



ARGUMENT FROM APPEARANCE: A NEW ARGUMENTATION SCHEME*

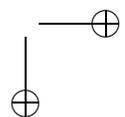
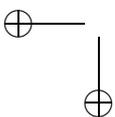
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Abstract

It is shown how two defeasible forms of argument, argument from appearance and abductive reasoning, are central tools of artificial intelligence for the analysis and evaluation of legal evidence. Defeasible argumentation schemes representing these forms of argument are presented, and applied to examples of the kind of reasoning used to draw a conclusion by inference from observational data. A common example from the Greek philosopher Carneades, the ancient case of the snake and the rope, is used to show how inferences from an appearance to a conclusion about the contents of that appearance are fallible, but can be provisionally acceptable. It is argued that the lessons of this example have not been fully taken advantage of in modern theories of reasoning, and that the best way to come to apply them is to use argumentation tools like argumentation schemes and argument diagramming.

Forms of reasoning in which an agent infers a conclusion based on observed data (facts) she has personally seen are extremely important for many reasons. First, they are basic to discovery tools being developed in artificial intelligence (Santos, 2004). Second, they are very important in argumentation theory, where they provide a focus for skeptical attacks, and give rise to controversies about whether such reasoning is inductive or not, and how it can be analyzed. Third, they are very important in scientific method and hypothesis formation, since scientific reasoning of this sort is supposed to be based on observation of data. Verifiability and falsifiability of scientific reasoning is also based on how this form of inference is to be evaluated, and in particular, how it is to be defeated by new data that may indicate revision

*I would like to thank the Social Sciences and Humanities Council of Canada for a research grant that supported the work in this paper, and to thank Henry Prakken and Chris Reed for discussions that led me to write the paper and strongly influenced my way of thinking about the subject.



of a hypothesis is called for. Fourth, this kind of reasoning is very important in legal evidence, of the kind based on witness testimony.

Many, like Pollock (1995) have argued that this kind of reasoning is inductive in nature. The observed facts confirm or disconfirm the agent's rational beliefs, according to this kind of theory. In this paper, an alternative theory is put forward showing that the reasoning in such a case is built on two new and vitally important argumentation schemes. One is the scheme for argument from appearance and the other is a scheme for abductive reasoning. The latter is presented in a format consistent with the analysis of abduction presented by Josephson and Josephson (1994), but the deeper structure of both schemes is revealed by using argumentation tools. In this paper, I analyze a classic example using the argument diagramming method called *Araucaria*, a widely used argumentation tool. This tool is used both to display the structure of the argumentation and to visualize how the argumentation schemes work in the structure. Once the reader comes to understand how these schemes work, and how they can be seen as providing evidence based on observations, she can gain a better understanding of how they are related to abductive reasoning.

Argument from appearance has a long history, going back to the ancient Greek philosophers. The skeptical philosopher Carneades used the classic example of the snake and rope to illustrate his theory of plausible reasoning (often translated as probable reasoning). According to his theory, plausible reasoning is based on appearances, meaning propositions that appear to be true and that have standing as acceptable premises in a rational inference used to draw a conclusion, even though the inference can later turn out to be erroneous. In modern terminology, we would say such an inference is defeasible, or subject to default as new data comes in. This notion of using defeasible reasoning in arguments that have premises based on appearances is evocative of Peirce's remarks comparing abductive inference to perception. In the paper, it is shown how Carneades' notion of plausible reasoning based on appearances is closely related to the views of the modern pragmatist Charles S. Peirce on abductive reasoning.

1. Pollock's Theory of Defeasible Reasoning

Pollock (1995) has constructed an epistemology in which knowledge is built up from beliefs based on defeasible, or what he calls *prima facie* reasons. Knowledge is built up by such reasoning in three stages. First, perception is applied to memory, yielding beliefs and memory is used to record them. Second, induction infers general rules from these beliefs and statistical syllogism derives new beliefs from the original set. Third, the beliefs thus derived persist over time. Defeasibility is an important characteristic of arguments



based on generalizations, and so we need a definition of the notion of one argument defeating another. Pollock (1995) drew a distinction between two kinds of arguments that can defeat another argument: rebutting defeaters and undercutting defeaters. A rebutting defeater gives a reason for denying a claim (Pollock, 1995, 40). Thus a rebutting defeater attacks the claim, or conclusion of the argument it is aimed at. An undercutting defeater, in contrast, attacks the connection between the claim and the reason rather than attacking the claim directly (p. 41).

Pollock’s leading example (1995, p. 41) can be used to illustrate how an undercutting defeater attacks an argument.

For instance, suppose x looks red to me, but I know that x is illuminated by red lights and red lights can make objects look red when they are not. Knowing this defeats the prima facie reason, but it is not a reason for thinking that x is *not* red. After all, red objects look red in red light too. This is an *undercutting defeater* (Pollock’s italics in both instances).

The sequence of argumentation in Pollock’s example can be analyzed below, showing that it is based on generalizations that link observational premises to conclusions in two stages.

First Stage

Fact: This object looks red to me.

Generalization: When an object looks red, then (normally, but subject to exceptions) it is red.

First Conclusion: This object is red.

