

## Plausible Argumentation in Eikotic Arguments: The Ancient Weak versus Strong Man Example

Abstract

Douglas Walton, CRRAR, University of Windsor

In this paper it is shown how plausible reasoning of the kind illustrated in the ancient Greek example of the weak and strong man can be analyzed and evaluated using a procedure in which the pro evidence is weighed against the con evidence using formal, computational argumentation tools. It is shown by means of this famous example how plausible reasoning is based on an audience's recognition of situations of a type they are familiar with as normal and comprehensible in their shared common knowledge. The paper extends previous work on this example by using three new multiagent argumentation schemes closely related to the scheme for argument from negative consequences.

**Key Words:** enthymemes; argumentation schemes; legal argumentation; artificial intelligence; ancient philosophy; reverse eikotic arguments

### 1. Introduction

In Western culture, plausible reasoning (and more generally, argumentation) came from the Sophists, who used it to plead cases based on argumentation from *eikos*, from what “seems likely”.<sup>1</sup> The Sophists were noted for using examples of eikotic arguments on two sides of a disputed case (pro-con argumentation) to teach their students argumentation skills (Gagarin, 1994; Kraus, 2007). Indeed, the *dissoi logoi* (conflicting arguments) is an ancient Greek rhetorical exercise (unknown authorship) designed to help a student gain deeper understanding of an issue by eliciting and examining the arguments on both sides (Schiappa, 2005, 146-148). A typical example where arguments on both sides of an issue are put forward, examined and evaluated in order to try to resolve the conflict would be a legal trial. For example, one side might put forward *pro* (supporting) arguments for the acceptability of the claim that the other side committed fraud while the other side uses *con* arguments that go against the acceptability of this claim. An eikotic argument is a plausible argument that is tentatively acceptable on balance, and that shifts a burden of proof against anyone who would dispute it because it has a *prima facie* weight of acceptance in its favor unless a con argument against it can be given (Rescher, 1976).

In this paper it will be shown how the best-known example of a reverse eikotic argument, the weak and strong man example, attributed to Corax<sup>2</sup> by Aristotle in the *Rhetoric* (1401b17), can be analyzed and evaluated using argumentation methods that take into account implicit premises based on a person's recognition of a situation of a type he or she is familiar with as normal and comprehensible in light of common experience. A reverse eikotic argument (Gagarin, 1990) is one that pits one eikotic argument against another, apparently resulting in a deadlock where neither party can win, unless they move ahead with further pro-con argumentation. This paper extends the research in Tindale (2010, 69-82) on the use of plausible arguments by the Sophists and the research of Walton, Tindale and Gordon (2014) on applying argumentation methods and models to classic ancient Greek examples of plausible reasoning.

---

<sup>1</sup> Plausible reasoning was attacked by Plato, as part of his general denunciation of the Sophists. This attack created a strong prejudice against plausible reasoning throughout the history of philosophy (Kraus, 2007, 3-4).

<sup>2</sup> See (Cole, 1991) for a discussion of the controversy on whether it should be attributed to Corax or Tisias, or even whether they may be the same person.

Section 2 defines the notion of a reverse eikotic argument more precisely by giving criteria that enable one to distinguish between a reverse eikotic argument and a straight eikotic argument. The best introductory example of a reverse eikotic argument (Kraus, 2007, 2) is the example of the weak and the strong man given in Aristotle's *Rhetoric*. This section shows how Perelman and Olbrechts-Tyteca cast suspicion on this argument by showing how it could lead to an infinite argumentation expansion. Section 3 defines the notion of plausible reasoning more precisely by presenting eleven identifiable characteristics of it. This section briefly surveys the state of the art on theories of plausible reasoning in the field of argumentation studies and introduces an artificial intelligence system that provides means of analyzing pro-con arguments using argument diagrams taking the mathematical form of a graph, a set of points and pairs of points going from some points to others (Harary, 1972; Poole and Macworth, 2011).

