

Critical Thinking

- an overview -

Thomas Olsson
thomas.olsson@telecom.lth.se

Introduction

It is often implicitly assumed that when learning a subject, for example research methodology, one also attains the ability to critically review the same. However, just as presentation and teaching skills are separate from the subject being presented or taught, so is the ability to think critically about a subject. This does not mean that the domain knowledge is not important. The knowledge and experience of a subject is important and necessary to be able to review arguments, present a topic or teach a subject. In critical reasoning, it is this knowledge that is used to assess whether the facts are correct or at least plausible. But there is also some general knowledge concerning critical thinking that is independent of the subject.

The major aim with critical thinking is to assess soundness of arguments [Hughes 96]. Is the conclusion valid? That is, based on the premises? Are the premises enough to support the conclusion? Is the argument strong? These questions typically needs to be answered when analyzing an argument. Critical thinking skills help structuring and evaluating this analysis. But it is not enough to be able to dissect an argument or reasoning. To be able to conclude whether the argument is sound or not the view on the philosophy of science is also important. Determine the truth of a statement is not always a straight-forward task. The philosophy of science provide some guidelines in assessment of statements.

Critical thinking is not just about assessing arguments. Neither is it the same as being sceptical. The general topic of critical thinking is not considered in this paper. The focus here is to supply some guidelines on how to evaluate research material, especially empirically collected. In doing this, arguments will have to be assessed. Hence, the focus here is the arguments and aspects regarding the evaluation of those.

This paper tries to give a brief overview of the area of critical thinking and related topics. The basic structures of an argument are presented, as well as some criteria on a good argument. Also, a very short introduction to the philosophy of science is given.

What is an argument?

A sentence that can be attributed either true or false is called a statement [Hughes 96]. The building blocks of an argument are the premises and the conclusion. The premises and the conclusion are statements, but the argument as a whole is not. In an argument, the premises claim to support a conclusion. For example:

(p1) Research methodology is important for a researcher
(p2) I am a researcher
(c) Therefore, research methodology is important for me

Here, the two first statements are the premises and the third statement the conclusion. All three sentences are statements, as a true or false value can be attached to them. Sentences such as “What time is it?” (a question) or “Wake up!” (an order) cannot be said to be neither true nor false. Hence, these are not statements. Note that the argument as a whole is not a statement either and therefore cannot be

attributed true or false. In the example above, the conclusion can be said to be true or false, so can the premises (i.e. they are statements). However, it does not make sense to say that the argument is true. The important thing is that the conclusion is true and supported by the premises. It is not uncommon, however, that people say that an argument is true when they in fact refer to the conclusion.

The structure of an argument

To be able to evaluate an argument, the constituents must first be identified. When the premises and conclusions are identified, each can be evaluated by itself and finally the soundness of the argument as a whole is evaluated.

A simple argument

A simple argument consists of only one premise and one conclusion. For example:

- (p) It is raining outside*
- (c) Hence, I should use an umbrella outside*

In a simple argument, if the premise is true then so is the conclusion. The opposite might not be true though. It might be wise to use an umbrella to avoid sun as well. However, if the conclusion is deemed false, then either the premise is also false or there is some missing premise (which will lead to a different structure of the argument).

A t-structured argument

Sometimes an argument has several premises that each might be enough to support the conclusion.

- (p1) Walking outside without clothes is cold*
- (p2) Running around naked in public is not allowed*
- (c) Therefore, I should use clothes when I am outside*

In this example, each of the premises (p1 and p2) supports the conclusion that it is wise to use clothes outside. Even if one of the premises is false, the conclusion might still be valid. In this instance, if the conclusion should be false, then knowing which premise that is false is not trivial. Sometimes when having more than two premises, a combination of premises might be adequate to the conclusion, but all are not needed.

A v-argument

If a conclusion in an argument requires all the premises to be true, then it is labeled a v-argument.