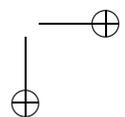
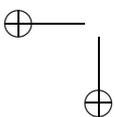
Second Stage

Fact: This object is illuminated by a red light.

Generalization: when an object is illuminated by a red light this can make it look red even though it is not.

Second Conclusion: Withdrawal of the prior conclusion that this object is red.

The counter-argument of the second stage undercuts the original argument





of the first stage because it attacks the connection between the claim and the reason. According to Pollock (p. 41) this argument is an undercutting defeater but not a rebutting defeater, because of the second generalization: red objects look red in red light too. The object may still be red, for all we know, despite the counter-argument above. But we can no longer say that the argument at the first stage supports the conclusion derived at that stage. The new data undercuts the original argument by removing the support of the inferential link between the premises and the conclusion.¹

One of Pollock’s defeasible rules is the basis of the reasoning used in this third stage.

Perception Rule: Having a percept with content φ is a prima facie reason to believe φ .

This rule could potentially be applicable to interesting cases of legal evidence judgments, like witness testimony or tangible evidence presented at a trial. But as Prakken, Reed and Walton (2003, 38) noted, Pollock’s theory of defeasible epistemic reasoning is based exclusively on inference rules of classical deductive logic called “strict reasons” and inductive rules like the statistical syllogism, mostly stated with numerical probabilities. For these reasons, although there could be a variety of kinds of generalizations supporting undercutting defeaters for the argument above, one of these can be formulated as follows (Prakken, Reed and Walton, 2003, 38):

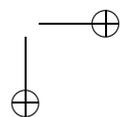
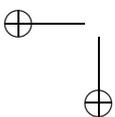
Defeater: ‘The present circumstances are such that having a percept with content φ is not a reliable indicator of φ ’ undercuts the original argument.

This undercutting defeater seems to have a similar role to that of a critical question in argumentation systems that admit types of defeasible arguments as inference warrants other than deductive or inductive rules of inference.

2. Argumentation Schemes

Why are defeasible arguments that draw a conclusion about the contents of an appearance important? And are they all that common? The answer is that they are so common in everyday reasoning that we scarcely notice them at

¹In Pollock’s system, these generalizations would be inductive. However, the word ‘normally’ inserted in them in the analysis above, suggests otherwise, indicating a contextual dependence on plausible expectations that are reasonable, but that cannot be realistically calculated by attaching numbers to the propositions and doing calculations using Bayesian axioms for the probability calculus.



work, and yet we use them all the time. They are fundamental to science, especially at the collection of data and discovery stages of an investigation where hypotheses to account for data are constructed. They also represent one of the most common and important forms of legal evidence. A legal example offered by Prakken (2002, p. 858) showed how common such forms of argument are in legal argumentation.

Fact: This object looks like an affidavit.

Generalization: If something looks like an affidavit, then it is an affidavit.

Conclusion: This object is an affidavit.

This argument, although obviously defeasible, surely represents a common form of legal reasoning. It is based on a presumption that guides an investigation or action forward, unless a defeater appears. For example, on a more detailed reading of the document, evidence might be found indicating it is not a real affidavit. But the argument is only plausible in the right context. Suppose the document in question is in a pile of affidavits that are evidence in a trial, and it is assumed that these documents have been taken from a source that normally contains only affidavits, and not other types of documents. There may not be enough time to check the document carefully to see if it meets all the requirements for being an affidavit, and not that much may rest on whether it is or not in the trial anyhow. Under these conditions of lack of exact knowledge and costs in time for doing additional searching and verifying, it may be best to just go ahead on the reasonable assumption that the document is an affidavit. This reasoning is not based on any probability calculation, but merely on the lack of evidence argument that there is no evidence that the hypothesis is false, and therefore it can be tentatively assumed it is true, because there is a defeasible argument based on appearances and normal conditions supporting the conclusion that it is true.

Prakken's affidavit example concerns the classification of an object as falling under a category represented by a term. This scheme is related to another one that is more general (Walton, 1996, 54), and that also has to do with verbal classification.

Argument from Verbal Classification

If some particular thing a can be classified as falling under verbal category C , then a has property F (in virtue of such a classification).

a can be classified as falling under verbal category C .



a has property F .

The following argument is an example: This thing I see is a bear; a bear is an animal; therefore this thing I see is an animal. In this case, the conditional is an absolutely universal generalization, a form of generalization that is not subject to exceptions. Thus the argument form, in this instance, is deductively valid. However, consider another example: Two percent per year is a poor return as an investment; this bond pays two percent per year; therefore this bond has a poor return as an investment. In this case, the first premise is a generalization, but one that is not absolutely universal. It could admit of exceptions. In other words, it is a defeasible generalization, and the argument based on it is defeasible too. The latter could be stronger or weaker, depending on the strength of the former. Thus argument from verbal classification is best evaluated in light of the critical questions that can be asked of it in a given case.

Critical Questions for Argument from Verbal Classification

CQ1: Does a definitely have F , or is there room for doubt?

CQ2: Can the verbal classification (in the second premise) be said to hold strongly, or is it one of those weak classifications that is subject to doubt?

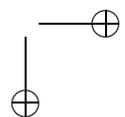
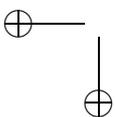
The affidavit example is not an instance of argument from verbal classification. It is an instance of an even simpler form of argument that is often used prior to argument from verbal classification. To represent this kind of reasoning, the following argumentation scheme is proposed.

