

THE LOGIC OF NATURAL LANGUAGE

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Summary

This chapter discusses the logic of natural language. After an explanation in Section 1 of what that phrase may be taken to mean and of why this logic is so important, Section 2 provides an account of the key ideas: logic, reasoning and argument, and of the relationship between logic, rhetoric and dialectic. Section 3 is a discussion of the norms that apply to natural language arguments. There are two types of norms: those that apply to the premises, and those that pertain to the support relationships. Three types of connection that may occur in arguments are discussed: necessary connections, probable connections, and plausible ones. Section 4 is an account of two important developments that provide assistance in coming to grips with plausible connections—fallacies and argument(ation) schemes—and how they relate to each other.

1. Introduction

Human beings reason constantly. Whether or not the capacity to reason is innate, we teach our children to reason better by identifying and correcting their mistakes. Moreover, all of our reasoning relies on information, or ways of identifying and classifying information, that we acquire from the social worlds we inhabit. We also regularly reason with others, either thinking together with them to work out implications, or seeking to persuade or convince them that certain conclusions or courses of action are reasonable and others, unreasonable. So in these respects, although each person reasons separately, reasoning has an essential social dimension. Although we can and do reason privately, reasoning is in principle, and often in practice, public.

Reasoning can be done well or poorly. Good reasoning does not guarantee success in our enterprises, but it contributes to their success. Bad reasoning contributes to their failure and can result in disaster. The norms distinguishing good reasoning from bad are called "logic." Insofar as reasoning is expressed or expressible in language, we can speak of the logic of reasoning in language, or the logic of language, for short. The topic of this essay is the logic of reasoning that is expressible in language. Why the title alludes to "natural" language will be explained below.

This essay contributes to the EOLSS Theme, "Philosophy and World Problems", from this logical standpoint. As a specific essay within the Topic, "Modes of Reason," it discusses modes of reasoning as they are represented in and subject to the logic of natural language.

The plan of the chapter is to begin at the narrow end of this assignment and work to the broad end. So Section 2 begins with an explanation of natural language, logic, and their connection. Section 3 contains a description and discussion of the logical norms that can be applied to reasoning in ordinary language. Section 4 discusses the relevance of this logic for world problems, and the relevance of such problems to it. Section 5 concludes with a summary of the chapter.

2. What Is "The Logic of Natural Language"?

A "natural" language is simply any language that children learn as they grow up in a culture. Arabic, Hindi, Swahili, Russian, Chinese, Japanese, Spanish, English, Italian, Dutch, Portuguese—these and thousands of others like them are "natural" languages. (There are 6,912 living [natural] languages, according to Gordon (2005), although the exact number will depend on the precise definition of 'language' and on how dialects are counted.) The term "natural language" was coined in the 20th century in order to distinguish the referent of the word 'language' as it is ordinarily understood from the purely formal "languages" that certain theorists were interested in, which they called "artificial" languages. Artificial languages are language-like symbol systems that are created for various technical purposes, or purely invented languages such as Esperanto. The codes used to create computer programs are examples of artificial languages. Thus a "natural" language is simply what all but a handful of specialists understand a "language" to be.

The phrase "the logic of language" stems from the philosophical work of the later Wittgenstein. In Section 89 of his *Philosophical Investigations* (1953), in a critique of the previous understanding of the relation between logic and language, Wittgenstein observed that "logic seems to have a peculiar depth—a universal significance. Logic lay, it seemed, at the bottom of all the sciences. For logical investigation explores the nature of all things. It seeks to see to the bottom of things, and is not meant to concern itself with whether what actually happen is this or that." Such an investigation is an *a priori* one rather than an empirical one, revealing how things had to be. Elsewhere (Section 437) he characterizes this feature as "the hardness of the logical must"—a hardness related to the developments in logic starting with Frege's *Begriffsschrift* (1879) and continuing on to Whitehead and Russell's *Principia Mathematica* (1910-1913). Wittgenstein writes: "On the other hand, this together with a misunderstanding of the logic of language, seduces us into thinking that something extraordinary, something unique, must be achieved by propositions" (Section 93). This passage suggests that Wittgenstein believes there is a logic to our language, but that he and Russell had misunderstood that logic by expecting natural language to conform to the precision and rigor of formal or mathematical logic. It seems clear that for the later Wittgenstein, the logic of natural language has nothing to do with the formal calculi that developed with the study of logistic systems and everything to do with what he calls "the grammar of our language"—how expressions, words, and sentences are used.