Section 4 shows that one needs to take great care with defining plausible reasoning as equivalent to endoxic reasoning because term *endoxon* is ambiguous in Aristotle's writings. To help deepen the notion of endoxical argumentation needed in this paper, section 4 relates *endoxa* to the expression 'common knowledge', which is given a technical meaning based on the notion of commonsense reasoning in artificial intelligence (Minsky, 1974; Schank and Abelson, 1977; Hosseini et al., 2014). On this meaning, what is called common knowledge is used as a device to reconstruct argumentation by finding an implicit assumption in an enthymeme, where this term is taken to have the standardized meaning in logic of an argument with one or more implicit premises or an implicit conclusion.

Section 5 introduces some additional tools, some new argumentation schemes that are variants on the scheme for arguments from negative consequences. Section 6 introduces some systems from logic and artificial intelligence that offer additional tools for comparatively weighing the comparative plausibility of arguments. Sections 7, 8 and 9 present three interpretations of the classic example of the weak and strong man example. This part of the paper analyzes and evaluates each of the three interpretations as reasonable eikotic arguments by using eight sequentially connected argument diagrams, each visually displayed in the characteristic style of the Carneades Argumentation System. It is shown by the weak and strong man example how the sequence of argumentation in it can be evaluated by propagating acceptance of premises and conclusions through a graph. Section 10 presents the conclusions and offers a way of showing how the infinite argumentation expansion implicit in the weak and strong man example can be turned into a device for supporting Aristotle's hypothesis that a reverse eikotic argument tends to be weaker than the straight eikotic argument it was designed to attack

## 2. Eikotic Arguments

Eikotic arguments are not conclusive. A proposition that appears true to one observer may appear to be false to another. Thus it is possible to have two arguments from the same evidence, each of which is plausible in its own right, but lead to opposite conclusions. Two Sophists, Corax and Tisias, who lived around the middle of the fifth century BC provided the classic example in the ancient world (Gagarin, 1994, 50). This reverse eikotic argument, as it was called by Gagarin (1990), was attributed to Corax by Aristotle (*Rhetoric* 1401b17).

In the example, there was a fight between two men, and each accused the other of assaulting him. One of the men was visibly smaller and weaker than the other man. He argued that it was not plausible that he would instigate the fight by assaulting the stronger man, knowing that he would have little chance of victory. But the strong man argued that it was not plausible that he

would attack a weakling, knowing that such an action would look bad for him in court. Here is the example as presented by Aristotle (*Rhetoric* II 1402a17 - 1402a20):

The *Art* of Corax is composed of this topic. For if a man is not likely to be guilty of what he is accused of, for instance if, being weak, he is accused of assault and battery, his defence will be that the crime is not probable [*eikos*]; but if he is likely to be guilty, for instance, if he is strong, it may be argued again that the crime is not probable [*eikos*], for the very reason that it was bound to appear probable [*eikos*]. (Aristotle 1926, 335; modified translation of Kraus, 2010, 362).

This example is “the best introductory illustration of what early Greek *eikos*-arguments basically are about and how they work in practice” (Kraus, 2007, 2). It is the classic case of a reverse eikotic argument of the kind used by the Sophists. So to have a reverse eikotic argument you first have to have another eikotic argument that responds to the first one by attacking it. In this instance, the straight eikotic argument is the argument of the weak man that it is not plausible that he would do such a thing, because he is visibly weaker. The reverse eikotic argument is the argument of the strong man that it is not plausible that he would do such a thing, because people would think it plausible that he would do it. As will be shown in section 7, there can be different ways of modeling the notion of one argument attacking another.<sup>3</sup> But the way we will model the relation between the pair of arguments is to take the conclusion of the second one as the denial of the conclusion of the first one.

Reverse eikotic arguments should not be confused with the sophistic technique of arguing for both sides of a case (pro and con). The former are a subspecies of the latter type of argument. While the latter was a fairly common practice among sophists and rhetoricians, the very peculiar type of reverse eikotic argument was not necessarily employed in such arguments. The *dissoi logoi*, for instance, showcased arguments for both sides of a given issue, yet without using any reverse eikotic arguments. Such pro-con arguments are common, even typical, in legal argumentation in trials. However, reverse eikotic are more rare and specialized. When they do appear, they look clever and tricky. They are sometimes thought to be associated with clever rhetorical deception (Tindale, 2010).