Argument from Appearance

It appears that object could be classified under verbal category C .

Therefore this object can be classified under verbal category C .

This argument, in light of ancient skeptical objections (considered below), is best seen as defeasible. It is best seen as providing only plausible reasoning, as opposed to deductive or inductive grounds of support of its conclusion. It is best evaluated on a balance of considerations, and subject to doubt, in relation to the following critical questions.



Critical Questions for Argument from Appearance

CQ1: Could the appearance of its looking like it could be classified under *C* be misleading for some reason?

CQ2: Although it may look like it can be classified under *C*, could there be grounds for indicating that it might be more justifiable to classify it under another category *D*?

These two argumentation schemes can be applied to any given case in which an object is classified as falling under a verbal category. Although such arguments are extremely common, we often tend to overlook their structure, or to not even identify them as distinctive arguments, because they seem so natural. Are they inductive, or are they based on some even more natural form of reasoning? A pragmatic approach to answering this question is based on the assumption that an argument as used in a given case needs to be evaluated not just as a set of premises and a single conclusion, but as an inference drawn in a context on a balance of considerations.

In some cases it is fairly clear how an appearance should be described or what inferences should be drawn from it. But in other cases, an inference may be plausible, but is only a surmise, and the conclusion drawn from it is only a presumption. Consider the following case. During a report of a convenience store robbery (*Radio News*, November 9, 2004), the following statement about the robber was made: "The handle of what appeared to be a handgun was visible in his pocket". The convenience store clerk would very likely draw the conclusion that the robber has a handgun in his pocket, or could be presumed to have one there. What would be the rationale of drawing such an inference? One rationale would be argument from appearance. If the item visible in the pocket appeared to be the handle of a handgun, then the conclusion can be drawn that it is, at least plausibly, the handle of a handgun. But if it is the handle of a handgun, why should one draw the conclusion that the robber has a handgun in his pocket? The reason for this presumption is safety. The object in the robber's pocket could be anything, as far as the clerk knows, for she can't see all of it. Even so, it is prudent to act on the assumption that it is a handgun, whether she really believes it is handgun or not. Thus in addition to argument from appearance, drawing the presumptive inference is based on considerations of prudence and safety.

3. Ancient Skepticism and Argument from Appearance

The accepted view that knowledge is of what is true, and is belief based on facts observed and verified beyond doubt, was exposed to withering attack by

the ancient skeptics. These skeptical attacks have historically been acknowledged as the basis of modern epistemology, but the real lessons of them have not yet been fully learned. It is often assumed that these skeptical arguments were merely negative dialectical attacks on the views of previous philosophical schools, and that modern philosophers like Hume and Descartes have successfully refuted them. It has often been overlooked that Carneades, the head of the 3rd Platonic Academy, expressed a positive theory about argument from appearance that could be described as skeptical but not purely negative. This theory arose as a reply to negative skeptical attacks pointing out that appearances can be mistaken due to fallible human perception and judgment. But it also led to a positive criterion for the reasoned acceptance of judgments or actions. According to what we know from *Outlines of Pyrrhonism*, a later work written by Sextus Empiricus, a Greek author of the second century A.D. (trans. Mates, 1996, p. 122), Carneades (c. 213–c. 128 B.C.) offered a theory of plausible reasoning based on so-called *phantasiai* (impressions or appearances). It has traditionally been called his theory of probability, suggesting it is some kind of antiquated theory of the modern notion of statistical probability. But this suggestion is an inadequate and wrong view of it. What Carneades meant by 'probability', or the Greek word he used that was so translated, is a theory of plausibility, or what seems to be true, as a basis for acceptance. In the meaning of the word used by the School of Carneades, according to Sextus (AL 174–175), 'probability' (*pitthanon*) has three senses: (1) that which both is, and appears true, (2) that which is really false, but appears true, and (3) that which is both true and false. This term looks puzzling or even incomprehensible at first to the modern reader, but Carneades' leading example of the snake and rope will show how the theory works, what it was designed to do, and how it led to a set of criteria for rational acceptance.

In the example of the snake and rope (*Against the Logicians*, 188), a man sees a coil of rope in a dimly lit room, and acts on the assumption that it is a snake. Hence he jumps over it. But then he turns back after jumping and sees that it did not move. He now retracts his commitment to the proposition that the object is a snake on the grounds that it failed to move and in place of that previous assumption he accepts the view that the object is probably a rope. But this new view is merely plausible, based on appearances or what seems to be true. To test it he prods the object with a stick. Still it fails to move. This supports acceptance of the hypothesis that the object is a rope, not a snake.² Thus the hypothesis is made plausible by having met three

²This example is a very simple one, and no doubt was chosen by Carneades as a key illustration for this reason. However, there are other possibilities that could also be considered. To extend the discussion, the object in question could be a dead snake, a sedated snake, or a toy snake.

criteria. First, a proposition is plausible if it appears to be true. Second, it is plausible, and still more so, if it appears to be true and is stable, meaning it is consistent with other propositions that are accepted because they appear to be true. Third, it is still more plausible if it is both stable and tested. According to this theory of Carneades, everything we accept, or should accept, based on what appears to be true, is subject to doubt and is plausible only, as opposed to being known (beyond all reasonable doubt) to be true. Still, it is rational to accept some propositions provided they meet one or more of the three criteria. However, according to the theory, acceptance should be tentative. If one has no evidence that a proposition is false, but one has evidence that the proposition is apparently true, or seems to be true based on some convincing stable and testable appearance, then it is wise to tentatively accept it as true, as a basis for taking rational action on how to proceed under uncertainty. There is much to be said about this theory, but the main thing to note here is that it is based on acceptance rather than on notions of knowledge or belief. It can be seen not as a purely negative skeptical view, but as offering a positive theory.

