit 10. Remember they mean specifically that the number of cases from which a general conclusion is drawn is too small. When an emotional impact causes a person to jump to a conclusion or hastily generalise from their experience, it can be called a case of misplaced vividness.

Activity 2.1 - discussion exercise

Samples that are insufficient

Compare the size of the population with the size of the sample in each case, and explain why the sample is insufficient.

Could these insufficient samplings be due to the fallacy of misplaced vividness? Why?

Example 1: Those students who died in that car crash were found to have been drunk driving. They were members of the Christian Students' Council, returning after one of their weekend spiritual retreats. So that just shows you the rapid decline in morality of the youth in this country.

Example 2: Five of the eleven hijackers who forced the planes into the World Trade Centre were known to be members of the al-Qa'ida network and all of five of them professed their faith in Islam. So you can see that underneath and deep down, all Muslims support terrorism.

Example 3: Our former Vice President and favourite future presidential candidate died last month in a road accident on the way to Accra and he was in a Volvo. His widow is my auntie, my mothers cousin and they have been close since childhood.

So I advise you never to believe the car-safety reports that consumer agencies publish. Volvo car sellers use those statistics in their advertising. But despite what the statistics tell you, I happen to know from experience that the Volvo is the most dangerous vehicle on the road.

Example 4: When I returned from the US and went back to my village I saw my best friend from childhood was dying of AIDS. He went into hospital where he was given anti-retrovirals for six weeks and he started to get better almost immediately while under hospital care, in fact he had never been to hospital before. His recovery had such a profound effect on me; so I am now an anti-aid activist because clearly the protease inhibitor AZT should be prescribed at affordable prices to everyone in Africa who has AIDS.

The evidence must be complete

Reporting about a good sample presented as evidence must contain all the factors known to be relevant to the attribute under study. If information that is crucial to the topic of the hypothesis is neglected, either in the analysis of results or in the presentation of the results, we say the evidence is incomplete. This omission may not be intentional or devious, but the effect is the same: a poorly defended conclusion is the result.

Depending upon the accumulated background knowledge shared by a research community, a sample might be recognised as incomplete because known relevant information has been ignored, or overlooked or left out of its description, either intentionally or unwittingly. Here is an obvious example:

Example 1:

Premise 1. 99% of the Pro-Vice Chancellors of African Universities are male.

Premise 2. Prof. AkuaDolphyne was a Pro-Vice Chancellor of the U. of Ghana.

So Professor Dolphyne is male.

The relevant factor missing from the data provided here about the subject of the hypothesis is the individual's first name, which is an overwhelmingly relevant factor when considering a person's gender throughout the Ghanaian population.

Since 'Akua' is attributed traditionally to women, the absence of this information may account for the erroneous conclusion drawn. In this case the evidence provided was incomplete.

Evidence may be incomplete because of the way it is displayed.

Example2. Suppose I am trying to convince you to invest in my company. I display a graph of the company's earnings. The horizontal axis of the graph indicates the sequence of ... in years from 1970 to the present 2010. The vertical axis displays the amount of earnings, rising with the height of the graph. The graph shows a steady upward climbing line, increasing at a slope of 45 degrees, indicating a steady increase in the company's earnings over the last four decades.

But suppose on my graph the vertical axis is not marked except by the label 'earnings'. So you don't know whether you are looking at an increase in cedis, or in pesewas, or in euros or in pounds sterling. More significantly, the graph does not show what the increments of increase along the vertical axis represent. You don't know if each increment represents 5 pesawas increase or 500 pounds increase. So there is no way to tell if the inclining line represents a significant or a trivial increase in profits over time. An accurate conclusion concerning the significance of the company's financial gains over four decades, and whether it would be a worthwhile investment to buy shares in my company, cannot be drawn.

The evidence is incomplete.

Incomplete evidence is a fallacy that plagues epidemiological research (the study of epidemics) in Africa, in particular the official prediction and explanation of the occurrence of AIDS throughout Africa. The following example has been excerpted, with permission of the rapporteur, from two published sources and from one communique dated 11 September 2000 from a member of the South African Presidential AIDS Advisory Panel to the Panel's Secretary, commenting on a working draft of the Panel's findings, a report that was released in a subsequent draft for public distribution in March 2001.

Example 3. At the July 4th panel session of the Durban AIDS Congress 2000, Dr. Makgoba made a slide presentation and alleged to show the effects that "AIDS" was having on mortality in South Africa and compared statistics from 1999-2000 to those of 1989-1990. He produced a graph that showed a steep incline in deaths from 1989 to 1999, a full decade. He showed that in 1989 the total deaths were approximately 100,000 for the country. In 1999 the total deaths recorded by the government was approximately 360,000.

It was estimated by the presenter that 1/3 of these deaths at the very least were due to HIV/AIDS caused by a retrovirus ostensibly spread through sexual licentiousness.

When asked how the researcher could consciously offer such a hypothesis about a purported epidemic due to the behaviour of black South Africans, knowing that his numbers for 'South Africa' in 1989 excluded the 14.3 million impoverished black South Africans of the bantustan or homeland countries, while the population figures for 1999, (collected during censuses conducted under the post-apartheid regime) included nearly double the number of South Africans included in the census regardless of their colour or their region of domicile, Dr. Makgoba had no explanation.

In this situation we say the evidence was incomplete. This is because the presenter failed to include important and relevant background information about the political boundaries and therefore the population dimensions of South Africa as a whole. In 1989 the population was approximately 22 million, because people who were not white Afrikaans-speaking in South Africa were not counted in the census when they were born and not counted when they died. Ten years later in 1999, shortly after the overthrow of the apartheid regime in 1994, unitary South Africa was installed. So an additional 14.3 million people were suddenly included as citizens of a single South Africa. Suddenly almost twice as many people had entitlement to enter a hospital and to receive professional medical attention. During the apartheid regime prior to 1994, black South Africans were not contained in the national census; neither their births nor their deaths were recorded, any more than the births and deaths of domestic animals. The sudden inclusion in health statistics reveals a great deal about the unsustainable living conditions that had long prevailed in the bantustan regions of South Africa for the majority excluded from voting rights and basic citizen entitlements, including health care, for generations under apartheid. During the proceedings of the July 3rd-4th 2000 AIDS Advisory Panel Session in Durban, another AIDS research expert Dr. Mhlongo repeatedly pointed out for the Panel how the lifting of travel restrictions and the abolition of pass laws³ enabled impoverished people to seek medical attention at facilities like Chris Hani Hospital (Soweto) or Addington Hospital (Durban) where they had been previously denied access, prior to 1994. This too affected the number of people whose deaths were recognised in 1989. Any careful observer of South Africa would expect to see starkly rising numbers of ill people treated at such hospitals in the period 1989 to 1999, five years after the end of apartheid. This was because of the momentous historical changes that had swept over South Africa since 1990, not because of the spread of some inexorable sexually transmitted disease.

Never underestimate how grossly misleading information can be when it is presented in the guise of scientific discourse

Activity 2.2

Spell out the misleading impact of incomplete evidence

1. What conclusion was drawn in Example 4 by the panelist Dr. Makgoba who was giving the presentation?
2. What information was missing in the evidence he presented which the commentary indicates was known and essential to the topic?
3. When the additional relevant information is included, does this strengthen or weaken the hypothesis proposed by the presenter?

Example5: During the proceedings of the Durban 2000 AIDS Congress, Dr. Makgoba cited the number of deaths that had occurred in South Africa during the twelve month period immediately preceding the conference. He then concluded by urging that the audience realise how serious was the crippling epidemic sweeping South Africa. He concluded by stressing the need to teach black South Africans the importance of sexual abstinence in order to stem “the worst and fastest growing epidemic in Africa.”

Political historian Charles Gesheker wrote in his report to the SA Presidential AIDS Advisory Panel Secretary after the Congress proceedings: “a closer examination of the total deaths in South Africa reported for the period April 1999-May 2000, reveals that approximately 360,000 people between age 15 and age 90 had died. But out of a total South African population now estimated at 42 million, this indicates a [per annum] death rate of only eight-tenths of one percent, a rate that is comparable to that of the United States. When I asked. . . upon what basis we were supposed to be alarmed. Dr. Makgoba had no answer.”

Activity 2.3

Explain how incomplete evidence results in misleading conclusions

1. In Example 5 above, what was the conclusion drawn by Dr. Makgoba about AIDS in South Africa?
2. According to Charles Gesheker’s report, what did his assessment reveal about the evidence illustrated in this example that was provided by Dr. Makgoba in his scientific presentation?
3. How might the evidence provided by the presenter be evaluated in light of Gesheker’s observation?
4. What does this suggest about the conclusion that was drawn?

Example 6: In Thailand, by the end of 1987, 200,000 HIV tests were taken with less than 100 positive results recorded. In 1988, 1,000 HIV positive test results were recorded. By the end of 1993, 8,000 cases of AIDS were recorded, and 700,000 HIV positive test results were recorded. It looks as though the incidents of AIDS increased following an increase in HIV positive test results. So we can conclude that HIV causes AIDS.

This passage reveals important omissions of relevant information so it counts as an example of incomplete evidence. Notice that we are not told how many people in 1993 were tested. Since we are not told how many tests were administered, we don't know what the 700,000 figure reveals about the population.

We also cannot tell what percentage or what portion of the population 8,000 AIDS patients represented, because what counted in 1993 as a symptom indicating the presence of AIDS was not necessarily interpreted in 1987 as indicating the presence of AIDS. Prior to the construction of the global HIV/AIDS definition and the ensuing campaign, these same symptoms would be classified according to the various categories of disease and illness they have always indicated (pneumonia, TB, gastro-enteritis, various cancers, *Candida albicans* yeast infection, bronchitis, anaemia, 'slimming' or 'wasting' disease, severe malnutrition) that were by 1993 associated all together as 'opportunistic infections' under the broad umbrella called HIV/AIDS.

Apart from this missing background information about the changing clinical definition determining the changing rate of AIDS diagnoses, the statistics representing the HIV positive test results are also incomplete. Here is why: We are told that in 1987, 200,000 people were tested for HIV, and 100 of these recorded positive, so we know that 1 in every 2,000 people who were tested showed an HIV positive result. But five years later, in 1993, we are not told how many people were tested. So we can't tell what the 700,000 positive test results represent. There was an explosion of HIV testing in Thailand in the early 1990s because so much money was put into marketing anti-retrovirals by the pharmaceutical companies. If five million people were tested in 1993, then that would mean 7 out of 50 people were HIV positive. But this in itself would not indicate an increase in HIV prevalence throughout the population. Because we don't know what would have been revealed in 1987 if five million people had been tested. It could be that the increase in HIV positive results reflects the fact that many more people in the population were getting tested 1993. Or it could be that the increase in HIV testing in 1993 finally uncovered a long established presence of HIV throughout the population that would have been revealed had the testing campaign occurred much earlier. The way to tell if there were an increase in the rate of prevalence would be to test the same number of people in 1993 as in 1987, and then make a comparison between two samples of the same size, and of the same cross section of people in the population, to see if the number of positive results increased or not.

Furthermore, a huge increase in drugs were imported into Thailand throughout the late 1980s and early 1990s. This increase also correlates with the increase in HIV antibody positive test results over the same period. But drug abuse is not studied in Thailand. So a very high incidence of drug use might account for the increase in AIDS incidents, but this is not considered. So it cannot be ruled out as a cause of the HIV prevalence. This reveals another kind of problem with sampling, 'the problem of the hidden variable'. We will see how this can lead to fallacies of reasoning about cause and effect in Unit 9.

Example 7: In the last decade, there has been a sudden increase in the reports of child sexual abuse in our big cities. So we have to think about what to do to curb this terrible scourge of sexual bestiality among adults in the population that is clearly rising over the last ten years. If we don't do something about this, where will it end?

This conclusion ignores the fact that public discussion of taboo behaviour gives victims confidence that if they complain their accusation will be treated as credible and that they will not suffer further humiliation and degradation. So it is possible that the increase in the statistics concerning child abuse may reflect an increase in the frequency of incidents reported over the last ten years, not necessarily an increase in the number of incidents that occurred.

The evidence must be unbiased

To say a sample must be *unbiased* means that it should be *representative* of the population. Notice here that *bias* is a technical term that applies to the sample's relationship to the population. Bias is not used here in its more common sense to mean prejudice or partiality of the researcher.

We are used to the ideal of a representative democracy. So to understand representativeness in the right sense, think of the ways that members of parliament are chosen to ensure that each region of the country is fairly represented by the body in government that creates legislation. Fairness of representation is contestable. Fair representation could mean that exactly the same number of representatives comes from each region despite the size or composition of the region. Or, fairness could require that larger constituencies require a larger number of elected members to represent them.

But some features of fairness are usually regarded as nonnegotiable. For instance, if a population were to be divided into a hierarchy of earned income brackets, so that the people making the greatest amount of money had the greatest number of representatives seated in parliament, or in a system whereby the richest people's votes were given more weight than the votes of poorer factions, these systems would clearly create unfair bias.

Yet not every single feature of every individual in a population can be or needs to be equally represented in the sample. So the question arises, how to tell which features of the overall population are essential to create a representative sample? The answer depends upon the background knowledge concerning the subject matter of research. For this reason, all the empirical sciences and social studies have techniques and strategies that are core to their particular research methods, and these are required of you to learn as a component of your training in that field.

Notoriously, background assumptions that are standard in a particular field may be inadequate because of the state of theoretical knowledge.

For instance in social and cognitive psychological research, until the 1980s, the extrapolation of data about a whole population has depended upon samples comprised exclusively of males. An infamous case of this theoretical error was highlighted in the work of the developmental psychologist Lawrence Kohlberg in the 1960s and 1970s, who mapped the course of what he proposed as normal moral development in humans by relying exclusively on samples of the judgements and behaviour of boys, thus rendering any differences in moral cognition between the sexes as a deviation from *the* norm or a uniform retardation in girls' development.

Another example of erroneous bias appeared in the prediction of the first generation of assays designed to screen blood for HIV. Quoting Christine Johnson, author of "Why the AIDS test doesn't work in Africa" in 2001:

Example 8: Test kit manufacturers "verify" the specificity of their tests (specificity is a measure of how often false-positives will occur) by testing several thousand random blood donors (by definition at a low risk for AIDS or HIV infection), with 20 or 30 subjects thrown in who represent several of the more commonly recognised cross-reacting conditions such as rheumatoid arthritis or systemic lupus erythematosus. The other known cross-reacting factors more prevalent in Africa are not added to the equation.

This practice of omitting Africans from the test sample (either healthy Africans or those with similar non-AIDS conditions that might elicit cross reactions) results in a picture of test accuracy that fits only the type of population in the test sample. This creates severe bias and overestimates test specificity. Constantine stated, "Test parameters thus obtained with this sort of a biased sample cannot be validly extrapolated to assess a test's performance in different diagnostic situations. In other words, an HIV antibody test kit developed in the West will yield different results in Westerners and Africans.

Several techniques are used to obtain representative samples. The use of these techniques does not guarantee that a sample will be representative but does increase the probability that it will be so.

So too, representative samples are achieved in different ways, depending upon the features being studied in the population.

If every individual in the population should have an equal chance of being in the sample, this is sometimes achieved by a method called random sampling, to insure completely arbitrary selection. So for instance if you are selecting a random sample of University of Ghana students for your sample, you might take every fifteenth entry on the list of student ID numbers for those registered in a given year.

On the other hand, tendencies toward bias might result from purely arbitrary or random selections. So creating quotas can correct for bias. This technique is called matching the sample to the population. Quotas are devised for a sample so that its composition reflects the frequency in the occurrence of relevant properties in the general population.

Many considerations have to be brought to bear upon creating a good sample, depending upon the subject matter of research. This is why each empirical discipline has its own principles and techniques for assuring a representative sample.

The evidence must be relevant

It is essential that the individuals in the sample are actually members of the population that is featured in the hypothesis which is inferred from research done on the sample. And the features of the sample that are studied must be those attributes that the hypothesis assigns to the population accordingly. Otherwise the conclusion's truth does not follow inductively from the premises in an argument based on facts about a sample.

Very often when fallacies are obstructing a correct inference from premises to conclusion, the sample and information gathered about the sample appear to be relevant to the conclusion. But on careful consideration you might discover that the figures culled about the sample are only indirectly related to the attribute featured in the concluding hypothesis. This is called the fallacy of semi-attached figures. This is often due to the fact that the sample is not actually derived from the population referred to in the hypothesis, but is somehow associated with that reference class. This is discussed further in Unit 10, Section.

Example 9: During an official query run by the U.S. Health Department, volunteers offered their views when asked about the usefulness of anti-retroviral therapy in countering the AIDS epidemic in Africa. An opinion survey was conducted among those members of the general public who participated in the AIDS Candlelight Service in Pomona New York, on December 23rd 2008. The Candlelight Service was held to fund raise for the Panel on Clinical Practices for Treatment of HIV Infection of the U. S. Department of Health and Human Services. 85.8% of those who took part in the interviews conducted over the course of the evening divulged that they believed in the effectiveness of antiretroviral therapy. So the anti-retroviral nevirapine is the treatment of choice to intercept mother to child transmission of HIV for newborns and their mothers at the point of post-partum delivery, in Kwazulu-Natal, South Africa.

Commentary: Whenever evaluating passages for quality of reasoning, first find the conclusion. In this example, the reference class in the conclusion is the NNRI drug nevirapine. The attribute is that it is the best drug to administer to neonatss and their HIV+ mothers who have just given birth in a low-income coastal province in South Africa. Now look at the information provided as the reason why this hypothesis is likely to be true. The sample involves volunteers taking part in a fundraising function in New York State.

A great deal of detail — time, place, and a very exact percentage to a tenth of a decimal point — is provided about opinions taken among the general public who were involved in this function. Nothing at all is said about any study involving nevirapine, nor about the outcome of administering it to newborns and mothers upon delivery. The sample cited might be associated with antiretroviral therapy, but their opinions are only indirectly related, if at all, with the actual effects of nevirapine. So you can say that the precise statistic is a *semi-attached figure*.

Another way of analysing what is wrong with this argument is that it is an illegitimate appeal to authority. Volunteers at a fundraising event might be experts about raising money, but it does not follow that their expertise can be relied upon to divulge facts about Pharmaceuticals appropriate for prophylaxis in the suppression of immune dysfunction in neonates. We will deal, with this and other types of fallacious rhetorical ploys in Unit 10.

Semi-attached figures are only one type of irrelevancy of data.

Example 10: In a recent two year survey, 75.38% of students at University of Ibadan were discovered to be spiritually motivated. So we can confidently suppose that over 3/4 of Legon students on campus today are spiritually motivated.

Commentary: In this passage, the hypothesis refers to Legon students on campus today. The sample concerns University of Ibadan students. So you can say the sample is not relevant to the hypothesis, it may be that there is no difference between factors in Nigeria and in Ghana, to determine the attribute described. But it would need to be established, and not assumed—as it so often erroneously-is assumed for instance by researchers abroad—that the differences between schooling in Nigeria and Ghana do not outweigh the similarities that impact on the attribute under study. This could also be called ‘pseudo-precision’ which we discuss below and again in Unit 10, section 1 as a type of manipulation of language to misleadingly persuade a listener or reader that what is being said has been well substantiated by rigorous research findings.

This kind of deliberate deflection from real supporting evidence is an indulgence in irrelevancy. Here, one is led to wonder where such an exact percentage could be created to characterise such an elusive and inestimably personal, not to mention unquantifiable, trait as being ‘spiritually motivated’. This application of figures to indicate precise quantities where, to date, no measurement can be feasibly expected, is called pseudo-precision. The preciseness of the figure adds no further understanding of the quality being attributed to the sample. It rather begs the following questions: what measurement could there be that can discriminate this characteristic to such an exact degree as two decimal points? What is the measure of spiritual motivation? If you take away the precise figure and replace it with a vague adjective like ‘some’, ‘most’, ‘many’ ‘few’, etc, no information about the sample is actually lost.

Another example of this kind of abuse of statistics is featured in Unit 10 Section 1, under the rhetorical ploy called the fallacy of pseudo-precision. To appreciate the impropriety of statistical manipulation of data about a sample without sufficient rationale, the example is an extensive quotation of a mathematician who is critiquing the use of inferential statistics and models to defend a widely read political scientist's theories of developing countries.

Summary for Sections 1 and 2

As we observed in Section 1, 'population' in the context of evaluating scientific evidence has a broader and more technical meaning than its everyday sense of referring to the citizens of a nation. In Section 1 you learned that 'population' implies the infinite reference class of a general hypothesis.

What we project accurately about a whole population depends upon what we can observe and measure about a sample of that population. For this reason it is very important for the sample selected to represent a population be unbiased, sufficient in size, and that the information collected is relevant and complete with respect to the attributions being made about the whole population in conclusion.

In general, across subject matters, samples can be evaluated on very basic principles for their adequacy in support of any hypothesis about a specified population. A good sample increases the likelihood that what is true of the sample will be true of the population. To count as good evidence, a sample must be sufficient in quantity, complete in the factors surveyed, unbiased (that is, representative) and relevant to the attribute of the population under scrutiny.

In Section 2 we have witnessed the radically misleading consequences that follow from a poor sample. You learned how to recognise

- the technical sense of population
- different senses of representativeness for a sample
- ways of insuring a sample will be representative of a population
- a sample of insufficient size
- what it means to commit a hasty generalization, or jumping to a conclusion
- the problems arising from biased sampling
- what it means to say evidence is incomplete
- what it means to say evidence is irrelevant
- the fallacies of using 'pseudo-precision' and 'semi-attached figures'

Failing to evaluate or question the quality of evidence referred to in the corpus of scientific knowledge about Africa that is presented as established truth in the global arena and which is distributed to Africa's policy-makers may have serious consequences. In the long run, it may adversely affect Africa's diverse publics. Assessment of arguments based on sampling, even using the most rudimentary and basic of criteria as reviewed in this section, has not occurred nearly as often as it should.

SECTION 3: HOW CHANGES IN A SAMPLE CAN WEAKEN OR STRENGTHEN THE PROBABILITY OF A HYPOTHESIS.

Introduction

Success at critical thinking about arguments based on samples does not demand that you acquire the background knowledge specific to every research result you come across. It demands instead that you are aware that certain questions must be raised and that, if these questions cannot be answered, the strength of an argument is in doubt.

There are a few basic principles that can guide someone who is uninitiated in a particular field, but who has practised critical thinking.

In Section 2 you learned what is needed from evidenced based on a sample: the sample should be sufficient in size; it should be representative of the population; the evidence should be complete and relevant, and the presentation should be free of 'pseudo-precision and semi-attached figures.

Objective

- To practice judging a sample and the quality of support it provides a hypothesis

An inductive hypothesis can be strengthened or weakened by changes in the sample, according to whether the sample is improved through the change by being greater in size, or more representative, or whether it has become irrelevant or whether it is more complete.

Some changes in the data have no bearing to either strengthen or weaken the hypothesis, because they are irrelevant to the hypothesis.

We say that evidence strengthens a hypothesis if it adds to the likelihood of the hypothesis being true. If making a change in the evidence gives less reason to believe the hypothesis than we had before, then we say it has weakened the hypothesis.

Activity 3.1

Judging evidence: strengthening and weakening an inductive hypothesis.

Consider the following enumerate inductive argument based on sampling.

(Evidence): All of the 5,000 swans observed in North America and Europe have been white feathered, and no non-white feathered swans were observed.

(Conclusion): All swans are white.

This hypothesis was sustained by ornithologists in Europe until the mid-1800s when European visits to Australia were documented by foreign scientific expeditions, and black feathered swans were first observed by European ornithologists (someone who studies birds).

Consider whether the confirmation of the hypothesis would be strengthened, weakened or unaffected if the sample were modified in the ways suggested by items (a-e). Take into consideration where applicable the significance of background information.

For each of the changes (a-f) decide if the additional information about the evidence:

(A) Strengthens the hypothesis

(B) Weakens the hypothesis

(C) Has no effect on the strength of the conclusion.

a. Suppose 10,000 white feathered (and no other-coloured feathered swans) were observed.

b. Suppose only female swans had been observed

c. Suppose all the observations were made only during the dry season and

d. Harmattan months in Western Africa.

e. Suppose the 5,000 swans were observed in Africa and Asia as well as North America and Europe.

f. Suppose all the observations were made only on Saturday and Sunday.

g. Suppose only swans under two months old were observed.

SECTION 4: ARGUMENTS BASED ON ANALOGIES

Introduction

Arguments Based on Analogy

Most explanations by analogy are based on systematic observation, like enumerative induction and arguments based on sampling. But the structure of an argument based on analogy is different.

Objective

- To recognise the pattern of reasoning in explaining or formulating hypotheses by analogy

Suppose we are considering item A and want to give an explanation why A has the property Z, or we want to find supporting justification for the hypothesis that A has the property Z. Then arguing by analogy, we can compare items of type A with items of type B as follows.

Objects of type A have properties U, V, W, Y.

Objects of type B have properties U, V, W, Y,

Objects of type B also have the property Z.

Therefore objects of type A have property Z as well.

The strength of an explanation based on analogy depends upon:

- ‘the relevance of the similarities’ among features mentioned in the premises of the argument to the similarity stated in the conclusion of the argument form above.
- One feature U is relevant to another feature Z if the presence of feature U increases or decreases the probability that the second feature Z will be present. Background knowledge is sometimes necessary to make assessments of whether one feature of a thing is relevant to another.
- the number and the variety of instances in the premises.

A larger and more varied sample facilitates recognising which similarities are relevant. If the similar properties mentioned are found together in a variety of otherwise dissimilar circumstances then this gives reason to believe that the connection is not accidental.

... For instance if experiments show that birth-control hormones had an adverse effect on brain development not only in rats but also in monkeys and other mammals then the conclusion that birth-control hormones will have an adverse effect on humans is strengthened.

We have observed one form of argument used in empirical explanations, explanation based on analogy. (Another type is called the deductive-nomological model of explanation, but we will not study that in UGRC 150). In the arena of ‘basic’ research and theorising concerning the fundamental structure of reality, deduction tends to prevail because the subject matter is generally beyond the reach of sampling and manipulation. But analogy also figures into scientific speculation. The two are not mutually exclusive patterns of reasoning. Analogy is an important and powerful tool of argument and thinking about the empirical world. But it does not yield conclusions that are proven to be true. It is a form of inductive, not deductive, reasoning.

Analogies are used in many contexts of scientific research. Quality-control studies depend upon analogy between the sampled cases and the general manufactured lot. In general any statistical argument which depends upon a sample and concludes about a population is based on the assumption that the sample is analogous in its relevant features to the population it represents. Poll-takers rely on similarities between the sample polled and the general population analysed. The practice of giving drugs and other potentially harmful substances to experimental animals and concluding that humans will be similarly affected depends upon assuming that humans and the other tested species are relevantly similar. Analogies are used in making consumer decisions and in adopting policies for development.

The expectation of success in implementing the Integrated Pest Management system of farming practice and agric-extension procedure was based on analogical reasoning by its chief facilitator, Professor Afreh-Nuamah of the Faculty of Agriculture at Legon. He supposed that the farming conditions for certain crops that he witnessed in Southeast Asia were sufficiently similar in relevant respects to those crops grown in Ghana. So he concluded accurately that the alternative of training farmers through a series of workshops, to become chiefly independent of chemical pesticides, as he witnessed in Indonesia, would be likewise successful if adopted here. And he was right.

Analogies used to provide explanations

Some of the most exciting and awe-inspiring empirical explanations are not in any way *a* direct reflection of how things appear to us through systematic observation. Sometimes an understanding of nature defies empirical observations altogether. As an example, consider one that Carl Hempel introduced into the philosophical literature:

From the look and feel of things, what could be more different from the process of water flowing through a pipe than the process of electricity going through a wire? Electrical current may buzz and spark, and if there is enough voltage it can shock one badly (as when using a badly wired electrical socket) or fatally (as when lightning strikes). But typically electric current is inaudible and invisible. Its effects are observable: bright glows in light-bulbs, heat from radiators, electrical appliances—but the flow of current itself is not observable directly. (Indeed ‘electric current’ might best be regarded as referring to a theoretical entity.)

Whereas, flowing water elicits a wealth of sense impressions; indeed, the flow of water is so sensual that it repeatedly has been found worthy of poetic expression or imposed in excess as a form of kinaesthetic torture.

Yet the formulas that express the law-like regularity in the strength of an electrical current through a section of wire on the one hand, and the volume of water moving through a section of pipe on the other, bear a striking similarity called syntactic isomorphism. This label describes the fact that there is a one-to-one matching between terms in the shape (called the ‘syntax’) of the formulas describing these movements.

Syntactic refers to the syntax or the grammatical structure of an expression and isomorphism means an exhaustive one-to-one matching. In other words you can substitute term for term the constituents of Ohm's law, which predicts the strength of current through a wire, and you will thereby express Pouseille's law which describes the flow of water through a pipe! To see this analogy—let K and L represent the factors:

Thus the analogy between the flow of electricity and the flow of water is based on the fact that the formula for calculating the strength of the electric current is syntactically isomorphic to the formula for calculating the quantity of the water flow. But to 'see' the one-to-one similarity between the motion of electrons and the motion of wafer molecules in sufficient number, one has to ignore the observable features of the water in the pipe and the electricity in the wire, and look instead at the structure of the law-like formulas that describe the respective motions taking place inside the water pipe and the electrical wire.

You don't need to memorize this example. It is just used to illustrate how truths of nature are discovered by relying upon analogies. Such symmetries in the designs of nature compel the reverence that scientists are accustomed to experience in the course of their work, not all of which generate from sensory experimental evidence, but instead from the mathematics that describes the phenomena observed. This is an example of what excites Steven Weinberg who discovered a unifying principle relating two of the four known forces, and supports his continuing quest to penetrate the logical structure of the physical world.

Descartes did indeed explicitly warn us 360 years ago that unless we ignore incoming sense impressions, the fundamental truths of nature are doomed to bypass us altogether. But Descartes was neither the first nor the most effective to put this wisdom into practice. The methods of the Pythagoreans and the pre-Socratic cosmoiogists (circa 6th century BC) reflect an understanding prevailing to this day among nuclear physicists and cosmologists, that the most basic truths of nature are observable only to the 'inner' eye, i.e. to the carefully tutored imagination.

False analogies

Sometimes analogies fail. The premises may not provide sufficient similarities, or the similarities considered are not relevant to the conclusion, or significant differences are overlooked despite the many similarities that are considered in the argument. These are all called 'false analogies'.

Example

The following paraphrase is extracted from a debate about foreign relations in the Middle East, broadcast by the BBC Worldservice News on July 8, 2010.

A: United States should stop criticising Israeli officials' behaviour in the occupied territories. After all USA is Israel's strongest ally.

36,000 US tax dollars per year per citizen in Israel goes into supporting that country's defence machinery. If you are somebody's best friend then you stand by them through thick and thin.

B: Certainly not. It's about time the US president began to stand up to the Israelis and express disapproval when they add to the dangerous situation there. A really true friend will tell you when he thinks you are doing something that is wrong. What are friends for?

Activity 4.1

Analysing false analogies

Discuss the debate presented in the example above about Middle East foreign relations between Israel and the USA.

1. State in one sentence what the difference in value judgments is between A and B's view. Make clear the reference class and the attribute class of their respective normative claims.
2. What is the reason provided by A and B for their respective views?
3. How would you evaluate the quality of this reasoning? Are there significant differences between friendship and foreign relations between countries that outweigh their similarities? State some of these differences.
4. What would the appropriate kind of evidence required to defend these respective views about outcome of relations between allied in the Middle East?

II Research exercise. Strengthen your research capacity by finding examples of false analogies in the textbooks mentioned in the references of this course reader, or others in the Balme Library, or online or in newspaper articles or TV and radio talk show discussions. Or make up examples of your own illustrating a false analogy.

Activity 4.2

Recognising arguments based on analogy

Which of the following passages illustrate arguments based on enumerative induction (Unit 7, Section 3); and which of the following illustrate arguments based on analogy? Which are deductive arguments?

1. All the animals we saw in the Accra zoo were well cared for. The buildings were renovated in the 1980s; the government has been subsidizing the zoo; they have collected money from World Wide Wildlife. The Kumasi zoo has also received government money to refurbish its buildings and the World Wide Wildlife Fund also provided money for its upkeep. Hence we can conclude that all the animals in the Kumasi zoo are well cared for.

2. 80% of the patients with cirrhosis of the liver who died in the last five years at Korle Bu Hospital were heavy drinkers. So 80% of the fatal cases of liver cirrhosis are caused by heavy drinking.

3. 90% of the students residing in Legon Hall Annex A are Presbyterian or Methodist, Kofi resides in Legon Annex A. so Kofi is Presbyterian or Methodist.

4 All the students scoring highest on logic exams from 1999-2009 were Muslim. Adam got the highest score in logic in the 2010 class. So Adam must be Muslim.

5. This year, all the highest scores in logic are achieved by Muslims. Paul got the top score in this year's logic final exam. So Paul is Muslim.

Summary of Sections 3 and 4

You have learned how to evaluate the quality of evidence and its impact on the likelihood of a hypothesis.

In both arguments based on sampling and argument based on analogy, the content of the premises and the conclusion must be scrutinized carefully.