- (p1) Research methodology is important for a researcher*
- (p2) I am a researcher*
- (c) Hence, research methodology is important to me*

To come to the conclusion that research methodology is important to me, both the premise p1 and p2 are needed to be true. If one of the premises is false, then so is the conclusion.

Complex arguments

The structures above are the basic structures of arguments. In reality an argument often constitutes of a combination of the basic structures. This is known as complex arguments. For example:

- (p1) As a doctoral student, I conduct research.*
- (c1) Therefore, I can be called a researcher*
- (p2) Research methodology is important for a researcher*
- (p3) I am a researcher*
- (c2) Therefore, research methodology is important for me*

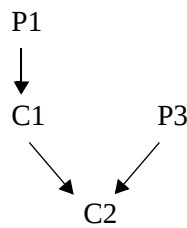


FIGURE 1. A tree diagram of an argument

Here, the first argument is a simple one. The second argument is based on the first, namely the premise p3 in the second argument is the conclusion c1 from the first argument. The second argument is a v-argument. Hence, the argument as a whole is a combination of a simple and a v-argument. Figure 1 illustrates the argument in a tree diagram. Tree diagrams can be used to depict the structure of a complex argument.

By identifying the structure of an argument, the premises and the conclusion can be analyzed on their own. The analysis of the premises is often not straightforward. To assess whether a statement is true requires knowledge about the domain and an idea about the strength of the

statement. Also, in many cases the structure of an argument is not easily identified. This, also, requires a great deal of knowledge and experience to assess if, for example, the premises are sufficient (t-arguments) or necessary (v-arguments).

Things that look like arguments but are not

There are statements that might look like arguments, but in fact they are not. Two examples on this are reports of arguments and explanations. If someone reports to another person that I argue that research methodology is important to me then this is not in itself an argument. It is a statement, though, as it can be attributed true or false. Explanations is another example of something that is not an argument. Consider the statement “I used an umbrella because it rained”. There is no conclusion in this statement. It is simply an explanation of an event. It is a statement, though, as the sentence can be evaluated either as true or false.

These, so called, near arguments can be difficult to separate from actual arguments. But knowing the structure of an argument helps identifying a near argument. Near arguments might still be statements that can be attributed true or false. Near arguments do of course also need to be evaluated. This does not differ from the assessment of a premise or a conclusion, but differs significantly from assessing an argument. Assessing an argument is more complex than assessing a single statement.

Truth, strength and soundness

Truth is a property of a statement. Both premises and conclusions can be said to be true or false. For example:

It is raining outside

This statement can be said to be true or false, depending on the weather. An argument, however, cannot be said to be true or false. An argument can be deemed to be sound or not. For example:

It is raining outside

Therefore, I will be wet if I go outside

Both the premise and the conclusion can be deemed true or false, but not the argument as a whole. True premises and conclusion and logical strength characterize a sound argument [Hughes 96]. The logical strength concerns the connection between the premises and the conclusion. For example, the structure of the argument, the adequacy of the premises and so on. This is further elaborated on later in this paper. Obviously, even if the premises are true but not related to the conclusion, then the argument cannot be said to be sound.

A good argument

So, what constitutes a good argument? What criteria should be put on the premises and the conclusion that is significant for a sound argument? There are three factors that can be used to assess the premises and their relationship to the conclusion [Hughes 96]:

- **Acceptable** - As seen earlier, a sound argument is one where the premises and the conclusion are true. This is the acceptability criterion. For some statements a simple true or false might not be applicable. It might be enough that the premise is plausible. A statement as “most people think murder should be illegal” cannot be proven to be true using logic or any other formal form of proof. Still, accepting the statement as true is likely to be what most people would agree with. Hence, the statement is considered to be acceptable, even though not proven to be true.
- **Relevant** - Even if a premise is true does not make it relevant to the conclusion. An argument as “It is sunny weather today. Therefore, we should get a raise.” is not sound, as the weather does not concern our pay and is therefore not relevant to the conclusion that we should get a raise. (Even though I am sure that most would agree that it would be nice if it was a sound argument, given that bad weather didn’t have the opposite affect.)
- **Adequate** - In many cases, a single or a few premises might not be enough. Assessing whether the premises are enough to support a conclusion relates to the adequate criteria. For example, “None of my friends know anyone who is prejudice against women. I conclude that there exist no injustice on women due to their gender in the world.” The premise is obviously not adequate for drawing the conclusion that no injustice against women takes place. To support such a claim, if sound, needs a bigger sample to support the generalization to the whole world, or even parts of it.