The logic of natural language, then, is the logic of the language(s) that anyone grew up speaking. So the next question is, what is the "logic" of such a language? Any answer to this question steps off the firm ground of established fact and onto the unsettled footing of contested theory, so the reader needs to be aware that other writers might well put matters differently. With that warning, here are some ways to understand what the logic of a natural language is.

2.1. Logic

In one sense of 'logic,' its subject matter is the norms for systems of *necessary connections*. A necessary connection is one that cannot be otherwise. Here is an example. If a flower is yellow, then it is colored. Indeed, if anything is yellow, then it is colored. Being yellow, it must be colored; it cannot be without color. There is, then, a necessary connection between being yellow and being colored. Other examples of necessary connections are between the propositions: "Sulja is a mother" and "(That same) Sulja is a woman who has a child"; between "Cairo is more populous than Sao Paul" and "Sao Paul is less populous than Cairo"; between "Leo is afraid" and "(That same) Leo believes he is somehow in danger." In these examples, if the first of the pair is true, then the second *must* be true. The second cannot be false if the first is true. That is what is meant by "necessary" in this context. Logic, in one sense, expresses in general terms the laws of such necessary relationships. And insofar as such necessary relationships as those illustrated above hold by virtue of the meanings of the words in a natural language, one way to define the logic of a natural language is as the norms or rules of necessary relationships that result from the meanings of the words and expressions of a natural language.

In this sense of the logic of natural language, it is not always very interesting, for just

understanding a language entails already understanding its logic in this sense to a high degree. Logicians or linguists might want to identify the general features of these norms, but their results will not necessarily lend illumination to those who already speak the language, because for the most part they already understand and know how to abide by those norms, even if they are not able to articulate them. In this sense, knowing the logic of a natural language is like knowing its grammar. Just as one can speak and write a language grammatically correctly without being able to formulate its grammatical rules, so one can use and follow the logic of one's language without being able to formulate its logical rules or laws.

On the other hand, the implications of the meanings of words in natural language can be very important. For example, note the connection between an obligation and a right. If one person has a right to something, then some other person or some body has an obligation to that person. For instance, if you have a right to an education, or to gainful employment, or to affordable medical care, then someone else or some body has an obligation to provide you with the means for an education, or gainful employment or affordable medical care. Conversely, if no person or body has an obligation to provide you with these things, then you have no such rights. These connections have obvious and important political, social and legal implications.

2.2. Reasoning and Argument

But 'logic' in reference to natural language has other senses. An explanation of a second of these senses requires introducing the notions of reasoning and argument as well.

First, reasoning. The word 'reasoning' names (among other things) a kind of mental activity, and also the expressions of such mental activity. You might reason that it is raining outside because you hear what sound like raindrops falling on the roof. And if someone asks you, "What is the weather like outside?" and you reply, "I think it is raining, because that sounds like raindrops on the roof," that sentence expresses your reasoning.

Reasoning includes the mental activity of drawing inferences, also known as coming to conclusions. This is something that everyone does many, many times in a day. On the basis of some information we have or certain assumptions we make, we judge that something else is the case as well. Someone sees the clouds covering the summer sky grow dark and infers that it might rain. Introduced to a person with the title of "Doctor," one may conclude that this person is likely a physician. Travelers assume that a man they encounter walking along a village lane is a native of the village and they infer that he can knowledgeably give them directions. There are any number of examples. Sometimes the inferences that we draw from the information we have or assumptions we make are warranted, and sometimes they are not. Either way, they constitute our reasoning.