You have learned to study evidence for its:

- Relevance to the hypothesis,
- Completeness of information provided,
- Sufficiency in size of the sample,
- Predominance of common qualities in a comparison,
- Faithful representation of the population,

Based on these criteria you can tell if a body of evidence helps to strengthen the basis for belief in a hypothesis, or rather weakens the likelihood of its being true; and you can tell whether features of the research design cited have no impact on the hypothesis.

Assignment 8

This problem set reviews material covered in Unit 3, 6, 7, and 8

Consider the passage in italics and circle the letter corresponding to the BEST option, for evaluating the passage:

1. The Sociology Students Association made a study through the Department of Sociology to see if there was any relation between revealing dress and a breakdown of morality of college women. They discovered through very discrete investigations in Volta Hall that 2 of the women known to have very rich older men as boyfriends, who support them with fancy clothes and expensive holidays off campus, also wear very short skirts and revealing, tight blouses. One of these women is said to have taken a short break from her studies to get an abortion. So clearly we can conclude that this wave of provocative dressing that has hit the Legon campus is corrupting the morality of the students.

A. The conclusion follows from the premises in an enumerative induction based on a good sample.

B. Since the sample is insufficient in size, the conclusion drawn is called a hasty generalisation.

C. The sample is insufficient in size so the argument is called a syllogistic fallacy.

D. Since the sample is irrelevant the hypothesis is said to be biased.

E. The sample is irrelevant since the researcher is clearly biased.

2. In several clinical trials conducted on Kenyans from 2008-2009, it was discovered that protease inhibitors help to prolong the lives of terminally ill AIDS patients. So it would clearly be the best policy for the Ghana Health Service to import protease inhibitors at the earliest opportunity, for distribution as widely as possible for all AIDS patients, including those who have just contracted the virus that causes the disease as well as those who are in a terminally ill condition.

A. This is a modus ponens argument.

B. This is an enumerative induction, based on a good sample.

C. The evidence here describes a sample which is insufficient in size for the population referred to in the conclusion.

D. The evidence here involves an analogy, but the sample is irrelevant to the population referred to in the conclusion.

E. None of the above are true.

3. The difference between a deduction and an induction is that. . .

A. The premises in an inductive argument are confirmed by the conclusion, whereas in a deduction if it is valid the premises prove or guarantee the conclusion.

B. The premises in an inductive argument are always confirmable and never verifiable whereas the conclusion is also unverifiable.

C. The premises in a deductive argument are confirmed by the conclusion.

D. The premises in a deductive argument are particular in nature and the conclusion is general in scope.

E. None of the above are correct.

4. In 1994 a special Commando Squad came on the campus and began firing at people and destroying property in response to a student demonstration. A few years later in September 2003, 15 Commonwealth Hall students took part in a destructive mob action. The police were called on to the campus to break up the inter-hall hostilities. A violent fight between Okponglo Annex and Vandals resulted in two students, one with a broken leg and one with a broken back being taken to 37 Military hospital; a fire was started and property damaged in the Annex—the police were called to stop the rioting. More recently in March 2006, non-registered students came to the Legon campus and helped sustain a rampage to express dissatisfaction after the election of the SRC Executives for the coming academic year. So again the police were called to come and patrol the campus in order to prevent further vandalism and related criminal activity. When Vandals disrupted the 2009 Congregation the police were called in to help defray the mob that was bullying those robed and gathered for the procession. When Vandals and other marauding students disrupted examinations in 2010, the police were called to come on the campus. In all, there may have been more police interventions on the Legon campus in the last twelve years than there have been in the previous forty years since the University was first established.

(A) An enumerative induction

(B) An analogy

(C) A set of instructions

(D) An expression of strong feeling or opinion

Unit summary

A sample can be evaluated even by untrained consumers of scientific claims. Professionals in all walks of life are correct to consider it their ethical responsibility to evaluate scientific claims that are based on samples, according to the rudimentary principles that have been reviewed in this Unit.

Many times you may raise questions that only an expert in the field is equipped to answer. But as a critical thinker and consumer of scientific information, your obligation is to ask the questions. Basic criteria and principles apply across the board to all disciplines of empirical research, and you can challenge and critique from a rudimentary platform of critical literacy.

In so doing you play a key role in leading a strong civic society, which is a requisite for participatory democracy a strong majority determining the course of enlightened and

transformative development to build a strong economy that can serve your country's future generations, not elites that dominate technocratic societies situated far away.

UNIT 9: CAUSAL REASONING

Introduction

We will give the label 'causal argument' to any argument in which the conclusion is a cause-and-effect hypothesis. But we should remember the term 'causal argument' does not refer to any single *form* of argument. (Notice the difference between *causal* which is an adjective connoting 'cause' and *casual* which means informal and is not a synonym for causal).

Concern with causal relationships is prevalent not only in the liberal arts and sciences but also in everyday life. When crops fail, when people fall ill, when economies crumble, when a fight in the neighbourhood escalates, when war breaks out, when the Black Stars lose a match, or when personal relationships improve or take a turn for the worse, we do well or poorly in an examination of the cause. We normally seek the cause or causes that explain what has happened.

Frequently, no evidence is presented in ordinary life to support causal declarations. As critical thinkers, we should be concerned with the quality of the evidence supporting causal claims. In other words, we need to learn how to evaluate evidence to support causal conclusions. We should also be aware of common mistakes in causal reasoning (causal fallacies) so as to avoid them.

This unit will cover the following topics:

Section 1: Different meanings of the word 'cause'

Section 2: Eliminating the reality of causes:

- Hume's classic scepticism about causes,
- Modern views of 'causal' vocabulary as vague

Section 3: John Stuart Mill's methods of causal reasoning

Section 4 Causal fallacies

Objectives

Upon completion of this unit, you will be able to:

- recognise different connotations of ‘cause’
- appreciate the logic of causal reasoning prevails independently of attributing causes to Nature
- methods of defending explanation in terms of causes
- identify common fallacies of causal reasoning

Section 1: Different Meanings of the Word ‘Cause’

Introduction

Our references to ‘the cause’ of some event or condition tend to conceal the complexity of most causal situations. The term ‘cause’ is used in many different ways, depending on such factors as the state of our knowledge and our practical or theoretical interest in a causal relationship.

Objectives

In this section you will learn that a statement which asserts a causal connection can be interpreted to refer to more than one kind of relation. You should be able to recognise that there is a variety of senses that can be intended for the word ‘cause’ and its cognates. But you cannot assume that in every causal statement it will be clear which sense of cause-and-effect is intended. The notion of cause is itself vague, as will be discussed in section 2. Often more than one sense can apply. You just need to appreciate this by recognising the difference between the following different senses. You might come up with a good typical example of your own to keep in mind, in order to keep track of the differences between:

- Proximate cause
- Agent as cause
- Cause as a necessary condition
- Cause as a sufficient condition
- Cause as a collection of independently necessary and jointly sufficient conditions
- Probabilistic cause

Later in this section you will be shown to understand these different senses.

For every effect, it is possible to identify multiple causes

Consider a murder trial in which the defendant is accused of shooting the victim.

The prosecuting attorney is the lawyer in the trial who is interested in showing that the defendant (the person accused of committing a crime) is responsible for the gunshot wound that led to the victim's death. This lawyer would say that the defendant's action was the cause of death.

Suppose in fact the victim did not die immediately he was shot, but was taken to a hospital and then suffocated after an allergic reaction to a drug that was supposed to put him to sleep before the operation that was intended to get rid of the bullet. Possibly if the operation had been successful in removing the bullet, the victim might have lived. But the victim's allergic reaction to the sedative stopped him from breathing before they had a chance to operate. So the medical examiner's report would cite suffocation as the cause of death.

There is no real conflict here: although suffocation was the proximate cause of death (the causal event nearest the occurrence under investigation), there is still the prior fact that the victim was shot, and this is why he was brought to the hospital in the first place. So clearly the action of the defendant, if he shot the victim, was an earlier part of the causal chain that led to the suffocation.

The prosecuting attorney charged with showing the defendant committed a murder is interested in one part of that chain—the earlier portion, involving the shooting—because the law is obligated to determine responsibility for the death, if the person who died was the victim of a murder, which is punishable with severe sanctions. The medical specialist who creates the autopsy report is interested in another part of the chain.

The causal chain of events leading to the victim's death undoubtedly contains many more links than these. Suppose the ambulance that took the victim to the hospital was delayed. Suppose if the victim had reached the hospital earlier there would have been less blood lost from his system, and if he were in better shape when he was given the anaesthetic his body would not have reacted to the drug the way it did. Suppose the delay was caused by traffic that built up on the road to the hospital, which is a chronic problem due to faulty traffic lights on a major thoroughfare of the city. Suppose these traffic lights are neglected by the city administrative unit that is supposed to take care of roads and highway equipment to ensure safety of the public. Suppose the money that was supposed to be used to fix traffic lights is deflected yearly into private building projects of political party supporters that are paid for by the Ministry of Roads and Highways' budget, so the routine road works and traffic light repairs that the money is supposed to be used for are never made.

Consider also at the hospital, the anaesthetist (that is the specialist in charge of administering anaesthetic to ready patients for operations) failed to check the victim for allergies. Suppose the anaesthetist was waiting for the family to come and give him something to help with the extra cost of administering an anaesthetic which would be unlikely to cause the allergic reaction. Suppose money had been promised by phone to the doctor who was waiting for it, but Kwame, the brother of the victim, who was expected to bring the money instead went to a drinking spot for a quick dram to steady his own nerves on his way to the hospital, since he was so upset by the

news of the shooting. Suppose the barman could see that the distraught customer gave him three times what he owed for the drinks he consumed, and since the barman needed the money himself, suppose he waited for the customer to realise the mistake. And suppose when Kwame didn't notice his error but rushed off to the hospital, the barman was at that moment busy doing something in the back room. So the anaesthetist never got his money so he went ahead and used the more affordable and riskier anaesthesia procedure, and the correct cautionary test was never carried out; so the man needing the operation was administered the wrong anaesthetic.

Now consider why the bullet was in the victim in the first place. The shooting may have been provoked by a quarrel resulting from the victim's attentions to the defendant's spouse. Suppose the victim's adulterous attentions might have been encouraged by the spouse herself, who was angry at her husband's infidelity and was looking for a way to make him feel jealous so she flirted regularly with the husband's friends, and one night the victim got drunk and took advantage of the flirtatious wife of his friend, thus inciting jealous rage in the husband, who picked up a gun and threatened his friend, and didn't realise the gun was actually loaded.

All of these events and conditions were a part of the complex causal process leading to the death of the victim. Only a special interest in some part of the complex set of events and processes (such as who is legally responsible or what should be put on the death certificate) leads us to refer to one part of this complex process as 'the cause'.

It is important to realise that in the course of everyday events, most things that happen have many multiple causes such as this, and more besides.

So even this complicated story of the chain of causal events that resulted in the death of this victim is actually oversimplified, for it neglects to take into account various other chains of events that might be interwoven with these and that could reinforce or counteract these events. You can wind the story further to reveal such possible events that contributed to the cause. (Who loaded the gun? Who is responsible for introducing the victim to the friend's wife? What was the barman busy doing? Why was the anaesthetist unable to administer the safer drug to avoid chances of allergic reactions? Who drove the ambulance to the hospital? What was the reason for not taking a different route?) Because it is artificial to rule out any of these events, it seems more appropriate to use the analogy of a 'causal network' of events rather than that of a 'causal chain' of events when thinking about the complete cause. Picking one event out of the complex as *the* cause requires a justification.

Sometimes one aspect of a complex causal process is identified as 'the cause' because that aspect is more susceptible to control than other events. This is usually how the cause of disease is determined.

Yellow fever, for example, occurs when the yellow fever virus enters the bloodstream of a person who is not immune to the disease. The virus, however, is transmitted by the bite of a mosquito, and programs to control yellow fever are usually aimed at eliminating the mosquitoes rather than

controlling the specific virus. The mosquito is usually called 'the cause' of yellow-fever epidemics.

Activity 1.1

Recognising that there different causes for one effect

Consider an occasion when a fire occurs during a big electrical storm and your house burns down. Consider all the different ways that a cause can be determined.

Which of these must be the cause of the house burning down?

- 1 Oxygen in the air and a source of energy (heat from the lightening) so hot that it can ignite the wood that the house is made of.
2. The foreman on the construction site of the house taking the lightening rod and selling it to someone seeking materials cheaper than on (he market, instead of installing the lightning rod on the roof of the house.
3. The contractor failing to check to see that all the materials for the house are allocated and used according to the owners expectations in accord with the contract to construct the house.
4. Your forgetting to ask the contractor if he has checked to see if all the inputs have been used properly.
5. The conductivity of very moist air, without which lightning will not reach your house.
6. The striking of lightning at that particular place and time on that particular day.
7. The weather conditions along the West Coast of Africa that caused the change in barometric pressure in the region prior to the electrical storm.
8. The failure of the Fire Department to come when emergency calls are made to in time to prevent a whole building being destroyed by fire.
9. The payroll check not clearing the day before the storm so that there was no cash available in order to provide the Fire Department staff on duty money to purchase water for the purpose of coming to quench the fire before the whole house burned down.
10. The International Monetary Fund advising governments who borrow from the World Bank to limit the amount of funds they allocate to social service including municipal emergency units of major city bureaucracies including the fire department, the public hospitals, and the water and sewage department.

In some way or other, all the items above can be said to be related causally — remotely or directly—with the house burning down to the ground. This is typical of events and their causes.

We describe this situation by saying that most events are over-determined. When we don't have a very specific way of deciding what exactly is required for an event to take place, then we are able to cite many possible contributing factors. This is the case with most human affairs.

Probably not all of these conditions would be acceptable if one is asked to cite the cause of the house burning down. So how do you choose? What counts as the cause will depend upon your interest and purpose for seeking the cause. Drawing up cause and effect relations depends very much upon human interests.

The different events constitute different types of cause as well. These different types will be treated next. An event or condition that does not fit into one or more of these categories might be recognised as bearing some relation, but not a directly 'causal' relation to the house burning down. How do you tell when a causal relation is justified to make? In section 3 we will consider principles that justify one rather than another event as appropriate to cite as a cause.

There are Many Meanings of Statements Having the Form 'A is the Cause of B.'

Proximate Cause

Bearing in mind the image of a 'causal chain' or 'causal network' of events introduced above, an obvious meaning of 'cause' is a proximate cause—the causal event nearest in time and place to the effect under investigation, in a chain or array of events.

Example 1: The gunshot victim died because his lungs filled with fluid due to an allergic reaction to the anaesthetic and so he stopped breathing.

Example 2: The French Concorde aircraft burst into flames because one of the tires hit a piece of scrap metal lying on the runway during take-off.

AGENT AS CAUSE

In another familiar sense, 'cause' refers to causal agent—whereby the cause is attributed to an individual or corporate entity with an intention, motive, or purpose for bringing about the effect.

Example 1: The gunshot victim died because he was shot by a jealous husband.

Example 2: The fifteen unarmed tribal elders en route to Kabul yesterday were killed in the anti-terrorist bombing campaign waged by the United States.

Attributing causal responsibility to an agent typically presupposes that the agent intended the effect in question. Yet there are many such circumstances where the causal responsibility is attributed to an action but the intention is not.

In the above example, this is effected by describing deaths of unarmed civilians caused by the US bombing as 'collateral casualties' of the anti-terrorist campaign.

Here are two more typical examples of attributing causal agency without attributing intention:

Examples 3: While performing his first by-pass operation, the surgeon became so nervous that he waited too long before finishing and so the patient died.

And in another less obvious example:

Examples 4: The University of Addis Ababa was closed down permanently by the administrators because final year student leaders were damaging property on the campus in their protest rampage against the government's recent policy of censorship and suppression of independent political mobilising.

Presumably the protesters wanted their demonstration to create an impression and cause some change; and presumably it was not this result which the protesting final year student leaders intended to bring about.

'CAUSE' AS A NECESSARY CONDITION

Sometimes the term 'cause' is used in the sense of an event that is required in order for the effect to occur, without which the effect cannot occur. A condition is called 'causally necessary' if the effect cannot occur without that antecedent or coincident condition. The presence of oxygen or another gas that will support combustion, for example, is a necessary causal condition for the occurrence of the house burning down due to the lightning strike.

Example: The victim died because his heart stopped pumping blood for more than ten minutes.

Our attention often focuses on causally necessary conditions when we are interested in eliminating some undesirable effect. When medical scientists are looking for ways to eliminate a disease, they often focus on some necessary causal condition, such as the mosquito carrier of yellow fever. But just discovering a necessary condition is not always enough to satisfy the goal of intervention to prevent an undesirable outcome. No one, for instance, would think of trying to prevent damaging forest fires due to lightning by reducing the oxygen in the atmosphere of populated areas, even though this would be an effective measure. Similarly, to prevent people suffocating from anaesthetics that cause allergic reactions it would not be an acceptable measure to operate on people without anaesthetics. It may not even be acceptable to eliminate those affordable anaesthetics from use for the general public that have a greater tendency to induce allergic reactions.

'CAUSE' AS A SUFFICIENT CONDITION

Sometimes the term 'cause' is used in the sense of causally sufficient condition. This means that whenever the condition is present the effect is present as well. It is important to distinguish clearly the difference between a sufficient condition from a necessary condition.

Examples Exposure to high levels of radiation causes cancer.

This condition is not necessary for cancer to be induced, because there are other known or suspected causes of cancer: hereditary susceptibility, toxic foods, prolonged exposure to chemical toxins, severe stress and prolonged trauma, amyl nitrite drug abuse, certain viruses. Although a sufficient condition to bring about the onset of the relevant cell proliferation, excessive radiation exposure is therefore not a necessary condition for developing cancer.

Example 2: The man died by a gunshot wound near his heart.

The bullet hitting his heart was sufficient to kill him; but it wasn't what we mean by a necessary condition because he could have died in other ways; he would have died if the shot hit him in the head, or if he had been poisoned with arsenic by the jealous husband, or by getting hit by a truck, and so on.

Examples 3: Ingestion of contaminated food causes hepatitis.

Here again, eating food contaminated with the hepatitis bacterium is called a sufficient but not necessary condition because there are other ways of catching hepatitis: you can get it by using a contaminated needle, or by receiving an infected blood transfusion, or by taking nevirapine which is the recently popularised NNRI drug intended to interrupt HIV transmission from mother to child.

Other examples where 'cause' indicates a sufficient condition: decapitation of a person is a causally sufficient condition for that person's death. Atmospheric testing of nuclear bombs is a causally sufficient condition for producing levels of radiation that are hazardous to humans and other animals in the areas near the test sites.

Often when we are interested in producing some desired effect, we look for a causally sufficient condition.

Examples Eating less than 1,500 calories per day for several weeks will cause weight loss.

It is unusual, however, to be able to isolate a single causally sufficient condition. Usually, the term 'sufficient condition' is used to refer to some important causal factor that, against a background of a complex of necessary conditions, is especially proximate, or interesting, or easy to control.

Examples: Bringing water to a temperature of 100° Celsius is sufficient to make the water boil.

This is true, however, only when certain necessary background conditions, such as relative freedom of the water from impurities and normal atmospheric pressure, are operative. When the background conditions are fairly normal, or are not subject to great fluctuation, or are not usually under our direct control, we often ignore them and use the term 'sufficient causal condition' to refer somewhat loosely to an event or process that we can control directly and that, under normal background conditions, will produce the desired effect. A necessary condition emphatically is not a sufficient condition: although oxygen, is necessary for combustion, it is not sufficient; combustion of a material also requires friction or an external heat source.

Independently Necessary and Jointly Sufficient Conditions

Sometimes we refer to a set of causal conditions as being individually necessary and jointly sufficient for some event to occur.

Example: The conditions necessary to cause germination in viable grass seed are: (1) water is applied in appropriate amounts, (2) suitable atmospheric temperature (3) light, and (4) oxygen.

With few exceptions, when all of these conditions are present jointly in the appropriate degree (proportions vary for different types of grass), the combination is sufficient to cause germination in viable seeds. Perhaps only because humans have been engaged in agriculture for thousands of years, our understanding of the cause of seed germination is so definitive. However, even when the causes of some type of event are fairly well understood, it is rather unusual to be able to specify complete sets of conditions that are individually necessary and jointly sufficient for the occurrence of the event.

PROBABILISTIC CAUSE

We may instead be speaking of a probabilistic cause. For example, in the statement: Heavy smoking causes lung cancer. Here, heavy smoking is cited as an antecedent condition whose occurrence makes the presence of the condition under investigation more probable than it would be in the absence of the antecedent condition.

Example: Dental caries, the localised destruction of tooth tissue by microorganisms, is a process familiar to some of you, and this process is well understood by medical scientists. There are three main causal factors: (1) host (saliva and teeth); (2) bacteria (streptococcus); (3) diet (high intake of simple carbohydrates). Experiments have shown that rats fed through stomach tubes do not get cavities even when the caries-producing *S. mutans* is present. Similarly, rats do not get cavities in their teeth when they are fed orally if their mouths are kept sterile. It would seem then that the presence of teeth, microorganisms, and food are individually necessary and jointly sufficient for cavities in rats.

However, rats do not always develop cavities under these circumstances — although they do develop cavities at a ‘normal rate’. Some rats, like some humans, apparently are able to resist cavities better than others.

Example: The presence of teeth, micro-organisms, and a food supply jointly form a probabilistic cause of tooth decay.

These conditions are not a sufficient causal condition for tooth decay. Some further necessary conditions may be specifiable in this case — for example, lack of fluoride protection of the tooth enamel, or genetic susceptibility to tooth infection, or while in the womb the baby may have an acquired susceptibility to tooth decay due to the mother taking antibiotics. *But* frequently the causal network is simply too complex to permit us to identify a complete set of conditions that brings about a specific effect. The effort expended by medical scientists in search of additional necessary conditions for a particular type of event depends largely on practical concerns, such as how much knowledge is necessary to control the causal process, rather than pursuing theoretical concerns, such as achieving knowledge of a set of jointly sufficient conditions

Although diet has received emphasis recently in the study of dental caries, research formerly focused primarily on host factors (fluoride treatment of teeth and drinking water) and micro-organisms (the possibility of immunisation).

Activity 1.2

Discuss the various meanings of cause. For each of the statements below, discuss which senses of cause that may be used.

- a) A proximate cause
 - b) An agent causally responsible
 - c) A necessary causal condition
 - d) A sufficient causal condition
 - e) Independently necessary and jointly sufficient
 - f) A sufficient causal condition against a background of accepted, stable and necessary conditions
 - g) A probabilistic cause
1. Kofi failed the exam because there wasn't enough time to finish it.
 2. Kwame will graduate this June because he passed all the courses he took this year.

3. Patience went to the workshop because Akua invited her to come.
4. Joshua prepared his paper for publication because the organisers chose his contribution to include in the colloquium proceedings.
5. The house burned down because there was a fault in the electrical wiring.
6. The criminal confessed because he was promised a light sentence.
7. The crops are small because there hasn't been enough rain.
8. The plantains were destroyed because of the heavy rains.
9. The train was delayed because a huge telephone pole fell across the tracks in the storm.
10. The oil drilling causes a disruption of the ocean floor and local ecology that is hazardous to the population levels of shrimp and other seafood that have been fished traditionally in the area for generations.

Summary

We have been looking at some of the different ways in which the term 'cause' is used. To summarise these different uses of 'cause':

- proximate cause—the causal event nearest in time and place to the occurrence under investigation, in a chain sequence of events.
- causal agent—the cause is attributed to an individual or corporate entity with intention or motive for bringing about the effect.
- necessary causal condition — a condition that is necessary in the sense that the effect cannot occur without that condition.
- causally sufficient condition— whenever the condition is present the effect is present as well. It usually implies that a background of necessary conditions is assumed, and the sufficient condition is considered to be easy to control, or especially proximate, or noteworthy. This sense of cause is intended when we are interested in producing some desired effect, as when introducing a cure for some disease.
- individually necessary and jointly sufficient conditions —anytime each of the conditions are all present, the effect will occur, and not otherwise.
- probabilistic cause— an antecedent condition whose presence makes the occurrence of the condition under investigation more probable than it would be in the absence of the antecedent condition.

SECTION 2: ELIMINATING THE REALITY OF CAUSES

Introduction

David Hume, Scottish philosopher of the 1700s, is well known for giving reasons why he suspects the very notion of 'cause' is a human construction, a habitual way of organising experience, convenient for the purposes of navigating through the world successfully. Some philosophers argue nowadays that the notion of cause and effect is too vague to take as a term which tells us anything about reality as it is given to us.

Objectives

By the end of this section, you should be to

- appreciate some historical scepticism about talk of 'causes'
- understand why in general the terms of cause and effect today remain vague in everyday and in scientific discourse

Hume's Analysis of Causation

In the eighteenth century, David Hume offered an analysis of the meaning of statements of the general form 'A causes B.' Hume was trying to solve the problem of how to justify causal inferences. For the purposes of simplicity, he analysed the type of causal relationship that held between two rather uncomplicated events (the striking of two billiard balls and their movement after the collision). Hume could find nothing in the ideas of striking and subsequent motion to connect the two events. That is to say, the concepts of 'striking' and of 'motion' are not related in the way that the concept of 'kid' and the concept of 'young goat' are related. When Hume turned to experience for a possible justification of causal claims, he said the features we could observe in such relationships were as follows. Given that A, B are two distinct types of event, A causes B just in case:

1. A is next to B in time and space (no action occurs at a distance).
2. A occurs before B (an effect never precedes a cause).
3. Whenever A occurs, B occurs (event types A and B are constantly conjoined)

The three principles above are called Hume's 'ordinary event model of causation. The first and second criteria reflect the sense of a cause being a proximate event; the third criterion reflects the sense of a cause as a sufficient condition. Hume's model presupposes that causes are deterministic, whereby the effect inevitably follows every occurrence of its cause (constant conjunction).

Hume's model fails to capture many senses in which we recognise causal hypotheses as credible, as we just surveyed. The most advanced theory in physics, for example, presupposes the probabilistic sense of cause.

Hume's sceptical account was an ingenious confrontation with the traditional legacy of Aristotle, whose understanding of causal relations follows deductively from his metaphysics.

Aristotle's account of causes existing in reality

It was Aristotle's metaphysical approach to causation that Hume over a hundred years later, also found damnably objectionable. Aristotle maintained that every entity shares with every other the basic material substrate of all physical reality, but each thing has an essence unique to its kind, and the particular identity of each thing is dependent upon four causes: formal, efficient, material and final. For example, consider a house. Its formal cause is the design or blueprint that determines the shape, layout and dimensions of the house. Its efficient cause is whoever or whatever agency actually executed the house's construction; its material cause is the tin, wood, cement, thatch, mud that constitute the materials used, and its teleological or final cause is the purpose for which the house was meant to be built, e.g. the need for shelter or storage.

Hume's rejection of causes existing in reality

Hume's objection to Aristotle's theory is basically that there is no way to establish the existence of the hidden essence of any thing. On Hume's view these four defining characteristics called causes cannot be demonstrated either, since by definition the 'essence' and the collection of causes that bring that particular essence into existence are beyond anyone's ability to observe empirically. Hume is labelled a strict empiricist because he rejects as idle any claim that is neither inductively testable nor deductively demonstrable.

Modern objections to the notion that causes exist in reality

Some modern philosophers follow in the tradition of Hume when they complain that the vague term 'cause' and its cognates should be regarded as fill-ins or place-holders used in informal talk until these vague terms are eliminated and replaced by a precise description—which inevitably requires mathematical structures and relations, and never the word 'cause'. In practice when scientists know exactly what is going on in a physical process they drop talk of causes altogether and use mathematical functions and equations instead to represent the phenomena.

Recall in Unit 5 that you were introduced to the discovery of natural laws as a goal of empirical sciences. This means that scientists are looking for absolute regularities and uniformities in nature, on the assumption and in the hope that they exist. When these are found, they are expressed not using the term 'cause' at all but using the language of mathematics. Here are three examples that are often referred to so worth being aware of:

Example 1 Newton's thermodynamics (laws of motion)

Remember that in Unit 6 we observed Galileo argued in the early 1600s convincingly by indirect proof that Aristotle's theory of free fall of bodies near the earth was untenable.

To explain the motion of bodies since Galileo's revelation that the notion of cause is not necessary in a theory of motion. Instead, the notion of force was introduced to explain motion an object. Newton condensed this new way of thinking about motion of objects in the 17th century with a definition of force exerted on an object as a product of its mass and acceleration: $F = (ma)$. Three laws were able to cover all observable motion; this definition of force constitutes the first of these laws: (N1) The force exerted on an object is the product of its mass and acceleration. (N2) Every action has an equal and opposite reaction. (N3) A body in motion (or at rest) will maintain its speed and direction (or will remain at rest) unless acted upon by an external force (as defined by the product of the object's mass and acceleration, which is thermodynamic law 1). Motion is no longer conceptualised as a sequence of events so much as a relation between objects.

Kepler's Laws of Planetary Motion Replaces Ptolemy's Picture of the Universe

Another famous example of how the notion of cause was dismissed and replaced by mathematical relationships describing uniformities is Johannes Kepler's laws of motion for the planets which he spelled out in the 1500s. (K₁). Every planet follows an elliptical orbit around the Sun. (K₂) Every planet with respect to the sun sweeps out an equal area over equal time segments during its orbit. (K₃) The square of the time it takes for a planet to pass through a segment of its orbit is proportional to the cube of the mean of its distances from the sun during that time.

One of the magnificent confirmations of Newton's laws at the time they were proposed was the possibility of deductively demonstrating Kepler's laws describing the motions of planets by deriving them from Newton's general laws of motion. The language of cause and effect could never yield such elegant simplification and unification of very different times of event. It is easy in science to give up the terms of cause and effect.

Boyle's Law of Ideal Gases Replaces Causal Talk of Alchemy

Example: The medieval theories about how gases change into liquids, solids, and back again in terms of causes were replaced by an equation that captures an 'ideal' of how substances behave:

The volume of a gas = (temperature /pressure) of the gas in a closed vessel. That is to say, when a causal explanation is adequate the term 'cause' does not appear in it. $5V = T/p$

On the ‘pragmatist’ view, in contrast, a causal explanation is best understood as a strictly practical set of instructions about what to do to stop or to induce a certain effect. Pragmatists believe that explanatory adequacy is not established by the construction of a mathematical equation. Rather, a causal explanation is adequate if it serves the purpose of prevention, cure or provocation of specified effects.

Summary

Our explanations hold up because they follow basic principles of using the vocabulary of cause and effect. In the next section we will learn these basic principles in a rudimentary way. Explaining events and processes with reference to causes is an inductive procedure, and so the conclusion of our reasoning may prove false in future; a better (more precise, or more unifying) explanation may in future eliminate the word cause and its cognates altogether with mathematical formulas. Still, in the meantime, our explanations can serve various needs and interests and purposes — like finding an effective intervention to stop disease, or to prevent natural disaster, or to anticipate a type of event to minimize its knock on destructive effects. So if the explanation we offer has these utilitarian functions, and if it is supportable in terms of these principles that justify asserting a cause exists, then that is sufficient to justify presenting a causal hypothesis as likely to be true.

SECTION 3: JOHN STUART MILL’S METHODS OF CAUSAL REASONING

Introduction

In this section we will learn principles of causal reasoning as formulated by John Stuart Mill in the 1700s methods that he proposed to be used as aids to proposing causal hypotheses. These principles are still in use. Current research in medicine, in social studies, in the study of nature, relies on these foundations.

Although the empirical discovery of causes is an important part of our lives, the logic of cause-and-effect reasoning carries on even though it is not completely clear what is meant by referring to something as a ‘cause’.

We continue to explain events and circumstances with confidence, in our everyday lives and as scientists, even if there is no guarantee that any things exist in nature called ‘causes’, as Hume pointed out (as we saw in the last section).

Objectives

To understand Mill’s methods of causal reasoning

- the method of difference

- the method of agreement
- the joint method of agreement and difference
- the method of concomitant variation

The methods still used today for conducting research into the causes of disease and other noteworthy types of occurrence and recurrence in Nature, were formally spelled out by John Stuart Mill in the 1700s. On Mill's approach we don't need to concern ourselves with what unites all of the different senses of cause. What characterises the special relation between any cause and its effect. None of that matters to the researcher after a particular 'cause.' Mill's methods are strictly practical, and quite ineffective when used in isolation from each other. Just for the purpose of exposition we separate them four kinds - method of agreement, method of difference (also called method of residues), joint method of agreement and difference, and concomitant variation.

But in general practice all the different methods are usually applied to an inquiry and pursued in tandem.

Method of agreement

Suppose a group of tourists have debarked from their KLM flight to Accra at KIA airport, excitedly ready to visit Ghana. But many in the group begin to complain about stomach problems, fever, extreme thirst, vomiting, diarrhoea and headache a few hours after their arrival at their hotel. Those suffering illness all visit a clinic, where the following pattern of investigative reasoning is pursued to discover the cause of these ailments, which we dub E (gastroenteritis symptoms). Suppose an inventory is made of the foods eaten during the flight by everyone with the complaints E:

Let X =: a cheese omelette, U = bacon, V = fruit salad, W = sausage, Y = a bread roll, Z = butter on the roll, T = orange juice, S = cucumber salad.

The method compares the antecedent factors of all the cases that share the effect under scrutiny

E = symptoms of gastro-enteritis (headache, vomiting, stomach pains, diarrhoea, fever, dehydration).