Perelman and Olbrechts-Tyteca (1969) showed how the strong and the weak man argument can lead to pendulum-like back and forth sequence of argumentation that could potentially go on forever. You can see how the sequence proceeds by looking at the first three stages in it (Hoffman, 2003, 505; Kraus, 2011, 368). First there is the straight eikotic argument. Second, there is a reverse eikotic argument that attacks it. Third, there is a reverse reverse eikotic argument that attacks the reverse eikotic argument. From these distinctions it can be appreciated how this reversal procedure could go on endlessly in what Perelman and Olbrechts-Tyteca (1969, 459) call a *mise en abyme*. *Mise en abyme* is a term used in Western art history for the technique of placing a copy of an image within the image itself, notably in a way that suggests an infinitely recurring sequence. These observations raise worries about an infinite argumentation expansion.

This clever analysis of the argumentation in the example is a little hard to figure out at first, but can be explained as follows, using the example of the reverse eikotic argument put forward on the side of the strong man. Where *S* represents the strong man, we can formulate the first three steps of the sequence as follows.

---

<sup>3</sup> Two kinds of argument attack (defeaters) are recognized in the literature that will be distinguished in section 7. A *rebutting defeater* (also often called a conclusion attack) attacks the conclusion of the target argument. An *undercutting defeater* attacks the inferential link joining the premises to the conclusion by citing circumstances in which the inferential link fails to hold, even though it may hold generally.

1. *The Straight Eikotic Argument*: *S* is guilty, because *S* is visibly stronger.
2. *The Reverse Eikotic Argument*: *S* is not guilty, since he would foresee that he would be held guilty by everyone because he is visibly stronger.
3. *The Reverse-Reverse Eikotic Argument*: *S* is guilty, since he would have foreseen that he would be acquitted, because people would have assumed that he foresaw that he would be held guilty.

Theoretically at least, this sequence could go on and on, like a pendulum shifting back and forth as the burden of proof shifts from the one side to the other at each step. One problem is that if this sequence continues infinitely there is no way to determine which party had the burden of proof at the end of the sequence so it can be judged on a burden of proof basis which party won the argumentative exchange.

This account suggests that there is something suspicious or dangerous about eikotic arguments, but Aristotle treats them as a species of argument from plausibility (*eikos*), which he describes elsewhere in book I of his *Rhetoric* (1357a34-b1) and in *Prior Analytics* II 27 (70a2-6) as a deduction from a plausible premise (*endoxon*). Aristotle tells us that in the case of the weak and strong man example both of the two arguments seem plausible but only the straight eikotic argument is absolutely plausible while the reverse eikotic argument is only plausible under special conditions (*Rhetoric* 1402a24-25). He also comments “this sort of argument illustrates what is meant by making the worse argument seem the better” (*Rhetoric* 1402a24), suggesting that this sort of argument may be connected with sophistical argumentation of a deceptive kind. These points will be taken up again in section 10.

In modern logic it is commonly accepted to call an enthymeme an argument that has one or more implicit premises, or in some instances an implicit conclusion. However, this terminology can become highly confusing because there were different concepts and definitions of the enthymeme in antiquity, and it is commonly agreed by scholars of ancient philosophy that Aristotle’s definition of an enthymeme as an instance of plausible reasoning from probabilities or signs originally had nothing directly to do with suppressed premises. The history of the subject is replete with all kinds of ambiguities and confusions. It was recognized in the nineteenth century that in its original Aristotelian meaning, an enthymeme was an argument based on “signs and likelihoods” that is not deductively valid, and that is warranted by a generalization that something generally appears to be true, subject to exceptions (Hamilton, 1874, 389). Joseph (1916, 350) also held that an Aristotelian enthymeme is an eikotic inference based on a defeasible generalization that holds only for the most part but is subject to exceptions. More recently Burnyeat (1994) has held a similar view, citing numerous examples of such enthymemes exhibiting an informal non-deductive kind of reasoning. Tindale (1999, p. 11) noted that many of the enthymemes in Book II chapter 23 of Aristotle’s *Rhetoric* are comparable to the defeasible forms of argument now known as argumentation schemes (Macagno, Walton and Reed, 2017). In recent argumentation theory (informal logic), it has been proposed that these forms of reasoning should be treated as defeasible argumentation schemes (Macagno et al., 2017).