Such inferences can be expressed in language. One can say, "Mrs. Yee is addressed as 'Dr. Yee,' so Mrs. Yee is a physician"; or "It is likely to rain because when a cloudy summer sky grows very dark, it is likely to rain, and the summer sky here has grown very dark (so take an umbrella with you when you go out)"; or "This man is a resident

of the village (and people who live in a village usually know their way around it), so this man can give us reliable directions." Such sentences are expressions of reasoning, good or bad. For example, possibly Dr. Yee is a professor with a Ph.D., so while correctly addressed as "doctor," she is not a physician. We can judge such sentences to be true or false according to whether the information asserted in them is correct and the inferences expressed in them are warranted. One of several different uses of the word 'argument' is to refer to such expressions of reasoning. In this sense of 'argument,' an argument is a sequence of statements that expresses a mental sequence of reasoning. In the second sense of 'logic,' then, the term refers to the general norms of good (warranted or justified) reasoning or of good arguments of the kind just described. The logic of natural language, in this sense, tells us the general criteria for distinguishing good reasoning from bad as we carry it out or, the equivalent, as it is or can be expressed in arguments stated in some natural language or other.

2.3. Logic, Dialectic and Rhetoric

Furthermore, 'logic' in this second sense also refers to one of the kinds of norms that are used to evaluate a different kind of argument. There are in fact at least three kinds of norms that can be applied to this other kind of argument—logical, dialectical and rhetorical. So the logical perspective must be distinguished from the other two.

In our daily lives, all of us encounter situations in which we want to convince someone that some proposition is true or to persuade another person to do something. Sometimes we want to convince or persuade not just one person, but many others. We might want to persuade a prospective employer to hire us, and in the process of doing that we want to convince him or her that we are excellent candidates for the advertised job. We might want to persuade a customer to buy a product we are selling, or as a customer we might seek to persuade the seller to lower the asking price of a product we want to buy. We might want to convince our friends or family of the merits of a particular political party or candidate, and persuade them to vote a certain way. The occasion need not be momentous. Perhaps we want to persuade a friend or colleague to join us for a cup of tea or coffee, or a family member to take an umbrella with him when he goes outdoors. And we can equally well be on the receiving end—just as often someone else is trying to convince or persuade us. It is easy to multiply indefinitely examples of situations in which someone wants to convince or persuade someone else or others of something.

One way to try to convince or persuade another of something is to provide reasons why that person should agree. A name for such reasons is "an argument." In this sense of 'argument,' an argument is a set of reasons that one person offers to another as grounds for agreeing—for accepting what the "arguer" is trying to get the other person to agree to. This is a familiar sense of 'argument': it is arguments like this that lawyers make in court, or that scholars make in articles in learned journals, for example.

An argument in this sense is like, but slightly different from, the sense of argument described just above in Section 2.2. Both involve the drawing of inferences. In the current sense, the person offering the argument is suggesting that the other should draw an inference from the information the arguer puts forward as reasons. And if the argument is successful, the other person does draw the inference that is invited or

proposed. But there is also this difference: the arguer might not privately draw the inference he or she is publicly asking the other person to draw. For example, one person might try to persuade another that her religious beliefs commit her to a certain action (perhaps giving to a charity for which he is collecting), even if he holds different religious beliefs, and so would not accept that argument for himself. Another difference is that the arguments described in Section 2.2, while they are expressions of a person's reasoning, need not be communicated to others and so need not play any role in trying to convince or persuade others, whereas those described here are by definition communicated to others for the purpose of persuading or convincing them of something.

As mentioned above, arguments used to convince or persuade may be evaluated from different points of view. In using arguments to try to convince or persuade others, a person is trying to be reasonable—or, at the least, pretending to try to be reasonable. That is so because an argument consists of giving reasons for beliefs, attitudes or actions. The arguer is using reasons as opposed to using force, or appealing to irrelevant emotions to try to convince or persuade. (The qualification "irrelevant" is added because by no means are all emotional appeals used in arguments irrelevant. For instance, sympathy and compassion are good reasons for helping others.) It follows that such arguments can be assessed as attempts at reasonable communication, and from three points of view.