Should analysis of rational argument and evidence be based on acceptance, or on notions of knowledge and belief? There are two opposed philosophical theories. The commitment-based theory (Walton and Krabbe, 1995) can be contrasted with the BDI (belief-desire-intention) theory (Wooldridge, 2002; Paglieri and Castelfranchi, 2005). In the commitment theory, two rational arguers case interact with each other in a dialogue in which each contributes speech acts. In the BDI theory, a set of beliefs is constantly being updated, and related to desires (wants) that form intentions, persistent goals not easily given up. Belief is a more deeply individual and psychological notion whereas commitment is more of a procedural notion based on dialogue in which two arguers (or more) reason with each other. According to Hitchcock (2002), the BDI model was first articulated by Aristotle who wrote (*Nicomachean Ethics* III.31112b15–20) that good deliberation begins with a wish for some end and follows through with a means for attaining it, along with other means that may be needed to carry out the first one. The conclusion in this process, according to Aristotle, is a decision to take action. On a variation of the BDI model (Bratman, Israel and Pollack, 1988), to form an intention to do something is to adopt a plan. Pollock (1995) added that what he called "likings", as well as desires, work in combinations with beliefs and intentions in the plan. Hitchcock (2002) pointed out that Pollock's system is solipsistic, in that it does not allow for back-and-forth discussion between agents, and does not take community values into account.

Carneades' theory was a forerunner of the American pragmatic school of thought represented by Peirce and James (Doty, 1986). Like Peirce and James, Carneades can be seen as having developed a pragmatic theory in opposition to the prevailing view (*endoxon*), widely accepted still, that truth

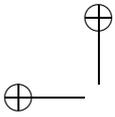
is a property that exists independently of the thinker or perceiver's defeasible acceptance of it. Carneades' theory was pragmatic in that it was based on rational acceptance of a kind meant to be sufficient for the needs of normal human action under uncertainty and lack of knowledge (Bett, 1990, p. 3). Carneades based his theory on the assumption that the criteria offered to judge what is accepted as true or false are fallible and should be seen as falsifiable, or open to refutation by new data, and subject to correction. Looking at Carneades' theory in this way, it can be seen as an early form of pragmatism. On his view, there is no perfectly reliable way to know or believe beyond doubt that a proposition is true in the sense that it accurately reports what it seems to report. Such an opinion can always be mistaken, but if a proposition is based on a presentation that is apparently true, then that proposition should, for practical purposes, be accepted as true, subject to further incoming evidence. So this set of apparently true presentations furnishes us with a basis for accepting propositions as true, providing a theory of rational acceptance. This pragmatic theory applies to practical reasoning of the kind used in everyday deliberations on how to carry out actions based on one's accepted goals and the means available to achieve them. The pragmatic agent is not dogmatic, but is ready to change his accepted opinions in deliberations, if the situation changes, as shown by new evidence. The characteristic of openness to defeat (defeasibility) can be viewed as an epistemic characteristic if one can see knowledge as being increased during an investigation. There needs to be a closure (concluding) stage at the end of the investigation. Closure is viewed as an epistemic property of how an investigation proceeds in a knowledge base to which propositions are inserted and deleted as questions are asked and replied to. On this view, epistemic openness is defined as meaning that new knowledge can come into the knowledge base, requiring retraction of a hypothesis that was formerly accepted as plausible.

4. *Analysis of the Snake and Rope Example*

We begin the analysis of the snake and rope example by identifying the main propositions that are part of the sequence of reasoning, and compiling them in a key list.

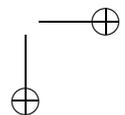
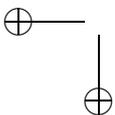
Key List for the Rope and Snake Example

- (A) A man sees an object.
- (B) It looks like a rope.
- (C) He infers the conclusion that the object is a rope.



- (D) The rope is in a dimly lit room (uncertain knowledge).
- (E) What he sees could be a snake or a rope.³
- (F) A snake bite can be deadly (safety factor).
- (G) A rope is harmless.
- (H) The man acts on the hypothesis that it is a snake.
- (I) Hence the man jumps over the object.
- (J) Then he turns back after jumping and sees that it did not move.
- (K) Rationale: a hypothesis is plausible, and still more so, if it appears to be true and is stable, meaning it is consistent with other propositions that are accepted because they appear to be true.
- (L) The man now retracts his commitment to the proposition that the object is a snake.
- (M) Reason: it failed to move.
- (N) The man now accepts the new hypothesis that the object is probably a rope.
- (O) To test this hypothesis he prods the object with a stick.
- (P) When prodded the object fails to move.
- (Q) This test supports acceptance of the hypothesis that the object is a rope, not a snake.
- (R) Rationale: a hypothesis is still more plausible if it is both stable and tested.
- (S) The man concludes as the most plausible hypothesis that the object is a rope.