S through Z are items that passengers ate on the plane. These varied among members of the group that contracted the bad symptoms, but in common they all ate the omelette. So this common factor X is concluded as being the cause, or part of the cause, of E. This method does not guarantee that the cause has been found, since there is no telling from the method whether there is not something else not yet considered and left off the list of antecedent conditions that brought about E as well as X. And there is no telling what there was about eating the omelette that caused E. Were the eggs spoiled? Was the cheese spoiled?

Were the eggs contaminated by bacteria from the cut on the cook's undressed finger? Later it was discovered that while some of the omelettes for the flight had been prepared by a cook with an infected finger, other omelettes were prepared by another cook without any exposure to infection. So was the contamination rather due to unsanitary utensils used in making the omelette? Or was the contamination a consequence of poor storage prior to serving the omelette? Or were utensils distributed with the packaged plates containing the omelettes not properly sterilized and therefore contaminated? You can see that it is not possible to *prove* a causal connection, given all these possible variables – there is no way to rewind reality and re-play through the sequence of particular events and conditions that did in fact obtain, even though in some investigations it might be appropriate to reconstruct a sequence of the same type of conditions and events to try to replicate the same results.

METHOD OF DIFFERENCE

Suppose that a couple on the flight were served nearly identical meals. But since the husband is allergic to eggs, he did eat the vegetarian bean and cucumber salad instead, and he gave a few tastes of that dish to his wife. So the food they ate was identical in variety, except for the omelette that the wife alone ate. The husband did not get sick, the wife did.

Case	antecedent	circumstances	effect for which cause is sought
1. (Wife)	X, Y,	S, T, U, V, W	E occurs
2. (husband)	Y, S, T	... U, V, W	E does not occur

Notice here that the only difference amongst the antecedent circumstances between E occurring and E failing to occur on this occasion was the presence of X (eating the omelette) which occurred in with E. This may mean that unless X occurs, E fails to occur. Of course, we do not know this, we are inferring it from the one instance where this was the difference observed between E occurring and E not occurring. So by the method of difference the data suggests that X is the cause or an indispensable feature of the cause of E. The method of difference is still inadequate since the real cause might not be listed in the antecedent circumstances considered so far, in which case the method would not be able to detect the real cause.

Joint method of agreement and difference

Case antecedent circumstances event or condition studies

i-h	X, S, T, U	E occurs
i-n	S, T, U, V	E does not occur.

Here the cases that have the effect under scrutiny are grouped together, and the cases that do not have the effect (in our example, the people on the aeroplane who did not get experience any illness).

The letters S - U represent foods that were eaten by everyone on the plane who turned up for the inquiry. The letter V stands for an alternative food other than X (either an omelette prepared by a different cook or another dish altogether). V is a difference between the two groups but it is not judged to be the cause of the illness because persons who ate V did not get present any symptoms. So although this is a difference between the two groups' food intake, it is not a difference that is indicated by this data as causally related to the effect in question.

The joint method is important for establishing a cause. If you just have two individuals in your sample, one with and the other without the effect in question, then there is no telling whether any detected difference in the antecedent conditions between them is related to that effect or not. But if one such antecedent factor is shared by several other cases where the effect also has occurred, then the likelihood of a causal connection is very much increased.

Method of concomitant variation

Cases or groups antecedent circumstances effect or condition studied

- | | |
|-------------|------------|
| 1. X+, Y, Z | E+ (or E-) |
| 2. X-, Y, Z | E- (or E+) |

Sometimes the suspected causal agent under investigation cannot be eliminated from any of the cases. Neither the Method of Difference nor the Joint Method of Agreement and Difference can be applied in such situations. If, however, the condition or event under study varies in degree or strength from one case to another, then the method of concomitant variation is a useful tool for justifying causal hypotheses.

For example, consider the causes of high blood pressure. In the United States a hypothesis was proposed that high blood pressure is exacerbated in regions where the soils have very low levels of selenium. Selenium is a metal found in tiny quantities in all soils.

Since selenium exists in some amount in all soils there is no way to contrast the effects where it is present with effects where it is absent. This fact rules out the applicability of the method of difference or the joint method of agreement and difference. So the method of concomitant variation is used, whereby cases are classified according to the severity or degree of strength of the antecedent condition. The death rates related to hypertension in states where the soil is selenium-poor (Connecticut, Illinois, Ohio, New York, Oregon, Massachusetts, Rhode Island, Pennsylvania, Indiana, Delaware) are three times greater than the rates in selenium-rich areas in nine Western states. It was noted that in Arizona the percentage of deaths due to hypertension was 41% lower than the national average. Individual cases were divided into severe and mild categories, or into three categories (severe, mild and moderate).

The letter X above represents the antecedent condition that varied in strength — either positively or inversely in relation to the effect under study. Here the death rate due to hypertension decreased directly as the selenium content of the soil increased. So a causal connection was hypothesised between the amount of selenium ingested through the local food chain and prevention of fatalities due to hypertension.

Another example: the method of concomitant variation was used for investigating fatal levels of air pollution from SO₂ in London from November 29 to December 16, 1952. There is no way to eliminate sulphur dioxide from any city's atmosphere anywhere so the only way to study this causal connection was to compare the increase and decrease of the effect under study (number of deaths per day) with the daily variation in amounts of sulphur dioxide fumes in the atmosphere from various sources. A positive correlation was noted, and in consequence a causal connection was hypothesised between sulphur dioxide emission levels and the daily death toll.

Activity 3.1

Examples of causal reasoning

For each item (i) identify the condition or event for which the cause is sought. Be sure to decide whether the effect is a specific occurrence or a rate (relative frequency of a specified kind of occurrence), (ii) identify all antecedent circumstances mentioned in the example, (iii) state which of Mill's methods is being used. (iv) identify the cause, according to the use of the method(s).

1. The use of a new anti-viral drug called 'ara-A' is tested in the treatment of herpes simplex encephalitis. Of 28 cases of the disease, 18 received ara-A and 10 were given an inert substance, for ten days. Five people in the first group died, and seven in the second group died. Thus the mortality rate of the

2. Untreated group was 70% and the rate of mortality for the group treated with 'ara-A' was 28%. So this new drug is very effective in protecting sufferers from herpes simplex from its sometimes fatal effects.

3. Alzheimer's disease is a serious form of senility that afflicts between five and ten percent of all persons over age 65. Recently, researchers discovered that patients who die of Alzheimer's disease have much smaller amounts of a particular enzyme in the cortex of their brains than persons the same age who do not suffer from the disease. The loss of this enzyme activity has been suspected as a cause of the lesions found on the brains of Alzheimer's patients. In post-mortem examinations of five Alzheimer's patients and five people without the disease, it was found that all the diseased patients had lost neurons from the nucleus basalis in the brain, while all the people without the disease had the normal number of cells in this area. Scientists who conducted this study believe that the loss of neurons from the nucleus basalis may be responsible for the decreased enzyme activity in the cortex.

4. It was thought at the time of Francesco Redi that there was “spontaneous generation.” Supposed evidence for this was the appearance of worms on meat after a few days. Redi observed that not only worms appear but also small objects (he called them “eggs” though they are pupae) and many flies appear. Redi wrote: “Having considered these things, I began to believe that all worms found in meat were derived from the dropping of flies and not from the putrefaction of the meat.” He then tested his hypothesis by eliminating the flies. First he sealed meat in a glass, and then he covered the glass with fine gauze netting which would not allow flies to enter. Even after many days no worms were seen, though in an open glass the meat had become wormy.

5. Johannes Fibiger, a pathologist in Denmark, found three rats that suffered from stomach cancers when he was studying dead tubercular rats. This was strange, since rats rarely suffer from tumors of the stomach. Fibiger queried the dealer who supplied him and found that these rats sent to the laboratory had come from a sugar refinery. He investigated the refinery and found a high infestation of cockroaches, which formed a fairly large part of the rats’ diet. Cancer as a disease of filth had been spoken about for years, and vermin were said to be responsible for the so-called cancer houses, private homes from which emerged many human cancer victims in the same family. Fibiger planned a controlled experiment. He collected

6. Thousands of refinery roaches and fed them to rats from another breeding establishment. The rats enjoyed the diet for three years. When they died, he performed post-mortem exams and found many stomach cancers. Fibiger discovered in every case the growths had formed around a parasitic worm, which was first in the roach before it was fed to the rat. The worm larva lived in the muscles of the rat, later found in the rat’s stomach. Around this the tumor grew. Fibiger had actually for the first time produced artificial cancer in a laboratory animal.

Summary

John Stuart Mill (1806-1873) offered in his *A System of Logic, Methods of Causal Reasoning* which constitute the first systematic summary of the way an experimental inquiry into causes should be conducted.

SECTION 4: CAUSAL FALLACIES

Introduction

Many of the errors in making causal links can be spotted by careful consideration. Passages may represent more than one type of fallacy, kinds of error are not mutually exclusive.

Objective

- Recognising examples of error in causal analysis

- Post hoc ergo propter hoc (Latin: “after this, therefore because of this”) — concluding that just because A occurred before B, A must have caused B.

Example: Every morning I eat maize cereal. This morning I had kenkey instead, and later this afternoon I got a perfect score on a class test that I was afraid I might fail. So from now on, to ensure that I get good grades, I need only be certain to eat kenkey for breakfast on the day when I write an examination.

Commentary: Perhaps there is some enzyme or other ingredient in fermented and steamed cornmeal, which has been confirmed to keep one alert and to improve concentration and memory, but this has not been mentioned in the reasoning. In any case eating fortifying kenkey would not in itself be sufficient or necessary to cause good performance on exams: one has to learn the material, prepare for the exam with proper revision, have gotten sufficient sleep, use the exam time efficiently, and so on.

Confusing cause with effect — making a mistake in judging the direction of cause and effect between two events or conditions that are indeed causally connected.

Example 1: In my hometown we were plagued by lice every year. But whenever I got sick, I never had any lice on me. And the same with my friends, the only time they had no lice at night was when they were sick with fever. So to this day, to keep away illness, I always make sure I have lice on my head every night before I go to bed.

Commentary: We are told independently of this passage that parasitic lice prefer a healthy host; and perhaps an elevated body temperature during a fever repels the lice from an acutely sick host. This shared background knowledge might provoke us to laugh that someone thinks it is the presence of the lice that keeps away the illness, and not the other way around.

Example 2: A mould (*aspergillus flavus*) is caused by letting groundnuts spoil; the mould produces in turn highly toxic substances known as aflatoxins; these chemicals can cause cancer when ingested.

Commentary: In fact it is the mould growing on the groundnuts that causes the spoilage by a discharge of the highly toxic aflatoxin. Letting groundnuts spoil does not cause the mould to grow.

- Ignoring a common (underlying) cause — there may be a correlation or regular connection observed between two conditions or events, but this is not sufficient evidence that one is the cause of the other. Some further condition or event may be responsible for both.

Example: All the women on my floor in my Hall at University who are doing very well in their courses have CD players and video tape decks. So in order to get good grades, all I have to do is somehow find enough money to invest in getting a CD player and a video deck.

Commentary: Owning a CD player and video tape deck indicates that the student may be financially well off, and this in turn may suggest that there is money in the family that might have financed the quality of the student's education and her study habits throughout her school years. So the students who have CD players and video tape decks may have been comparably financed to receive vacation classes, extra tutelage, books and time to concentrate on their studies exclusively, thereby doing well throughout their schooling, a trend which continues in their university careers. The CD and video decks are symptomatic of an underlying cause that also brings about the effect of good performance on exams and in class.

- Genetic fallacy—circumstantial facts about the antecedent conditions under which a theory was produced (when, where, and facts about its producer) are mistakenly taken as an indication of whether the theory is true or false.

Example 1: This new policy that will determine students' maximum credit load per semester was proposed by a committee that did not include any students. So clearly it cannot address the urgent needs or the best interests of students.

Example 2: The theory that we are expected to memorise is the most recent received view, proposed by an American Nobel Prize physicist who worked with the greatest nuclear physicists at the best laboratories in the world during the 1960s. So the theory must be true.

Activity 4.1

Determine the type of causal fallacies that are represented by the passages below.

1. I had sex with this boy that my parents didn't like so we are not going to get married. Then I got very sick with a cold that turned into pneumonia and I didn't see him for a long time. Later I learned he was also sick. So I know that I got sick because I had sex with him.

2. The last time I saw the tro-tro pass by my Hall, this 'anywork' young man was fetching water from the tap. This morning again, the same working boy was fetching water and again the tro-tro came along right at that moment. Last week when the same young man fetched water quickly for another student who hired him, the same tro-tro came right away. So if ever you | want to board the tro-tro without wasting time waiting for it to come, you should just ask that boy to go fetch water.

3. This community has some very sick individuals in it, and they have no lice in their scalp. Everyone who is healthy here has lice in their scalp. So if you want to be healthy, be sure to carry a full load of lice in your hair and that way you will never get sick.

4. There is ample evidence to prove that having very badly yellow-stained fingers causes fatal lung cancer. I know this because every corpse with advanced lung cancer that I examined as a medical student had yellow stains all over the first and second fingers of one hand, usually the right hand.

5. Serena lives in this Township and her husband is a truck driver who returned just last week from a long trip overland. Serena has not been feeling well for a long time; now she seems to be dying; she is losing weight very fast, she is very weak, and always has a fever, and has constant diarrhoea. So she must have AIDS which she surely caught from her husband who must have gone with prostitutes on the road.

6. My friend's partner recently died of tuberculosis, which was masked for a long time by other symptoms. They lived together for many years but were not married. Now my friend is losing weight and is very sick. Many people with TB test positive on HIV tests. So she must have HIV.

7. Mental health experts in Boston have conducted a 17 year study involving almost 1,000 individuals. Results were reported in the latest issue of Neurology that 22% of depressed patients went on to suffer dementia. Researchers discovered that two episodes of clinical depression doubles the likelihood of the onset of the neural degeneration disease known as Alzheimer's disease later in life. Only 17% of people with dementia showed no signs of depression earlier in their lives. So I keep telling my older sister that she should watch her negative attitude and count her blessings more often; because if she keeps lying around the house without taking care of herself and complaining all the time without ever smiling, she will eventually make herself really sick and pretty soon she won't even be able to recognise her own husband or remember who her friends are.

8. My roommates both have laptop computers and they both got As in their 300 level courses in philosophy. So if I want to do well in this course I should get a laptop computer as soon as possible.

Summary

We have studied several types of fallacy of causal analysis: the mistakes known as:

- Post hoc ergo propter hoc (after this, therefore because of this)
- Confusing a constant correlation with a causal connection
- Overlooking (ignoring) a common (underlying) cause
- Confusing cause and effect

Assignment 9

Choose the best answer of the alternatives for each item:

A. State which of the following must be the case if A is a sufficient condition for B:

1. Whenever A occurs, B occurs.
2. Whenever A fails to occur, B fails to occur.
3. Whenever B occurs, A has occurred already.
4. Whenever B fails to occur, A has failed to occur.

B. State which of the following has the danger of resulting in the fallacy of confusing a correlation with a causal connection:

1. Method of Agreement
2. Method of Concomitant Variation
3. Joint method of Agreement and Difference
4. Method of Difference

C. On the basis of your general knowledge, state two 'sufficient' conditions for each of the following:

1. Scoring in football
2. Getting a red card in football
3. Getting expelled from university
4. Finding a spouse

D. State a necessary but not in itself a sufficient condition, against a background of other stable conditions, for the following:

1. Moving forward in the World Cup tournament to the semi-finals
2. Getting a first class honours degree at the University of Ghana
3. Being a citizen of Ghana
4. Voting for the presidential candidate in Ghana

E. The Joint Method of Agreement and Difference is a way of determining.

1. That particular event A is necessary for the particular event B to occur.
2. Whether B was always destined to occur.
3. Two things: that event A is a sufficient condition for event B, and that event of type A is a necessary condition for an event of type B to occur.
4. Whether more people agree A is the cause of B than the number who differ in their view of the connection between A and B.

Unit summary

We have examined techniques that are used to justify proposing particular causal hypotheses about how to discover causes. These principles not be misconstrued as a general prescription for the discovery of causes. We have also examined why people have had reason to doubt the existence of cause/effect relations as anything independent of our way of speaking about events. Justification of an hypothesis depends upon the logical relationships among our thoughts, and need not presuppose anything metaphysical about how the world is independently of our thinking about it.

Whether discovery of the cause of a particular event or observable process is a recognition of a relation occurring in nature, or if it is a projection of our minds which helps us organize our impressions of what is going on in nature, producing evidence to support a causal connection has its place. Though such hypotheses we are able to understand phenomena to some degree, along the way toward realizing mathematical relations between observable and measurable occurrences. There are practical benefits to these principles as well: identifying causes according to John Stuart Mill's methods has been useful over generations in finding ways to intervene and prevent undesirable effects, and to help as well intercede to evoke desirable effects.

We have also studied particular commonsense fallacies that occur routinely in determining when an apparently striking correlation between two types of event, or a one-off association between two occurrences, does warrant assuming a causal relations exists.

UNIT 10: POLEMICAL TRICKS AND RHETORICAL PLOYS ('INFORMAL FALLACIES)

Introduction

When the premises of an argument fail to support the conclusion but not because it fails to fulfil a particular logical form, then the error is neither a deductive fallacy nor an inductive fallacy, but is sometimes called an informal fallacy.

Forms you have learned are either deductive or inductive—where the rules of inference apply to every step in thinking. You saw four valid deductive forms in Unit 6; in Units 7-9 you were introduced to good inductive forms, for drawing conclusions based on analogy, on samples, on statistical hypotheses, on enumerative induction, on methods of support causal hypotheses.

When an apparent argument eludes all these forms it may be neither inductive nor deductive, but created with the intent of persuasion. Then the discourse is called rhetoric, and the reasoning is called rhetorical. If the speech is designed to argue a point with the intent to manipulate the listener or reader into believing there is a legitimate basis for dissent but in fact provides none, then the argument is called polemic and the reasoning is described as polemical.

This unit will cover the following topics

Section 1: Fallacies of manipulating language

Section 2: Fallacies of changing the subject

Section 3: Fallacies of manipulating the data

Objectives

Upon completion of this unit you should be able to recognise the following types of polemical (informal) fallacies and rhetorical ploys:

- Equivocation
- Circularity (begging the question)
- Mathematical mystification
- Grandstanding (appeal to masses, appeal to consensus)
- Ad hominem (eulogistic and dyslogistic)
- Genetic fallacy
- Illegitimate appeal to authority
- Appeal to threats or force (appeal to consequences)
- Appeal to emotions (vanity, pity)
- Fallacy of misplaced vividness
- Semi-attached figures (statistical irrelevance)
- Hasty generalisation (insufficient evidence)

The Classification Scheme Adopted is not the important Point of Classifying Fallacies

Subdividing these types of informal fallacies into distinct categories is done as a matter of convenience only and as an aid to understanding these labels. It is not important that the distinct categories of fallacy be well defined. These types of fallacy may as well be classified in some other way. Moreover you will find hundreds more if you look hard enough in the literature. Similarly, these very common types of fallacy go by many different names; the particular label you select to use is not very important. Latin names are impressive; but unless you understand which labels can be used in their stead they are not of much use.

In fact each apparent argument that you encounter in this Unit or elsewhere that falls short of providing a good reason to believe its conclusion is almost always prone to several 'informal' or rhetorical fallacies, not just one. *There is usually more than one way to correctly interpret the faults of a passage that attempts to persuade you to believe something but evades the rules or the forms of either inductive or deductive logic.* So long as you explain the label you are using then your analysis of an informal fallacy will be useful.

The best way to understand what these labels mean is to find an example of the fault each one describes in a way that makes sense to you, and stick to that as a prototype to remember. Then when you find that type of manipulative tactic in a passage you will recognise it.

If a passage contains more than one type of fallacy, which most passages do, the question arises about which is the primary or most fundamental type of fallacy. (This may be on your mind if you are going to be examined on the material in this Unit.) In that case, list for yourself all the fallacies that appear to be glaring initially. Then correct for each in turn. If you clear the problem of appeal to pity, for instance, but the premises still fail to provide a good reason to believe the conclusion, then you know that appeal to pity was not the primary or most fundamental problem with the passage. Continue to adjust the premises to correct for the different types of informal fallacy that you detected from the outset, until you have an argument which does give a good substantive basis for believing the conclusion, and does not just persuade or motivate such belief through verbal trickery. The last type of fallacy you corrected will have been the one that was the most offensive in the passage. That is how you can know you have found the primary fallacy in the passage.

In general, however, there may not be any primary fallacy; this is because shortfalls in human reasoning and psychological motivations to believe cluster together without any priority. Most often, more than one fallacy may be responsible for making a conclusion seem acceptable, without any way to adjudicate between the types of tricks being played. So long as you can explain your criticism, in most contexts that will suffice to do the job of evaluating the argument's flaws.

SECTION 1 FALLACIES OF MANIPULATING LANGUAGE

Introduction

If one is unable to provide a good inductive or deductive basis for believing a conclusion, a common deviation from logical reasoning is to motivate the listener or reader by a number of ploys. This can involve manipulating language to give the impression of saying something which actually has not been expressed nor established.

Objectives

To understand the kinds of rhetorical fallacy which are various ways of changing the subject unwarrantedly and deflecting attention from the actual subject matter of the conclusion, in order to motivate confidence in the conclusion through psychological manipulation or a play on feelings

- Equivocation
- Circularity (begging the question)
- Pseudo-precision (mathematical mystification)

Equivocation

In Unit 3 Section 3.3 and again in Unit 5 you encountered the notion of equivocation on the concept of law. Some books call this manipulation the fallacy of ambiguity.

Example: Look at almost every country's criminal code and you will discover that sodomy is outlawed almost everywhere. Obviously homosexuals are violating laws of nature when they engage in sexual activity with members of their own sex. If you break the laws of Nature, then Nature has a way of punishing you. So is it any wonder that in the 1980s HIV caused so much death and destruction among the gay community in California? And don't Africans have something to learn from this example of Divine retribution? If you break your covenant with God by going against Divine law, His wrath will come upon you.

In this example, how many connotations of 'law' are appealed to? Is the sense used in the conclusion the same as the sense used in the premises? The shifting of the subject from scientific or natural law to criminal law to divine law creates the impression that the conclusion follows from the premises. The second sentence also commits an equivocation in its own right, since Nature cannot punish anyone for breaking a natural law. Return to Unit 5 and read about the meaning of natural law if this is not clear to you.

Example 2: I don't see why women are always complaining that they do not enjoy the same freedoms as men do. It's a free country; so what's the problem?

Everybody in Ghana here is free to do what they like. Take education for instance. In Ghana the constitution says everyone has a right to free education. Basic education is free, universal and even compulsory for all.

So if the young lady wants to go to school then all she has to do is walk in the door and she is in school; is anyone putting a gun to her head to tell her she cannot enter the building? She is free to go. Everybody is free to do whatever they like. Women should stop their squawking and go to school if that is what they want to do.

In this example, the central equivocation is on the notion of freedom. It is used in three senses here. To say that everyone is free to do whatever they like in Ghana because Ghana is a free country first of all is an equivocation and it is also false; it equivocates between being free as an individual to act in any way at all with impunity, and being a country governed by rule of law and not suppressed under a military dictatorship. The second clause is true, but the first is an illusion. People are held to account if their actions are offensive or illegal. But even if it were true for some people that they are free to do as they please, this is a different sense of freedom than being free to exercise one's constitutional rights. Similarly being free from coercion or free from obstruction is not to be free in the sense of being capable or empowered to exercise one's rights.

In this passage the speaker is shifting between talking about being free in the negative sense of not being obstructed (no one is holding a gun to your head to stop you) and freedom in the positive sense of being released from obligations to the family, having sufficient money to afford the fees, the uniform, the books and the time to attend school regularly.

The speaker commits a second equivocation on the phrases 'to be in school' and 'to go to school'. To be free to enter the building ("no one is holding a gun to the young lady's head so if she wants to go in, she can go and be in school") is not the same meaning as intended by 'being in school' as an ongoing status of engaging in the activities of a pupil attending school long enough and in a way that yields a certified education.

The campaign to support women's enjoyment of equal freedoms does not concern freedom from obstruction, although that is a factor as well. It rather concerns freedom to act in the sense of providing women the *capacity* to do what men do: that is, provide them the social support and financial resources to enable women to enroll and attend an educational institution, for instance, long enough to benefit by gaining a certificate.

Activity 1.1

Analysing equivocation

Discuss or write out the ambiguities that are used in order to draw by equivocation the conclusion that drawn from the premises in this passage.

Every young person craves freedom. People as they grow older seek freedom from the burdens of their family and job. But it is only through Bondage to God that a man or woman can find freedom from the cares of this world.

So when you join my church and obey the dictates of my pastor, you will find the freedom you desire, by giving yourself up to his commands; that is, whenever you bind yourself to him mentally and do what he bids you to do without question, only then will you be free.

CIRCULARITY (BEGGING THE QUESTION)

This type of fallacy was encountered in Unit 2 when it was encountered in poor definitions. It also arises when a passage gives the impression of explaining or justifying with words that are repetitious of those used to describe what is being explained or justified. You are caught in a vicious circle in the sense that the argument provides no way of breaking out to get any insight about the topic raised in it; you simply go “round and round”.

Examples 1: The belief in God is universal because everyone believes in God.

Example 2: Moral correctness is illustrated by doing what is morally correct.

Example 3: Free international trade will be good for this country. The reason is obvious: it is very clear that unrestricted commercial relations will bestow on all sections of this nation the benefits which result when there is an unimpeded flow of goods between countries world-wide.

Example 4: The Government should sell off their manufacturing firms and their public utilities. This is because if the government owns its manufacturing plants and utilities like water and sewage, or electricity, which are all public utilities, then it will be following a socialistic *policy*.

Example 5: God exists. How do you know? Because the bible says so. How do you know that what the Bible says is true? Because the Bible is the word of God!

Example 6: The university authorities should leave the Hall to carry on according to its traditions, and do as it always has done in its enrolment policy and in its resident status and the infrastructure should be left alone. Nothing should change; because that will be in the best interests of the student body and the country at large.

Form S. Morris Engel (1982) pp. 114-116.

Activity 1.2

Analysing cases of circularity and begging the question

1. For each of the examples 1-6 above, underline the word or phrase in the consequent clause of the statement or the consequence of the passage which is repeated in the statement's antecedent or in the premises. Identify why the circularity is 'vicious'.

2. In Example 4 and 5, locate the conclusion, and explain how the premises fail to explain or justify it, but instead beg the question. What particular question is begged in each of these examples?

Pseudo-precision

Many people have undergone poor and sometimes traumatic numerical training in their early years; the result is that otherwise very intelligent and highly educated people tend to be uncomfortable or self-conscious around quantitative descriptions and analysis. Another consequence of numeracyshyness in the general public is that people are easily cowed or subdued by discourse that contains a lot of mathematical flourishes. When presented with detailed percentages or mathematically technical jargon, people tend to shut down their critical distance and just accept what they are hearing on the grounds that since it is mathematically supported, the source must have been very detailed and precise in generating the information posed in such a numerically involved way. This is called mathematical mystification. It will be useful to return to Unit 8, Example 10 to see an example of pseudo-precision.

Here is an excellent and informative critique of an extensive case of the fallacy of pseudo-precision appearing in political science. The case was mentioned in Unit 8 Section 2 where the problem of irrelevancy of evidence in arguments based on sampling was discussed. A case of pseudo-precision can also be identified as a semi-attached figure. Below, you will discover the deliberate obfuscation of a political scientist's opinion being criticized vehemently by the late mathematician Serge Lang of Yale University:

Example 1: S. P. Huntington's *Political Order in Changing Societies* (Yale University Press, 1968) is one of his most famous books, and was one of three books offered as evidence of Huntington's scientific contributions when he was nominated to the National Academy of Sciences. In this book Huntington purports to deal with changing societies, especially developing countries, their political order, and the factors entering in this order. I shall now describe the broader context for the classification of South Africa as a "satisfied society" in Huntington's book. One person (non-academic) who tried to read the following material when it was circulated in draft stopped reading after a couple of pages with the comment; "This is over my head." But indeed, I regard this material as a pompous and pretentious tissue of pseudo-science. I hope readers will not be stopped by it, but will refer to the material widely available in the international press as needed for documentation. On page 55 we find the following passages in which Huntington discusses developing countries:

"The political backwardness of the country in terms of political institutionalization, moreover, makes it difficult if not impossible for the demands upon the government to be expressed through legitimate channels and to be moderated and aggregated within the political system. Hence the sharp increase in political participation gives rise to political instability. The impact of modernization thus involves the following relationships:

Social mobilisation

(1) _____ = Social frustration

Economic development

Social frustration

(2) _____ = Political participation

Mobility opportunities

Political participation

(3) _____ = Political instability

Political institutionalisation.

The absence of mobility opportunities and the low level of political institutionalization in most modernising countries produce a correlation between social frustration and political instability. One analysis identified 26 countries with a low ratio of want formation to want satisfaction and hence low “systemic frustration” and 36 countries with a high ratio and hence high systemic frustration.” Of the 26 satisfied societies, only six (Argentina, Belgium, France, Lebanon, Morocco and the Union of South Africa) had a high degree of political instability. Of the 36 dissatisfied countries, only two (Philippines, Tunisia) had high levels of political stability. The overall correlation between frustration and instability was 0.50.”

When Huntington summarises his own book elsewhere he himself refers to the “relationships” as “equations,” when he writes:

The impact of modernization on political stability is mediated through the interaction between social mobilization and economic development, social frustration and nonpolitical mobility opportunities, and political participation and political institutionalization.

Huntington expresses the relationships in a series of equations (62) (p. 314, footnote 62 refers to his book).

Thus Huntington writes of himself in the third person, and the “equations” are those listed as (1), (2), (3) above.

As Koblitz has observed, Huntington does not inform the reader in what sense these are equations. How does Huntington measure ‘instability’, ‘social frustration’, ‘social mobilisation’? Abbreviating the equations in the form are we allowed seventh grade algebra to conclude that $A = BC = BDE = BDFG$,

i.e., that “social mobilization is equal to economic development times mobility opportunities times political institutionalization times political instability”? And Koblitz remarks: “Huntington’s use of equations produces effects-mystification, intimidation, an impression of precision and profundity . . .” Huntington fails to define just what these terms mean, or how he dealt with them quantitatively. In particular, how is one to take the sentence: “The overall correlation between frustration and instability was .50.” What is the meaning of the two decimal figures?

In Huntington’s book *Political Order in Changing Societies* there is no discussion of how numbers were assigned to vague notions like frustration and instability. As far as I am concerned, the sentence from this book quoted above is nonsense. Huntington gives similar “correlations” to two or three decimal figures, in more than a dozen instances pp. 39-57 (of his book) so the one I have mentioned is not an isolated example:

Summary

There are many ways to manipulate language in order to cast a convincing spell on a listener. Just three strategies were discussed here, called equivocation, begging the question (circularity) and pseudo-precision.

SECTION 2: FALLACIES OF CHANGING THE SUBJECT

Introduction

A very powerful way of motivating belief in a conclusion, rather than providing good deductive or inductive reasoning to warrant believing it, is to deflect attention from the content of the conclusion and talk about something else which has a known emotive impact and persuasive power. In other words, to generate a mood of acceptance for the conclusion in the listener’s or the reader’s mind, a change is conjured in the subject matter between the premises and the conclusion. Instead of focussing on the reference class and the features attributed to that subject matter in the conclusion, the premises talk about something else which provokes the desired response.

There are very many ways to talk about something else; here are some common types of fallacy that all follow this deliberate effort to detract from the absence of good evidence or from a deductive demonstration that would logically warrant accepting the conclusion.

Objectives

To differentiate and recognise by example:

- Grandstanding (appeal to masses, appeal to consensus)
- Ad hominem (eulogistic and dyslogistic)

- Genetic fallacy
- Illegitimate appeal to authority
- Appeal to threats or force
- (appeal to consequences)
- Appeal to emotions (vanity, pity)

Grandstanding (appeal to the masses, or appeal to consensus)

Here the subject changes from what is asserted to the conclusion and whether it is likely to be true (premises providing inductive evidence) or whether it must be true given other statements are true (premises providing deductive demonstration). Instead the premises talk about how very many people believe the conclusion or otherwise embrace it. Given the human tendency to be conformist in our beliefs and attitudes, we are easily motivated to believe or embrace a conclusion ourselves when we learn that many other people have done so. We even become afraid to challenge a belief if it is advertised widely enough as a given 'self-evident' truth. (For an essay about the prevalence of this tendency in technocratic societies, see the Appendix to Unit 12).

Examples: At the Durban 2000 AIDS conference, a petition was signed by 5,000 medical workers, community activists, NGO campaigners for human rights, ordinary citizens, television celebrities, UN goodwill ambassadors, and doctors from all over the world, which declared their conviction that HIV causes AIDS. Then the petition was put on the internet, and another 300,000 signatures appeared over the course of fifteen days. So clearly HIV causes AIDS.

A causal hypothesis about the factors that are necessary and sufficient for the onset of acquired immune deficiency syndrome requires research that investigates the syndrome and antecedent conditions that might be regarded as causes. It also requires the method of difference to establish that in the absence of these factors, AIDS does not occur. It also requires testing rival hypotheses about the causes of AIDS so that by a process of elimination, hypotheses that are clearly contra-indicated by the known evidence are discarded in favour of one that withstands all the available tests conducted so far. That is how a scientific hypothesis is established provisionally.