One point of view emphasizes the communicative properties of such communications. That includes all the factors that go into being persuasive or convincing, and more. For instance, the argument needs to hold the attention of its audience. So besides appealing ultimately to grounds that the audience is willing to accept, it needs to be clear enough for the audience to follow it and it needs to avoid making the audience hostile and unreceptive. In addition, the language and tone of the argument need to serve the arguer's other goals in the communication, such as retaining the goodwill of the audience in order to be able to work with its members constructively on future occasions. The field that studies the norms of arguments as communications is called *rhetoric*

It should be emphasized that such communicative advice as “avoid making the audience hostile” and “retain the good will of the audience” does not mean that communication must be more concerned to swing the audience to one's view than to communicate the truth—that it encourages sophism. A hostile or indifferent audience will tend to be disinclined to consider the arguments, or to consider them with an open mind, no matter how cogent they might be. The truth of an argument's premises does not by itself guarantee that they ought to be accepted by the audience. Moreover, the "logic" of an argument, however sound, must be communicated somehow, well or poorly, effectively or obscurely. That involves rhetoric. To be sure, rhetoric can be used to manipulate, but it can also serve to help reveal the truth to the audience and to render the audience receptive to cogent arguments aimed at convincing them of the truth.

A second point of view from which to assess natural language arguments judges them for their degree of reasonableness as *communications*. If one is genuinely trying to communicate reasonably, one is committed to the norms of such an activity. For one example, if one is trying to persuade an audience that someone's views are mistaken, it

is only reasonable to represent those views accurately, and not to critique a distortion of them that is easy to rebut. For another example, in such communication it is only reasonable to respond to objections that the other party makes to the view you are trying to persuade them of or to the arguments that you have presented so far. These are just two examples among many. The field that studies the norms of such arguments as reasonable communication is called *dialectic*.

But there is also a third perspective from which to assess arguments used to convince or persuade others. Because they are attempts to be cogent, or at least as pretending to try to be cogent—that is, to truly justify their conclusions—arguments used to convince or persuade can be assessed for the merits of the reasoning that they embody or express: they can be measured against the norms for good reasoning in arguments. In other words, their *logic* can be assessed (in the second sense of 'logic' noted above, the one that refers to the general norms of cogent reasoning.).

In sum, an argument can be evaluated using any or all of three distinct kinds of criteria. The criteria of effective communication are those of rhetoric; the criteria of responsive argumentation are those of dialectic; and the criteria of cogent reasoning are those of logic. A "good" argument, all things considered, is one that scores well on all three.

The following section sets out in more detail and explains the different logical norms that can be applied to reasoning and to its expression in natural language in arguments used to persuade or justify.

3. Logical Norms for Natural Language Arguments

3.1. The Two Elements of Arguments

An argument starts from grounds (information, assumptions) and the reasoner or arguer draws inferences or tries to get another or others to accept other claims (conclusions, positions, standpoints) on the basis of those grounds. The reasoner or arguer is thinking or saying, "These grounds are cogent grounds, and they support that claim; it follows from them; and so that claim is cogent, too." Thus an argument has three elements: the grounds or starting points, and inference from those grounds to the outcome or conclusion, and the conclusion. A useful metaphor is to think of an argument like a house. If the conclusion is the roof, walls that support it must hold it up, and the walls must rest on a solid foundation. The foundation is the premises, the link is the supporting walls, and the roof is the conclusion. (The metaphor of the house was introduced by Missimer, 2005.)

In a logically good argument, the starting points are solid, and the support they provide for the claim in question is strong. The outcome is justified by the grounds offered. It is reasonable to accept the conclusion on the basis of the reasons given. And, correspondingly, a logically weak argument can fail for either or both of two reasons. Its grounds can be problematic (for various reasons, as we will see); or, even if the grounds are solid on their own, the link from them can fail to provide any, or enough, support for the particular conclusion adduced from them. In the following sections there is, first, a discussion of the norms that apply in judging how good the grounds are, and then a

discussion of the norms that apply in judging how good is the support that grounds provide for the claims based on them.