³As noted above, other alternatives could be considered. It could be a drugged snake, for example.



These propositions form a key list of the premises of the conclusions in the sequence of argumentation in the snake and rope example. But what kind of reasoning connects them together into an orderly sequence that leads to the final conclusion and provides evidence that supports it?

We begin the analysis with the first step of inference from premises A and B to conclusion C. On Carneades' analysis, the warranting generalization is the general rule B. On Pollock's analysis, it would be his defeasible rule of perception. On this analysis the inference could be cast into the following form.

The man has a percept with the content that it is a pile of rope.

Having a percept with content φ is a prima facie reason to believe φ .

The man reasonably believes that what he sees is a pile of rope.

Carneades analyses the inference as an instance of his first rule of plausible reasoning⁴, used to support an agent's acceptance of a plausible hypothesis. Pollock analyses the inference as an instance of his rule of perception, used to draw a conclusion about an agent's reasonable belief. Whichever rule you use, the structure of the inference is pretty much the same. An appearance that something seems to fit a certain category of object is used to support a defeasible inference leading to a conclusion that the object does fit this category.

According to an analysis using the argumentation scheme for argument appearance (above), this first part of the snake and rope example can be diagrammed as below using *Araucaria*, an automated system of argument diagramming based on an Argumentation Markup Language (Reed and Rowe, 2003).⁵ The user inserts the text of discourse containing an argument as a text file into *Araucaria*, and he/she can then use the software to draw in lines representing each of the inferences from the premises to the conclusions in the argumentation. *Araucaria* is very helpful in representing the structure of the argumentation in a visual way that displays not only its premises and conclusions, but also the argumentation schemes on which the inferences are based.

According to this way of diagramming the argument, the conclusion C appears at the top, and the two premises A and B form a linked argument

⁴His first rule is that a proposition is plausible if it appears to be true.

⁵The *Araucaria* software can be downloaded at no cost from the following location on the internet: <http://araucaria.computing.dundee.ac.uk/>

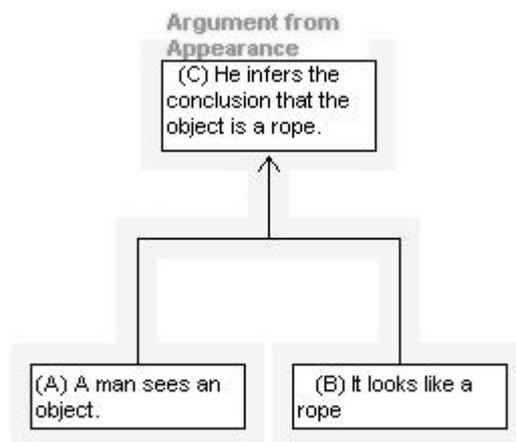


Figure 1: Araucaria Diagram of the First Step

supporting C. The argumentation scheme is shown on the linked argument leading to C.

What takes us to the next stage of the argumentation analysis is the observation that the argument so far, based on the scheme for argument from appearance, is defeasible. It is open to critical questioning. The second critical question, as displayed on the screen shot from *Araucaria* below, is whether the appearance could be classified under some other category.

Conclusion C has now been accepted provisionally. But the inference that led to its acceptance is open to doubt. This leads us to a consideration of the next step.

5. The Second Stage of the Analysis

The second step of the sequence of argumentation sets the stage for a retraction of the conclusion C and replacing it with conclusion H. The hypotheses C and H are inconsistent with each other, meaning that it is not possible for both to be true. So a rational agent has to accept one or the other. Or at least, he cannot accept both in the same commitment set. If he accepts one, he must reject the other. The inference to H is based on premises D, E, F and G. It is a kind of disjunctive reasoning that involves a choice between two competing hypotheses. First, premise D postulates lack of knowledge (or uncertain knowledge) that sets up the opening for defeasibility, indicating that another hypothesis could also be possible. E sets up the disjunction, by naming this second hypothesis. F and G set up conditions of burden of proof