Example 2: The indicator of administrative success in this decade is owning a new Jaguar. Ten years ago the status symbol was driving a new Mercedes Berz. Everyone has got a Jaguar now who can afford it. Therefore it must be the best car made which is on the road

Examples 3: The Black Stars failed to get to the semi-finals because they are all selfish: the key players who have had the opportunity to get contracts outside care more about money than they

do about playing for their own country. Those that played in the World Cup were only playing for themselves and for the TV cameras, hoping a talent scout will notice them; they don't play for the team. Ask anyone.

Activity 2.1

Correcting for grandstanding

1. In examples 1 -3 of *grandstanding* above what is the conclusion?
2. State what is given as the basis for accepting the conclusion.
3. Consider what sort of evidence would be required instead for logically supporting the conclusion in each of the examples above. .

Ad Hominem

In this type of rhetoric, instead of focussing on the content of the conclusion, the premises dwell on facts about the person (literally in Latin, *ad hominem*) who is advocating the conclusion.

If pleasant and laudatory facts are cited about the individual responsible for or associated with the conclusion, then the fallacy is called *eulogistic ad hominem*. *Eulogistic* is the adjective cognate of *eulogy*, which is a praise song or poem. Nice facts about the person proposing a conclusion motivates the listener to approve or believe that conclusion.

If the facts cited about the person associated with the conclusion are negative and detracting from the person's integrity or worthiness of confidence, then the fallacy is called *dyslogistic ad hominem*. This adjective might be easier to remember if you recall that in current slang, to say negative things about another is said to be 'dissing' that person.

Example 1: That student wearing the T shirt saying 'Peer Teacher: STOP AIDS!' in Legon Hall has been hired by an NGO to counsel students about AIDS and sexual relations especially on campus. I believe what he says about the terrible consequences that you might die if you have unprotected sex or even sex outside marriage. It must be true, because he is so smart and gets really good grades in his philosophy courses, the philosophy teachers like him which is how he got the job, and his father has been an Evangelist for over ten years and has been on TV and even preaches overseas; moreover my father knows his uncle very well.

Example 2: You cannot believe this Deputy Minister when he says the new health care policy is going solve the needs of the country. His brother-in-law was involved in a law suit against a hospital where his wife died, and he was found guilty of not paying taxes in 1985 on some property that he owned, just at the time when he was speaking out against the government's health care policy; not only that, but he has never supported Hearts of Oak.

Examples 3: The most important thing for Ghana today is to ensure a stable political and social environment to attract foreign investment and to increase foreign exports of basic commodities needed in the global economy. That way, the government will build up tax revenue and the nation will be stronger. This must be so since it was the message of the USAID representative who came and gave the Congregation Address in 2000. That man used to be the director of AT&T, which is one of the biggest multi-national corporations in the world and a major contributor to the World Bank. His family is also very wealthy.

Activity 2.2

Recognising the change in subject matter in an ad hominem fallacy

1. What are the conclusions of these examples?
2. What are the facts provided in the premises in these two examples?
3. What is the reference class of these premises?
4. Has the subject changed between the premises and the conclusions?

Illegitimate Appeal to Authority

In this deflection of attention from the content of a conclusion, a particular type of facts about those associated with supporting it is featured, namely, the individual's or group's authority or the basis of their prestige. The problem is that the area of their authority or prestige is different than the topic in the conclusion of the argument. Some people confuse this type of fallacy with ad hominem, because a person's authority is a fact about him or her. But it is not a personal fact about their character, individual tastes and behaviour, or their personality, or personal connections, friends or family. Appeal to someone's authority is an appeal specifically referring to his or her public persona and reputation based on what they have achieved in their career, not the way they are known to the speaker in a private capacity.

Example 1: HIV causes AIDS, it must be so; since George W. Bush created a whole programme titled Presidential Emergency Plan For AIDS Relief (PEPFAR) and he is the president of the most powerful military force in the world.

Example 2: The reason Structural Adjustment Policies in the 1980s did not work is because African leaders are corrupt and inept. This certainly must be true since it was the explanation provided by the prestigious Bob Geldorf, the producer of Live Aid and a selected member of the UK Prime Minister's Commission on Africa. He is quoted by an interviewer for African Farmer, a magazine published in Washington DC and distributed in Africa.

Examples 3: This economic policy cannot be worth anything since it was criticised by the novelist who authored it. The Constant Gardener, recently made into a film which won the Cannes Prize.

Example 4: This is certainly the best automobile available on the market. Just look at Michael Essien's official website and notice the car he has chosen to buy; he can afford any car he wants but this the brand he picked. So that proves it.

Examples 5: The Executive Committee of the National Council, of Churches unanimously approved this new food crop programme as an environmentally sustainable policy so clearly it should be implemented immediately.

Activity 2.3

Analysing the change in subject matter in illegitimate appeal to authority

1. For each of the examples 1-5 of illegitimate appeal to authority, state the conclusion. Identify the reference and attribute classes.
2. What is the reference class of the premise(s) in each example?
3. What would be the appropriate focus of research to collect evidence that might inductively or deductively support the conclusion in each case?

GENETIC FALLACY

In another closely related fallacy of changing the subject matter, personal facts about the private lives, or the character or individual behavioural traits of the people associated with a conclusion or a policy are not the sort of facts dwelled upon. Instead it is impersonal circumstantial facts about where the conclusion comes from or *when* it was created, or other antecedent conditions which prevailed at the time and place the conclusion was produced. This could be accomplished by mentioning the nationality of the conclusion's author, as if this fact alone is a basis for believing or rejecting a proposition. When premises convey strictly geographic and temporal details about the origin of a conclusion are misleadingly proposed as an indication of whether it is true or false, the argument has committed the genetic fallacy. The fallacy obtains because *every* conclusion originates at some place and time, so these facts in and of themselves is no reason to approve or reject one conclusion rather than another. It is necessary to spell out *why* facts about the genesis of a proposition—why its being created at that time and place or under the conditions noted—are likely to confer improbability or likelihood on the conclusion; otherwise merely stating these facts constitute a fallacy.

Example 1: This new policy that will determine students' maximum credit load per semester was proposed by a committee that did not include any students. So clearly it cannot address the urgent needs or the best interests of students.

In example 1 above, it is not stated why the composition of the committee has anything to do with the credit load policy being a benefit or a deficit for students. Research would be required to see what the outcome is for students under different grading policies, the long term impact on their career options and outcomes, the difficulty of achieving the thresholds that distinct policies entail, and so on. Facts about the membership of the committee cannot in and of itself constitute a basis for speculating about the impact of the policy.

Example 2: The new undergraduate system is a copy of the American University system, so it must be an improvement over what we had before.

Examples 3: The new undergraduate policy concerning the number of electives required to graduate was developed by a committee which contained no students. So the policy cannot be a good one for the quality of students' education or their welfare.

Appeal to Threats or Force or Fear (appeal to consequences)

A very obvious way of trying to motivate someone to do something is to threaten the person with physical injury, or to warn of adverse future consequences if they don't do what you want. Coercing you to believe or to accept a conclusion by shifting the subject to what will happen if you don't believe or accept it, is called in Latin *argumentatum ad baculum*. The negative consequences need not be directed at you specifically for the fallacy to be committed; because it is assumed that by changing the subject to such threats of impending negative consequences you will be impacted as the listener or reader in a persuasive way. So fallacies that appeal to threats, or to force, or to fear, or to consequences (positive or negative) all fall into the same category of manipulation in place of providing good reasons. This is such a significant problem in so many aspects of our lives, that Units 11 and 12 are specifically focused on techniques and skills to combat against the tendency to be manipulated in our decision making by people prepared to take advantage of our vulnerabilities, our need for approval, our need for acceptance and for social recognition.

Example 1: It is clear that the US plan for oil drilling off the coast of Ghana are the way forward for this country. If you do not agree with it, this shows that you are against development of our country and that you don't like the American way of life. If you interfere or protest against their activities, you could be taken for a terrorist like those Nigerians in Ogoniland who were put in jail and executed for challenging the activities of the big oil companies in the Niger Delta. And you know what happens to people like that.

Example 2: Our student leader has our best interests at heart. Otherwise he would not have been elected into office to represent us. If you don't support his programme for resisting the university authorities then people will take you for a coward or a toady who always sides with the university authorities. Then you will never have friends and later after you graduate you won't be able to get a good job in town.

Appeal to pity (or to vanity and other emotions)

Similarly, changing the subject from what is stated in the conclusion to tap into various feelings and psychologically vulnerable tendencies of listeners and readers are further examples of the fallacy of appealing to something other than your reasoning capacity, and thus constitutes providing you a motive to believe the conclusion, but not a good logical basis for believing it, inductively or deductively.

Example 1: Nkosi Johnson, 11 years old, made the keynote speech for the opening ceremony of the 13th International AIDS Conference in Durban. Just look at how sweet and innocent he is, doomed to die in only a few months, yet so courageous and selfless. And indeed he died within that same year. So certainly whatever he said about how the most important thing to do for Africans with AIDS is to administer anti-retroviral drugs must be true.

Examples 2: HIV/AIDS is a terrible disease which is sexually transmitted. How can you deny the truth about such a devastating fact of so many poor and destitute African children's lives? Can't you feel for the poor AIDS orphans who are forced to grow up alone, hungry, themselves doomed to die early due to this terrible plague, through no fault of their own, but only because their thoughtless and brutal male relatives cannot control their insatiable and savage sexual impulses.

Summary

The fallacy of changing the subject matter can be committed in several ways: One is when personal facts about a person are used to motivate believing or rejecting a declarative statement about the world that the person being praised or condemned has endorsed.

Be careful about when you apply the criticism of *ad hominem*. Students tend to overuse it carelessly when they offer their own examples of the fallacy. Sometimes you *do* need to rely upon the character traits and behavioural tendencies and personal reputation of a person, in order to make practical decisions about what you are going to do. For instance relying upon facts about an individual should inform whether or not you vote for that person as your representative in school or in government, or whether you want that person as a close friend, a colleague, a boss or employee, or a spouse.

Other ways of deliberately providing motives for believing a conclusion rather than good logical (inductive evidence or deductive proof) reasons to believe it is true, include appealing to emotions, threatening that in the absence of the desired belief bad things will occur, deflecting attention to popularly attractive or repugnant facts about where the conclusion originated, drawing attention to the celebrity or prestigious credentials of people associated with the conclusion indiscriminately, drawing attention to the fact that many people believe the conclusion.

SECTION 3: FALLACIES OF MANIPULATING THE DATA

Introduction

All of the fallacies focused upon in this section have been presented already in the last section of Unit 8, when you were introduced to fallacies in arguments based on sampling. It is advisable to go back and re-read that section in your study of informal fallacies and rhetorical persuasion.

Objectives

To recognise these types of fallacy

- Fallacy of misplaced vividness
- Semi-attached figures (statistical irrelevance)
- Hasty generalisation (insufficient evidence)

Misplaced Vividness j

This kind of error in thinking involves deflection of attention by focusing too much on a particularly traumatizing or sensational and provocative instance. We have discussed this already as the fallacy of insufficient evidence in Unit 8. Whether such a deflection of attention is catalogued as a case of appeal to emotions like pity or fear will depend upon the way words are used in the premises.

Remember in any case that the labels you are mastering in this Unit are not mutually exclusive; there is likely to be more than one way to describe a manipulative effort to change the subject and thereby give a motive rather than a reason to believe a conclusion.

Example 1: Why are women always complaining about economic inequality? There is plenty of economic equality. The former Prime Minister of the UK was a woman; the former Head of the Biochemistry Dept. at Legon was a woman, and so was the former Pro-Vice Chancellor. Also the current President of Liberia is a woman. USA has a woman as its Secretary of State. So there really is no economic inequality between men and women. The problem is just a figment of the average woman's jealous imagination.

Example2: I saw one of my friends dying of AIDS and at first he refused treatment because he was afraid of what people would think. For his whole life he never saw a conventional doctor nor went to a clinic. Finally he went into hospital and stayed there for the first time, where he was given anti-retroviral for one week and then after some weeks he started to feel better while under hospital care. Then after four weeks he died. So clearly the anti-retroviral should be prescribed to everyone all over Africa who has AIDS.

Semi-attached Figures

One way of intimidating listeners and readers is to overwhelm them with numerical details that give the impression a conclusion has been meticulously researched. But on the contrary, sometimes these mathematical flourishes deflect attention from the subject matter, if they are attached to attributes or qualities that do not lend themselves to precise measurement. For a very comprehensive example of semi-attached figures, the critique supplied by Serge Lang of Samuel Huntington's theory of apartheid South Africa as a 'satisfied' society provides insight into the spurious use of mathematics.

This does not suggest that quantifying properties is a bad thing to do. The question is whether mathematical modeling is reflecting the reality on the ground, or whether it is used rather as wallpaper to obscure the human condition it is purportedly representing.

For example, there may well be a difference in the religious attitudes of students in Legon and students in Ibadan, and it may well be important to find out what factors are responsible for this contrast. Sociological methods may require statistical analysis. But there has to be a basis for attaching percentages to qualities. It cannot be assumed that adding mathematical descriptions adds anything to an understanding of the phenomena described:

Examples 1: Ghanaian university students are more mature than Nigerians; recent studies reveal that they have a higher level of moral character than students enrolled in Nigerian universities. A research team from Boston College discovered that at Legon, over the 3 year period 2001-2004, 75.3% of enrolled university students were spiritually motivated. But in Ibadan over the same period, only 58.7% of the students were found to be spiritually motivated.

Sometimes the propriety of quantitative analysis is appropriate, but the sample is not relevant to the conclusion, so the figures provided are only partially relevant to the conclusion. So this example, which is a version of one that was offered in Unit 8 to illustrate irrelevant evidence, could also be criticized as an appeal to semi-attached figures:

Example 2: During an official query run by the U.S. Health Department, 1,204 volunteers offered their views when asked about the usefulness of antiretroviral therapy in countering the AIDS epidemic in Africa. An opinion survey was conducted among the 845 members of the general public who participated in the AIDS Candlelight Service in Pomona New York, on December 23rd 2008. The Candlelight Service was held to fund raise for the Panel on Clinical Practices for Treatment of HIV Infection of the U.S.

Department of Health and Human Services. 85.82% of those who took part in the interviews conducted over the course of the evening divulged that they believed in the effectiveness of antiretroviral therapy. 13.2% of the participants did not take part in the survey. 57.8% of those who took the survey were women.

So the researchers concluded from the survey that the anti-retroviral nevirapine is the treatment of choice to intercept mother to child transmission of HIV for newborns and their mothers at the point of post-parium delivery, in Kwazulu-Natal, South Africa.

Hasty Generalisation

This fallacy was introduced as a problem encountered in arguments based on samples that are too small to represent the population referred to in the concluding hypothesis of an inductive argument. However the same problem occurs more generally when samples are not formally introduced in the premises.

Example 1: Two of the women on my floor in Volta Hall are known to have very rich older men as boyfriends who support them with fancy clothes and expensive holidays off campus, also wear very short skirts and revealing, tight blouses. One of these women is said to have taken a short break from her studios to get an abortion. So clearly we can conclude that this wave of provocative dressing that has hit the campus is ruining the morality all over the campus.

Example2: I lived with a roommate from the Eastern Region and all the time there was a question about who was using my things. There were six of us in the room; it caused a lot of tension. I will never room with anyone from the Eastern Region again.

Examples 3: *I can't believe the grade I got in this course; my friend said the same thing; she is a year ahead of me and she took the same course with the same lecturer and couldn't believe how tough the examination was. I am getting out of this Faculty; I can't deal with such tough lecturers. It's not worth it.*

Examples 4: During the break I didn't want to cook so I went to the local market for some waakye. But it wasn't very wholesome. You could tell it wasn't freshly made. So I'm never going back to that market. None of the caterers there is trustworthy.

Summary

The fallacies that were encountered with size of samples also infect our everyday thinking in ordinary situations. The nature of prejudice and other rigid forms of thinking are based upon hasty generalisation.

Assignment 1

Identify one or more informal or causal fallacies that are exhibited in these passages.

1. All the boys I know are more demanding than their counterparts in Nigeria; they have a higher expectation of their girlfriends and they are less likely to trust their partners when they get married as well. Social scientific research proves this: At Legon, 74.23% of university males today are emotionally demanding of their girlfriends. But in California, only 58.27% of the students were found to be demanding and insecure with their girlfriends.

2. This new policy intended to determine students' maximum credit load per semester was proposed by a committee that did not include any students. So clearly it cannot address the urgent needs or the best interests of students.
3. The theory that we are expected to memorise is the most recent received view, proposed by an American Nobel Prize physicist who worked with the greatest nuclear physicists at the best laboratories in the advanced countries during the 1960s. So the theory must be true.
4. This public health policy cannot be any good and therefore it should be rejected by the Board of Trustees. I know this because the policy was developed by a sub-committee of the Board and I know the chairman of that sub-committee. In fact he is my cousin so I know him very well. He is a very ambitious business man looking for a way to make a lot of money and he is just interested in promoting his own career.
5. I visited hospitals in South Africa where there were adults wasting away who were the first members of their family who in living history had ever seen the inside of any medical institution and who was treated with conventionally manufactured medicines. But the TB was too advanced for him to recover with the drugs available. This cemented in my mind the fact that there is an unprecedented HIV/AIDS pandemic that is sweeping Africa, most intensely in South Africa.
6. The Hearts of Oak are the best team in football played in this country. I know they are the best team because they will win the next MTN trophy. And they will win the trophy, because they are the best team in the tournament.
7. This policy cannot be any good because it was developed by the World Bank and IMF joint committee, which is based in Europe, so certainly the people involved in the planning must be exploitive and inhumane when it comes to Africa.
8. My roommates both have laptop computers and they both got As in their 300 level courses in philosophy. So if I want to do well in this course I should get a laptop computer as soon as possible.
9. Last time I raised my hand in class the lecturer completely ignored me. There was no chance to ask my question, even though he had told us at the beginning of the semester to ask questions. So I am never going to raise my hand in that class again, just to be looking like a fool. I don't know what he has against me, but that is what he wants to do.

Unit summary

A critical thinker will not be duped if armed with an awareness of the different ways there are to provide a motivation to believe a conclusion instead of being provided good logical reasons to believe that conclusion.

UNIT 11: PROBLEM SOLVING AND FACTORS THAT INFLUENCE PROBLEM SOLVING

Introduction

Dear student: We have finally come to the very last Unit of this course which is on Practical Solutions. It has been a long journey but I congratulate you for reading up to this point. I hope you have enjoyed the course from the very beginning.

In the first section I will discuss how we solve problems. In other words, we are going to discuss the process through which you figure out how to reach your goals, starting from your current state. You may define problem solving as an attempt to achieve a goal in a situation where there is a barrier that seemingly prevents the goal from being realized.

Human beings are problems solvers and we solve a variety of problems all the time. Think about these examples: “I want to pass this psychology paper but Mensah has borrowed my lecture notes”. “I want Jennifer to notice me at the party, how should I arrange for it?” “I am trying to prove this theory, how do I do it based on the stated premises?” “Consider Apollo XII, the first successful attempt to land man on the moon.” These are all examples of problems we face every day; some of them we confront rarely. You will have noticed that some problems are trivial, but solving them have implications for our survival and social recognition.

Some problems that we will be looking at are well defined, which means that such problems are clear from the start and you know what you are supposed to accomplish and what your choices are. Other problems we solve everyday are more diffused or ill defined. For example, problems like ‘what is the best way to educate children in our society?’ You can see clearly that in this type of problem, there could be a lot of debate about how to define our goal or what choices we have in reaching the goal. We will also be looking at other problem classifications as routine and non-routine problems, adversary and non-adversary problems and the creative process in problem solving.

We will proceed to examine the various approaches we usually adopt when problems are identified and solutions are envisaged.

This unit will cover the following topics:

Section 1 Types and approaches

Section 2 Factors that influence problem solving

Objectives

Upon completion of this unit you will be able to:

- classify different kinds of problems as obstacles to your goals
- recognise distinct stages of reaching a goal
- utilize specific methods for identifying a problem
- identify appropriate solutions
- understand obstacles to problem solving
- appreciate ways of overcoming obstacles

SECTION 1: PROBLEM SOLVING –TYPES AND APPROACHES

Introduction

Several researchers have found it important to compare problem-solving to a process of a search — a search as if you were navigating through a maze, looking for a path to enable you to reach a goal. Some of the paths in the maze will lead you to realize the goal of getting out, while others will lead to dead ends or will result in wrong turnings. Some of the paths in the maze are direct, others are long and overstretched, while others may be blocked.

This idea of problem solving as a search was central to the thinking of Newell and Simon (1972). For these researchers, problem-solving starts with an initial or start state, which includes the knowledge and resources you have at the outset that helps you to work toward a goal state. In addition, the problem-solver has a set of operators that may be described as tools or actions that can change your current state, in other words, the operators help the problem-solver to move from the initial state to the goal or end state. In the process, there is likely to be a set of path constraints which present as blocks to reaching the goal. Now if you consider the initial state, the operators and the constraints, there could also be a number of intermediate constraints that may lead to the creation of sub-goals, en route to the main goal.

The processes described so far constitute the problem space. In other words, you may describe problem-solving as a search through the problem space. A large problem space (from start to finish) can make solution to a problem difficult while a small problem space enhances problem solution. For example, if you are absolutely certain that you left your phone in your room, the solution to the problem (finding your phone) can be easy because the problem space is small. But if you are not sure where the phone was left, the problem space in this case is large and the solution (finding the phone) can be amazingly frustrating and difficult.

Objectives

At the end of this section, you should be able to:

- describe problem solving as a cognitive process
- classify problems into broad categories that are well-defined or ill-defined
- list other typologies of problem solving
- discuss the various approaches to solving problems

CLASSIFICATIONS OF PROBLEMS

Researchers have found it convenient to classify problems faced by problem solvers. An especially important one is the distinction between well-defined and ill-defined problems (Reitman, 1965).

WELL-DEFINED PROBLEMS

A well-defined problem is one in which the initial and goal states as well as the operators and actions needed to move from one state to another can be specified. Such problems have:

1. Clearly defined start state
2. Clearly defined goals

If the problem is well-defined, every proposed solution can be evaluated against the criteria implied by the goal, if the proposed solution matches the criteria implied by the goal, the problem is solved.

If the criteria have not been achieved the problem is not solved. For example getting to the football stadium from your house in time for the kickoff is an example of a well-defined problem.

It could be seen that a correct answer exists for a well-defined problem. In word puzzles, an anagram (word or phrase rearranged to form another word or phrase) is a good example of a well-defined problem. For example, if you are asked in an anagram problem solving to rearrange CLEPOMX into a word, the initial state is the configuration of the letters. By applying operators and rearranging the letters, the goal state that is an English word **COMPLEX** is derived. Other examples of well-defined problems include finding the value of the unknown in the equation $48 = y/3.2$.

There are three common types of well-defined problems (Greeno,1978).

1. Problems of Inducing Structure
2. Problems of Transformation
3. Problems of Arrangement

PROBLEMS OF INDUCING STRUCTURE

Such problems require a person to discover a pattern that will relate elements of the problem to each other, (i.e., look for elements of the problem and how they relate to each other). An example is that of verbal analogies such as:

- a. Chimney is to house as is to ship.
- b. University of Ghana is to Accra as is to Kumasi

A person solving this problem must understand that a chimney is a structure designed to allow smoke and carbon to escape safely from a fireplace in a house. With this knowledge, a problem solver can properly produce smokestack as analogous structure for a ship and Kwame Nkrumah University of Science and Technology as analogous for Kumasi.

PROBLEMS OF TRANSFORMATION

With this type of problem a person must manipulate objects or symbols in accordance with certain rules in order to obtain a solution. A characteristic example used to illustrate this type of problem is the well-known Tower of Hanoi problem.

Unit 11 Problem Solving and Factors that Influence Problem Solving

Instructions

Transfer the three disks from the first peg to the third peg, moving only one disk at a time and never placing a bigger disk on top of a smaller one. Try to determine the number of moves until goal state is achieved.

Problems of arrangement

The third type of problem involves rearrangement of elements of a task in order to solve a problem. All of the elements of such tasks are given and the problem solver must rearrange the elements in some way that solves the problem.

Remember that the elements are not transformed into another form but are rearranged.

A typical example of problems of arrangement is also the anagram, and the principal cognitive skill needed to solve such a problem is that of constructive search. For example, how many words can be formed from the two anagrams GANRE, TARIL (range, anger; trial, trail). Based on research by Mayer (1983) it took an average response time of 8 sec to solve for RANGE, but took an average of about 114 sec to respond to ANGER.

Ill-defined problem

Ill-defined or ill-structured problems have components of the **problem space** (either initial or goal states or **operators** or some combination) not specified or are incomplete. There may also be more than one “correct” answer. For example, buying a car, renting an apartment are examples of ill-defined problems. (As stated earlier, operators are actions that modify problem states).

In these examples, the goal state, the car purchased or the house rented, is not always known at the beginning of the problem. Although the problem solver may have an ideal model to buy, he or she may settle for a compromise based on a number of factors.

We usually select what is ‘best’ and what is best may be defined in terms of location, cost, and amenities available. Notice that what we may consider best at any time may not be good enough compared with well-defined problems which have clear starting states and well defined goal states.

While a lot of problems studied in the laboratory are well-defined, many of the problems we face in life are ill-defined. In ill-defined problems, a person is likely to use some type of heuristic (shortcuts) in solving the problem but such heuristics are less likely to provide guarantees for solving the problems.

In ill-defined problems, the problem solver may generate potential hypotheses and test them to find the one that provides an acceptable solution. Research on ill-defined problem solving often relies on thinking-aloud protocols. Here, the subject is asked to think “aloud” as he works through the problem. Their verbalizations constitute the protocol which is then analyzed. The use of heuristics and changes in strategies are then inferred from the protocol.

Routine vs. Non-routine Problems

Problems are also classified as Routine vs. Nonroutine. A Routine Problem involves the use or application of operators in a predictable, systematic manner known to the problem solver. Multiplying 2986 by 3434 is a routine problem. You only need to follow the rules for multiplication and addition toward the solution of the problem.

A Non-routine Problem requires the problem solver to apply operators in a novel fashion or use a procedure that is not well known to the solver. Most of the research problems in the social sciences are based on non-routine problems. In other words, solving such problems is not systematic and predictable. It will require a lot of thinking and innovation to solve such problems. Insights gained during problem solving situations involve largely non-routine applications.

ADVERSARY AND NON-ADVERSARY

Another useful distinction for problems is that of Adversary and Non-adversary problems.

Adversary problems involve competition between two or more players. Chess and most competitive games are example of adversary problems. Problem solvers here are competitors, who adopt variety of strategies to win, defeat or out-manoeuvre their opponents.

Non-adversary problems do not require the problem solver to face a competitor and the problem solver can exert a lot of control over the problem space than those in adversary types of problems. Examples are solving crossword puzzles, writing a compelling novel or fixing your car.

Problems and General Methods of Solution

As a general rule, people attempt to solve problems by using some kind of strategy, which represents a systematic attack to a problem.

Psychologists distinguish between two kinds of general strategies algorithms and heuristics.

- Algorithm is a set of rules or procedures which ensures the solution.
- A heuristic strategy by contrast, is a rule of thumb or approximation which may or may not ensure the solution.

For example, if you are searching for your friend's telephone number in a reliable and up-to-date telephone directory from A to Z, you are using an algorithmic strategy which will guarantee an answer.

Short-cut and trial and error strategies like looking at the area where he or she stays, or trying some guessed numbers first are heuristic strategies, which may or may not provide the answer.

If algorithmic strategies ensure solution, why will a person use a heuristic rule of thumb when an algorithm is guaranteed to work?

The reasons for using heuristic strategies despite their inherent weaknesses are that:

- Algorithmic strategies are quite cumbersome and time-consuming.

- They are sometimes very expensive.
- Many problems we face as human beings do not have an algorithmic solution (e.g., guessing an answer during exams, piloting a plane when you have not been trained).

Algorithms and heuristics are strategies that can be considered at the general level. However, there are specific strategies that are identified which may fall into any of the two broad categories. These specific approaches to problem solving are:

- Generate-and-test technique
- Means-end analysis
- Working backward
- Backtracking
- Reasoning by analogy
- Hill-climbing heuristic

1. GENERATE-AND-TEST TECHNIQUE

As the name implies, it consists of generating possible solutions to problems and testing them. It is a technique that loses its effectiveness very rapidly when there are many possibilities and when there is no particular guidance over the generation process. For example, if you forget the combination numbers used to open your padlock, searching can be so frustrating that you may give up (the problem space may be too large).

However, where there aren't many possibilities the generate-and-test technique may prove useful. This resembles the trial-and-error process in which solutions are tried and discarded until one that works is discovered.

2. Means-end analysis

This approach to problem solving requires that people determine the ends they wish to achieve and the means by which they will reach these ends.

For the very complex problems the desired end cannot be accomplished in one stroke. Problem solvers must establish sub-goals which gradually lead toward the final desired goal. For example, if your goal is to obtain a First Class honours at the University, that constitutes the end and you will have to determine the means to reach the end, for example, taking lectures serious, discipline, preparing a study plan, and so on.

3. Working backward

This strategy to problem solving requires its user to analyze the goal to determine the last step needed to achieve it, then the next- to-last step and so on. For instance, in the problem of getting to your friend's house, the very last step is to walk from outside her front door into the house. The problem of getting to her front door can be solved by taking a taxi to her house. You can get a taxi at the Gate etc.

Working backward often involves establishing sub-goals so its functions are similar to means-ends analysis but in a reversed order in this case.

4. Backtracking

Sometimes in solving a problem, you need to make provisional assumptions before you start. In several instances, the assumptions turn out to be wrong and must be "unmade" or corrected. In such situations the assumptions need to be reviewed to enable you resolve the problems.

5. Reasoning by analogy

One undeniable fact in human reasoning is that we use prior knowledge and experience to solve new problems or simply, we draw on analogies. It has been suggested that many new discoveries are accomplished by drawing an analogy between a new problem and an already solved problem. Problem solving in this situation therefore is based on perceived similarities between the prior experience and the new problem. For example, when we are confronted with a problem in mathematics, we refer to previous examples in our textbooks. When you write an exam in social psychology, you may use many of the strategies that were helpful when you wrote a paper in environmental psychology. We can say that whenever we try to solve a new problem by referring to a known, familiar problem, we are using analogical reasoning.

However, research on the use of analogy show that people are more likely to use analogies effectively under the following circumstances:

- a. When people are specifically instructed to compare two problems that initially seem unrelated because they have different surface structure
- b. When people are shown several structurally similar problems before they tackle the target problem.
- c. When people actually try to solve the source problem, rather than simply looking at the surface of that problem.
- d. When people are given the hint that the strategy used on a specific earlier problem may also be useful in solving the target problem.

6. Hill-Climbing Heuristic

One of the most straightforward approaches to problem solving is the hill climbing heuristic. In this strategy, one seeks to make moves that reduce the distance between the current state and the goal state. Imagine your goal is to climb to the top of a hill. Just ahead of you in this task, you realize there is a fork in the path and you cannot see ahead into the distance on either path. For you to meet your goal to climb upward, you decide to use a path that has the steepest incline. Generally, in real life when we reach decision points in problem solving, just like the hill-climbing heuristic, we select the alternative that seems to lead to the solution or the goal state. This problem solving heuristic is useful especially, when you don't have sufficient information about your alternatives. Like many heuristics, the hill-climbing can lead you astray. The biggest drawback so far is that problem solvers must consistently make choices that appear to lead to the goal. In doing so there could be failure which leads to frustration.

Activity 1.1—Thought exercise

Distinguish methods of problem solving

1. In problem solving, how do algorithms differ from heuristics? When you solve problems, what situations encourage which of these two approaches?
2. Describe a situation in which the means-ends heuristic was more useful than an algorithm.
3. Identify a time when you used the hill-climbing heuristic, and explain whether it was effective in solving the problem.

Summary

In this section we have looked at problems, definitional issues, their classifications and several approaches adopted by problem solvers to tackle formal and everyday problems

In discussing the approaches to problem solving, we looked broadly at heuristics and algorithms and the rationale for adopting each as a strategy. More specific approaches adopted by problem solvers were discussed.

Congratulations for successfully completing this section. I hope you have enjoyed working through with me. You may take a brief rest and when you return, you will join me in the next section which looks at obstacles we face when solving problems. Enjoy yourself.

SECTION 2: FACTORS THAT INFLUENCE PROBLEM SOLVING

Introduction

Welcome to the section on factors that influence problem solving. You will remember from the previous section that I discussed definitional issues of problems, the cognitive processes, their

typologies; and finally, we looked at the general methods of solution. We follow up in this section by looking at several factors that influence problem solving. We can think about problem solving as the cognitive process used in transforming starting information into a goal state, using specified means of solution.

This implies that a problem is something that cannot be solved in one single obvious step. We usually have a starting point and a defined goal. For example, you don't consider brushing your teeth an instance of problem solving because most of what you do is routine that does not require much thought and no special obstacles must be overcome in order to complete this routine.

In contrast, problem solving implies a goal with some constraints and barriers that must be overcome to reach the end state. The barriers or constraints are sometimes very strong and may prevent, interfere or frustrate us from successfully solving the problem.

We proceed in this section to look at some factors that prevent or hinder us from solving various problems.