3.2. The Norms for Premises (Also Known As: Grounds, Assumptions, Starting Points)

Whether you are reasoning for yourself or trying to persuade someone else, the grounds you start from—the beliefs, assumptions, alleged information—should ideally be true. Certainly, false starting points cannot produce good reasoning or sound arguments. Often, however, we are not in a position to know that our premises are true. (For example, suppose you are trying to decide what clothes to pack for a trip and you must rely, as the premise of your reasoning, on the weather forecast or on a guess about the activities you might be asked to take part in when you arrive.) If you cannot know that your premises are true, they should at least be reasonable for you to believe. Any likelihood that your premises are not true requires you to qualify whatever conclusion you draw from them accordingly. For example, if the weather forecast not very reliable, then you can only conclude that "probably" you should pack this or that clothing. So starting points for reasoning should be true, or at least reasonable for you to believe.

If you are using arguments to try rationally to convince or persuade another person and that person can interact with you, you need to start from premises that you think it would be reasonable for the other person to accept (grant, or concede). If your interlocutor refuses to grant your premises, your argument cannot succeed. So if the other party is hesitant or unwilling to accept a premise you want to use and that you think is reasonable for him or her to accept, you can try to convince the person of it by appealing to other things you think the person reasonably accepts that show it to be true—that is, by making it the conclusion of another argument. (Using premises that are open to challenge by the interlocutor without defending them results in the fallacy of problematic premise, to be discussed later).

Some might think that appealing to what it is reasonable for the interlocutor to accept is being rhetorical rather than logical, or risks conflating rhetoric with logic. To be logical, they might contend, requires appeal to grounds that are justified, *simpliciter*, whether or not the interlocutor finds them reasonable to accept, or indeed, whether or not they are reasonable for the interlocutor to accept. But such a view risks misunderstanding the nature of argumentation in ordinary language. Such a view seems to assimilate arguments to the proofs of mathematics. A proof starts from true premises, and deduces a conclusion from them by means of formal entailments. But an argument typically is an attempt by one person to persuade, rationally, another person or group of people to accept some claim (as true or probable or plausible), to adopt some attitude, or to perform, or be disposed to perform, some action. If an arguer offers to an interlocutor, as the starting points of argument, premises that the interlocutor does not find it reasonable to accept, the argument cannot get off the ground. So the "logic" of arguments in natural language has to be different from the "logic" of proofs. The logical norms that apply to arguments have to take into account the necessity of obtaining the assent of the interlocutor(s) to the premises.

To be sure, it is always possible to argue from what you know or believe are prejudices

or superstitions that the other party endorses. You can appeal to irrational fears or unrealistic hopes or expectations. But in that case, you would be in some sense inconsistent in doing so. For since you are using arguments, which are ostensibly a tool of reasonableness, there is a presumption that it will be reasonable of you to employ the arguments that you use. Normally, it will be reasonable for you to employ an argument only if (as far as you can judge) it is a reasonable argument. So, if you don't, then on the one hand you are purporting to be reasonable and on the other hand, by appealing to propositions that you do not believe are reasonable: you are being disingenuous. There is a kind of pragmatic inconsistency involved here. This is analogous to lying. The liar must purport to be telling the truth even as he deliberately does not tell the truth. The philosopher, Immanuel Kant, argued that this kind of deliberate inconsistency makes an action immoral. Readers can decide for themselves whether appealing to unreasonable beliefs that another party (nevertheless) holds, in order to convince or persuade him, is morally wrong as well as a violation of the norms of reasonable argument. (To be sure, there might be rare cases in which it would be reasonable to use premises you don't think are reasonable, for example to try to persuade someone who believes them to refrain from committing some heinous act—just as, in rare cases, it can be morally right to lie.)

To sum up, the starting points, grounds, or premises of reasoning for oneself should ideally be true, and failing that, plausible or probable—that is, reasonable to believe or accept. If the person (or persons) you are trying to convince or persuade is not present or not otherwise able to communicate with you, you are faced with the task of trying to determine what grounds for your arguments they are likely to accept and that they would be justified in accepting.

The kinds of sources of the information that is available to use as premises in arguments are twofold: our own imagination and experience (including our observations) and the testimony of other people (what people tell us, what we read, and in general what is communicated—by conversations, newspapers, magazines, books, radio, television, the internet, and so on). In order to be a sound basis for reasoning or arguments, such information needs to be reliable.