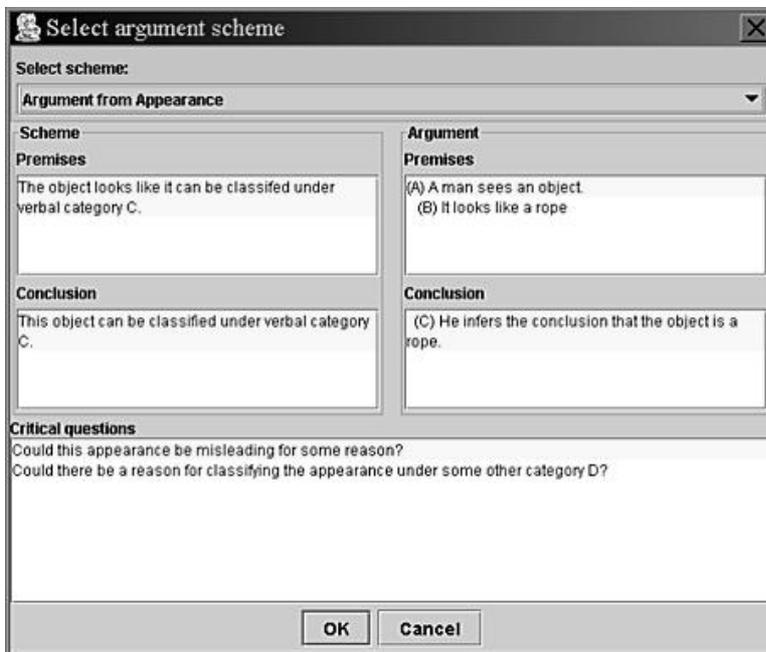


Figure 2: Screen Shot of the Scheme Selection Menu

as part of the context of the collection of data as the investigation moves forward. A snake could be deadly, whereas a rope is harmless. These two propositions, F and G, set the burden of proof in which the deliberation on how to proceed is structured. The consequences of acting on the hypothesis that the object is a snake, even if you turn out to be wrong, are relatively benign, whereas the consequences of acting on the hypothesis that the object is rope, if you turn out to be wrong, could turn out to be deadly. If it is a snake, you need to take care not to go too close to it. Thus the burden of proof is sharply tilted to one side, and that ought to partly guide your deliberations on how to proceed. Hence the conclusion H is inferred. The proposition that object is a snake, rather than a rope, is the best conclusion to tentatively accept, as the investigation moves forward through its next stages of acting and collecting of data.

The general principle at work in this chain of reasoning could be called the equiplausibility principle. This principle rules that given two hypotheses in a case where neither one is more plausible than the other, if acting on the first is known to be dangerous and acting on the second is thought to be harmless, other things being equal, act on the second hypothesis. Figure 3 shows how

the chain of reasoning above is based on the equiplausibility principle, which warrants the disjunctive inference.

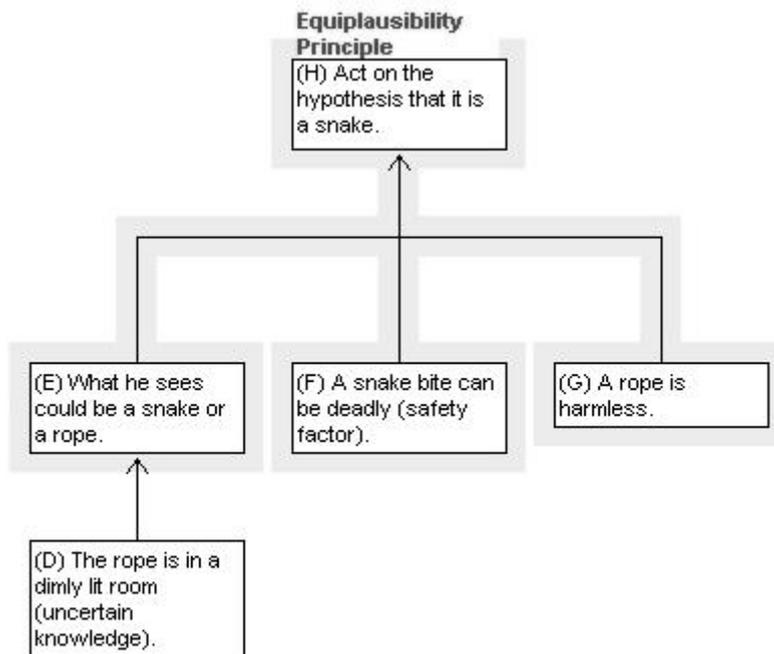


Figure 3: The Equiplausibility Principle as Warrant of Inference

The equiplausibility principle tilts the burden of proof to one side of the disjunction and against the other, on the grounds that safety ought to partly guide deliberations on how to select a hypothesis that will lead to a course of action that will have consequences. Hence the conclusion H is inferred as the better hypothesis to go ahead with.

This second step in the sequence of argumentation is harder to represent in the analyses of either Carneades or Pollock, according to the kinds of defeasible reasoning cited in their accounts. How could it be represented? It seems to be a kind of disjunctive reasoning that leads to acceptance of a course of action in a deliberation that is also an investigation moving forward in which data is being collected and used to draw conclusions. Once a conclusion has been accepted, it can be part of the next sequence of reasoning. It can even be retracted, by defeasibility, and then lead to a different hypothesis being accepted, one that is inconsistent with the original hypothesis. The best way to represent the part of the sequence is to see it as an instance of abductive reasoning, or inference to the best explanation.

There are two argumentation schemes representing abductive reasoning (Walton, 2004, 288). One is a defeasible *modus ponens* form of inference. It is forward moving. The other is based on a dialogue model of explanation, and represents a typical abductive inference of the backward type, going from data to a best explanation. Explanation (Walton, 2004, chapter 2) is defined as a speech act in which understanding is transferred from a questioner to a respondent by means of the respondent's offering an account that answers the question put by the questioner. An account is a set of particular and general statements that can be colligated together, but some fit the data better than others.⁶ A_i is one particular account selected from among a given set of accounts, A_1, A_2, \dots, A_n . Each account given may be successful in explaining the data D , but some are more successful (better) than others.