Objectives

At the end of this section, you should be able to

- discuss some of the obstacles to problem solving
- think about effective ways of improving your problem solving ability

STRATEGIES FOR AVOIDING PROBLEM-SOLVING OBSTACLES

Several researchers have examined why mental short cuts (heuristics) do not often work. Similarly, cognitive psychologists have offered advice to help people improve upon their problem solving skills and abilities. We will consider some of this advice at the end of the section. However, in order to offer good advice to those who need our help, we need first, to identify the obstacles that block our paths as we work toward our goals. We discuss these obstacles under the heading Blocks to Problem Solving.

Blocks to Problem Solving

1. Mental set

Mental set as a constraint to problem solving refers to the tendency to adopt a certain framework, strategy, or procedure or, to see things in a different way instead of in other, equally plausible ways. In other words, it reflects the tendency to perceive a problem in a certain way on the basis of our immediate experience. Mental set seems to be produced by limited or short amounts of practice.

Let us look at the example below. The problem is referred to as Water Jar Problem.

The containers below are jars holding liquid (water). Your task is to imagine pouring water from one jar to another in order to finish up with a specified amount of water in one of the jars. What formula can you use to solve all the puzzles? Are there easier alternatives?

In working out the solution to the water jar problem, you could solve all the problems using the formula $B - A - 2C$. However, a more direct solution for Problem Number 7 would be $A + C$ and for Number 8, it could be solved easily with the formula $A - C$.

If you did not realize the variations, then your performance is characterized or constrained by mental set.

Let us look at another problem to enable you understand the phenomenon of mental set. This problem is called the nine-dot problem.

Draw three or four straight lines that pass through each of the nine dots without removing your pencil from the paper.

Mental set often causes people to make certain unwarranted assumptions without being aware of making them. In the above famous nine-dot problem, people make the assumption that the three or four lines must stay within the “borders” of the dots, though this is not stated in the instruction.

Now look at the figures below and see how the solution is achieved.

SOLUTION TO NINE-DOT PROBLEM

This phenomenon of making unwarranted assumptions which prevent us from solving a problem is called functional fixedness. As you can see, functional fixedness is an instance of mental set, in that a person subject to functional fixedness adopts a rigid mental set to solutions or objects.

By far, mental set and functional fixedness constitute the most serious constraints to problem solving. You need to be flexible and try other viable alternatives during problem solving.

2. Using incomplete or incorrect representations

Another related difficulty in problem solving has to do with the initial interpretation of the problem, if the problem is misunderstood, or wrong information is focused on, the solver will be at a disadvantage. The problem solver needs to have a proper mental representation of the problem to facilitate solution.

3. Lack of problem-specific knowledge or expertise

Another stumbling block or constraint to problem solving is that most people approach problems with lack of required knowledge for the task. Familiarity with the task changes the way problems are solved.

For example, in the game of chess, experts and novices differ in their perceptual abilities. Research shows that experts pick more perceptual information than a novice would. Experts recognize more patterns during Chess and Draught play than novices. Once again the ease and dexterity in problem solving could be a function of practice and experience.

4. Over confidence

Over confidence is the tendency to overestimate the accuracy of your knowledge, strength and judgments. When you overestimate your abilities and capabilities, you unnecessarily put constraints in your path that prevent you from realizing your goal. Overconfidence affects decisions outside the laboratory too.

- Overconfident Hitler invaded Russia in the 2nd World War
- Overconfident Johnson waged war with North Vietnam
- Overconfident Saddam Hussein marched on Kuwait etc.

5. Cultural and emotional barriers

Certain outmoded cultural practices as well as certain emotional states can prevent us from solving problems, in certain cultures women or men are prohibited from engaging in certain activities and these inhibitions might prevent them from developing certain skills or abilities (for example, it was only recently that women started playing football publicly). Women have in the past suffered from negative stereotypes when they were mathematically precocious. Lastly, certain emotional states like fear and anxiety may prevent us from solving certain problems.

6. Multiple hypotheses

Our inability to envisage several hypotheses in problem solving situation presents a stumbling block in our attempt at solution. For example, there could be a dozen reasons why a car will not start in the morning. Several hypotheses must then be considered when we are attempting to solve problems.

7. Confirmation bias

Tendency to perceive and accept data only when it supports our hypothesis or beliefs is a major source of constraint in problem solving situations. There is the need for negating evidence and the need to play the devil's advocate when problems are presented.

Suggestions for Improving Problem Solving

Having discussed some of the constraints to problem solving, let us turn to look at some hints and suggestions about how to improve your problem solving. Some of these suggestions are based on empirical research while others are intuitions that people have experienced about the problem solving process.

Ellis (1978) identified five rules of thumb which are useful in virtually all problem-solving situations. These include: understand the problem, remember the problem, identify alternative hypotheses, acquire coping strategies, and evaluate the final hypothesis.

1. Understand the problem

Before you solve a problem, you must be sure you understand it. This sounds trite, but one of the reasons why students do poorly in examinations is that in their haste to answer a question, they fail to analyze and re-examine the question itself. It is a good practice to check again to see if your initial understanding is still correct. Try to draw inferences while you analyse the problem and draw analogies and inferences.

2. Remember the problem

On occasion, students produce incorrect answers on an essay examination because they fail to remember the problem as it is formulated. Somewhere in the middle they veer off from the central issue and deal with irrelevant ones. Recheck your memory periodically to ensure that you stay with the issue.

Bransford and Stein (1984) have offered a model strategy called IDEAL as a memory aid for problem solving. Each letter represents a step in the model.

I for Identifying the problem is the first stage

D for Defining and representing the problem (mental representation of problem)

E for Exploring possible strategies to attack the problem

A for Acting on the strategies

L for Looking back and evaluate the effects of the problem solving activities

3. Identify alternative hypotheses

Problem solving requires that you produce hypotheses. Rather than fixate on one or two hypotheses, try to generate many and test them. Try easier ones first before complex ones. Avoid premature selection of a particular hypothesis until you have evaluated all reasonable alternatives. It is important that you also search for contradictions as you look for alternatives. Check for the rigidity in yourself and avoid bias.

4. Acquire coping strategies

Coping refers to ways of dealing with difficulties, failure, and frustrations in problem solving situations. Frustrations and difficulties are inevitable accompaniments of problem solving. Since these cannot be avoided in all circumstances, you must learn how to cope with them when they show up. Try to recognize the rigidity in yourself and to avoid inflexibility when solving problems.

5. Evaluate the final hypothesis

Once you have decided on a final hypothesis, re-evaluate your choice. Take one final look before you commit yourself to a particular sequence of action.

There are two additional tips that have been emphasized especially by Moates and Schumcher (1980).

6. Explain the problem to someone

Talking about the problem to someone else may help you gain a better perspective, understanding and insight into the problem. As you continue to explain the problem to your colleagues you gain better understanding yourself. Unfortunately, some friends who cannot be trusted can worsen the problem in terms of its containment.

7. Put the problem aside

When all attempts have failed in solving a problem, it is advisable to put the problem aside for a while. This is known as incubation when your unconscious mind may be “working on” the problem. Incubation may work for some people some of the time but do not use the waiting period as a way of regularly avoiding problems.

Activity 2.1

Problem solving exercises

1. Three jealous husbands and their wives, who have to cross a river, find a boat. However, the boat is so small that it can hold no more than two persons. Find the simplest schedule of crossings that will permit all six persons to cross the river so that no woman is left in the company of any other woman's husband unless her own husband is present. It is assumed that all passengers on the boat debark before the next trip and that at least one person has to be in the boat for each crossing.

2. You are a medical doctor supposed to administer medication to some patients. Note that wrong identification of patients will lead to wrong administration of drugs and serious health implications.

Read the following information and fill in the information in the matrix (write names and diseases in the relevant boxes), and then answer the question, “What disease does Ms. Aboagye have, and in what room is she?”

Five people are in a hospital. Each person has only one disease, and each has a different disease. Each one occupies a separate room; the room numbers are 101 through 105.

1. The person with asthma is in Room 101.
- 2 Ms Oduro has a heart disease.
3. Ms. Boateng is in Room 105.
4. Ms. Nyamekye has tuberculosis.
5. The woman, with mononucleosis is in Room 104.
6. Ms. Lamptey is in Room 101.
7. Ms. Nyamakyo is in Room 102.
8. One of the patients, other than Ms. Aboagye has gall bladder disease.

Summary

You have successfully completed this section. You have learned in this section about several obstacles to problem solving. That is, between the start state there is bound to be constraints that will prevent you to reach the goal.

In the latter part of the section, several effective strategies or advice were offered to help you in your problem solving processes. Whereas some of the suggestions are empirically supported, others seem intuitive. All of them are to help you improve your skills as a problem solver.

Assignment 11 —Thinking Exercise

You have the “problem” of putting together a class schedule for next semester. Explain how you solve that problem utilizing concepts in this unit; include in your answer the notions of a problem space, start state and goal state.

Unit summary

In this unit you learned

- That classification of virtually all human problems can be reduced to one or more of the categories identified in this unit.

- That problem solving processes pass through stages from start state through intermediates and finally reaching the goal state.
- That problem solving embodies obstacles that prevent us from reaching our goals. Some of these obstacles were identified and discussed.
- Finally, we discussed some of the effective ways by which we can improve our problem solving ability.

UNIT 12: BRINGING IT ALL TOGETHER

Introduction

This unit provides an opportunity to reflect upon what is worth taking away with you from these eleven units and twelve weeks of study.

In Section 1 you will look at various examples of how tacit knowledge needs to be questioned in the social sciences and humanities, and one example of how tacit knowledge in the natural sciences should be applied in the liberal arts.

In Sections 2-4 there are further questions that help you to locate subject matter and vocabulary covered in this module as you may meet them on the final examination or continuous assessment tests.

This unit will cover the following topics:

Section 1 Questioning tacit knowledge and received modes of inquiry

Section 2 Review questions on language in use

Section 3 Review questions on types of reasoning

Section 4 Review questions on problem solving

Objectives

Upon completion of this unit you will be able:

- To recognise tacit knowledge and the need for critical questioning
- To observe when in particular critical thinking and practical reasoning are useful skills
 - In absorbing information provided to you in your various courses
 - In the course of your everyday life
 - In the situations demanding you to take a stand in your professional career

- To practice the use of vocabulary and principles in tackling objective exam questions.

Section 1: Questioning Tacit Knowledge and Received Modes of Inquiry

Introduction

As you take in ideas from textbooks, you should be revising and improving those ideas in light of your own experiences and your own perspective. In this section it will be demonstrated using examples why such active learning is so important.

The superficial classification of knowledge that was underlined by Unit 4's metaphor of the Map of Knowledge requires regular revision and renewal. It is especially important to always consider whether something you have learned in one academic discipline should be cross-germinated with subject matter learned in another discipline.

Critical and innovative contributions are the work of cutting edge scholarship and research, including your own. Your own experience and personal insights and concerns will alert you to where and when knowledge needs to be revised, reconstructed, or reinforced—no one else can do that but you.

Objectives

By the end of this section, you should be able to

- recognise why active, critical learning is important in academic work
- understand what is tacit knowledge
- see by example critical questioning of tacit knowledge

As we discussed in Unit 5, some description?; of tacit publicized in the social sciences presuppose norms which are value judgments about what is the normal, standard, appropriate, ideal, rational, or in society's best interests.

In this era of 'globalisation', with the way the World Wide Web is constructed, most of the information readily available or the internet is generated from the G8 countries. Passages are purveyed instantaneously, with little if any assessment, most often anonymously, throughout the rest of the world. Statements are repeatedly broadcast over and over. When the internet and satellite telecommunication rapidly transmit images and 'bits' of information and assumptions all over the globe, the tacit beliefs of a few societies come to dominate the whole world.

These happen to be former colonizing countries in relation to Africa. This is the way Eurocentric prejudices about what is rational, ideal, normal and appropriate are distributed throughout many

of the claims made about African historical episodes, contemporary social behaviour, and economic circumstances.

But are all these tacitly shared beliefs on all topics always true? Is there only one correct way of understanding the social world and its history?

We have to ask these questions in tertiary education. It is important therefore to recognise when a statement conveys both a factual judgment (its explicit meaning) and at the same time conveys a value judgment (its implicit meaning)—as we discussed this possibility in Unit 3.

Very often a dual meaning is not intended by the author. It is left up to you, the reader or listener, to frame the statements you read and hear in a context that highlights related beliefs ('presuppositions') of which the author or speaker may not be consciously aware.

We call these presuppositions 'background' knowledge or 'tacit' knowledge, even though it may not be true. The tacit nature of a belief which is taken for granted is very important: at any given time and place in history, there is this general background of assumptions people share. These beliefs are not widely shared because they are true (although they may be true) but they are shared because as claims they are encountered over and over. From early childhood people learn these shared assumptions. They are repeated in the press, in the school books, in sermons, in talk shows, in magazine articles, in newspaper editorials and op-ed articles, and these assumptions may get attention by social scientific researchers. You learn not to question such beliefs.

Example: Challenging tacit assumptions in HISTORY

School children all over Africa still learn that the history of Africa is divided into three periods: pre-colonial, colonial, and post-colonial.

But is this credible? Given there is good reason to believe that human civilisation itself may have begun in Africa, pre-colonial period spans very many thousands of years. Therefore millennia are presented by the history books as one epoch, on an equal par with the seventy years when some European traders set up administrative posts in Africa and defended their activities with military aggression. Then the last sixty years are regarded as the third epoch. That is it.

Critical reflection upon the unlikelihood of this division of Africa's entire history is an example of what is meant by questioning tacit knowledge.

Such questions have already been copiously raised and settled concerning Africa's history, in an eight volume encyclopedia containing tens of thousands of pages of corrections supplied by carefully cross-vetted historiographers, whose scholarship has been painstakingly organised under the aegis of UNESCO (United Nations Educational, Scientific and Cultural Organisation) in the 1960s. But it is very difficult for scholars to locate these volumes. The encyclopedia is not available in the Balme Library. It is expensive. And most importantly, none of the set textbooks

required for reading by students in basic schools through secondary schools in Ghana contain any of the corrective information stored in these volumes.

In fact schools are not teaching history at all anymore to students; it is now a sub category of social studies. So the Eurocentric periodization of Africa remains a fixed feature in the background knowledge that people accept about their history.

Empirical descriptions of the past express implicit values of the political culture and social conditioning of the observing historian's present. The tacit knowledge of Africa's history reinforces current standards of what counts as feasible goals for social transformation, who is a viable administrator of African natural resources and manager of African states' finances.

Comparable tacit beliefs about Africa's political economies determine who should make future economic decisions, what to count as a successful result brought about by previous development decisions, and what to regard as a feasible and fair distribution of social goods and entitlements worldwide.

The point here is to realise that when you take up history as a subject in university, it is just as important to raise critical questions about the content of what you read, as it is for you to absorb information from your required readings and the material provided in your lectures.

Example: defining SOCIOLOGY

We often learn in a given academic discipline that its 'father' is a European from some time past. For instance you will often hear and read that August Comte was the 'father' of modern sociology. The origin of social science is thus confined to Europe, as if it were developed strictly as a consequence of the Enlightenment remaining within the confines of discursive texts produced and published in Italy, then in Germany, UK, France and the United States where it flourished with the work of Max Weber two hundred years later. Such an impression is reinforced in Unit 4 of this module.

Questioning this tacit knowledge about the history of a discipline constitutes an important contribution to the discipline itself. Professor Max Assimeng has stressed that sociology is not only and always written down as treatises or developed through periodicals and disseminated in textbooks. Sociological analysis is not always "preservational" and reinforcing the continuity of social structures. Sociological theory also disrupts continuity with the past. Assimeng illustrates this in his illuminating redefinition of the essentially contestable term 'sociology', by analysing first order data (that is, letters and documents and cultural practices and artistic staples) of Akan village life in the late 19th and early 20th centuries. To do good sociological theorising, Assimeng had to engage in historiography. Questioning the tacit knowledge about the history of a discipline in this case proved to be the first step in correcting it.

Assimeng displays how, in the history of the Ghanaian social institutions and arrangements, changes were narrated and critiqued by community heads and political commentators. Chronicles and critiques of social change do not always manifest in written texts, but in performance art, oratory at public functions, at annual durbars and rites of passage.

In traditional society corrections were made to an administrative change going on, or reinforcements expressed of such change. For instance if a chief were acting in a way that was inspired by British influence which was not functional for the good of his people, then at the right time and place the appropriate court official would speak to this, e.g. the master drummer might do so.

Assimeng observes the importance of innovative contributions by contemporary scholars in sociology who are prepared to ask what constitutes knowledge, and to move beyond “teaching to a syllabus on which books already exists” and instead to fulfil “a more rewarding responsibility that rests with African intellectuals to codify and analyze social and political thought in Africa as responses to the imperatives of African social and cultural life.”

EXAMPLE: MISLEADING INSTRUMENTS IN COGNITIVE PSYCHOLOGY

In Unit 2 we looked at the contrast between a well-defined term on the one hand, and open-textured terms on the other. And we observed the use of operational definitions in the sciences designed to ensure that statements containing only operationally defined terms will thereby be testable.

A huge controversy has opened up in social science for some decades, generating a lot of debate in the literature, about the testability of statements concerning people’s morally significant character traits, e.g. intelligence. Might there be anything misleading about applying an intelligence test designed in one culture to measure intelligence of a child brought up in another culture? The Stanford-Binet, and other intelligence tests, are meant to reflect a universally established definition of what it is to be intelligent, through operationalising the notion of intelligence and rendering it *quantifiable* (measurable). It is assumed that using a language of numbers will neutralise cultural differences and create a standard of IQ rankings that is uniformly applicable. But does it? J.Y. Opoku has suggested that we have to rethink what is meant by the word ‘intelligence’. His suggestion illustrates that what follows from a term being open textured may be very practical and graphic: in this case, different testing procedures and content are required to appreciate intelligent behaviour as it is recognised in different cultural contexts.

“I will feel more comfortable assessing the intelligence of a formally unschooled African by using the traditional criteria established over centuries of ‘African’ wisdom; for in Africa those standards remain both intuitively and practically well-grounded; therefore they provide a measure which is both valid and reliable.”

EXAMPLE: MISLEADING STATISTICS IN ECONOMICS

Another discipline where we need to be vigilant about misleading use of numbers is Economics, which is notorious for its use of quantitative tools (tools for measuring quantity) in the effort to measure qualities as precisely as possible, in order to make hypotheses testable.

Failures to fulfill scientific goals of precision and faithfulness to the reality on the ground is very common in the literature about economic development and its various specialisation topics, for instance women in development.

Abena D. Oduro has supplied a serious assessment of the widely purveyed discourse about the Millennium Development Goals (MDGs). Governments all over the world negotiate aid, loans, recognition in world trade bodies, and political esteem, in terms of these goals. But how effective are these goals in fulfilling the agenda that they purportedly support? Can claims about progress towards any of these goals testable?

In light of the introduction you were given in Unit 8 about arguments based on statistics, and about evidence which may be misleading because it is incomplete, consider the following critique of the way the third MDG which is supposed to serve the interests of women around the world.

The third MD Goal: promote gender equity and empower women

This goal is critical in a country such as Ghana that has norms and practices which discriminate against women and girls. A weakness of the goal is that it focuses only on education. Important though education can be in eroding the norms and beliefs that inform practices denying women equal opportunity compared with men, it is not the only way in which gender equality and empowerment of women may be achieved.

The chief shortcoming of the third MDG resides in the inadequacy of the indicators used to track and monitor progress towards achieving this goal. The use of ratios as a measure of progress creates a lot of grey areas. One of the indicators to track progress in empowerment of women is the ratio of literate women to men aged 15-24 years. This ratio was highest in the Upper West region in both 1997 and 2003 (Table 1 below). Since this is an MDG indicator of the empowerment of women one would arrive at the erroneous conclusion that women in the Upper West region have greater opportunity to become literate than in other regions of the country. However, the literacy rate amongst the population of men and women aged 15-24 years in the Upper West region in 2003 was less than 50%, whilst the literacy rate of women in aged 15-24 years in the Greater Accra region in 2003 was over 80%.

Table 1. Ratio of Literate Women to Men 1997, 2003

Figures for 1997 in the various regions in Ghana:

Western Region	0.754
Central Region	0.712
Greater Accra Region	0.890
Volta Region	0.843
Eastern Region	0.885
Ashanti Region	0.764
BrongAhafo Region	0.630
Northern region	0.518
Upper East	0.773
Upper West	1.086

Figures for 2003

Western Region	0.787
Central Region	0.801
Greater Accra Region	0.910
Volta Region	0.844
Eastern Region	0.885
Ashanti Region	0.836
BrongAhafo Region	0.776
Northern Region	0.615
Upper East Region	0.860
Upper West Region	0.930

Source: Ghana Statistical service

Core Welfare Indicators Questionnaire Survey 1997 and 2003, Accra

Another MDG indicator to monitor progress made on the empowerment of Women is the share of women in wage employment in the non-agricultural sector. This is an imprecise measure of women's empowerment within the world of work for two reasons. The first reason is that women may be employed at the lower end of the wage scale, earning low incomes and will not necessarily be in positions of responsibility.

Second, self-employment rather than wage employment may be a conscious decision of women because self-employment may provide them with greater flexibility to combine their activities in the market economy with their responsibilities in the care economy. (Abena D. Oduro. 2010)

Activity 1.1—Thinking exercise

Critiquing popularised discourse about development

- (i) How does J.Y. Opoku regard the effort to create an operational definition which, yields a uniform test for intelligence?
- (ii) Using the vocabulary learned in Unit 2, critique the notion of intelligence as an operationally definable concept.
- (iii) What does Abena D. Oduro reveal about the carefully displayed statistics cited to show that women have an advantage now in gaining literacy in Northern Ghana?
- (iv) Given the vocabulary for assessing the quality of evidence provided in Unit 4, what might be said about the way statistics are presented according to the revelations exposed by Oduro?
- (v) Oduro also points out in the quoted passage how women's contribution to the non-agricultural sector in Ghana is misleadingly presented as empowerment of women. Using the vocabulary you learned in Unit 8, how might you criticize the evidence used in supporting the hypothesis that women are empowered by quoting their numbers in non-agricultural wage work, in light of Oduro's analysis?

The need for independent thinking and innovative cross-disciplinary scholarship extends between the natural sciences and the liberal arts and social sciences. The next example shows that we need continually to revisit how to cross over divisions of knowledge that we take for granted as tacitly assumed to be independent and unrelated.

Unfortunately the artificially strict divides between subject areas has been reinforced in Unit 4 by the metaphor of a Map of Knowledge which encourages viewing the subject areas that you are studying as regions having fixed locations in relation to each other, with clearly defined borders. This imagery was intended only to help picture the existing contrast between different ways of reasoning and pursuing knowledge, and to spell out the logical distinctions between the ways of justifying our beliefs that are established by these different modes of inquiry. But it will be

misleading if we allow this metaphor to reinforce the mistaken assumption that distinct subject matters are given by Nature as separately meaningful and unrelated domains of knowledge.

What follows is an important case where the cross reference from one subject area to another clearly needs reinforcement.

EXAMPLE: BASIC MISUSE OF CONCEPTS FROM BIOLOGY AND ZOOLOGY

It is very common to find world renowned theorists and consultants in political science and international affairs writing and theorising about persistent conflict, for instance, in terms of racial categories, even though for over sixty years scientists have recognised that the concept of 'race' is not founded in biological fact. The Ghanaian philosopher Kwame Anthony Appiah, who is not a geneticist, adopted this information from human biology as his point of departure for challenging tacit knowledge shared by socialscientists about class divisions in society, and by African Studies specialists concerning the notion of ethnic identity.

Interviewed on BBC August 2001, renowned geneticist Prof, Steven Jones (Galton Laboratory, University College, London) claimed that as a 'biological concept' distinct races simply don't exist. He indicates that within the total human genome profile, 85% of all the variety occurs between two individuals from the same place; roughly 7.5% of variation occurs between two individuals from different countries, and 7.5% of the variety detected in human genetic makeup is found between people of so-called different 'races' in Hoffman's sense.

Activity 1.2—Thinking exercise

Recognising cross-disciplinary relevance. As you sit in your lectures given in different departments, keep a vigilant ear open for claims made in one discipline that may challenge or reinforce something you learn in another discipline.

Summary of this Section

Global should not be confused with uniform. What counts as 'universal' needs constant correction from the diversity of opinion that exists worldwide?

Most students do not appreciate the importance of challenging authoritative views and established theories and distinguished scholars. Students do not realise that the actual dynamics of first rate professional academic discourse depends upon vigorous questioning and proposed refutation of what is given to you as 'knowledge' or the 'received view'. Unless you are; prepared to take in what you are told in lecture and in textbooks and consider it very actively against your own experience, you can hardly be said to be taking part in humanities and social studies scholarship as a living, growing body of knowledge.

It is our responsibility as students and as teachers in tertiary education, to question and challenge uses of language that harbour ‘obvious truths’.

SECTION 2: REVIEW QUESTIONS ON LANGUAGE IN USE

Introduction

Here are ‘objective’ questions that cover material that was presented in Units 1-3.

Objectives

- To revise Units 1 and 2, and prepare for objective examinations
- To self-test your understanding of principles and facility with new vocabulary

ACTIVITY 2.1

Recognising when an expression can be true or false among the items (1-6) some are declarative statements that convey:

- information about the use of a word, or
- about the way the world is, or
- about the way the world should be.

Declarative statements **can** be **true or false**.

Other items among (1-5) do not contain declarative statements; instead they contain:

- a question (interrogative), or
- an emotive expression, or
- a command (imperative), or
- a sentence fragment—only part of a statement (subject or verb phrase)

Non-declarative expressions cannot be true or false

To revise this material go back and see Unit 1 and 2

Sample

A triangle is a three sided, closed figure in a plane.

- (A) Declarative statement
- (B) Question (interrogative)
- (C) Command (imperative)

(D) Sentence fragment

(E) Emotive expression

For each of the items below decide whether it is a declarative statement intended to supply information, or a question, or a command, or an expression of emotion, or a sentence fragment, and select the corresponding letter.

1. Is the increasing price of petrol causing the increase in the cost of public transport?

- (A) Declarative statement
- (B) Question (interrogative)
- (C) Command (imperative)
- (D) Sentence fragment
- (E) Emotive expression

2. Banku with okra soup.

- (A) Declarative statement
- (B) Question (interrogative)
- (C) Command (imperative)
- (D) Sentence fragment
- (E) Emotive expression

3. I'm having so much fun! What an easy test!

- (A) Declarative statement
- (B) Question (interrogative)
- (C) Command (imperative)

(D) Sentence fragment

(E) Emotive expression

4. The people standing at the bus stop are all waiting for a tro-tro going to central Accra.

(A) Declarative statement

(B) Question (interrogative)

(C) Command (imperative)

(D) Sentence fragment

(E) Emotive expression

5. Not all the applicants who were eligible to get accommodation were able to find room on campus.

(A) Declarative statement

(B) Question (interrogative)

(C) Command (imperative)

(D) Sentence fragment

(E) Emotive expression

6 National Football Association.

(A) Declarative statement

(B) Question (interrogative)

(C) Command (imperative)

(D) Sentence fragment

(E) Emotive expression

The next set of items (7-10) also contains declarative statements, questions (interrogatives) and commands (imperatives). But in this set, the declarative statements are of two types. One type is called a 'contingent statement' because its truth or falsity is contingent (dependent) upon something outside the sentence:

- Factual statements are contingent upon the way the world is.
 - Verifiable statements are contingent upon directly observable states of affairs
 - Hypotheses or confirmable statements are contingent upon verifiable statements

- Value judgments are contingent upon how we think things should be, couched in moral principles or general postulates about quality or excellence or utility

The other type of declarative statement that appears in this set is called 'true by definition' because its truth is constant and depends only upon the definition of the words contained in the statement.

Sample:

Every triangle figure has three sides.

- (A) A contingent statement (true or false depending upon something outside the sentence)
- (B) A statement that is true by definition
- (C) A command (imperative)
- (D) A question (interrogative)
- (E) None of the above

The statement in the sample is always true because of the definition of the word 'triangle'. So the letter selected was (6),

Read each statement in the set (7-10) and select the letter corresponding to the category to which the statement belongs.

7. Leave all your belongings outside when you enter the examination hall, except your ID card.

- (A) A contingent statement
- (B) A statement that is true by definition
- (C) A command (imperative)
- (D) A question (interrogative)
- (E) None of the above

8. If some man were to marry his senior brother's eldest son's daughter, then his nephew would be his father-in-law.

- (A) A contingent statement
- (B) A statement that is true by definition
- (C) A command (imperative)
- (D) A question (interrogative)
- (E) None of the above

9. In order to ensure the likelihood of germination, never plant seeds in packed soil without watering.

- (A) A contingent statement
- (B) A statement that is true by definition
- (C) A command (imperative)
- (D) A question (interrogative)
- (E) None of the above

10. Friday always follows Thursday in the week.

- (A) A contingent statement
- (B) A statement that is true by definition
- (C) A command (imperative)
- (D) A question (interrogative)
- (E) None of the above

Activity 2.2

Identify types of linguistic expression

For items 1-16, decide which one of the following alternatives A-J best captures what the expression represents, or which option completes the italicised clause correctly to form a complete and true statement.

- A. sentence fragment
- B. emotive expression

C. is a declarative statement that may be true or false

D. asking a question

E. giving a directive

F. depends upon a state of affairs or event that might not have occurred.

G. is false

H. always true

I. true because of the non-logical words in the statement

J. value judgment (moral)

K. none of the above.

1. What a gorgeous and talented SRC president we have this year.

2. Rice and stew.

3. Goats and sheep are expensive these days.

4. There are over 500 people registered in UGRC 150 this semester.

5. Can you show me where the library is located?

6. Free and universal compulsory education.

7. The best football player of all time.

8. The number of days in one week is seven.

9. The number of days in one month is thirty.

10. Either there are seven days in a week or there are not seven days in a week.

11. If God exists then God exists.

12. A triangle is a plane closed figure with three sides.

13. Unless you go to town.

14. A proposition is a type of linguistic expression that . . .

15. A synonym for 'imperative' is ...

16. A definition, if correct, never. . .

Activity 2.3

Definitions—distinguishing them from other types of statement, and evaluating their worth.

- Determine which of the following are definitions. (What are the other items?)
- Determine which of the category or categories apply to each definition—ostensive, stipulative, lexical, theoretical, operational, ‘essential’ or ‘ideal’?
- Then analyse if the definition is adequate or rather if it is too broad or too narrow.

1. Genocide is any organised intentional effort to eliminate an entire group or population.

2. A funeral is the ceremony accompanying a burial, cremation, or other respectful elimination of a corpse, usually human.

3. A big man like he was, the paramount chief of this region, had the largest and most expensive funeral that the village has seen in a decade.

4. Lagos is not the capital of Nigeria.

5. A capital offence is any crime which is punishable by the death penalty, or in some legislatures, by life imprisonment.

6. Terrorism is the greatest evil action recognised by mankind.

7. A fruit is the seed carrying portion of most plant species.

8. E.T. Mensah was a great highlife musician in Accra in the mid-20th century.

9. See the people over there dancing—that dance is called agbadza.

10.1 love dancing Kpalogo. Sometimes I feel like 1 could go all night!

11 .Human sacrifice is practiced unofficially or officially on very important occasions in many cultures, e.g. when a chief dies.

12.For the purposes of discussing a cross-cultural human rights convention, ‘human sacrifice’ does not denote mass murder. Ritual sacrifice entails the intentional ceremonial killing of one or few victims, captured specifically for the purpose of their involvement in an orderly, highly structured ceremony on a pre-specified occasion and place, in the presence of witnesses, all of whom are aware of the symbolic significance and purpose of the death.

13. Abortion is the most evil kind of murder possible.

14. To say that a statement is unfalsifiable means it is testable; it is empty of empirical content, since it is unable to be false.

15. A tautology is: useless in the scientific pursuit of truth, since however it is interpreted, it is always true.

16. A 'roux' is a classic sauce base in French cuisine, made by starting off with about a two-to-one ratio of butter to flour, heated in a saucepan and stirred until the mixture becomes a paste, adding double the amount of milk and stirring over heat until thick and smooth, then adding slowly any vegetable or meat broth to thin the mixture, with herbs and spices over a low heat while stirring constantly, until a smooth, creamy liquid of the desired consistency is achieved. It is served hot as a sauce or stew base, along with or over cooked fish, poultry, wild game or any other meat off the bone.

17. A newton is a unit of force, acting for one second on a mass of one kilogram, giving a velocity of one meter per second.

18. Homosexuality is behaviour which violates natural law.

19. Objects that are moving close to the speed of light do not obey Newton's laws of motion.

20. The substance in this beaker is contaminated with DDT.

21 - Any substance contaminated with 5 mg. of DDT is lethal if ingested.

22. The most toxic pesticide used in recent years in this part of the country is DDT.

23. DDT is a white chlorinated hydrocarbon used as insecticide (abbreviation for dichlorodiphenyltrichloroethane).

24. 'Water' is a colourless, transparent, tasteless odourless compound of oxygen and hydrogen in liquid state convertible by heat into steam and by cold into ice; any liquid consisting chiefly of this in seas, streams, lakes, rain, tears, sweat, saliva, urine, serum.

25. Every mammal needs water to live.

26. A mammal is a class of animal having a milk-secreting organ in the female for nourishment of the young, and usually quadruped with hair or fur.