If an argument has acceptable and relevant premises but is not adequate, then it is sometimes referred to as a weak argument. The argument might be true, but there isn’t enough information to assert this completely. Still, it might be a good argument. For example:

Historically, the stock market tends to have a periodic pattern with ups and downs, with an average increase over a long period of time.

Therefore, I think that the current weak stock market will recover and my investments will increase over time.

If the premises and the conclusions are consider to being strictly true and fully adequate then the argument is called strong, given that the premises are relevant as well. The premise that history dictates the future of the stock market is acceptable and relevant but not adequate. The argument is then called weak. Still, most analysts agree that this is the case and there is no evidence that history should not repeat itself.

Inductive and deductive arguments

The soundness of an argument is sometimes a matter of degree. If it is reasonable that the premises support the conclusion then the argument is referred to as an inductive argument. If, however, the truth of the premises guarantee that the conclusion is true, then the argument is deductive. An example on the former is empirical observations. Even though there are ample empirical evidence of a conclusion, this does never guarantee that the conclusion is true. The soundness of the argument is then dependent on the amount of empirical evidence that support the conclusion. However, in a deductive argument, the argument is either sound or not. For example:

I have got more than a million dollars

Therefore, I can be called a millionaire

If the definition of a millionaire is that one has more than a million dollars, then this argument is either sound or not, depending on the amount of money I actually have. (No, it is not a sound argument as the premise is not true...)

Truth assessment of statements

One important part of assessing an argument is evaluating the truth of the premises and the conclusions. This is not always a simple task. Assessment of statements is very dependent on the topic and the nature of the statement. Domain knowledge is used to assess if a statement is true or not. The focus in this paper is on the arguments. The assessments of statements is largely left out, a part from some general guidelines regarding the philosophy of science and moral reasoning. The reason is that the assessment of truth of statements is to a large extent learnt when learning a subject.

Things that make critical thinking difficult

The arguments presented so far in this paper have been very simple. They have been little or no extraneous information and most of the premises and conclusions have been clear and unambiguous. In reality, this is usually not the case. This section presents some of the obstacles that can be encountered when trying to assess an argument critically. These obstacles are not directly related to the structure or the soundness of an argument. Rather, this section touches on issues that are more related to the way an argument is presented and sometimes even deliberately hidden to elude the reader.

Rhetorics

Critical thinking is about analyzing arguments to evaluate whether they are sound or not. Rhetorics, on the other hand, is the skill of presenting arguments (and other things) in a convincing way. Rhetorics is sometimes referred to as “the art of speaking and writing” or “the art of convincing people” [Johannesson 98].

In rhetorics, there are several tricks to convince the receiver that the argument is a valid one and to convey a specific message as effectively as possible without it necessarily being true or right. As a result, the argument is not always clear and the motivation for the message is hidden in loaded terms or by other measures of confusion. Here are some examples on techniques that are common in rhetorics:

- Repetition - Repetitions are often used to convey a specific message or perhaps to cloud the real message. By repeating the same thing over and over this is what people remember and the real argument is lost. It is easy to be eluded to believe the presenter without just cause if the receiver is not alert and thinking critically.
- Escalation - To emphasize some aspect of an argument, an escalation can be used. Starting with the least important fact and then escalate the importance to finally arrive at a premise that seems so convincing that you have to believe it. For example, in conducting an empirical study we find three premises supporting the conclusion. The first is our own gut feeling after having performed the study, the second is the support of existing literature, and finally the strong statistical significance supporting our hypothesis. It is easy to be fooled to believe that the last premise then is very strong as it is stronger than the other premises in the argument. Also, escalation can serve as a way to establish confidence. The receiver might perceive the person that is presenting the argument as honest as the first premises are weak but still mentioned.
- Counter-parts - To make a conclusion seem as the sensible one, the principle of counter-part or we-and-them, can be used. Typically, “their research didn’t even consider the construction threats, but we did not only consider this threat, but also internal and external validity”. This is not an argument but a way of moving the attention away from the actual argument. This is a special case of a “red herring”, see below.

Rhetorics is not evil. Rhetorics is very useful to know when presenting a material. But as the purpose is to convince the receiver of the message of the soundness of an argument, it is often used to cloud the real argument. (The observant reader might notice my use of rhetorics in the last sentence...) It is therefore important to know the common ways of constructing an argument according to the arts of rhetorics and the common ways of clouding the argumentation to be able to effectively evaluate it.

In rhetorics, there are three basic things that is seen as the basis for how to convince the receiver of the message [Johannesson 98]:

- Ethos - Character, credibility
- Pathos - Emotional response
- Logos - Message, argument

Ethos refers to how the disseminator of the argument or message is perceived. Is the person credible? For example, if a known speeder is talking about safety on the roads, this person is not likely to be perceived as credible. In rhetorics, *delectare* is referred to when the disseminator tries to establish a good ethos.

Feelings are often used in rhetorics. This is referred to as pathos. The aim is not to upset or agitate. Sometimes it might be useful for the presenter to limit the emotional response. The art of using pathos is called *movere* in rhetorics. That is, the skill to move and enthusiasm the receiver.

Logos is what this paper is mostly concerned with. The logos part of rhetorics refers to the argument and the soundness of the argument or message. The logos should be the most important part of an argument, but a skillful rhetorician will use pathos and ethos to persuade the receiver of the soundness of the argument, that the logos (the argument) is sound. *Docere*, informing or arguing, is used to support the logos in a presentation.

Here are some more ways often used by a skilled rhetorician to confuse the receiver:

- Misleading statistics - How to lie with a statistics is a book of its own. It is quite easy to present only the statistics that speak in favor of your conclusion.
- False confidence - By being a good rhetorics, it is quite easy to sway the reader or listener by seeming confident. Don't be fooled just because it seems as the person knows what they are talking about. Confidence has nothing to do with if the argument is sound or not.
- Selectivity - It is common that when presenting an inductive argument contradicting evidence is left out. It won't make the argument stronger, but it might make it less weak.
- Red herring - A so called red herring is when responding to an entirely different issue than the one brought up to steer the attention away from the real issue. This is typically used by politicians that don't want to answer the real question. A special case is using the counter-part technique, mentioned earlier in this paper.

Meaning and definition

We use a language to communicate our thoughts and ideas. However, our language is complex and ambiguous. This poses some problems when considering arguments and their soundness. This section briefly presents some of the issues involved with meaning and definition.

Meaning

Natural language is ambiguous and context dependent. The same thing can be expressed in many different ways (synonyms), the same word might mean different things in different contexts (homonyms). Also, many words have a value attached to them. This makes the analysis of an argument difficult. Here are some examples of some of the problems languages pose us:

He is self-confident
He is arrogant

Kalle said I was angry
Kalle said, "I was angry"

Sven decided to quit smoking while driving to Stockholm

Dogs must be carried in the escalator

Applicants must hold a diploma in early childhood education or have the equivalent work experience

The examples above are difficulties related one way or another to our language. Both when writing and assessing arguments, much care must be taken to make the argument clear and to bring out the true meaning of a statement. Further studies into the use of language are referred to, for example, *Critical Thinking* [Hughes 96] and *Retorik* [Johannesson 98].