Backward Argumentation Scheme for Abductive Inference

D is a set of data or supposed facts in a case.

Each one of a set of accounts A_1, A_2, \dots, A_n is successful in explaining D .

A_i is the account that explains D most successfully.⁷

Therefore A_i is the most plausible hypothesis in the case.

Corresponding to a backward abductive inference there is also a forward abductive inference, represented by an argument diagram made up of a sequence of defeasible *modus ponens* inferences.

Forward Argumentation Scheme for Abductive Inference

D is a set of data or supposed facts in a case.

There is a set of argument diagrams G_1, G_2, \dots, G_n , and in each argument

⁶The process whereby a set of accounts is colligated to fit data is given in analyses of abductive reasoning (Josephson and Josephson, 1994; Walton, 2004). This process is called marshaling of evidence by Schum (1994).

⁷This last premise of the backward scheme for abductive inference rests on a theory of explanation that would offer direction on how to judge the extent to which an account is successful as an explanation. Useful guidance can be found in (Josephson and Josephson, 1994) and (Walton, 2004).

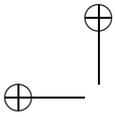


diagram D represents premises of an argument that, supplemented with plausible conditionals and other statements that function as missing parts of enthymemes, leads to a respective conclusion C_1, C_2, \dots, C_n .

The most plausible (strongest) argument is represented by G_i .

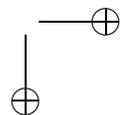
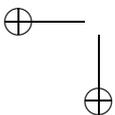
Therefore C_i is the most plausible conclusion in the case.

The backward and forward schemes represent two different uses of abductive inference that can be applied to the same case. The backward scheme represents inference from the observed data, or given facts in a case, to a hypothesis claimed to be the best explanation of those facts. The forward scheme represents abductive inference as having a defeasible *modus ponens* form, and as being an argument from a set of premises, some of which are conditionals, to a plausible conclusion. In the snake and the rope example, the person in the dimly lit room reasons backwards from the given data to the conclusion, revising his conclusion at each stage, as new evidence comes in. But as shown above by the *Araucaria* diagrams, the chain of reasoning goes forward from the premises to interim conclusions, and hence to the ultimate conclusion.

First, based on argument from appearance, the object seems to be a rope. But applying the backward scheme for abductive inference, there are two competing explanations of the observed appearance. The object could also be a snake. In a dimly lit room, these two objects are hard to distinguish. Which is the better explanation? Here, pragmatic factors play a part in the reasoning. It is easy to jump over the object. There is little cost in effort to that, and the consequences could be better. For if the object is a snake, it might bite, and that might be deadly. Thus as a basis for taking prudent action, the best conclusion is to adopt the course of action of jumping over the object. Burden of proof plays an important role in the argumentation, because safety is a factor. If there is doubt whether the object is a rope or a snake, it is best to assume that it could be snake, and then take actions that could lead to more evidence.

The action taken provides a test. If you were to jump over a snake, it is likely that it might move. Thus the man collects more data by observing the object as and after he jumps over it. He observes that it did not move. The best explanation of these new observed facts is the hypothesis that the object is probably (or plausibly) not a snake, and therefore is a rope. The man uses backward abductive inference to draw this conclusion, as pictured in the *Araucaria* diagram in figure 4. This test provides new evidence for the hypothesis that the object is a rope, not a snake.

This hypothesis is open to testing by taking an action that has observable consequences. It could be called an experiment. The man prods the object



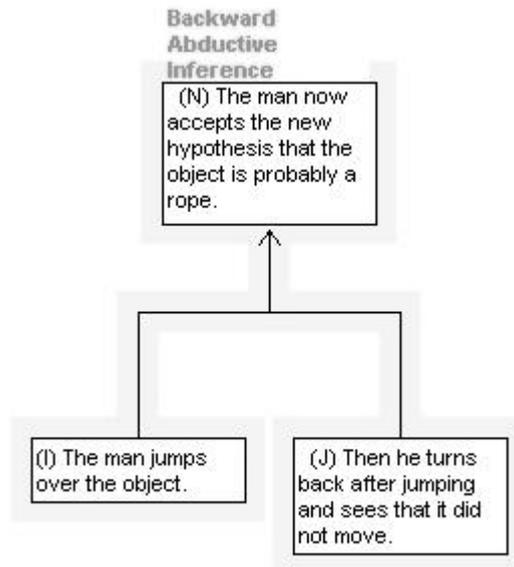


Figure 4: Abductive Inference in the Snake and Rope Example

with a stick. He observes that it still fails to move. This new data introduces further evidence supporting the rope hypothesis as best explanation against the snake hypothesis. Thus the sequence here is one of inferring a conclusion (The object is a rope) as a best explanation of the data. The agent then tests this hypothesis by performing actions that can have observable consequences. He prods the object with a stick. As the results come in, providing new evidence, the hypothesis is confirmed. The rope hypothesis becomes much more plausible while the snake hypothesis becomes much less plausible.