27. A whale is a mammal.

28. A 'whale' is a marine mammal of order Cetacea.

Activity 2.4

Definitions—constructing and critiquing

1. Which of the statements below is an operational definition? Circle one letter.

A. Take a clean beaker. Add 50 cc of unsaturated water at room temperature and 1/4tsp. of the substance to the beaker. Stir five to ten times, and when the substance dissolves, then it is called 'water-soluble'. All triangles have three sides.

B. All salts are water soluble.

C. The NaCl in this beaker has dissolved.

D. NaCl is sodium chloride, also known as table salt.

E. Look at the trace in that cloud chamber. That is what is meant by the path of an electron.

2. Which of the options below is NOT an ostensive definition?

A. This is an example of igneous rock, which is contrasted with 'sedimentary' rock, which is illustrated by that rock.

B. The oil in this glass jar is what we call 'glycerine'.

C. All salts are water soluble.

D. Taste this substance; that is what is meant by 'salty'.

E. Look, at the trace in that cloud chamber; that is what is meant by the path of an electron.

3. (i) Moral correctness is the doing of what is morally right.

(ii) Philosophy is the study of the works of Plato.

If the two statements above are taken to be definitions, select the alternative below that best evaluates them:

A. (i) is a good operational definition and (ii) is a good lexical definition.

B. (i) is too broad and (ii) is too narrow.

C. Both of the statements are tautologies (syntactic analytic).

D. Both of the statements are circular.

E. (i) is circular and (ii) is too narrow.

Activity 2.5 – Discussion Option

Essentially contestable terms in social studies Consider the following terms (A) - (R)

- i. For which term would it be difficult or ill-advised to provide an operational definition?
- ii. Which term's meaning involves tacit reference to values and to standards of quality or excellence?
- iii. Which might be regarded as open-textured or essentially contestable terms?
- iv. Is there an overlap between your answers to (i) - (iii)?
- v. Which of the terms is well-defined?
- vi. (vii) For which terms and in what contexts would an operational definition be welcome and productive?

- | | | | |
|-----------------|-------------------------|------------------|-------------------|
| (A) Masculinity | (B) Femininity | (C) Creativity | (D) Efficiency |
| (E) Stubborn | (F) Corruption | (G) Bilingualism | (H) Impulsiveness |
| (I) Obesity | (J) Contagious | (K) Immature | (L) Responsible |
| (M) Acidic | (N) Aggressive behavior | (O) Perseverance | (P) Stubbornness |
| (Q) Hyperactive | (R) Ambitious | | |

Summary of this section

Language in use is often a controversial focus of critical thinking; you have to be ready and flexible for the changing standards that exist for different contexts of communication. Being sensitive and responsive to language in use requires as much attentiveness and care as keeping an important relationship alive and growing. It is also the very platform on which you can launch into deeper thought, about your favourite subject matter.

SECTION 3: REVIEW QUESTIONS ON TYPES OF REASONING

Introduction

Both inductive and deductive reasoning are at work in all the subject matters you study, as well as in everyday affairs. But the two kinds of reasoning are evaluated differently and that is the only reason to differentiate them.

To evaluate reasoning we break up thoughts into packets called arguments. To recognise when to apply the rules of reasoning we need to distinguish arguments from other kinds of passage

(narratives, instructions, emotive expressions, metaphor and allegory, fables and parables, fictional activities—drama, poetry).

Objectives

- To revise Units 6-10
- To prepare for answering objective questions
- To understand the difference between induction and deduction
- To practice the use of syllogistic rules of inference
- To distinguish syllogistic fallacies from deductively valid arguments
- To recognise the meaning of valid argument as distinct from true statement
- To evaluate inductive arguments based on samples and related evidence, on statistical hypotheses, analogy, enumerative induction, causal reasoning
- To apply labels used to identify informal fallacies

Activity 3.1

Recognising types of discourse

For items (1-6) read each passage and select the letter (A-D) corresponding to the description that best depicts the content of that passage. If no description applies, select the letter (E).

1. All the students had their specimens with them, after they had collected materials on their field trip, and it was time to go home. They had to wait for the bus. After waiting half an hour it didn't come. So someone suggested hiring a taxi. Then it was realised this would be too expensive, because of the long distance. So then someone suggested calling the bus station to see what was the matter. But they could not get the phone number. It took an hour to try to make the call, to no avail. Finally the bus came along, but it was two and a half hours late. The students were all complaining, and some even asked to get their money refunded for half of the cost of the trip. Later the bus company refused; they claimed the bus had broken down and was delayed by servicing. The students decided to take another bus company the next time they planned a field trip. The following month the field trip was scheduled and the transport came and left with them on time.

(A) A narrative reporting a time-ordered sequence of past events

- (B) A list of instructions, directions, or proverbial advice
- (C) An argument containing premises supporting a conclusion
- (D) An expression of strong feeling or opinion

(E) None of the above

2. If someone hits you on the right cheek, turn and offer him your left. For the tree that stands tall in the forest will be cut down for timber, while the gnarled and crooked tree that bends in the wind will be left alone and will outlive all the others. The wise man rarely speaks, while the fool never stops giving advice. Remember that three things are the greatest of all: faith, hope and love, but the greatest of these is love.

- (A) An argument containing premises supporting a conclusion.
- (B) A narrative reporting a time-ordered sequence of past events
- (C) A list of instructions, directions, or proverbial advice
- (D) An expression of strong feeling or opinion

(E) None of the above

3. Once it was believed that all the planets are perfect spheres, and can move only in perfect circles around the earth. This theory dates back to Ptolemy in the 9th century AD. When Mercury was discovered, it seemed to move forward and then reverse its direction for some time, and move forward again. This was known even a thousand years ago, and the Ptolemaic system explained it in terms of epicycles, or little perfect circles ('perihelion') that some planets made as they proceeded around the earth. In the mid 16th century, when Kepler discovered that planetary orbits are elliptical and not perfectly circular, then all the planets but Mercury could be predicted by using his laws of planetary motion. There were assumed to be five planets in Kepler's time. Since Kepler's time we have discovered four more, totaling nine in all. Each new planet discovered has been found to follow Kepler's laws of planetary motion, and so it is still believed that all planets travel in elliptical paths. Not until the first decade of the 20th century, when Einstein's theory of relativity was tested could anyone predict the elliptical path of Mercury with accuracy.

- (A) An argument containing premises supporting a conclusion
- (B) A list of instructions, directions, or proverbial advice
- (C) An expression of strong feeling or opinion

(D) A narrative reporting a time-ordered sequence of past events.

(E) None of the above

4. Sexual infidelity is prevalent these days, sad as this is to say. Even though people know better, for instance, it is said that they often have sex outside their marriage.

No surveys have been conducted, but it is accepted as true that even men with several wives will have sex with women they have not married. Some prefer this practice to sex when it is legal. Clearly infidelity is abhorrent in many respects, but the traditional priests and the churches cannot do anything about it. What should be done? Infidelity is truly a great blight on society!

(A) An argument containing premises supporting a conclusion

(B) An expression of strong feeling or opinion

(C) A narrative reporting a time-ordered sequence of past events.

(D) A list of instructions, directions, or proverbial advice

(E) None of the above

5. The rebels gathered outside the hall and demanded the delegates to stop holding their meeting. The rebels made the point that either the delegates should hear the rebels' point of view or they should go home. But the delegates refused to go home. If they went home, then there would be no further opportunity to pursue peace talks. Without further peace talks, the war would continue. And no one wanted the war to continue. So the delegates would have to hear the rebels' point of view.

(A) An argument containing premises supporting a conclusion

(B) A list of instructions, directions, or proverbial advice.

(C) A narrative reporting a time-ordered sequence of past events.

(D) An expression of strong feeling or opinion

(E) None of the above

6. A cold (catarrh) or flu (influenza) is an infection caused by a virus or it is a bacterial infection. There is no cure for it, although there are many effective antibiotics on the market. If the flu was caused by a known bacterium, with a known antibiotic, then there would be a cure for it. So the flu must be caused by a virus. A flu infection lasts no more than two weeks. If one doesn't get rid of the symptoms in two weeks, then the viral infection might have turned into a bacterial infection, such as pneumonia. If you do not treat pneumonia, you can die of it. To treat

pneumonia, you need a doctor. So if one doesn't get rid of cold symptoms in more than two weeks, one should see a doctor.

- (A) Arguments containing premises supporting conclusions
- (B) A list of instructions, directions, or proverbial advice
- (C) A narrative reporting a time-ordered sequence of past events
- (D) An, expression of strong feeling or opinion
- (E) None of the above

7. HIV causes AIDS. I am sure this must be true because my pastor has repeatedly said so, and he is a very trustworthy man who never does the wrong thing. He counseled my wife and I before we got married. Last month he was interviewed by The Ghanaian Times and he regularly appears on panels on GTV treating various important subjects, and he is widely recognised by a very large and faithful congregation in Labone.

- (A) Ad hominem (B) Genetic fallacy (C) Equivocation
- (D) Hasty generalization (E) Circularity or Begging the question

8. The women in my village do washing at the river bank and they collect a lot of money for it. They invited me to join them since I am looking for a way to earn some money. But I learned from a representative of Barclays who was on the radio that when you collect money at a bank, because of the depreciation of the cedi, the amount that you keep may not accrue interest, and that after you spend on charges for bank services you may wind up with less than the amount you would have saved if you just kept away from the bank and stored your money in the house or in treasury savings bonds. So I think it is best if I find something to do in the house and don't go with them to do washing, because in the end I will just lose money.

- (A) Ad hominem (B) Genetic fallacy (C) Equivocation
- (D) Hasty generalization (E) Circularity or Begging the question

9. The University is going to change the way that Commonwealth Hall is being utilized. The University has been planning for a long time to organise the Hall to become a residence for graduate students to consolidate all the men and women who are doing their MPhil and PhD work to live in a prestigious location on the campus. But this plan absolutely cannot be a good thing for the students. The reason is clear if you just look at all the discussions that have resulted in development planning on the campus over the years. You realise that very few if any of the boards or committees involved have ever contained any students as members. Even now student representatives do not have any vote in the final arrangements made by the University with outside contractors, in the end everything that is done with building and construction on the

campus, as well as allocation of facilities, goes to the Vice Chancellor for approval. So the Vandals should take the University to court because what it is doing is very wrong and must be designed to destroy the power bloc of the students.

- (A) Ad hominem (B) Genetic fallacy (C) Equivocation
(D) Hasty generalization (E) Circularity or Begging the question

10. Everyone who gets good grades has a computer. I don't have a computer. That is why my results are so poor that I have been put on probation.

- A. A hypothetical syllogism B. A modus tollens argument C. A statistical argument
D. A fallacy of ignoratioeienihi E. Confusing correlation with causal connection

11. The most important thing for Africa is to unite as one country under one single leadership. This must be true since it was stated repeatedly by James Wolfensohn, the former president of the World Bank. As a distinguished speaker in the Aggrey-Fraser-Guggisberg Memorial Lecture series in 2008 he gave the advice that Africa unite under one government. He has his own corporation and he was knighted by the Queen of England. He is also a nationalized American citizen, has a lovely wife and four children—all of them are sons and they are all going to very fine schools and will become very successful.

- A. Eulogistic ad hominem B. Appeal to pity C. An enumerative induction
D. An expression of strong feeling or opinion
E. A narrative reporting a time-ordered sequence of past events

12. The World Bank's new recommended policy of terminating school loans is a mistake. If you need to buy books then it is usually necessary that you get a school loan. But the World Bank cut the university loan scheme in Ghana, since poor people who use the scheme often don't pay the money back. Since students will not be getting school loans in future, one has to conclude that most students will not be buying many books in the future. But without books, the quality of the degree awarded is of less value. After many years, employers will realize that the degrees awarded at Legon are not of very high quality, and they will not be interested in employing the University's graduates—they will choose from other better endowed universities. So the World Bank policy to terminate loans will undermine employment opportunities for our graduates, and destroy the chances of filling the entire purpose for which a university education is supposed to help in economic development, in order to save the government money in the short term through lost loan repayments.

- A. A deductive argument that employs hypothetical syllogism
B. A fallacy of appeal to illegitimate authority

- C. A list of instructions, directions, or proverbial advice
- D. An expression of strong feeling or opinion.
- E. A narrative reporting a time-ordered sequence of past events

Activity 3.2

Recognising syllogisms

The following set of items contain logical syntactic schema—that is, argument patterns without any semantic content (no subject matter other than the logical structure). For each item choose the statement among (A-D) that correctly evaluates the pattern by circling the corresponding letter. If none of the alternatives (A-D) provides a correct evaluation, then select (E)

1. All As are Cs. All Bs are Cs. Therefore all As are Bs.

- (A) This is a valid deductive argument pattern.
- (B) The correct conclusion is that all Cs are As.
- (C) The conclusion given in the passage does not deductively follow from the premises.
- (D) This pattern is called hypothetical syllogism.
- (E) None of the above.

2. If that creature is an A then it must also have the characteristic B. But that creature does not have the characteristic B. So it cannot be an A.

- (A) This is a valid deductive argument pattern.
- (B) This is an invalid argument pattern.
- (C) No conclusion follows deductively from these premises.
- (D) This pattern is called hypothetical syllogism.
- (E) None of the above.

3. Either A is true or B is true, but both cannot be true. If A is true then C must also be true. It was discovered that B cannot be true. So C must be false.

- (A) The correct conclusion is that C must be true.
- (B) This is good inductive reasoning.

- (C) This is a valid deductive argument pattern.
- (D) The correct conclusion is that C might be true or it might be false.
- (E) None of the above.

Activity 3.3—Thinking drill

Applying knowledge of syllogistic arguments

This set of passages contain the premises of an argument but they are missing a deductively valid conclusion. To say a conclusion is deductively valid means it would be logically impossible for that conclusion to be false if the premises were true.

Sample:

All birds can fly. All flying creatures have feathers. Therefore

- (A) All feathered creatures fly. (B) All flying creatures are birds.
- (C) All feathered creatures are birds. (D) No feathered creatures are birds.
- (E) None of the above follows deductively from the given premises.

Since none of the alternatives (A-D) follows validly as the conclusion of the given premises, (E) is the correct answer for the sample item.

For each item in this exercise, select the letter corresponding to the correct rejoinder which follows as a valid conclusion from the premises given in the passage, if none of the rejoinders follows as a deductively valid conclusion, then select (E).

1. Some snakes have poisonous venom and some do not. All creatures with poisonous venom are lethal. Therefore:

- (A) All snakes are lethal. (B) Some snakes are lethal. (C) No snakes are lethal.
- (D) All lethal creatures have poisonous venom.
- (E) None of the above follows deductively from the given premises.

2. Either the new patent protection laws will be introduced in Africa or they will not. If the new patent laws are introduced in Africa then the price of antibiotics definitely will increase. If the prices of these drugs increase, then the ability to fight contagious disease will be undermined all over the continent. If the ability to fight contagious disease is undermined, then mortality rates in African countries will increase. Therefore:

- (A) This proves that the mortality rates definitely will increase in Africa.
- (B) The WTO does not care about African lives, because WTO supports the new patent laws.
- (C) If the patent laws on drugs are introduced in Africa, then mortality rates will also increase.
- (D) If the patent laws on drugs are not introduced, then drugs will be of lower quality in Africa.
- (E) None of the above follows deductively from the given premises.

3. Citrus fruits contain vitamin C. Oranges are citrus fruits, and so are pineapples.

Tomatoes contain as much vitamin C as oranges do. Another name for vitamin C is ascorbic acid. Therefore:

- (A) Citrus fruits and tomatoes contain ascorbic acid
- (B) Tomatoes contain more ascorbic acid than do oranges and pineapples.
- (C) The only foods containing ascorbic acid are citrus fruits.
- (D) Oranges and pineapples contain ascorbic acid but tomatoes do not.
- (E) None of the above follows deductively from the given premises.

4. In the early 1970s, anyone playing reggae music in Jamaica, where it originates, was likely to be arrested. Only political and religious revolutionaries played reggae music in those days. Bob Marley started playing reggae music in Jamaica in the 1970s, we can conclude that:

- (A) Bob Marley was a commercial businessman, not a revolutionary, in the 1970s.
- (B) Bob Marley was a revolutionary in Jamaica, and was likely to be arrested in the 1970s.
- (C) Bob Marley was too famous to be a revolutionary in Jamaica, and so he could never be arrested.
- (D) Bob Marley was never in Jamaica.
- (E) None of the above follows deductively from the given premises.

5. If someone is aware of current events then he or she is able to make an informed decision as a voter. Anyone who reads newspapers or listens to the news on the radio is aware of current events. Unless voters are making informed decisions, elections cannot be effective. Therefore:

- (A) No elections in Africa are effective.
- (B) In order for elections to be effective, voters must be able to read and write English fluently.

- (C) In order for elections to be effective, voters must be aware of current events.
- (D) Without effective elections, citizens cannot read and cannot afford radios.
- (E) None of the above follows deductively from the given premises.

6. The World Trade Organisation talks can proceed productively provided world trade can be made fair for all farmers. But world trade will be fair for all farmers only if the price for selling farm products on the world market is not reduced artificially. Farm product prices are reduced artificially on the world market now because big American businesses in farming receive huge subsidies from the US government. This allows them to grow an excess of cotton and sugar, which is then dumped on the world market. The US government will not stop subsidizing the big American farming businesses. Therefore:

- (A) The greatest obstacle to Africa's development today is HIV/AIDS.
- (B) The rich will always oppress and exploit the poor.
- (C) The World Trade Organisation is corrupt.
- (D) The World Trade Organisation talks cannot proceed productively.
- (E) None of the above follows deductively from the given premises.

Activity 3.4—Thinking exercise

Identifying informal fallacies

This set of passages illustrates different ways that a set of premises inductively fails to support a given conclusion.

Recall from Units 7 and 8 that 'evidence' is the term for information provided in premises that constitute a good (logical) reason for accepting the conclusion. But instead of providing evidence, the passages below may contain non-evidential tactics of persuasion and rhetoric that give a motive for accepting the conclusion without providing good inductive evidence or a logical reason to support it. Listed below are four standard labels used to identify common types of fallacy in evidential arguments:

- (A) Illegitimate appeal to authority: This fallacy is committed when the opinion or testimony of a recognized authority figure is cited on a subject matter that is outside or totally unrelated to the domain of his or her expertise.

Sample: The famous master of football George Weah has gone on radio and TV to say that the new chemical fertilizer Super-Grow will ensure that crops are properly fertilized with all the

necessary nutrients to protect against draught and poor soil quality. So Super-Grow must be the best fertilizer now available for our maize crop.

(B) Appeal to threat: Sheer intimidation that provokes fear or trepidation about the future can induce or provoke acceptance of a claim independently of whether that conclusion merits acceptance on the basis of evidence indicating that it is correct.

Sample: The best candidate running in the election is clearly the man seeking re-election who is already in office. So you should vote for the incumbent, because if word gets round that you did not show your continued support for him, he has the power to destroy your business or to harm your relatives.

(C) Appeal to the masses: Citing widespread public support of a belief can induce acceptance of that belief even if it is false.

Sample; Life in America must be better than life in Ghana for every young adult in every way. I know this to be true because everyone I know in university who is able to go to America is trying to get there at their very first opportunity.

(D) Ad Hominem: This fallacy is committed when a conclusion is drawn either for or against a claim based upon premises that discuss the character or other features of the person making that claim, rather than premises providing facts that bear upon the truth or falsity of the claim itself.

Sample: The new proposal to improve health care benefits for civil servants is not going to work well; I know because I live next door to the couple who own the insurance company that devised the new scheme, and I can tell you that even though they must be very wealthy, they always dress very unfashionably and moreover they keep an untidy yard swarming with stray cats, dogs, and all sorts of loitering children who do nothing but, make noise all day long.

(E) Equivocation: when the persuasive force of premises in support of a conclusion depends upon shifting the meaning of one or more key words in the argument, then the illusion of a reason being provided for the conclusion is the result of a 'play on words'.

Sample: The sport of jumping off cliffs with a parachute is not only a foolish and dangerous past-time, it is also an attempt to break a law of nature. This is obvious since everybody knows that the law of gravity exists everywhere on earth and when a man uses a parachute to break the speed of his intentional fall he is trying to violate this law. Therefore people should be prosecuted if they are caught using a parachute when they jump off a cliff just for sport.

For these items, read each passage and select the letter (A-D) corresponding to the label that identifies the type of evidential fallacy illustrated by that passage. Rely upon the definition provided for each label, in order to make your selection. If none of the labels are suitable to correctly describe the passage, then select (E).

1. If you want to get a certificate with honours when you graduate, clearly you must first get a PC (personal computer) and that will ensure that you will get a 'first upper' degree. This is evidently true since the majority of students on the campus either own a PC or have access to one.

- (A) Illegitimate appeal to authority (B) Appeal to threats (C) Appeal to the masses
(D) Ad hominem (E) Equivocation

2. When Nelson Mandela led his people to fight against the apartheid regime in South Africa, he was disobeying God's will. We know this to be true because Mandela had to stay in Polsmoor prison for thirty years. He had been tried in a Pretoria court and found guilty of breaking the law; and clearly anyone who acts against the law of his own country is acting against God's will, since God's will is law.

- (A) Illegitimate appeal to authority (B) Appeal to threats (C) Appeal to the masses
(D) Ad hominem (E) Equivocation

3. My neighbour died recently after suffering from AIDS for a long time. She had been taking medicine for her tuberculosis but she ran out and could not afford to buy any more medicine. But the reason she died is because her husband was unfaithful to her. This is not surprising since it is the reason why most women die of AIDS in Africa. I am sure of this because the bishop of my church said HIV/AIDS is caused by sexual misconduct.

- (A) Illegitimate appeal to authority (B) Appeal to threats (C) Appeal to the masses
(D) Ad hominem (E) Equivocation

4. Clearly the most recent war was good and was fought for a just cause, it is important to realise that this is true, because that war was declared and waged by the most aggressive and powerful military force in the world, and you can imagine the long-term consequences that might follow from refusing to support such a strong and powerful nation's crusade against terrorism.

- (A) Illegitimate appeal to authority (B) Appeal to threats (C) Appeal to the masses
(D) Ad hominem (E) Equivocation

The following passages contain arguments which may contain a fallacy of reasoning which does not involve logical form; on the other hand the hypothesis may be confirmed on the basis of good evidence.

For each passage (5-8) select the alternative (A-E) that provides the BEST analysis.

5. You should believe that the Student President has made the right decision in calling a strike action to force the administration to meet the students' demands. Because clearly if you don't

support the Student President's decision, you will be regarded as a traitor for the rest of your time here, and you will not have much future when you graduate because people will grow to distrust and dislike you.

(A) Ad hominem (B) Appeal to threats (C) Appeal to pity

(D) Appeal to the masses (E) Confirmation based on good evidence

6. Terrorism is the world's greatest threat to civilised freedom and democracy. It must be so, since George W. Bush said it and he is a Born Again Christian and a loyal friend to all his neighbours in his home town. All his business colleagues like him very much. He is very personable and laughs a lot. He is always making toilet jokes and he farts at meetings to be funny. The Bush family has been involved in the international oil business with the Bin Laden family for decades. So he knows the terrorists very well on a personal level and through many business deals. Certainly he knows what he is talking about.

(A) Ad hominem (B) appeal to threats (C) appeal to pity

(D) Appeal to the masses (E) Confirmation based on good evidence

7. Listen to this poor and thin, very sick little boy. He is so brave; don't you just wish his life could be saved? Isn't it a shame that he cannot afford treatment? Just look at him—he is dying. You just have to believe what he says; don't even bother looking into the research done on the drugs. This boy's life is at stake. Certainly what he says about the importance of making anti retroviral medicine available for every child in Africa must be true.

(A) Ad hominem (B) Appeal to threats (C) Appeal to pity

(D) Appeal to the masses (E) Confirmation based on good evidence

8. Everyone who can afford a computer has one at Legon. And everybody says if they had a computer they would do better in their subjects. So clearly, my not having a computer is the one thing that is keeping me from getting an honours degree.

(A) Ad hominem (B) Appeal to threats (C) Appeal to pity

(D) Appeal to the masses (E) Confirmation based on good evidence

Summary

Recognising what type of evaluation a passage requires is chiefly a matter of carefully reading it.

Once you know you are interpreting and analysing a passage that contains an argument:

1. Look always first for the conclusion. Determine its reference and attribute class.

2. Study the other statements to see if they can act as premises supporting this conclusion.
3. Is the conclusion 'contained' in such premises? Do you find the passage contains two or three classes related to each other, possibly by a valid syllogistic scheme?
4. If you suspect a syllogism, then symbolise it (see Unit 6) to reveal the two or three classes; rewrite without this content using the letter symbols to see if there is a valid structure for any known, one or more, syllogistic pattern.
5. Otherwise see whether the premises provide a good reason to believe the conclusion is likely to be true.
6. If there is an inductive argument relation based upon evidence and hypothesis, what sort of induction is it?
 - An analogy
 - An enumeration
 - A causal hypothesis
 - A statistical hypothesis
 - A sample
7. If there is a failure to provide a good reason in the premises to believe the conclusion, consider why. Ask:
 - If there are statistics, are they used successfully or is there a mathematical mystique?
 - Is there a change in subject matter between the conclusion and the premises?
 - Is there a misuse of language in the conclusion or the premises?
 - What has been tried to motivate belief in the conclusion, if no deductive or inductive reason has been provided?
 - If there is a sample, is it sufficient in size, and unbiased?
 - Is the evidence presented complete, and relevant?
8. If the conclusion is a causal hypothesis, what methods were used to support it? (See Unit 9).
 - Is the conclusion the result of a causal fallacy;
 - Post hoc ergo propter hoc

- Confusing cause and effect
- Confusing or overlooking a common cause
- Confusion correlation for a causal connection

SECTION 4 REVIEW QUESTIONS FOR PROBLEM SOLVING

Introduction

The methods for avoiding mental blocks to solving puzzles which you learned in the previous Unit 11 are employed in this section. By practicing we can improve our problem solving abilities.

Objectives

- Practice overcoming the barrier to solution known as mental set
- Practice representing the problem in its key aspects
- Learn to be alert to emotional and cultural inhibitions to finding solutions
- Avoiding confirmation bias
- Applying the IDEAL model of pursuing a solution

Activity 4.1

The drinking glass problem

Six drinking glasses are lined up in a row. The first three are full of water, the last three are empty. By handling and moving only one glass, change the arrangement so that no-full glass is next to another full one and no empty glass is next to another empty one.

Activity 4.2

Prisoner's escape

A prisoner was attempting to escape from a tower. He found in his cell a rope which was half long enough to permit him to reach the ground safely. He divided the rope in half and tied the two parts together and escaped. How could he have done this?

Activity 4.3

The three pole ring problem

The rings on the left pole need to be moved so that they end up on the extreme right pole. The rings must be moved one at a time, and with each move, a ring can be placed only on a larger ring. Thus, ring 1 can be placed on the top of Ring2, but Ring 2 can never be placed on Ring 1.

Can you solve this? Count the number of moves you made before reaching the goal state. Compare your moves to the moves made by your colleagues.

Summary of this section

We have practiced the methods proposed to systematically outmanoeuvre a design set up to elude our mental abilities. Often we have succeeded when we have:

- Understood the problem
- Remembered the problem
- Identified alternative hypotheses
- Acquired coping strategies
- Evaluated the final hypothesis

Employing the memory aid called IDEAL, we:

- Identified exactly what is at issue in the problem as stated initially
- Defined or represented the problem in a vivid way for ourselves
- Explored alternative possibilities for solving the problem
- Acted out these alternative strategies to their conclusion
- Looked back to see the results of those strategies we pursued

Assignment 1—Think, Query, Discuss

Compare your own answers to the activities in all four sections in this Unit with those suggested at the end of the Reader. If there is a consistent misunderstanding then set up the next stage of learning: write questions about the material where these disparities occurred and present your questions to an instructor or tutor to get answers: turn the tables. Find the core of the confusion on any one topic that you are troubled with: is there a passage in the text that makes no sense? An exercise that doesn't come through the way you think it is supposed to?

Is there a basic principle which is not well enough explained? Create challenging questions and you will be an active learner, thereby fulfilling the purpose for which this module was created on your behalf.

Unit summary

In this unit you learned:

- How to respond to and to use objective questions for learning.
- You had an opportunity to solve problems by allowing yourself to think creatively and to challenge assumed ways of handling a problem.
- You learned what it means to critically question tacit knowledge, including the tacit knowledge exhibited in this Reader.

APPENDIX

The following essay, reprinted here posthumously, is by a former lecturer in the philosophy department at Legon, a widely recognized Newton scholar and philosopher of science affiliated with the Open University in UK until his death.

The essay presents is about the commonplace tendency of the general English reading public to commit failures in critical thinking. The author provides many examples of the formally educated population's shortfall in critical acuity when confronted with scientific discourse through newspapers, broadcasts on television and radio, magazines, special interest magazines and popularised scientific literature.

Superstitious thinking is rampant in modernity; it is prompted through an excessive reverence for the appearance of scientific rigour and thoroughness.

This essay may be a lively and engaging source of questions for your continuous assessment assignments and examination questions.

VIRUSES OF THE MIND

By DEREK GJERTSEN

I use the term 'vices' to refer to diseases of the mind, which are not so easy to recognise as diseases of the body. This is because we have frequently experienced sound bodily health, but have never known true health of mind.

Rene Descartes, Private Thoughts (1619-1622)

Nothing is as common as stupidity.

Cicero, On Divination (44 BC)

INTRODUCTION

The twentieth century widely known English philosopher Stuart Hampshire served in Intelligence during World War II and one of his duties had been to interrogate Kaltengrunner, head of the Gestapo and a man responsible for the deaths of many civilians.

Hampshire later confessed how surprised he had been to discover just how easy it was to organise “vast enterprises of torture and murder,” that there had been no shortage of “unmitigated evil and nastiness;” and that, against all his expectations he had been forced to admit that “high culture and good education are not significantly connected with elementary moral decency.”

Equally surprising, although this time to the intellectual historian, is the continued survival of archaic superstitions and popular delusions long since exposed. Hume (1757) had argued that it is natural for superstition to prevail everywhere “in barbarous ages” among people ignorant of astronomy and the anatomy of plants and animals. In their ignorance they search for those “invisible powers who dispose of their happiness and misery.” On Hume’s view it would follow that once societies move beyond barbarism and become acquainted with astronomy, anatomy and other matters, superstition and belief in invisible powers would decline.

The first part of Hume’s argument has been fulfilled in that societies have for the most part moved beyond to becoming acquainted with astronomy and anatomy. It has not, however, produced a corresponding decline in superstition and the belief in invisible powers. Astrology, for example, had almost disappeared in the west by the late eighteenth century.

Yet today in highly industrialised countries where there is almost universal literacy and where easy access to higher education is probably stronger than at any time in history few newspapers are without their horoscopes; astrologers advise presidents in the west and in the east alike, and officers of multinational corporations are reported to consult clairvoyants and spoon-benders before making major investments.

A visit to a bookshop in current day London or New York will reveal some strange contrasts. It will contain various works on popular science by Stephen Hawking, Paul Davies, and Richard Feynman that cover Darwinism, relativity and quantum theory. In recent years the number of such best-sellers has grown considerably and the Popular Science section has become a well established feature of most bookshops. At the same time the visitor to a European or American bookshop is sure to find a larger section devoted to some very curious subjects. There will almost certainly be a large number of books on Nostradamus, an equally large number on Atlantis and extra-terrestrial abduction, on witches, and numerous works inviting us to predict the future once we have mastered the Ching, the Tarot, Runes, or once we have learnt how to read

our palms, or to construct a horoscope. Once the future is established men and women of modernity are encouraged to learn how to live long and healthy lives by surrounding themselves with the right colours, the right smells, eating especially pure foods, manipulating the soles of their feet, sticking needles in their skin, drinking herbs or simply by meditating. And if by chance we have foolishly allowed ourselves to contract cancer, schizophrenia, migraine or arthritis there is bound to be some book helpfully offering a simple and painless cure.

And these books, it must be stressed, are not from small presses producing badly printed texts; rather they come lavishly illustrated and expensively produced from the lead publishing houses of the land. As we begin a new millennium it is chastening to realise that bookshops in all the major cities of postindustrial societies really do have sections neatly labelled **OCCULT** and **RITUAL MAGIC**.

To anyone at all historically minded the presence of such books can be deeply disturbing. Belief systems of the past long exposed as worthless are offered as the latest wisdom. Centuries of criticism go unnoticed and unanswered. Ritual magic and astrology, long abandoned, are now offered as serious approaches to nature. It is as if the scientific revolution of the seventeenth century had never happened and as if the names of Descartes, Newton and Boyle now count for nothing. While no one supposes Roman chariots are a more comfortable means of transport than a modern car, many seem willing to consider Roman methods of divination to be serious rivals to the diagnostic tools of modern physicians.

Why have such powerful intellectual movements as the scientific revolution and the Enlightenment failed so markedly in freeing modern educated men from superstition and irrationalism? We can simply accept with Hume that men are liars, or with Cicero that men are stupid, and indeed, observing the world today there is much to support both judgments. Alternatively there is Descartes' view that certain vices-or viruses in a more modern terminology-are inherent in the mind. We can all recognise pathologies of the body (boils, cuts, bruises, chronic allergies and breaks) but are less adept at recognising mental pathologies. The suggestion that they are mental-or as I would prefer to call them, intellectual-pathologies, is prompted by their universality.