Definitions

Definitions are used to give words and phrases a precise meaning. The most common usage is reportive definitions [Hughes 96]. The purpose of a reportive definition is to define the correct use of a word. The correct use of a word is the standard usage within a specific context. Dictionaries, for example, provide reportive definitions. Another way to use definitions are stipulative. With stipulative definitions, the meaning of a word is fixed to a specific context. This meaning need not be the standard usage of the word, although it is wise not to divert too much from standard usage for obvious reasons. Stipulative definitions are used to give a clear meaning to a word, and also shorten a presentation by giving a word a meaning that does not always have to be repeated on each usage of the word.

Providing good definitions can be difficult. If the definition is made too broad too much is included and the definitions becomes useless. If a definition is too narrow, on the other hand, things are left out that ought to be a part of the definition. For example:

If you perform research, then you are a researcher

Is this a good definition? Probably not. This definition is too broad and also dependent on another definition, research. Other problems that can occur when using definitions are circular definitions (for example, defining research as performed by researchers combined with the definition of researcher above) or obscure definitions (for example, a researcher expands the boarder of knowledge). Hence, care should be taken when using, and reviewing, definitions.

What is this thing called science?

The heading of this section is taken from Alan Chalmers book about the philosophy of science [Chalmers 99]. The philosophy of science tries to answer questions such as: What is science? What makes science different from other knowledge? This section presents some theories that try to answer these questions. Still, being familiar with the basic concepts and theories is important when assessing research material, which this section tries to explain and make plausible. The more philosophical reader of this is referred to for example Chalmers book with the same title as this section for further reading [Chalmers 99].

Theories

There are many theories about the nature of science. The selection of the theories presented here is not claimed to be representative. However, hopefully the examples give an insight into how one might reason about the philosophy of science. The basic principles of the theories are presented along with the common criticism against them. The aim is not to promote or demote any of the theories, rather to present them as objectively as possible.

Science as based on facts

One theory on science and knowledge is the statement “science is based on facts”, typically supported by positivists and inductivists. The idea is that “the careful use of our senses” will give us all the facts and theories. Science is not based on opinion or imagination. The theories as such are derived from the facts, using induction and deduction.

This view of science has some problems. For example, by observing that metal m1, metal m2, metal m3 etc. expands when heated, is it valid to draw the conclusion that all metals expand when heated? There is a problem with when an inductive argument like this is how to determine if it is a strong or weak argument. Also, there is the problem with our human perception. When it was believed that the earth was the center of the universe, several observations supporting this were put forward. But as our knowledge about the universe evolved, this was refuted and the earth was not attributed any special place in space. Hence, as our theories and understanding of the universe evolved, our perception also evolved. Hence, how can facts precede theory? Also, this view has some problems dealing with theories that are proven wrong. How can a theory be wrong if it is based on facts?

Falsificationism

An attempt to alleviate the positivistic view of science is presented by the falsificationists. According to them, science is theories which can be falsified, i.e. proven to be false. For example, “all material expand when heated” is typically falsifiable, but “all points on an Euclidean circle are at the same distance from the centre” is not. The latter is not falsifiable as this is the definition of an Euclidean circle. As science evolves, theories are falsified and replaced by new, falsifiable theories. A good theory is one that survives the test of time, that is can but has not yet been proven false.

Falsification focuses on the evolvement of science. Also, it tries to alleviate the inductivism from the problems of theory dependence and fallible theories. However, the problems arise when considering a new theory. When a new theory is introduced, there are often many observations that falsifies it. Again the example with the earth being the centre of the universe. When the theory that the earth does in fact orbit the sun was introduced, there was many observations contradicting this view. Still, people stuck with the theory and it proved to be more accurate than the previous idea that the earth was the centre of the universe. Hence, a similar problem is arrived at as with the inductivists. How long should one stick with a theory even though there is ample evidence that it is false?