6. Pragmatism and Plausible Reasoning

Carneades' theory provides the best definition of the basic notion of plausibility. Something is plausible if it seems, or appears to be true, or if it fits in with other things we accept as true, or if it is tested, and passes the test. According to this approach, if something is plausible to someone, it does not follow that this person knows it to be true, or even necessarily believes it to be true. Plausibility is not based on inductive inference from knowledge or belief (Josephson and Josephson, 1994). It is a guide to rational acceptance or commitment, with a view to action. Bett (1990, p. 4), using evidence

from Cicero, argued that Carneades distinguished between two kinds of assent. There is a strong kind of assent, based on knowledge or belief. But the alternative to this is not indifference or skepticism. There is also a kind of attitude called commitment or acceptance that enables the skeptic to go ahead with the ordinary tasks of life. Carneades was reacting against Stoic and other ancient views that claimed rational thinking to be exclusively based on knowledge and belief. He argued that plausibility offers an alternative to these views that is compatible with skepticism. You might think that the notion of plausibility was only a kind of answer to Greek skepticism, and that it was an obscure ancient notion that did not carry over into later philosophy. That hypothesis is not entirely true, however. It can be argued that some modern philosophers have also adopted and advocated the notion of plausibility as important in rational thinking.

Doty (1986) argued that the Carneadean notion of plausibility is manifested in the tests of truth and rational inference advocated by the modern pragmatist William James. Even more interesting for our purposes here, however, is the relationship between Carneades' theory of plausible acceptance and the theory of abductive reasoning presented by C.S. Peirce. The two theories do seem to have certain key elements in common. According to Carneades, plausible reasoning is based on appearances, meaning propositions that appear to be true. In his account, these apparently true statements can have some standing as premises used to draw conclusions, even though they could turn out to be false. The reason, of course, is that appearances can sometimes be misleading. This notion of premises based on appearances is quite evocative of Peirce's remarks comparing abductive inference to perception. According to Peirce (1965V, p. 97) perceptual judgments can be general. For example, one event can appear to be subsequent to another. It is clear, then, that for Peirce, generalizations of the kind that support abductive reasoning can be based on appearances or perceptions. At the end of his discussion of abduction, Peirce (1965V, p. 119) wrote, "according to my account of abduction, every hypothesis, however fantastic, must have presented itself entire in perception". Although Peirce's account of abduction becomes quite general and not very clear towards the end, he felt that it was important to see abductive inference as based on perception and that it was somehow deeply perceptual in nature. This view of abduction does seem to tie in quite well with Carneades' account of plausible reasoning as based on appearances, or what seems to be true. Both depend on argument from appearance as a form of rational thinking.

The above account of argument from appearance as a form of plausible inference is clear enough perhaps. But it is often very hard to get modern readers to come to accept plausible inference as having any hold on rational assent at all. We are so accustomed to basing our notion of rationality on knowledge and belief that we tend to automatically dismiss plausibility

as "subjective", and therefore of no worth as evidence of the kind required to rationally support a conclusion. This viewpoint is exhibited in Pollock's analysis of reasoning based on perception, thinking of rationality as change of belief or knowledge guided only by deductive reasoning and inductive probability. This approach finds the notion of plausibility alien or even unintelligible, as an aspect of rational thinking. Pollock's view takes defeasible reasoning seriously, but stops short of the next step of acknowledging plausible reasoning. To replace this narrow view of reasoning, we need to move to a pragmatic view that has plausible reasoning as its central tool. The center of such a pragmatic view is the notion of acceptance based on the theory of plausible reasoning provided by Carneades. The other tools needed are the argumentation schemes: argument from appearance, argument from a verbal classification and abductive reasoning, both of the backward and forward varieties.

In this pragmatic view, a rational argument needs to be seen as not just a set of premises and a conclusion that are known or believed to be true, but as the acceptance or rejection of such a set during an investigation in which questions are asked and answered at different stages. Such arguments can be seen as having uses prior to the inductive stage of collecting and assessing statistical data, or to the deductive stage of deducing consequences from a hypothesis. At a prior discovery stage, hypotheses are formed, based on what initially appears to be the case as a plausible explanation of given facts. According to this pragmatic approach, an argument is seen as not just a set of premises and conclusions but also as a sequence of dialogue moves made by a proponent and a respondent who take turns. An investigation or inquiry can be seen as a special type of dialogue framework in which evidence is collected based on data that are carefully verified by standards of proof.

Any such dialogue should be seen as having four characteristic stages.⁸ The sequence of argumentation in the argumentation stage should be seen as moving towards the closing stage. A dialogue, generally speaking, can be open or closed. A defeasible argument that has not yet been defeated, while the dialogue is still open, even if it is a strong argument that should be accepted, only requires commitment to the conclusion as still tentative and subject to possible retraction as the dialogue proceeds further. Thus defeasible arguments can fail. Still they can be provisionally reasonable to accept in cases of uncertainty and lack of knowledge where some decision for action, or to advance an investigation, needs to be taken. They are fallible. They could be described as necessary but dangerous. They can even be associated with fallacies. We should be wary about them, and they should give way to deductive or inductive arguments when harder evidence comes

⁸ Van Eemeren and Grootendorst (1992, pp. 34–37).

in. They are most useful at the discovery stages of an investigation. As the investigation proceeds, they should be supplanted by deductive or inductive arguments that test a hypothesis, once that hypothesis has been chosen for testing and carefully formulated.

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