We all know that our own observations and experiences can be unreliable in various ways. For instance, we might have poor eyesight or poor hearing, or be hurried or tired or stressed during our observations, or be observing in poor light or in a noisy place or with other distractions, or be influenced by expectations or biases or prejudices, or not have the experience properly to interpret what we observe, and so on. We can misidentify our experiences, for example, mistaking lust, or the excitement of a new relationship, for love, or mistaking embarrassment for shame. So to reason or argue well from our own experience, we need to make sure that none of these distorting or misleading factors has affected the "information" that we are relying upon.

The information that we get from others can be unreliable too, in many and various ways. There might be miscommunication from our source to us. It might not be clear, or we might fail to understand it. Assuming we understand the information accurately, it can still be unreliable for a variety of reasons relating to its source. Its source, like we ourselves, might have been subject to one or more of the many distorting or misleading

factors to which most are liable. It is also possible for others deliberately to lie or mislead us, given their particular interests—that is, they might be untrustworthy. If the source is someone who might be expected to be authoritative about the information, such as a physician about medical matters, and in general anyone who is supposed to be an expert in some area, there can still be problems. Perhaps the person's expertise is limited, or does not apply to the particular matter at hand. Perhaps, although the person is an expert in this matter in general, he or she has not examined the particular case in question. Perhaps this matter is very hard to determine and equally qualified experts will reasonably disagree about it, as happens sometimes with medical diagnoses. Or perhaps a mistake was made—an instrument wasn't properly calibrated, or it malfunctioned, or someone misread a number or innocently transposed a number in writing it down. In matters in which the outcome is particularly important but we must rely on the information that only experts or other kinds of authorities can provide, it is a prudent practice to get a second opinion or several other opinions, on the assumption that agreement among experts suggests reliable information and disagreement indicates the opposite.

The track record of a particular source of information can help us judge its reliability about a particular item of information. That is why tabloids can be properly held to be unreliable as news sources: their track record is spotty. The "established" media in many countries—radio, television, newspapers—tend to be more reliable than the tabloids, but they too are often misleading in their points of view (for example, blocking out the point of view of one side in an international or labor dispute), and slanting report of the evidence (i.e., reporting only the facts which support a favored side, even if the facts are as reported.)

McMurtry approaches this problem in a logically systematic way in his 1988 article in *Informal Logic*, "The Unspeakable: Understanding the System of Fallacy in the Media"). Relatedly, we need to keep in mind that in most countries the "media"—newspapers and television broadcasters—are controlled by large corporations which not only cut corners to maximize profits, but also have a financial interest in supporting the ideology of corporate capitalism. So the selection, completeness and balance of their information need to be treated with strong reservations.

It is in the interests of some kinds of sources to be meticulous about accuracy. Reference works like dictionaries and encyclopedias, if up-to-date, though not infallible, can be expected generally to be very reliable, because the costs of unreliability are great. Academic reputation, not to say sales, would be destroyed by a record of poor reliability. Similarly, scientific and other scholarly journals take pains to check the reliability of the articles they publish, and they tend to publicize and correct mistakes, because their value to the scientific and scholarly communities that they serve depends on their reliability. Even so, one must be on guard. In the early 2000s there were reports that accounts of pharmaceutical research reports had been ghost-written by the drug companies making the drugs in question and simply "fronted" by physicians who accepted payment for the use of their names. If those reports are true, this practice, by casting the reliability of medical journals into doubt, threatens to undermine the credibility of a major source of important information.

This has been a quick scan of the sorts of factors that can come into play in judging

whether to accept the grounds or premises offered in an argument or to be used in reasoning. In general, anyone who is reasoning or making arguments needs to be, and can be, vigilant about the reliability of the information he or she takes as the starting point.

3.3. The Norms for Inferences (or Types of Support for Conclusions)

Assuming that the premises are true, or reasonable to believe or grant, the second critical question to be asked of any piece of reasoning or argument from a logical point of view is this: Is the conclusion supported by the offered premises to the extent alleged or to the extent that it needs to be?