Theories as structures

Both inductivism and falsificationism suffers from the theory-dependence and falsification of theories. Both are dependent on theory, even though they try to avoid this. More importantly, none of them handles the problem with theories later proving to be false very well. The idea of theories as structures tries to tackle these problems. The theories within science are to be seen as structures or scaffolding that support science, but are not science themselves. Terms such as paradigm or research program indicate the general area. For example, Newton’s laws of motion can be seen as a paradigm. A paradigm has some fundamental laws, dictating methodology and instrumentation. Normal scientific work basically constitutes of puzzle-work or “filling in the blanks” within a paradigm or research program. Lack of empirical evidence for certain aspects of a paradigm or internal inconsistencies are acceptable. The aim

is to rid the paradigm of these. Sometimes, though, there is a need to change the paradigm. This will happen when there is some crisis in the paradigm, for example some event that is not explainable within the paradigm. This is followed by a revolution where a new paradigm is established and normal scientific work resumed.

This approach has two major drawbacks, namely subjectiveness and applicability. Firstly, the distinction between two paradigms is difficult to make. The criticism is that this is done mainly subjectively. The foundation for a paradigm or research program is not easily defined and this leads to the second objection. The second problem concerns the applicability of this approach. There is little knowledge in the world that would not fit this definition of science. The question is, then, if it is a useful approach when one is not able to distinguish scientific knowledge from other.

Why is this important?

Is it really important to debate about the philosophy of science? Even more, is it relevant to the topic of critical thinking? In a risky attempt to motivate this, I provide an argument motivating why the philosophy of science is important. This is risky since it is likely to be scrutinized, given the topic of this paper.

I make the following base premise:

The three criteria acceptable, relevant and adequate are the constituents of a good argument

This is in fact a conclusion which is not very well supported, more than with an appeal to authority [Hughes 96]. However, even though one might not acknowledge these three criteria, the conclusion is not necessarily falsified. A similar argument can be taken given other criteria. The question then is whether the same premises are valid and if the conclusion will be the same. This is not further elaborated here.

If accepting this conclusion, the argument continues:

To be able to assess the acceptability of a statement I must be able to assess the facts of the statement. But what is a fact and how is it deemed true or false? In the philosophy of science, a way of assessing facts is given. Therefore, to be able to assess the acceptability of a premise it is important to understand the philosophy of science.

The relevant criteria attribute the relationship between the premises and the conclusion. To be able to evaluate the relationship then the premise and conclusion must be identified. This is not always easily done. The different theories of science help to identify premises and conclusions. Hence, to be able to evaluate the relevance of the statements in an argument, it is useful to know about the philosophy of science.

Assessing the adequacy of a premise is, as seen in this paper, not an easy task, as adequacy is not always absolute. Adequacy is one of the fundamental issues addressed by philosophy of science. This leads to that a philosophy of science is needed to be able to assess the adequacy of the premises in an argument.

The acceptability of these premises is not strictly true, especially since they also are arguments on their own. However, I consider them to be weak arguments, which are acceptable, relevant and adequate to conclude that:

Therefore, to be able to assess an argument one must be familiar with the philosophy of science

This complex argument is a weak one and I leave it to the reader, after having read this paper and perhaps some of the references, to critically review it and assess whether it is a sound argument or not.

But which of the theories of science is right? This is a matter of opinion. I do not propose any of the theories before the others. Personally I do not think that it is relevant to choose one theory. I do, however, think it is important to understand the consequences of each theory and use the knowledge when assessing an argument. Not choosing and not knowing is not the same.

Moral reasoning

Moral reasoning doesn't significantly differ from critical thinking in general. The main difference lies in assessing the premises. The justification of right and wrong is comparable to the assessment of true or false.

A word on ethics

Ethics is, just as the philosophy of science, a very large and diverse but exciting subject. Defining what is moral¹ (good, the right thing) is something that many philosophers has struggled throughout history since ancient Greece and still not come up with a satisfying answer [Denise 99]. The ethical theories range from "the pleasant life", to "social contracts". The former meaning that moral judgement can only be done on an individual basis and a moral decision is one that enhances the personal pleasure. The latter argues that moral is acting according to the social virtues and contracts of the society. A moral life is one that is lead according "reason and virtue" will lead to. Also, some cultures and religion provide moral principles that should be followed. However, these are not always acknowledged by non-followers.