As some form of astrology is to be found almost everywhere it would be difficult to link it with any particular socio-economic system. If astrology can take root in theocratic Egypt, democratic Athens, Imperial Rome, Islamic Baghdad, Confucian China and Reagan's Washington DC, its presence is most unlikely to be explicable in religious, social or economic terms.

There are other analogies to pursue, other features with the capacity to thrive in capitalistic New York City, as readily as in feudal Riyadh and once communist Moscow. The great influenza epidemic of 1919 was no respecter of cultures. Equally it was as prone to infect the illiterate as well as the learned, the wealthy as much as the poor, the pious as readily as the profane. No classes, race, or age seemed immune. But, perhaps, at least figuratively just as there

are viruses of the respiratory system there can also be less tangible viruses of the intellectual faculties. These are just as capable of crossing the borders of time and space. They can also spread prodigiously and once entrenched can be as persistent, durable and infectious as the common cold. Also like colds they come in various guises.

A full classification of intellectual viruses is yet to be developed, as is a reliable therapy. What we can do is to identify and describe a number of common viruses in the hope that once exposed they may be less virulent. Perhaps vaccines can be devised.

Antiquity and Distance

One of the strangest delusions not just of modern times, but one prevalent in most places at most times, is the conviction that antiquity possessed a store of truths far superior to anything discovered in our own times. And if by chance we do stumble upon something of significance it will quickly be seen as a fortunate recovery of some long lost ancient truth. We are in reality still struggling to rediscover the wisdom and insight that the ancient Egyptians, Chaldeans, Maya, Chinese, Tibetans or whoever took for granted. Such a view, for example, was held by Isaac Newton, in the 1690s he prepared a short document now known as the *Classical Scholia* and in it he made the surprising claim that all the features of his own work could be found in the writers of antiquity. Atomism he traced to a certain Moschus the Phoenician, the inverse square law he found in Pythagoras and universal gravitation in Lucretius (c.98-c.55 AD). The tradition is an old one, attractive to the early Greeks. Proclus (410-485 AD), a late neo-Platonist accepted that “Geometry was first discovered among the Egyptians” and was brought to Greece by semi-mythical Thales (fifth century BC). Aristotle too noted that “the mathematical arts were founded in Egypt,” 2000 years prior to his own fourth century BC. And so on through the writings of Herodotus (c.490-c.425 BC), and Plutarch (c.46-120 AD). Nor is it just the distance in time that holds a trusted wisdom. Equally attractive, is the appeal of the spatially distant. In European Renaissance markets, for example, we find peddling their wares such characters as Benedetto il Persiano and the Americano. Even today there is a tendency for drugs and medicines to be offered as if their age and remoteness added to their potency. Thus you can buy *Ma Huang* “one of the oldest” of Chinese medicinal herbs, or indulge in *Reiki* “an ancient science from India and Tibet.” When Cagliostro set about duping eighteenth century Europe he populated his seance rooms with statues of Isis, Anubis, and other gods of ancient civilisations. His servants were dressed as Egyptian slaves and hieroglyphics were scrawled on the walls.

In modern times few places are as remote, distant and inaccessible as Tibet. It is presumably therefore no accident that for many it has been the preferred source of esoteric wisdom. Few places can be so hard to get to for both physical and political reasons. Yet since the late nineteenth century and Madame Blavatsky's published escapades, it has been widely held to be the home of an esoteric wisdom and powers far exceeding the wisdom of any western disciplines.

It should be clear that such claims are bogus but it is far from clear even to the educated elite of technically advanced societies.

The Prince of Wales, for example, recently came across the figure of Paracelsus and after reading a few pages concluded ‘the principles upon which Paracelsus had based his treatment four hundred years earlier have a message for our own time: a time in which science has tended to become estranged from nature.’⁸ But consider how little Paracelsus could ever have had to teach us about science or medicine. He was writing a century before the circulation of the blood was discovered and a couple of centuries before there was any real understanding of the physiology of respiration or of the workings of the nervous system. Yet he did teach that Nature was sovereign and that we should treat ourselves in harmony with and not opposed to its principles. His moral precepts may have been sound although his science was laughable in many respects.

The trouble is that for Paracelsus the principles of Nature tended to be identified with a liberal use of heavy metals. Thus he is well known for introducing such metals as mercury, antimony, lead, arsenic and gold into the medical pharmacopeia. So if you yearn for a good strong dose of lead and mercury to cure your syphilis—the new disease of his day – then Paracelsus, was your man or, again, acting in harmony with Nature, for Paracelsus, could mean experimenting under the right astrological signs. Thus if you want to change silver into gold, Paracelsus warns, “begin when the moon is within six degrees of Cancer... for all negotiations and actions in this world are most happily brought to perfection, which are begun with due respect to the Course and influences of the Celestial Bodies.”

The truth is that such claims and judgements are hopelessly naive and betray such a colossal ignorance about the past as to be scarcely credible. The state of Egyptian maths, for example, can be seen on the Rhind papyrus dating from 1650 BC. They had yet to develop the wit to progress beyond unit fractions – thus $\frac{2}{9}$ becomes for Egyptians $\frac{1}{6} + \frac{1}{18}$ – but even this is anachronistic as they had no sign for addition (+). The kind of problem they tackle is: ‘A number and a half make 16; so what is the number?’ And, most important of all, they lacked all idea of mathematical proof. In the words of its foremost student, Otto Neugebauer, “Ancient science was the product of very few men and these few happened not to be Egyptians.” Or if the preference is for medicine, the Ebers papyrus dating from 1500 BC should be consulted. Here we are told that baldness could be cured with “the fat of lion, fat of hippo, crocodile, cat, serpent, ibex mixed together” – a complex compound which no doubt increased its price. Otherwise you can choose a spell “to expel evil things from your stomach.”

Seen in their proper context these are fascinating and important documents. They show a people trying to understand number and not surprisingly going about things in a rather confused way. Only by working our way through and out of these confusions could a more sensible maths and medicine emerge. Scientific understanding and credibility are the Jonathan Dimbleby (1994:

306-307) slow accumulation of millennia of hard work; they are not the proper claim of any one culture or period of human history.

Compare trying to get a similar argument going in praise of the Ancients' cartography. Could anyone claim that our ancient maps reveal a wisdom long since lost? Look at a few ancient maps and see just how ignorant early cartographers were. It is not just that before Columbus and Cook they were unaware of the Americas and Australia, but that they knew very little about the great land masses of Asia and Africa, it was not until the nineteenth century that the sources of the Nile and Niger were indicated by mapmakers of Europe.

One group who quickly saw that ancient knowledge was indeed limited was the early travellers to the Americas. Thus Vespucci commented that Pliny "did not touch upon a 1000m part of the species of parrots and other birds," while Acosia after passing through the 'torrid zone' noted: What could I do then but laugh at Aristotle's *Meteorology* and his philosophy! For in that place and that season where everything should have been scorched by the heat, my companions and I were cold. It could well be that in some areas the works of antiquity remain unsurpassed. The claims that no one has yet written a funnier play than *The Clouds* of Aristophanes or a greater tragedy than Sophocles' *Oedipus* would win much support. And the building of ancient Athens centuries before Christ could well be held to match in style and grandeur the architecture of Renaissance Florence a thousand years later. It is even acceptable to claim that nothing produced since has yet to match the depth of Plato's philosophy. But to go beyond these claims and argue that great secrets of logic, maths, medicine, chemistry, physics and other sciences await their discovery in ancient texts is to ignore all history.

CREDULITY

There is also a widespread willingness to believe at first sight personal reports of strange happenings, the claims of self-styled sages, gurus or prophets, obscure messages in ancient texts or any old unsubstantiated newspaper report. On many occasions we hear the query, "But why would he lie?" as someone claims to have been kidnapped by aliens, taken to alpha centauri (the star nearest to our Sun) and to have had the secrets of the universe revealed to him. Indeed even when people confess that they are lying, there remains a tendency for others to discount the deception. When some spoon-bender or mind reader is caught flagrantly cheating, the defence is soon raised that his only proof is that he was cheating *this time*; at other times psychic powers may well have been exercised by him and certainly by others. People at all times and places love magic and yearn for miracles.

One intriguing contemporary example was reported by David Jones, a physical chemist who began a brief career in 1981 "as a self-confessed fraud," exhibiting perpetual motion machines at scientific conferences. But, as he explained, "Perpetual motion is of course one of the classic impossibilities of science. Every real mechanism needs a source of energy which sooner or later must run out." Nevertheless pseudo perpetual motion machines with hidden sources of energy

can be built. The point of the machine was to challenge his colleagues, scientists and engineers, to detect where and how he had concealed his energy source.

Once the hoax was displayed, Jones remarked that he experienced “the most staggering surprise of my career” as he came across people who believed in it for real; and these were for the most part professional engineers and designers. He protested that his machine was a hoax, that he was a self-confessed charlatan. At which point he was simply accused of “lying to protect his secret.”

The seventeenth century saw the appearance of a new literary genre (Thomas Browne’s *Pseudodoxa epidemica* (1646) is perhaps the best known) which sought to shake people out of their complacency and to reveal to them that many commonsense notions and widely shared beliefs were simply false.

In part they were antidotes to earlier works describing the fantastic marvels to be found in the world. In Pliny (23-79 AD), for example, we read of the phoenix, of men without mouths, or with the heads of dogs, with only one leg but a leg so large that “when the weather is hot they can lay on the ground and protect themselves by the shade of their feet,” or the cave dwellers “without necks and with eyes in their shoulders.” Such tales were repeated endlessly, illustrated in books of wonders and elaborated by later travellers.

The *pseudodoxa* tradition set out to expose a large number of these popular errors that mankind had accumulated since antiquity. They cover beliefs about minerals, animals, man, history and geography. False or dubious beliefs that were examined range from whether elephants have joints, whether Jews stink naturally, and whether rainbows and eclipses are signs of “succeeding contingencies.” Typical of this approach is Browne’s account of the phoenix. Is there really such a bird which “burneth itself, and from the ashes thereof ariseth”? But, as Browne notes, there are no actual eye witnesses, no “definitive confirmatory.” Herodotus, for example, who introduced the phoenix to Greece, had only seen paintings of the bird. As for those, who do write about the bird it seems that they are unsure of its properties and ascribe to it a life of 300, 500, 600, 1000 or 1500 years. Nor is there any agreement on where it can be found; claims of its origin made for Ethiopia, Egypt, India, and Arabia. Given such dubious evidence, belief in phoenixes could not be recommended.

Throughout the genre of *pseudodoxa* appeals were made to more general principles. Browne, for example, singled out the blind adherence to antiquity, “the mortallest enemy unto knowledge” and spent much of his time exposing for his medieval contemporaries many common beliefs found in Pliny, Aristotle, and Herodotus. Another relevant universal feature of the educated mind is “supinuity” or neglect of enquiry, because it is so much easier to believe what we are told than to investigate the facts ourselves.

Where appropriate, experience should be trusted. For example, does a man have one rib less than a woman as the Bible’s Genesis suggests? Observation reveals that the sexes have an equal number of ribs (24).

But at a certain point when presented with something strange and unfamiliar how can we steer between the dangers of arrogantly dismissing everything outside our experience and naively accepting whatever we are told? The dilemma was felt acutely by philosophers such as John Locke witnessing the scientific revolution in seventeenth century Europe. One man (Robert Boyle) invents an air pump and thereby creates a physical vacuum—previously thought a logical impossibility – and reports on several wonders; another describes how his neighbour has bewitched him. Is Boyle's report more credible than the claim of the bewitched neighbour? Diderot asked, why can I accept the testimony of one reporter that the king has won a battle, while I will not accept the claim from all the inhabitants of Paris that they had seen a man raised from the dead? In his *Essay Concerning Human Understanding*, John Locke proposed a set of helpful but fairly commonsense rules. These were adopted and modified in various ways by other writers.

Shapin has identified seven maxims in the seventeenth century literature governing assent to testimony. Thus: Are the witnesses numerous? Are they skilled? Are they plausible? Are they consistent? Are they disinterested? Are they first hand? Do they inspire confidence?

The rules are no more than helpful. Any self-respecting confidence man could easily operate within these criteria, while many a revolutionary theory would most likely be dismissed for violating them. The lone stammering prophet would go unrecognised.

Error

We should all be more aware of the prevalence of error. People make mistakes often and repeatedly. They may even make the same mistake time and time again, most often with little harmful effect. The nearly universal false belief that a spider is an insect damages no one. A casual inspection of newspapers about a topic one is familiar with can often shock when we see just how wrong reports can be. If accounts of our own country can be so wrong, may we not be prudent to distrust stories about distant and less accessible realms?

Where studies have been done they reveal a sizeable error rate of twenty percent or more in the general population. Thus the British newspaper *The Independent* (21 October 1990) noted a National Audit Office study of the U.K. Department of Social Services revealed that 1 in 5 claims had been miscalculated. Or in a British hospital in Grantham, 602 errors had been found in 4,500 laboratory tests (*The Independent* 15 July 1995). And this was work done by well trained, and carefully supervised staff. In court cases the sworn testimony of eye witnesses to a serious crime can subsequently be shown to be bogus. And this is just error. Add on the tendency to lie and exaggerate and there would seem to be no reason why we should not be moderately skeptical all of the time. One experienced barrister estimated that serious perjury took place in “as many as 3 out of 10 criminal trials.” And this refers only to police evidence given under oath.

In medicine it has been estimated from post mortem studies that forty percent of initial diagnoses are in error.

Nor is serious scientific research exempt. Fraud does take place although inadvertent error is more common. That matters are serious and involve vast expense or the risk of life still cannot preempt error. Consider the Hubble Space Telescope (HST). The mirrors were completed by 1981. There was no shortage of labour or undue pressures of time in the construction. The optics of mirrors is an area well understood by both physicists and technologists with two centuries' experience behind them. Yet when in June the first tests of the focusing power of the telescope were routinely run through it was found that the resolving power was far less than predicted and was better than any terrestrial telescope.

More damaging was the 1986 Challenger disaster. With many lives at stake, an investment of billions of dollars, and the highest of high-tech apparatus at their disposal, NASA (U.S. National Aeronautic Space Agency) still managed to commit several careless, elementary and wilful errors with the spacecraft's explosion as the catastrophic result.

In some areas such as meteorology, scientists work with a known level of error and aspire to reduce their error rates to as low as twenty percent.

The physicist Richard Feynman observed that the sign of a good theoretician is the speed with which he can detect his own errors. The geneticist Seymour Benzer keeps a file on supposed breakthroughs linking genes and behaviour. Between 1965 and 1995 he notes there have been serious studies linking genes with reading disabilities, manic depression, psychosis, alcoholism, autism, drug and gambling addiction, attention deficit disorder, post-traumatic stress disorder and Tourette's syndrome. Every one of these studies had to be retracted."

Textbooks are not exempt from flagrant errors. Once an error has entered the literature and been repeated in several textbooks in various languages and editions there is a good chance it is there to stay. A typical example is to be found in the taste map of the tongue with the four areas labelled bitter, sweet, sour and salty, neatly displayed with e.g. sweetness always shown as related to frontal taste buds . . . But a recent article in Scientific American (D.V. Smith and R.F. Margolskee, March 2001) noted that:

Taste researchers have known for many years that these tongue maps are wrong. The maps arose early in the 20th century as a result of a misinterpretation of research reported in the late 1800s and they have been almost impossible to purge from the literature.

Apparently the truth is that "all qualities of taste can be elicited from all the regions of the tongue that contain taste buds."

The conclusion to be drawn from this is that if mistakes can occur in such carefully contrived environments, they are surely just as likely to arise when seers predict our future, when experts provide us with winning lottery numbers, and financiers guarantee that they will double our money overnight. Indeed, one of the surest ways to spot the crook, the con man, and the deluded is at the point when the numerous successes are produced and mention is never made of any failures whatsoever. Whether they be theoretical, mechanical or political, systems which never fail are bogus, to be found only in the realms of fantasy, fiction and deliberate manipulation.

Verification

The crucial notion of critical analysis is that of evaluation. We do not believe everything we are told or read, nor do we dismiss all reports as false. How then do we operate within the borders of total credulity and unrestricted scepticism? How, in fact, do we judge ideas, theories, hypotheses or whatever, to be sound, probable, plausible, true, well established, absurd, false or implausible?

Presumably we accept those propositions which are well supported, which have been confirmed or verified, and reject those which have no supporting evidence or have been refuted by counterevidence. But how do we establish which propositions have been supported and which refuted?

The basic logical weaknesses of verification are well known and will receive only a brief mention here. There is first the inductive problem that although all *examined* swans are white it is simply false that *all* swans are white. And secondly there is the *modus tollens* problem. Thus we might try to confirm a hypothesis by checking its consequences. If they hold then the hypothesis is accordingly confirmed. But the inference that this conclusion is based upon is an invalid inference known to logicians variously as *modus tollens* or the fallacy of affirming the consequent.

There are, however, other features of verification which can be discussed. The question of whether or not some proposal has been adequately supported is not simply a difficult practical problem calling for greater and greater expertise or more and more evidence. It is rather like the question whether someone - a friend, perhaps, a colleague, an acquaintance, or an employee - can be trusted in a certain situation. Just as we do not accept everything we are told or doubt everything we hear, neither do we trust or distrust everyone indiscriminately. For the most part we feel that there is evidence for our beliefs and that this evidence warrants our belief by confirming or verifying it (in some way not fully understood). And this is possibly where the biggest confusions lie — in the fact that the strengths and weaknesses of the process for warranting a belief - that is, the relation between empirical evidence and the hypotheses that it supports - are simply not fully appreciated. We review some of these confusions next.

Claims once thought to be beyond the reach of experience can now be routinely verified. In 1842 the positivist philosopher Auguste Comte sought an example of something straightforwardly matter of fact which would remain forever unknown.

He opted for the chemistry of the stars. He implied that we could make the claim with impunity that the moon is made of green cheese. No one would ever be in a position to verify or to refute it. Shortly afterwards in 1859 the physicist Gustav Kirchoff pointed out that stars emit light and that when passed through a prism light produces spectral lines characteristic of the lengths found in the light source. Consequently astronomers were soon able to identify the presence of the elements sodium and hydrogen in various stars and indeed to identify the element helium in the Sun before had been discovered on earth, using this technique of spectroscopic analysis. The procedure is by now as commonplace as observing the moon through a telescope. Astronomers can now almost casually, routinely and rapidly determine the chemical composition of stars millions of light years away.

Technical propositions frequently supported by many experts over many years may eventually be regarded as false. For example, consider the question of the number of human chromosomes. They were first observed in the 1870s and although early counts varied, by the 1920s it was agreed that human cells contained 48 chromosomes. The figure quickly entered the textbooks and students throughout the world repeatedly verified this figure. Yet in 1955 the cytologists J.H. Tijo and A. Levan, benefiting from improved equipment and techniques “counted just 46 chromosomes.” These counts were completely unexpected. But after a total of 261 concordant counts Tijo and Levan accepted and published their results. Textbooks now report, and students throughout the world now find, 46 human chromosomes.

Nor does the fact that a theory has survived successfully for the best part of two millennia guarantee its truth. The *humoral* theory of disease goes back to Hippocrates in fifth century BC Greece. With a history longer than Christianity; this theory of bodily *humours* was still widely accepted in the Renaissance and only breathed its last with the appearance of the germ theory of disease in the nineteenth century.

Evidence can always be found to support a false hypothesis. There are no shortages of volunteers to remind us that their courage and nobility derive from their birth under the astrological sign of Leo. A little girl might be resigned for life to autistic behaviour by her eiders who attribute all her morbid shyness to the fact that Pluto was in the house of Virgo on the day that the child was born.

Or consider a simple game. You are given the number sequence 2, 4, 6 and told that the numbers are generated by a simple rule. You are invited to find the rule. In your search for the rule, you can offer as many numerical triplets as you like but you will only be told whether or not they conform to the rule. Initially players tend to formulate some such rule as:

Rule A: Choose three successive even numbers and then offer as supporting examples the sequences (8 10 12) and (22, 24, 26). Hen told that these sequences do conform to the rule in question but that Rule A is not that rule, players are initially surprised and go on to offer further examples that confirm rule A such as {100, 102, 104}, etc. They eventually accept that their original supposition, confirmed by all their examples, is not in fact the genuine rule that was applied. Players frequently persist in presenting further successive triplets of even numbers, becoming more and more annoyed. They have become entranced by the magic of confirmation, able only to see data consistent with their hypothesis. In fact it will be possible to offer an infinite number of triplets {2, 4, 6}, {4, 6, 8}, {6, 8, 10} etc. which all confirm the hypothesis. They all satisfy Rule A as well as the actual rule:

Rule B: The numbers are in ascending order.²¹

Rule B is actually simpler, and therefore by classic standards for scientifically judging competing hypotheses, it is preferable *aver* Rule A to account for all the triplets that can be produced as evidence consistent with both Rule A and Rule B. But Rule A, even though it is incorrect, is favoured by many who thought of it initially because of their psychological preference for the feeling that they are right, as opposed to the uncomfortable uncertainty involved in discovering what is true.

Similarly, evidence can always be presented *as* if it were favourable even when it appears quite manifestly to the untutored to be damaging to a hypothesis. Thus when the patients of Chinese alchemists complained that the medicines prescribed for them were producing itching, swelling, vomiting and diarrhoea they were simply told that these were signs of success, that “the elixir you are taking is successfully dispelling you; latent disorders.”

Comparably, evidence can always be found to count *against a true* hypothesis. There is no shortage of volunteers to show us that the cowardly and the ignoble can also be born under the sign of Leo. Indeed, given that 1/12 of humanity are born between late July and late August it is likely that there are many millions who are born in the ‘house of Leo’ who are ‘typically Leo’ just as there are many millions born at the same time of year who have characteristics atypical of Leo. Equally, of course, for the emotional gregariousness of people born between late August and late September while Pluto in its orbit is moving through the constellation of Virgo.

Take one of the most successful theories of all time – Newton’s theory of universal gravitation linked with his laws of motion. Note that ever since its inception there have always been significant phenomena for which Newton’s principles simply cannot account. Strictly speaking, Newton’s laws are not laws at all. Even from the outset, there were problems over the orbits of Saturn and Jupiter, the motion of the moon, and the speed of sound. As these were cleared away new problems arose for Newton’s theory in the form of counterevidence provided by the orbit of Mercury. And so it has continued. Successful scientific theories are always playing catch-up. This is the fate of a bold, comprehensive theory; it generates problems as readily as it produces

solution. A theory without difficulties is likely to be not only boring but vacuous, empty of empirical content.

Some problems lead to a fairly quick closure. Thus, with a few examples behind us, we might think that the formula $X^2 + x + 41$ produces primes. If we substitute the first five numbers for x we get 41, 43, 53 and 61 - and as we carry on up to $x = 39$ with solution 1601, each time producing primes, our confidence may increase in this hypothesis. But when $x = 40$, the resulting number 1681 (41²) is composite. And there the matter ends. Our growing confidence was misleading us all along.

On the other hand, take the case of possibly the most important discovery of the previous century, the structure of DNA as revealed by James Watson and Francis Crick in a one page paper in 1953. Everyone who saw their paper introducing the famous double helix - whether they were chemists, physicists, crystallographers or biochemists - immediately saw the strength of the model and its inherent plausibility and, instead of endless controversy, there was almost universal support and delight. Watson recorded the "instant acceptance" of some and the "immediate enthusiasm" of others. Some checking, of course, was required but few doubted at the time that it would fall apart.

Other problems are more open-ended and lead less readily to closure. It could simply be that we do not know how long to continue an experiment. Surely, a reasonable time must be permitted to allow the expected effect to emerge. But how long is reasonable? The geneticist Ronald Konopka ruled that in searching for a particular gene amongst thousands of fruit flies: "If you don't find it in the first two hundred, quit." Yet Paul Ehrlich examined several hundred chemicals before he found the first effective treatment against syphilis, the famous Salvarsan 606. Edison noted during his intense yet prolonged search to find suitable material to serve as the element in his incandescent bulb that "I have not failed. I have just found 10,000 ways that won't work."

Many other workers, however, have tried equally hard for years to establish some result only to fail. Early chemists, for example, thought that repeated heating or distillation could eventually extract the essence of a substance. It was also thought that gold was part of mercury and that it could be extracted by continuous heating or repeated distillations. The eighteenth century chemist Herman Boerhaave heated mercury from November 1718 until January 1734 to a temperature of more than 100 F. But it remained mercury to the very end.

Perhaps if he had kept the furnaces burning a few more years gold would have been produced as he was expecting. Negative results need not refute. They may simply show that the experiment has not been allowed to run its proper course or that it has not been performed under the right conditions in the right way. Nor need a seemingly successful outcome prove to be a successful verification.

In other cases patience has been rewarded. For example in 1909 Peyton Rous found that he could transmit chicken sarcoma from one fowl to another with a “non-filterable agent” (virus).

But all attempts with other species invariably failed—that is, until 1944 when Ludwik Gross began the attempt to infect mice with leukaemia. But after 5 years’ work nothing had been transmitted. At this point Gross was just about to give up when he heard that transmission of other kinds worked with young mice. He had been working with adults. He soon found that when he injected leukaemic tissue into neonatal mice they too developed leukaemia.

How many research programs on the verge of success have abandoned their work?²⁷ On the other hand, how many billions of dollars must we spend and how long must we search for the causal link between the presence of HIV and the onset of AIDS? How long must we search the heavens for objects predicted but not as yet observed?

Consider the case of the French astronomer Leverrier. In a moment of glory in 1844 using no more than Newton’s laws of motion he explained some anomalies in the orbit of Uranus by predicting the existence of an undiscovered planet. His calculations were confirmed when astronomers first observed the planet Neptune exactly where Leverrier had told them to look. Similar discrepancies were discovered in the orbit of Mercury. The behaviour of Mercury contradicted Newton’s theory, but rather than reject the Newtonian model, Leverrier again sought to find another explanation to account for the anomalous data of Mercury. Leverrier’s calculations led him to conclude that a further undiscovered planet might lie between Mercury and the Sun. He named the planet Vulcan and once more told the astronomers where to look. To this day no one has ever observed Vulcan. Leverrier never lost his belief in the existence of Vulcan. It was small and close to the Sun. It would therefore, inevitably, be difficult to observe. Leverrier insisted astronomers should look harder. But for how long should they search? And how hard? The task is clearly open-ended. The skies are vast, planets are small, and astronomers’ viewing time is valuable.

Evidence for verification may be elusive. Even when verification is not open-ended it can still present a variety of other practical difficulties. The claim that there are mystics in Tibet able to levitate and move as speedily as a Boeing 747 can be made repeatedly, seriously doubted, but seldom checked. Or consider historical claims. Historians often come up with exciting new theories based usually on documents found in some distant and inaccessible site, which may be written in an obscure language that few can read. Who can verify these claims? More often than not no one verifies the claim and a new theory slips effortlessly into the text-books to be repeated endlessly thereafter. Occasionally someone does examine the original claim and finds the evidence to be highly suspect. But if the view has been widely received, it may be very difficult to change.

A case in point was described by the anthropologist Derek Freeman in his work on Samoa. An earlier work by Margaret Mead, *Coming of Age in Samoa* (1928) had presented young Samoans

of the 1920s as free from the disturbances “which vex our adolescents.” Rape, sexual assault, suicide and aggression were virtually unknown.

Her account remained unchallenged until 1983. Yet, Freeman realised, there will be court records of the period, written in Samoan, but still available for study. Examination of these records revealed the young Samoans to be uncomfortably like the young of much of the rest of the world in that they were aggressive, violent, insensitive and ever prone to commit or to be victims of violent sexual assaults. In these cases past Samoan court records have been made public. They do not support the celebrated conclusion that inspired the historical research. How many other claims based on remote foreign archives or naive first hand testimony do we uncritically accept?

The verification process may be costly and inconclusive. Does smoking cause lung cancer? Does HIV cause AIDS? To answer such questions satisfactorily it is necessary to examine the history of a large number of people - in the first instance this must include smokers and non-smokers alike. In 1951 studies began in the UK on 40,000 doctors and a year later in America on 196,000 men. Over the next decade numerous reports derived from these studies did in fact establish a causal link but it had been an expensive and time-consuming process.

At least the issue of linking smoking with lung cancer has been resolved. Other questions prove to be simply too expensive to pursue. The standard model of particle physics predicts that at sufficiently high energies a particle known as the Higgs boson will be generated. To reach these energies an accelerator some 54 miles in circumference was needed. A site was selected in Waxahachie, Texas and a ten billion dollars budget drawn up and initially approved. Eventually, however, after spending two billion dollars the U.S. Congress decided to spend their money elsewhere and consequently we remain in doubt as to whether or not there really is a Higgs particle.

Is intelligence inherited? Are there variations in the intelligence of different races? For much of the century geneticists, statisticians and psychologists have devoted much effort trying either to verify or to refute propositions of this kind. Despite thousands of studies little has been achieved except the creation of very strong views on either side while the question itself remains unresolved.

Given appropriate criteria can everything be explained? Why are there just six planets?’ the mathematician Rheticus, the amanuensis of Copernicus, mistakenly asked in his *Narratio prima* (1539). He asked rhetorically: “what is more agreeable to God’s handiwork than that this first and most perfect work should be summed up in this first and most perfect number?” Numbers which are the sum and the product of their factors were termed by Pythagoras (in the sixth century BC) perfect numbers; the number 6 with factors of 1,2,3 is the first and smallest such number. ($1+2+3$ and $1 \times 2 \times 3$ both equal 6). The uselessness of this criterion is exposed by the fact

that there are more than 6 planets; consequently the notion of perfect numbers has no universal explanatory value, since it fails in this context.

Astronomers no longer accept numerology as appropriate criteria in their theorizing. But just what is the appropriate criteria in any given context is hard to say. Seventeenth and eighteenth century physicists argued endlessly about the criteria appropriate to explain the transmission of gravitational, magnetic and other forces. Were the forces transmitted through a tenuous ether as waves are transmitted through water? Or were they pulled or pushed by intermediate bodies? Or was it sufficient to describe the mathematical laws governing the forces? Or was force perhaps something completely different? Whatever its outcome the argument was prolonged, arduous, and one that was frequently revised by the discovery of new phenomena.

The Greek astronomers found that they could represent the motions of the planets geometrically. No matter how the planets moved, no matter how much they varied in distance, brightness or velocity, there was always a geometrical construction available to represent these patterns. Things might become complicated but as long as the criteria were purely geometrical, a proposed system of explanation could overcome all apparent contradictions with evidence by further elaboration. Serious problems only arose when astronomers demanded that models of the solar system should represent an actual physical reality. Then the principles of geometry were no longer enough to explain the motion of heavenly bodies. With a set of new criteria by which to judge planetary motions, events which had once appeared perfectly natural were now suddenly in need of explanation. Why, for example, did a planet's velocity increase at perihelion (the point in its orbit furthest from the sun)? This observation is a matter of indifference to a pure geometer but it is a crucial fact requiring explanation for astronomers influenced not just by mathematicians but also by physics.

Precision and Novelty

Are there any particularly reliable kinds of verification? It is common to recognise two distinct situations where positive verification is found to be especially persuasive. The first situation concerns precision. Many psychics routinely predict the assassination of a head of state or a major marine, air or rail disaster. Inevitably in the course of a year some one of these psychics will get lucky. Claims of this kind are invariably lucky guesses showing no more psychic ability than the lottery winners who each week overcome odds of fourteen million to one. With two hundred states in the world it is more than possible that some head of state or other will die violently while in office during the next twelve months, in this situation a claim that a European head of state will die in a crash of some kind, even if verified, will carry no weight because the prediction is too vague. The trouble with the advice given by mediums, psychics and astrologers is that it is far from novel and unexpected. Normally it consists of little more than the commonest of everyday wisdom. Clients are told to expect significant changes in their lives, and that difficult financial decisions need to be made. If they could have forecast specific events unforeseen by the rest of us -a favoured politician's fatal traffic accident, perhaps, or a particular

massive tear-gassing and stampede in an Accra football stadium, or a royal family murder in Kathmandu - then their supposed powers would be more convincing.

If however the psychic predicts that the head of a particular *named* state will die from a *named* condition on a *specified* day and if the event comes to pass exactly as predicted then we might be warranted to concede that the psychic's powers may have been verified. Scientists use theories to make specific predictions all the time. They do not simply claim that a solar eclipse will occur next year somewhere over Africa; they specify the precise time and place where the event will be observable. An example of the power of prediction in physics is the expectation of an electron's magnetic moment: according to theory, in the appropriate units, the value is 1.00115965246 while experimental measurement establishes a figure of 1.00115952211

A second situation concerns the accurate prediction of the unexpected, the novel, something we would normally not expect to happen or even to have dreamed about. Thus, Halley predicted the return of the 1682 comet, not sometime in the future, but more precisely in 1758. In the seventeenth century Halley's prediction was novel. Previously, the sight of a comet had been regarded as a special, unique event, something which flashed across the heavens and, like a particular thunderstorm, was witnessed once never expected to be seen again. No one had previously supposed that comets were like the planets in that they had orbits, that these orbits could be calculated and that the comet's return could be predicted. Halley made the prediction by deducing it from Newton's new gravitational physics.

Conclusion

The conclusion to be drawn from this is not that we can never verify, confirm nor refute any hypothesis. Rather it is that such procedures cannot always be pursued mechanically. Trying to evaluate the relation between a hypothesis and evidence is more like trying to comprehend a serious novel than working out a logical exercise.