3.3.1. Necessary Connections

The concept of necessary connections between statements has been explained above. In the case of some arguments, a necessary connection is claimed to exist between the grounds or premises and the claim or conclusion that they are adduced to support. It is said of them that if the premises are true, the conclusion must be true—it cannot in that case possibly be false. Such a connection is termed, in logic, an "entailment," and the premises of such arguments are claimed to "entail" their conclusion. The logic of entailments is called "deductive" logic. Deductive logic is the most developed branch of logic, and many systems of deduction have been worked out.

Deductive connections or entailments can be found in the reasoning or arguments of ordinary language involved in daily life. If you reason that your misplaced keys must be somewhere in your apartment, because (you know that) you brought them into the apartment with you last night and there is no way they could have been taken out of it since then, you are alleging a necessary connection. If the two premises you reason from are indeed true, then your conclusion cannot be false. In other words, such an argument is "valid" in the sense of that term used in logic. Here validity refers to the situation that obtains when it is not possible that the premises of the argument be true and the conclusion false. To say that such an argument is valid is another way of saying that the premises of the argument entail the conclusion. (The term 'valid' is used differently in sampling, or survey research, where a "valid" measuring instrument is one that measures exactly what it is supposed to measure.)

Entailments are also found in arguments in certain kinds of specialized subjects, such as mathematics and philosophy. When Descartes reasoned, "I think, therefore I am," he was claiming that he had to exist (as a thinking being), given that he could question whether he really did exist.

A deductive logic can often be expressed in general terms and thus given a "formal" expression. An analogy is mathematics. We know that $2+2=4$, $9+9=18$, $130+130=260$, and so on. These truths can be generalized—any positive number added to itself equals a number that is twice its magnitude. And so this truth can be expressed formally. Let x represent any number; then $x + x = 2x$. Consider now the argument just seen: "My keys are either in my apartment or they are not in it; and they cannot be anywhere else; so they must be in it." That argument has the same form as, "You will certainly find

Georges in the café, because he is always either in the café or in his office and he is not in his office"; or "You are either with us or you are against us, and you are not with us; so you must be against us"; and so on. (As these examples indicate, the subject matter can range from the innocuous to the politically explosive.) This "form" of reasoning or argument can be expressed in general or formal terms. Let p and q be symbols representing any two (declarative) sentences whatsoever; the form of the argument then is, "Either p or q , and not- q , so p ." That is why deductive logic is often called "formal" logic. (If we add other symbols for the terms 'or,' 'and,' 'not,' and 'so,' we can express the whole argument in symbols. Thus formal logic is also known as "symbolic" logic.)

A deductive logic identifies the forms of reasoning or argument that have the property of expressing in general terms necessary or entailment connections among their component elements for different kinds of elements. Thus there is a deductive logic for simple declarative sentences joined by the constants "if ..., then...", "and," "or" and the prefix 'not' (called "propositional" logic)—just exemplified in the preceding paragraph. There is also a logic that studies the necessary connections among sentences expressing obligation, permission and prohibition joined by the above constants: e.g., if an act is permitted, then it is not obligatory and it is not prohibited. This logic is known as *deontic* logic. It applies to strict moral or legal reasoning. It is the logic of the reasoning about strict rules, as opposed to reasoning about rules that hold only for the most part, with room for unspecified exceptions. *Modal* logic is the logic that studies the connections among sentences expressing possibility and necessity joined by the above constants: e.g., if something is necessarily the case, then it is not possible for it not to be the case). Modal logic helps to clarify the concept of implication, which is crucial to reasoning and argument, by marking a distinction between different kinds of implication and their entailments.

Such logical systems have the property that for any form of expression in the system, it can be determined whether that form is an entailment. It can be worked out and proved which forms of expression in the system are entailments. If any argument in ordinary language has the form of an expression that has been proved to be an entailment in a formal logical system, then that argument's premises entail its conclusion, and that means that the conclusion must be true, provided that the premises are true. This kind of premise-conclusion supporting link is the strongest possible, and anyone is justified in accepting the conclusion on the basis of those premises if they are true.