Instead of presenting some of the ethical theories, two general guidelines on how to assess a moral argument is given. Which of the two that is superior is a matter of opinion and based on the ethical principles of the individual, if indeed one should be better than the other.

Appeal to principle

One way to analyze a moral issue is to consider a general principle. For example, neglecting to repay borrowed money can be argued to be immoral. One argument might be that I would think it was wrong for someone not to give me money back in the opposite situation. So, by appealing to a general principle, my action that I don't give back the money is considered immoral. This does, of course, require that a general principle is accepted. To avoid having a double standard, we must follow the general principles that we accept. In assessing an ethical argument with the appeal to principle, some basic steps can be taken:

1. Identify a general principle applicable in the situation which is considered to be moral by us.
2. Show that we accept the principle by accepting that it applies to all humans, even ourselves.
3. The claim that the principle is accepted must be honest and sincere. We must be able to make the sincerity believable if challenged.
4. If either we fail to show the acceptability of the principle or fail to apply it to ourselves, a new principle must be found.

The main problem with this approach is that different people might generalize to different principles. As a result, the same argument can be both moral and immoral, dependent on who analyses it.

Appeal to consequence

Another way of reasoning morally is to assess the consequence of the action, not the action itself. The process is this:

-
1. Moral and ethics are basically synonyms
-

1. Identify the different outcomes of an action.
2. Evaluate the outcome to some goodness or badness criterion.
3. Calculate the outcome that produces the most good.

Examples on evaluation criteria are happiness and unhappiness, benefit and harm, or pleasure and pain. The tricky part is to evaluate the outcome. The consequences of an action might be too complicated to evaluate or the evaluation criteria might be subjective or difficult to assess. Also, by assessing only the particular outcome, failure to see general principles and thereby being inconsistent in the assessment might be the result.

A Critical thinking process

Now knowing about arguments and philosophy of science, how do we apply it in a research context? This section presents some guidelines on how material can be reviewed critically, identifying some steps that are necessarily taken, in some form. Each of the steps might not be explicitly taken or several of the issues might be addressed at the same time.

The process

A seven-step process is introduced for assessing an argument [Hughes 96]. The order is not crucial, but it is often logical to analyze an argument this way.

1. Identify the main conclusion
2. Identify the premises
3. Identify the structure of the argument
4. Check the acceptability of the premises
5. Check the relevance of the premises
6. Check the adequacy of the premises
7. Look for counter-arguments

1. Identify the main conclusion

The first thing to do is to find the main conclusion. This is what is being evaluated. It is often not that difficult. Problems with this step can be missing (implicit) conclusions, ambiguous conclusions, or perhaps that it is not an argument at all. Note that a missing conclusion is not the same as it not being an argument. The conclusion might be implicit.

2. Identify the premises

The second thing to do is to identify the premises, if any, in the argument. This can be troublesome as extraneous material is often given, especially if the conclusion is weak and the rhetoric is good. Be careful not to fall for rhetoric tricks. Premises are statements, that is something that can be assessed as true or false.

3. Identify the structure of the argument

When having identified the conclusion and the premises, the structure of the argument can be recovered. As mentioned earlier, it is common that the structure is complex. This will mean that some of the premises are probably conclusions themselves. In very complicated instances it might be useful to draw some kind of tree diagram or equivalent to visualize the argument. Pay special attention to the difference between v- and t-arguments, as the difference is sometimes subtle.

The first three steps are likely to be done iteratively, as identifying the conclusion and premises might require the structure to be known, especially if the argument contains sub-conclusions.