Do the parts of the novel fit together? Is the narrative coherent or are silly and irritating coincidences thrown in to keep the plot moving? Do the characters work within the plot? Are they interesting? Does the language convince? Is anything fresh and interesting being said in the novel? Thus, for novels and scientific theories, it is often their coherence and plausibility by which they are judged.

SUGGESTED ANSWERS TO SELECTED ACTIVITIES

NOTE TO READERS:

The suggested answers presented here are only for those activities and assignments which are NOT labelled 'Thinking drill' or 'Thinking exercise' or 'Research exercise' or 'Discussion option'

UNIT 1

Activity 1.1

1. Kofi, please close the door. / Kofi, would you please close the door?
2. Kwame, go to town.
3. Afua, return this library book.
4. Joshua, you need money. / Joshua, you must get money somehow.

Activity 1.2

5. Did Kofi close the door?
6. Kwame, are you going to town?
7. Afua, do you want to return this library book?
8. Joshua, do you need money?

Activity 1.3

This exercise helps you recognise how two things can be said or done in one sentence, so you get used to recognising implicit and explicit meanings of statements,

9. This might be an covert or polite way to get the library attendant to keep the place open longer than 5 p.m.
10. A genuine question. The person asking the question might also be looking for an extension of time.
11. This is a request for instructions. It is a polite way of directing someone to give the instructions; it would not be satisfactory if the person queried just answered, "yes I can" but said or did nothing further to help the inquirer to get a reimbursal.
12. This is a polite directive to provide an appointment outside the timeperiod of 2-4 the next day.

13. The person asking this question is likely to be expressing the desire to make a cash withdrawal.
14. The person who makes this remark is making a polite command to tell where to buy coins.
15. This is a directive that states the topic will be deferred until the next meeting.

Activity 2.1

This exercise helps you recognise the difference between a complete statement and a sentence fragment. It also helps you see how much you can read into a clause without any obvious cues from the words on the page. You comprehend a great deal more when you read English than you realise from a logical point of view. Other sentences for each item could comparably be written in answer to this instruction. These are only examples.

1. At this venue you can get rice and stew. / Rice and stew is on the menu here and now.
2. The organisation 31st December Women's Movement has its headquarters here.
3. I'm taking the lead. / I am going to leave you now.
4. You will not get what you want / see who you want to see / unless you return tomorrow.
5. The education of the girl child has become an important issue in this day and age.

Activity 2.2

6. Please bring me rice and stew for lunch.
7. I am researching the activities of the 31st December Women's Movement.
8. Please take the lead; I have work here to do still.
9. You must come back tomorrow.
10. Have you any information about the improvement in education of the girl child in this district since 1994?

Activity 2.3

Whoopee!

Ayekoooooh!

Phobia!

No! OMG! I don't believe it!

Nufrespek!

Check!

Hey, Charlie, way deb go.

Activity 2.4

A. and B.

1. Imperative

2. Imperative

3. Interrogative

4. Fragment: He will come if only he can get transport

5. Imperative

6. Imperative

7. Interrogative

8. Declarative (factual)

9. Fragment: President FL Rawlins and the charming First Lady are on holiday.

10. Imperative

11. Imperative

12. Fragment: The best football player of all time is playing for Chelsea instead of his own country.

13. Fragment: My roommate is running for JCR president.

14. Emotive utterance

15. Emotive utterance / imperative: Vote for Weah!

16. Fragment: My girlfriend is the most popular girl in Volta Hall.

17. fragment: We are concerned about the education of the girl child.

18. Declarative statement

19. Fragment: Red red and beans are on the menu for lunch.

- 20. Emotive utterance
- 21. Emotive utterance
- 22. Imperative
- 23. Imperative / declarative (value judgment)
- 24. Emotive utterance
- 25. Imperative
- 26. Imperative
- 27. Imperative: you must come back tomorrow since we are going to go home now.
- 28. Declarative statement (factual)

C. 8, 18, 23 are the only propositions

- 8. Is Kwesi in the dining hall now where he normally studies?
- 18. How many people are enrolled in UGRC 150 this semester?
- 23. Do you think it is always morally wrong to tell lies?

D. 14, 15, 20, 21, 24

- 14. George Weah, according to a Gallup poll, has a popularity rating in Liberia of 97%.
- 15. Weah is running for President
- 20. The lecturer does not approve of partisan prejudice and discrimination based on ethnic camaraderie.
- 21. He has received an award as the Most Handsome Man on campus; he has won prizes for his talent in football.
- 24. I have only 50 Ghana cedis and the medicine costs 90 Ghana cedis and without the child may die.

Activity 3.1

- 1. Factual
- 2. True by definition of 'sister', 'marriage', 'brother-in-law', 'father-in-law', 'brother', 'husband'
- 3. Factual

4. Definition
5. Emotive utterance
6. Factual
7. Emotive utterance

Activity 3.2

1. Factual
2. Value judgment
3. Factual
4. Value judgment
5. Factual
6. Value judgment
7. Value judgment
8. Value judgment
9. Factual statement
10. Factual / proverbial advice / metaphorical adage

UNIT 1 Revision activity 1

1. Factual
2. Value judgment (nonmoral) / metaphorical (see Unit 3)
3. Definitions
4. Factual
5. Factual
6. Fragment
7. Value (nonmoral)
8. Factual
9. Instruction

10. Factual
11. imperative / value judgment (moral)
12. Definition
13. Definition
14. Factual
15. Definition
16. Emotive
17. Factual
18. Emotive / imperative
19. Fragment
20. Fragment
21. Imperative / value judgment (moral)
22. Emotive

Revision Activity 2

- | | | | | | |
|---|------------------------|---|-----------------------------------|---|--|
| A | Value judgment (moral) | B | Factual | C | Value judgment (non-moral) |
| D | Factual | E | Factual | F | Fragment |
| H | fragment | I | imperative value judgment (moral) | J | Factual |
| K | Definition | L | Definition | M | Proverbial statement (metaphorical)—see Unit 3 |
| N | True by definition | O | Factual | P | Factual |
| R | Imperative | S | Factual | T | Emotive |
| | | | | U | Instruction (imperative) |

UNIT 2

Activity 1.2 ‘turtle’

When you point to a turtle, the person learning the word may not appreciate that ‘Hurtle’ applies to all reptiles of the same shape and structure but of very different sizes, unless they are very large in which case they are called ‘tortoise’. But a tortoise is a turtle. Also by pointing the person might think the word turtle means any animal with a shell, or any animal that walks on all fours or that turtle refers to any silent creature. So the pointing alone cannot fix the denotation, it

needs to be assisted with further explanation to make the purpose of the pointing more accessible.

Activity 1.4

Nuclear family: sociology

Superego: psychology

Inflation: economics

Phonetic: linguistics

Proletariat class: political science

Sedimentary: geology

Semi-conductor: solid state physics

Higg's boson: theoretical physics

Oedipal complex: psychology

Bipolar disorder: psychology

Antibody: microbiology

Reverse transcriptase: genetics

Iambic pentameter: English literature

Viral load: microbiology

Red-dwarf: astronomy

Drug resistant strain: microbiology

ACTIVITY 1.4.3. arguably culture-specific lexical definitions will be found for: nuclear family, super-ego, Oedipal complex, Bipolar disorder, proletariat class

Activity 4.1

1 This is a verbal ostensive definition (listing an example of the word's denotation). But lots of evil actions are not murder but they would be left out of the denotation if we rely on this definiens. So it is too narrow.

2. Circular (begging the question), in order to understand the definiens you need to know the meaning of courage, which is what it was supposed to tell you.

3, Many creatures are pre-historical but not correctly called dinosaurs (birds, insects, reptiles, aquatic creatures). So the definition is too broad.

4. This is too broad and also too narrow. It is too narrow because there are lots of examples of violence that would not fall under this description. For instance, deer hunting is a violent sport, so are boxing or wrestling or other sports like fox hunting which involve violence towards animals and actually engages people in doing what they like to do. Seal clubbing is considered violent and is part of people's livelihood and not a matter of coercion. Sado-masochism is at least supposed to seem violent otherwise people's desires are not getting fulfilled. The definition is also too broad because in many situations forcing people to do something that they don't want to do is not always violent: protecting a child by yanking him or her out of traffic is not regarded as violent. Refusing someone a grade they would prefer to get is not violence. Declining sexual activity in the interest of preserving fidelity is to act against desires—one's own or someone else's, but is not considered violent. Getting up to go to work when one needs more sleep fulfils the definiens but would not usually be called an instance of violence.
5. Another case of circularity or begging the question.
6. Also circular.
7. Too narrow; many other works besides Plato could be studied as philosophy. A good definition would reflect the notion of a 'real' definition of philosophy: it should describe the features that all activities and results of work referred to as philosophy have in common.
8. Too broad: discussed earlier in the section.
9. Lots of things would be characterised as intellectually stimulating that would not count as learning. Playing video games, or chess, or working out a football strategy, or speculating who will win the World Cup. Also there are aspects of learning which involve drill work and repetitive practice and are not intellectually stimulating. So the definition can be said to be both too narrow and too broad.
10. Too broad: marching, swimming, aerobic exercise, weight lifting, racing, all fall under the connotation but are not called dancing.
11. This is an emotive utterance and not a definition.
12. This is a metaphor that begs the question. If you don't know already ready what religion is then you won't be able to understand Marx's and Freud's allusion to narcotic as a way of soothing people and calming them, which is how religion is being characterized here. It could be criticized as not a definition at all, or it could be called too vague.

13. This is a value judgment and clearly requires knowledge of what is being referred to as terrorism before it can even be understood: so it is also begging the question.
14. This is too narrow: lots of terrorists claim to uphold the American way of life, e.g. Timothy McVeigh who bombed a government building in Ohio in order to promote Christian values and American independence. There are also many critics of American political elites who might be regarded as 'enemies' of those in power without being terrorists. Some would regard the American way of life as itself provoking or exhibiting terrorism, e.g. the apparent support by Americans for some time of the invasion of Iraq in 1995. So this statement rather begs the question of what a terrorist is, and what is the American way of life, and what relation the two have to each other. It may be a value judgment that condemns anyone critical of American foreign policies and reputation, but is not a good definition.

Unit 3

Activity 2.1

1, 2, 3, 4, 9, 10 are giving advice, descriptions

5. Emotive utterances

6. , 7. Value judgment

1. Life has only one beginning and one end for each player, neither are voluntary players of a game can start and stop innumerable times, at will
2. Life is a process that everyone takes part in, war is anomalous, and most people outlive it.
3. Love is not moving nor stationary; it has no locality.
4. Life does not have a pre-determined destination, and its purpose may be discovered at the end, or after it is over.
5. The sun is impossible to look at without damaging the eyes, not true of a person. The sun requires no water to live, the sun is much bigger than Juliet, the sun is not dependent upon Juliet for its existence.
6. Peter is not inert; Peter talks
7. There is only on Einstein. John may not be a mathematician or a physicist.
8. A cesspool is inert; a cesspool does not talk
9. Man is not a continent either, nor is he a peninsula.

10. No comparisons here overtly. The implication is that if someone is crippled or humble or unattractive then he will not be a target of exploitation.

Activity 3.1

1. breakdown in morality running our youth corroding society
2. Without structural adjustments
3. Growing day by day
4. Integrating principles of sustainable development
5. Empower all women

Activity 3.2

6. Any moment from now
7. Younger person
8. Temporarily at this time
9. Cruel and unusual punishment Banned
10. Tradition ... our culture
11. An endangered species
12. Disrespect and protest ... a threat to the very fabric of society
13. Developing country
14. The youth have no sense of right and wrong ... indulge ... inappropriate behavior
15. Equal pay for equal work
16. Adequate social services

Activity 3.4

1.
 - a. Drunken person is expected to stay in a laptop container for 9 months
 - b. Drunken person is sentenced to jail for nine months for stealing a laptop

Ambiguity based on 'case'; intended meaning is (b)

2.
 - a. Military official is looking for weapons

- b. Head of the body of someone in the military is looking for anatomical arms
head and arms are ambiguous; (a) is intended
3. a. Pope finds prostitutes desirable
b. Prostitutes are asking for Pope's forgiveness appealing is ambiguous; second interpretation is correct
4. a. A teacher is hitting candidates for the exam who are late
b. Stop-work actions of unionized teachers hold up the exam schedule for candidates 'strikes' is ambiguous; (b) is correct
5. a. Police squad assist a dog to bite someone
b. Police squad help someone who has suffered a bite from a rabid dog 'bite' (b) is intended
6. a. Goat strikes farmer with a cutlass
b. Farmer holding cutlass is hurt by a billy goat
'injures . . . with cutlass' second interpretation correct
7. a. Miners refuse to work after they die
b. Miners refuse to work after an injury that led to death in a mine occurred 'death'
8. a. The court attempts to hit the defendant with a bullet
b. The court puts on trial the defendant in a gun firing incident 'try' ambiguous; (b) is intended
9. a. Tree discovers the jewels.
b. Someone discovers the jewels near the tree. 'by' is ambiguous; second one is intended
10. a. Either one or the other tanker dies in the collision
b. One person on board dies when the tankers collided
one dies—one is the referring instruction and it wasn't clear which one

11. a. They meet in a market stall after an 18 year separation
- b. They have spent 18 years living in a stall before being reunited.

Activity 4.1

1. An opinion
2. Narrative
3. Narrative
4. Argument
5. Polemic
6. Argument
7. Argument Assignment 2
 1. Argument (enumerative induction)
 2. Argument (enumerative induction)
 3. Bad argument (insufficient evidence)
 4. Rhetoric (emotive utterance)
 5. Deductive argument (disjunctive syllogism)
 6. Narrative
 7. Rhetoric
 8. Instructions
 9. Narrative

UNIT 4

Activity 1.2

4. Business school courses yield a BSc degree. Agricultural economics courses and School of engineering courses can yield a BSc degree.

UNIT 5

Activity 1.5

1. Factual
2. True by definition
3. Factual
4. Factual
5. Factual
6. Factual
7. True by definition (operational definition)
8. Factual
9. Factual
10. True by definition
11. True by definition (also factual—the neo-cortex information is supported by evidence)
12. True by definition
13. Factual
14. True by definition
15. True by definition
16. Factual
17. True by definition
18. Definition
19. Factual
20. Factual
21. Factual
22. Definition

Activity 2-1

1. D

2. C

3. C

4. B

5. A

6. C

7. B

8. C

Assignment 5.1

a) Factual, infinite

b) Def'n, theo'l or lexical

c) Factual, infinite

d) Def'n, theo'l or lexical

e) Def'n, ostensive

f) Factual, finite

g) Factual, finite

h) Def'n, lexical

i) Factual, finite

j) Defn, theo'i

k) Factual, finite

l) Factual, Infinite

m) Factual, Finite

- n) Factual, infinite
- o) Factual, infinite
- p) Def'n, theo'l
- q) Def'n, lexical
- r) Factual, infinite
- s) Def'n, lexical
- t) Factual, infinite
- u) Def'n, theo'l, lexical

Assignment 5.2

1. This statement is a value judgment, comparing actions from the point of view of what ought and ought not to be done.
2. Describing the policies as imposed, and as a form of genocide, explicitly indicates that the speaker disapproves of them. So this is a clear cut value judgment. Genocide literally means the intentional elimination of an ethnic group- or population.
3. In this case the words 'rescuing' and prevention from the country 'deteriorating' makes it clearly a value judgment implicitly, although explicitly the statement appears to be a causal hypothesis.
4. Here is another example of a statement which both proposes explicitly a causal hypothesis to explain the bad effects of structural adjustment programmes and at the same time is a value judgment which implicitly condemns and morally blames West African officials; because of the words 'corruption' and ineptitude' as attributed to them. Analyzing the statement as factual and a value judgment does not mean the statement is true, nor that the value judgment is warranted.
5. This states a fact about Hitler that is testable, since height can be measured and shortness can be given an operational definition.
6. Clearly this describes Hitler from a moral perspective.
7. This is a factual statement about the criminal statutes of Ghana; it is either true or false depending upon what the legislature has written.

Statements 10-15 convey value judgments. There are no codes in the law books nor physical features of the referents of these statements that can be measured to test whether the judgments are warranted or not.

In each of statements 14-21, the words 'must' or 'ought' occurs. But in 16, 17, 18 and 21, the meaning of 'must' and 'ought' is to describe regularities and uniformities of nature. These are clear-cut factual statements because they describe what to expect the world to be like, and they are testable. They harbour no value judgment at all. They contrast very clearly with statements 19 and 20 where clearly value judgments are expressed. Statement 19 might be interpreted as non-moral. For instance it might be moral to give your money to the poor, or to spend it on your boyfriend's drug detoxification therapy, or to save it for your grandmother's need for medicine in the future, but from the point of view of taking care of your immediate responsibilities to yourself, it may be more prudent and strategic, if less virtuous, to save the money and apply to the items you need to do your work and to be successful in school. Others might regard the characteristic of being financially viable as a moral trait. This shows the open-textured nature of 'ought' terminology in the moral domain.

22. Both of these statements implicitly express value judgments, but the first is explicitly factual generalisation which depends upon the second, which looks explicitly to be true as a logical consequence of definition. But implicitly it challenges the view that whether women are married or single, they have a basic human right to choose whether or not they will consent to sexual intercourse on a given occasion, if it is desired by someone else. The issue of what is or is not a basic human right is a value judgment. According to the legal meaning of a contract, there is no contradiction in the notion of marital rape, where marital indicates that the parties are legally bound by contract, and rape means that one party of the contract is being forced or coerced by physical force or threat of physical harm to engage in sexual intercourse. This is because it is not rational for an adult to agree to a contract (in this case, marriage) in the knowledge that the contract binds you to do things when you do not want to do them, by physical force or coercion. If a contract is legally binding only when its signatories are consensual, that is, rationally and knowingly in agreement to its terms, then the concept of marital rape is not a contradiction, because it can be the case that a woman is being forced to have intercourse through physical violence or through coercion, against her will, by her husband.

23. This statement reflects tax laws, so it is a factual judgment. It is testable because you can look at the law books and find out who is required to pay tax.

24. According to Hindu religion, Brahmins are an elite class into which one is born, and then carries social obligations and responsibilities as part of one's spiritual development. This might be regarded as a social code, a religious custom, or a theological law. It can be tested by reading the Pali canon and the scripture of the Bhagavad Gita where the rules for Brahmins are set down. The statement will stay true of the religious doctrine of Hinduism even though it is possible to find Brahmins who do not give alms.

UNIT 6

Activity 1.1 Conclusions of arguments are in capitals bold and underlined

3. When the accident occurred there were no witnesses. Without witnesses you cannot claim insurance. Without insurance you have to pay for the repairs yourself. So I **WILL HAVE TO PAY FOR THE REPAIRS MYSELF**.

5. On Saturday, the military officer never comes to the barracks. He is busy at the hospital all day Saturday. So if you need to see a military officer, then do not go to the barracks on Saturday. Since I need a military officer and it is Saturday, I won't go to the barracks.

6. If I want a mobile phone, then I have to use my school loan when it comes. But if I use the school loan up on the phone, I will not be able to return my mother's money for the tuition. If I don't return my mother's money she will not pay for my tuition next year. I cannot afford to pay tuition next year unless my mother helps with the tuition. But I have to pay tuition next year. So I cannot buy a phone.

8. Either I took the book to the library or I've left it in my room. I can't find it anywhere in my room. So the library must have the book.

Activity 1.2

Reference class

- | | |
|-------------------------------|------------------------------------|
| 1. this student | people reading philosophy |
| 2. that man | People who are Deans of Arts |
| 3. the water in this bucket | things that are finished |
| 4. that table | green things |
| 5. this stone | germs that are not real diamonds |
| 6. the students in this class | people who have not registered |
| 7. fourth and seventh samples | Meat infected with lethal bacteria |
| 8. all the voters interviewed | those prefer a recount of ballots |

Activity 1.3

Reference class

Attribute class

- | | |
|----------------------|--------------------|
| 9. all heated metals | things that expand |
|----------------------|--------------------|

- | | | |
|-----|---|---|
| 10. | all planets | things moving in elliptical orbits around the sun |
| 11. | all heavy smokers tissue | anyone with carbon on the lung |
| 12. | any green table | things that are costly these days |
| 13. | any meat from UK | any infected with e-boil |
| 14. | all students | people who register only if forced |
| 15. | all philosophy students | people who must take PHIL 203 |
| 16. | all retailed stones (8 of any 10) | things that are not diamonds |
| 17. | all Ghanaians (3 of every 10) | people allergic to pineapple |
| 18. | 75 of any 100 with mad cow disease will die from the infection. | |

Activity 1.4

Example 3. 95% of the students in Annex B have contracted headache, fever and painful joints in the last month. 80% patients presenting headache, fever and painful joints at the clinic were tested for malaria parasites and were diagnosed with malaria. So the doctor concluded that Yaa, who is residing in Annex B and has a headache and fever and painful joints, has malaria.

a) The doctor concluded that Yaa has malaria.

b) Yaa

c) Particular

d) First premise reference class = The students of Annex B currently in residence

Second premise reference class = all patients in the clinic last month who presented symptoms of headache, fever and joint pain.

e) First premise reference class = Particular. Second premise reference = particular

f) This example contradicts the definition of inductive reasoning as always moving from general to particular.

Example 4.

95% of the students interviewed preferred free access to a computer services instead of kitchen facilities. So we conclude that students coming to Legon will welcome the installation of computers instead of cooking pantries in the new residence blocks.

- a) Students coming to Legon will welcome the installation of computers instead of cooking pantries in the newresidence blocks.
- b) Students coming to Legon
- c) general
- d) The students interviewed
- e) Particular
- f) This is a case of induction from particular sample to general conclusion

Activity 1.5

- 1. Inductive
- 2. Inductive
- 3. Deductive
- 4. Deductive
- 5. Deductive
- 6. Deductive
- 7. Not an argument
- 3. Inductive

ACTIVITY 1.2

- 2)
 - (i) H = herbivores, B = easy to breed.
 - (ii) This x is H. All Hs are Bs. (If x is H then x is B). So this x is B.
 - (iii) Modus ponens
- 3)
 - (i) G = goats, H = herbivores
 - (ii) All Gs are Hs. (If x is G then x is H) x is not an H. So x is not a G.
 - (iii) Modustollens
- 4)
 - (i) G = goats, V = requires vaccinations E = expensive to breed
 - (ii) All Gs are non-Vs. (If x is G then x is not-V) All non-Vs are not-E (If x is not-V then x is not-E) So all Gs are not-Es.

(iii) Hypothetical syllogism

Activity 2.3

- i. C
- ii. A
- iii. C
- iv. Invalid

If you bring in your own premises you can create a valid argument. For instance add these premises.

(1) If the Gaza strip remains occupied then the terrorism will continue and

(2) The military will not withdraw

Then the argument will read like this:

The occupation of the Gaza Strip will not end unless the military withdraws. If the Gaza strip remains occupied then the terrorism will continue. But the military will not withdraw. So the terrorism will continue in Gaza.

To see that this is valid,

Let T = terrorism will continue; O = **Gaza remains** occupied; M = military withdraws

Premise 1. O or M

Premise 2. If O then T

Premise 3 Not M

Premise 4 O (from 1 and 3) disjunctive syllogism

So T (from 2 and 4) modus ponens

This is valid because of the rules of inference disjunctive syllogism and modus ponens as indicated in the 'natural deduction' demonstration above.

Activity 3.2

1. Let V = Vandal student leaders, T = leader who makes trouble

If x is V then x is T. This x is not V, so this x is not T

Fallacy of denying the antecedent

2. Let T = he goes to town, M = he passes my mother's house

If T then M. M Therefore T. Fallacy of affirming the consequent

3. Let L = the question is on last years exam,

T = the question is on this year's exam

P1 NotL P 2. If T then not L

Fallacy of affirming the consequent

4. Let J = I have luck in my job hunt, V = I visit my girlfriend

P1.Ifnot-JthenV

P2. V

Therefore not-J.Fallacy of affirming the consequent

5. Let F = x is his friend, N = x is from Nigeria; M =x is a Muslim in this room.

P1. If F then N P 2. If M then N. Therefore if M then F. Fallacy of false hypothetical syllogism

6. Let F = x is a forensic medical expert that I know, G = x gets over 5,000 Gh.¢ per month

L = x is a lawyer that I know

P1. If F then G

P 2. If L then G. Therefore If F then L. Fallacy of false hypothetical syllogism

Assignment 1

1. Not an argument

2. Argument

Let O = leave the door open M - mosquitoes come in C = we catch malaria H = we go to hospital

P 1 If O then M

P2 If M then c

P3 If C then H

P4 Not H

Therefore Not-0

This is a valid argument combining Hypothetical syllogism and modus tollens.

3. Let H = we help private schools P = we destroy public schools V = I will vote for candidates

P 1 If H then P (If we help private schools we destroy public schools)

P 2 not P then not H (If we save public schools then we don't help private)

So If not H then V (If the candidates stop helping private schools then I will vote them)

The conclusion doesn't follow from the premises, it's just another way of stating the premises; so this counts as rhetorical expression of an opinion

4. This is a conditional statement, not an argument

5. Let W = you weed more than once a month

G = weeds grow plenty

T = tomatoes don't get nutrition

D = tomatoes die

P1 If not W then G

P2 If G then T

P3 If T then D

P4 Not D

P5 not T (from 3, 4 modus tollens)

P6 not G (from 2, 5 modus tollens)

Therefore W (from 6, 1 modus tollens). This is valid, using modus tollens three times

7. This is not an argument, just a conditional statement either true or false.

8. This is not an argument

9. This is an explanation. The conclusion describes an event likely to occur if the premises are true.
10. This is another explanation. If the premises are true the conclusion is going to be something you will believe.
11. Another explanation
12. This is not an argument.
13. Not an argument
14. Deductive syllogism, includes disjunctive syllogism, and modus ponens
15. Expression of strong feeling
16. Polemic
17. Hypothetical syllogism
18. Hypothetical syllogism
19. Inductive argument to explain the increase in criminals on campus
20. Emotive expression
21. Emotive expression

Assignment 2

1. Deductive modus tollens
2. Deductive modus ponens
3. Hasty generalisation (insufficient evidence, also biased) fallacy of induction
4. Induction (enumerative)
5. Misplaced vividness, fallacy of induction
6. Affirming the consequent, fallacy
7. Modus ponens
8. Induction based on sample
9. Deduction

10. Polemic venting of feeling
11. Enumerative induction
12. Inductive fallacy of incomplete evidence
13. Enumerative induction
14. Induction based on sample
15. Modus ponens
16. Deductive fallacy of affirming the consequent

Unit 7

Activity 1.1

- 1-5 Each of the reference classes includes only one individual which can be observed directly.
- 6 The reference class includes listed students in one class on one day; each can be checked to see if he or she has registered
- 7 The fourth and seventh samples are only two, each can be tested for the bacteria
- 8 The reference class includes a group of voters that were interviewed; the record of the survey can be cross checked for what each said to the interviewer

Activity 1.2

a)

9. However many metals are sampled, there still will be more in future and more in the past that are referred to in the statement
10. We can check all the known planets but the reference class contains those not yet known that may be discovered in future
11. Anyone who is a heavy smoker, anywhere anytime, cannot be x-rayed to study the condition of his or her lung
12. Any creature that is a mammal, now and in future, cannot be checked to see whether it needs oxygen. Alternatively if this is regarded as a definition then it is not falsifiable—that is not testable. That means if a creature is found that doesn't need oxygen or that does not have mammary glands then it will be called something else besides a mammal.
13. The reference class is all students, past, present and future.

14. The reference class includes anyone past, present and future who votes, and no matter how big the sample it cannot include this infinite number.

15. The reference class refers to any cow meat imported from England now and in the future, which cannot all be tested to see if at least 40% (some) of each tested amount is infected.

16. All retailed stones cannot be inspected because the reference class includes stones retailed in future.

17. All Ghanaians referred to will not include those in future, and all these cannot be checked for the allergy

18 This reference class includes all those who contract the disease in future.

b)

11. 'All' is implied by 'heavy smokers'

12. As a definition the reference class is the word 'mamma' or the concept it stands for, or all the individuals that fill the characteristics of the definients. As a hypothesis the statement refers to any creature which falls under the denotation of 'mamma!', now and in future. So it is always possible that, for example, mammals evolve to the point where they don't need oxygen, perhaps provoked by a global nuclear change in the atmosphere

13. No As are Bs = All As are not Bs. And you cannot observe all As.

15. This refers to any cow meat imported from England

17. Few Ghanaians refers to all Ghanaians, of which 25% or less are allergic; and you cannot test the allergic reaction of Ghanaians not yet born, nor of those that have died

18. The reference class includes anyone with the disease, whenever they contract it; and you cannot monitor all those who contract it in future to see whether the disease kills them.

Activity 2.1

a)

13. If x is a student then if x registers, then x has been forced.

14. If x is a voter then x prefers a recount of the ballots.

b) Anyone who does these exercises well will do well on the final exam. If x does these exercises well, then x will do well on the exam

Activity 2.2

a)

17. In any group of 100 Ghanaians, less than 5 or so will be allergic to pineapple.

18. In a group of 20 people who contract the human equivalent of mad cow disease 18 of them will die from eating the infected beef.

b) 58% of the graduates who are looking for a job have been successful.

In a group of 100 graduates who are registered with the employment agency 58 have found a job.

Activity 5.1

Sentence (1) refers to the Earth's orbit alone

Sentence (2) refers to five planets discovered by Kepler

Sentence (3) refers to anything that may be a planet, known or unknown

Thus (1) will be true just in case the Earth's orbit as described, and no matter what the orbit is like for any other planet, (1) will remain true. For instance if Saturn has a circular orbit and not elliptical, then (2) and (3) will be false but (1) will remain true. So (1) is the least falsifiable of the three sentences.

(3) Is the most falsifiable, because if a new planet is discovered whose orbit is not elliptical then only (3) will be false, the others can remain true. Similarly if Uranus had turned out to have an orbit that is not elliptical this would make (3) false while (1) and (2) remain true.

Thus (3), if it is true, tells us more than the other (2) statements. It gives us capacity to predict the orbit of more planets than the other two sentences provide.

Activity 5.2

(i) H is the most falsifiable

(ii) E and F are not falsifiable at all

(iii) H gives the most precise information if it remains true in light of new evidence

(iv) C will remain true no matter what else is observed about ROTRAID

Unit 8

Activity 2.2

1. In example 4, the panelist concluded that over the period from 1989-1999, 120,000 deaths at the very least were due to HIV/AIDS caused by a retrovirus ostensibly spread through sexual licentiousness.
2. Makogba did not include the change in the political boundaries of the Republic of South Africa, which resulted in a doubling of the number of people that were counted in the census (births and deaths recognized) over the same period. This means that the overall size of the population of South Africa over the same period changed administratively, from 22 million people to roughly 42 million in 1999. Obviously the number of deaths recorded would also have to increase, which would occur anyway. So even if everyone were completely healthy and died of old age, one would expect to see at least a considerable increase in the number of deaths, which would indicate no change at all in the rate of deaths per number in the population.
3. This added evidence weakens the hypothesis presented by the panellist, who was trying to show that an increase in the death rate occurred and that it was evidence of a raging epidemic.

Activity 2.3

- i. The presenter in Example 5 concluded that the failure of South Africans to control their sexual behaviour was causing “the worst and fastest growing epidemic in Africa.”
- ii. Geshekter analysed the data presented by Dr. Makgoba in light of the total South African population in 1999. The rate of deaths was for that year no greater than the death rate in the USA.
- iii. Geshekter’s analysis reveals an important omission in the information provided by the presenter, so the evidence provided was incomplete.
- iv. This indicates that the hypothesis advanced was not confirmed by the evidence supplied by the presenter.

Activity 3.1

(a) A (b) B (c) B (d) A (e) C (f) B

Activity 4.1

- I. (i) A: The USA should provide unconditional support to Israel.
 Reference class: USA foreign policy makers
 Attribute class: those who should not criticize foreign allies
- B: The USA should set conditions upon its support to Israel.
 Reference class: US president
 Attribute class: those who should criticize their foreign allies.
- (ii) A and B rely on the way best friends should relate as the basis for their views
- (iii) This is a false analogy.

Personal friendships are different in more respects than they are similar to foreign relations:

- People choose their friends on the basis of personal preference. Elected officials are not involved with foreign powers on the basis of personal likes and dislikes.
- Life and death of hundreds of people do not depend upon the confidential conduct between personal friends. But foreign diplomatic moves can determine whether war breaks out in a volatile region.
- Citizens' interests are represented by a government's foreign relations. Personal relations between friends have no responsibility to their nation's citizenry.
- The economy of nations depend upon good diplomacy. Personal relations have no bearing on national economies.

(iv) The way to determine whether USA should support Israel unconditionally or not is to study historically the impact of these countries' foreign relations in the region, and also to survey opinions of citizens in the affected countries in the region. It would be helpful to review the principles determining the role of USA in the Middle East overall and then to see whether unconditional or conditional support currently best follows from these general principles. It would be important as well to consider principles governing the behaviour of nation states in occupied territories that have been ratified by the United States according to international covenants and resolutions, and to analyse the behaviour of Israel in light of these treaties and declarations. This will determine whether the US president has a moral obligation in the interest of consistency to challenge Israel officials' behaviour or not.

Activity 4.2

1. Inductive argument based on analogy
2. Inductive argument based on sampling
3. Inductive argument based on statistical hypothesis
4. Enumerative induction
5. Deductive argument: modus ponens