Unfortunately, such deductive logic systems are of limited usefulness for ordinary language reasoning and arguments, for several reasons. For one thing it is impractical to require everyone who wishes to assess his or her own or another's reasoning or arguments to learn all the deductive systems, even if they had been worked out for every possibility (which they are not). For another thing, it is usually necessary to reformulate the reasoning or arguments as expressed in ordinary language in order to see whether they correspond to the forms proven to be entailments in a deductive system, and whether a reformulation is faithful to the original reasoning or argument is very often a controversial matter.

Most of the reasoning and arguments expressed in ordinary language in most contexts,

especially for purposes of daily living and for reasoning and arguing about moral, aesthetic, legal, social and political issues, is not intended to consist of formal entailments in accordance with an external logical scheme not found in natural language

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Biographical Sketches

J. Anthony Blair was born in Ottawa, Canada, educated in primary and high school there and at McGill University (Hons. Philosophy B.A.) and the University of Michigan (Philosophy M.A.). He is married to June Fulford with whom he has a son, Jay.

Blair taught in the University of Windsor Philosophy Department from 1967 to 2006, serving two terms as Department Head, and retiring with the title of University Professor. In 2006 he founded the Centre for

Research in Reasoning, Argumentation and Rhetoric (CRRAR) at the University of Windsor. Together with Ralph Johnson: he wrote the influential textbook, *Logical Self-Defense* (1977, latest edition 2006); chaired the First International Symposium on Informal Logic (1978), the Second (1983) and the Third (1988); started the journal *Informal Logic* (1984), which he continues to co-edit; authored several survey-of-the-field articles; and directs CRRAR. With Robert Pinto he wrote the critical thinking textbook, *Reasoning, A Practical Guide* (1993). He has served on the board of the International Society for the Study of Argumentation (ISSA) based at the University of Amsterdam and on the organizing committee of the quadrennial ISSA conferences since 1986, and on the organizing committee for most of the Ontario Society for the Study of Argumentation (OSSA) conferences. He was a keynote speaker at the 2005 OSSA conference, and the J. Anthony Blair Prize for an outstanding student paper at the OSSA conferences was established in his honor.

Blair has published some 70 papers on theory and pedagogy of informal logic and critical thinking and on argumentation theory. His theoretical papers address the nature of arguments and argumentation, the logical norms of argument, the dialectical character of argument and argumentation, and the rhetorical character of argument and argumentation.

Ralph H. Johnson was born on September 14, 1940 in Detroit, Michigan. He received his B.A. from Xavier in 1958, an M.A. in Philosophy from Notre Dame (1966) and his Ph.D. from Notre Dame in 1973. In 1967, he married Margaret Moran. They have three children: Mary, Sean and Matthew.

Johnson retired in Fall 2006 after 39 years with the Department of Philosophy, University of Windsor, during which he served two term as Head of Department. In 1971, he along with his colleague, J. Anthony Blair, developed a new approach to logic they called informal logic. In 1977, Johnson and Blair published their text, *Logical Self-Defense* (3rd edition, 1993; U.S. edition, 1994; IDEA, 2006). In 1979, Johnson and Blair founded the *Informal Logic Newsletter*, which became the journal, *Informal Logic*, in 1985. They have been its publishers and editors from the beginning. In 2006, he and Blair founded the Centre for Research in Reasoning, Argumentation and Rhetoric, for which they currently serve as Co-Directors.

Johnson has published more than 50 articles on various issues in argumentation theory and informal logic, for all the major journals and delivered keynote addresses at many conferences. His *Manifest Rationality* [Lawrence Erlbaum 2000] was well received.

In 1993, Johnson received a 3M Teaching Fellowship for outstanding university teachers, one of ten such awards conferred that year in Canada. In 1994, he was awarded the rank of University Professor by the University of Windsor. In 2000, he was awarded the Distinguished Research Award by the International Society for the Study of Argumentation. In 2003, he was elected a Fellow of the Royal Society of Canada. Johnson is listed in *Who's Who in Canada*.