4. Check the acceptability of the premises

When the structure is known, then an evaluation of the premises can begin. The premises can be a large part of an argument. The premise might be a presentation of an empirical study or an analytical reasoning. To evaluate whether these are true can be difficult, especially when the premises might be conclusions in other arguments. Sometimes it can be more sensible to ascribe a degree of truth instead of just true or false. However, it is important not to get lost in a lot of half true premises, which will lead to the acceptance of the conclusion.

5. Check the relevance of the premises

After the acceptability of the premises has been evaluated, the premises can be assessed with respect to relevance. The purpose, as mentioned earlier, is to evaluate whether the premises are relevant to the conclusion. The structure of the argument is important to take into account here. A premise by itself might not be relevant, but given the context of the other premises or sub-conclusions it might.

6. Check the adequacy of the premises

Are the relevant and acceptable premises, after the two previous steps, enough to support the conclusion? This is the next thing to assess. Again, the structure as well as the degree of acceptability is important to evaluate the adequacy.

7. Look for counter-arguments

As a final step, looking for counter-arguments is useful. This might be considered to go beyond the assessment of an argument, but can still be useful. If a different conclusion can be derived from the premises then there is something wrong. Perhaps something is missing in the argument or the conclusion is not adequate.

In some cases, the premises might be evaluated as true but the conclusion is evaluated as false. If this is the case, there are a couple of sources of errors:

- The evaluation of the premises might be wrong. Check that the premises are in fact acceptable.
- Perhaps some premises are missing, that is the adequacy criterion is not fulfilled. This can be difficult to uncover as we are looking for something that is not there.
- Check the structure of the argument. Perhaps the analysis is wrong and the argument is a v-argument rather than a t-argument. This will affect the conclusion if one or more of the premises is false.

Summary

Critical thinking involves not only knowledge about the domain, but also knowledge of basic logic and the anatomy of an argument. An argument consists of statements, premises and conclusions. These statements can be deemed to be true or false. An argument is considered sound if the statements are acceptable (true), relevant and adequate.

When evaluating the premises and the conclusions of an argument, some notion of the nature of science might be needed. For example, is the observation of a light moving irradically across the sky an evidence of UFOs? How much empirical evidence is required to be able to conclude that a theory is true? Does the theory precede the facts or the facts precede the theories? There is no universal theory accepted by all humans. Therefore, it is important to be aware of which theory that a person conforms to in order to be able to evaluate the argumentation.

Matters is further complicated when considering rhetorics. Rhetorics is used to present a topic in a convincing way. This can mean that the argument is hidden in a web of cleverly chosen words and phrases. Also, many times words have several meanings (homonyms) or several words have the same meaning (synonyms). The meaning of words and phrases vary in different contexts, in different cultures and even changes over time. The ambiguity and impreciseness of natural language makes the life difficult for a critical thinker!

There are some basic steps that is mostly taken when analyzing an argument. First, the structure of the argument and its constituents must be identified. Then, the premises and the conclusions should be evaluated for truth, relevance and adequacy. Lastly, the soundness of the argument as a whole is considered and possibly counter arguments.

Is critical thinking the same as good thinking? No, it is not. Critical thinking is about the analysis of arguments, about evaluating the true meaning of statements and not to be eluded by a good speaker or subjective arguments. Good thinking, I would argue, involves, among other things, creativity, wit, language and logic abilities.

References

- | | |
|----------------|--|
| Robson 93 | Colin Robson. <i>Real world Research</i> . Blackwell Publishing, 1993. |
| Hughes 96 | William Hughes. <i>Critical Thinking - An introduction to the basic skills</i> . Broadview Press, second edition, 1996. |
| Johannesson 98 | Kurt Johannesson. <i>Retorik - eller konsten att övertyga</i> . Nordstedts förlag, second edition, 1998. |
| Chalmers 99 | Allan Chalmers. <i>What is this thing called science?</i> Open university press, third edition, 1999. |
| Denise 99 | Theodore Denise, Sheldon Peterfreund, Nicholas White. <i>Great traditions in ethics</i> . Wadsworth publishing company, ninth edition, 1999. |