In this paper we will analyze the plausible sequence of argumentation in the ancient weak versus strong man example using argument diagrams that have a graph structure. In order to apply such a structure to this example and to virtually any example of argumentation in natural language discourse, it is important to mark implicit premises and conclusions on the argument diagram. So we have to have some sort of name for this in a single word, and the best way to

proceed is to accept the modern logical meaning of the term ‘enthymeme’ as referring to an argument with implicit premises or conclusions that need to be filled in in order to properly analyze and evaluate the argument. It is hard to overcome such terminological confusions.

Now, forget about the modern meaning of the term enthymeme for a moment, and let’s go back to the Aristotelian view of it. Aristotle treated the arguments in the weak and strong man example as an ‘apparent enthymeme’ related to the type of enthymeme from plausibility (*eikos*), which he describes elsewhere in book I of his *Rhetoric* (1357a34-b1) and in *Prior Analytics* (II 27 70a2-6) as a deduction from a plausible premise (*endoxon*). On the Aristotelian view, when the plausibility of a premise is not absolute, but only holds in particular respects, the enthymeme turns into an apparent enthymeme. On this analysis of the weak and strong man example, only the argument of the weak man is plausible absolutely (an enthymeme), while the argument of the strong man holds only in particular respects (an apparent enthymeme). But Aristotle stops short of calling the latter a fallacious argument. He discriminated between apparent enthymemes, which are inconclusive, and sophisticated fallacies, which are willfully deceptive (Wolf, 2010).

All in all then, the example of the weak and strong man is an intricate argument that deserves a careful analysis using current argumentation tools in order to help us work towards a clearer and deeper appreciation of how it works.

### 3. Current Theories of Plausible Reasoning

Plausible (*eikotic*) reasoning was not just confined to the ancient philosophers. Walton, Tindale and Gordon (2014) showed that there has been a continuous thread of recognition of plausible reasoning running from ancient philosophy through Locke and Bentham that survived the rise of Pascalian probability in the Enlightenment. Walton, Tindale and Gordon (2014, 114) set out eleven defining characteristics of plausible reasoning of this sort (paraphrased below).

1. Plausible reasoning goes from more plausible premises to a less plausible conclusion.
2. Something is found plausible when hearers have examples in their own minds.
3. Plausible reasoning is based on common knowledge.
4. Plausible reasoning is defeasible.
5. Plausible reasoning is based on the way things generally go in familiar situations.
6. Plausible reasoning can be used to fill in implicit premises in incomplete arguments.
7. Plausible reasoning is commonly based on appearances from perception.
8. Stability is an important characteristic of plausible reasoning.
9. Plausible reasoning can be tested, and by this means, confirmed or refuted.
10. Probing into plausible reasoning by questioning it is a way of testing it.
11. Plausible reasoning admits of degrees of strength.

Walton, Tindale and Gordon (2014) applied the Carneades Argumentation System to another classic case of plausible reasoning in the ancient world, the case of the rope and the snake. In this famous example of plausible reasoning, a man sees what looks like a coil of rope in a dark room, but thinking it might be a snake, jumps over it. Afterwards he looks back and sees that the object did not move, so this corroborates his hypothesis that it was not a snake. However, knowing that snakes can be numbed by the cold in the winter and can remain motionless, he prods the object with a stick. He takes this test to further corroborate the hypothesis that the object is not a snake (Walton, Tindale and Gordon, 2014, 98). This example has to do with cumulative reasoning where a hypothesis is initially supported by some evidence, but then new evidence comes in further corroborating the hypothesis or taking away some support from it.

The example of the weak and strong man is comparable to the example of the rope and the snake in that both are instances of plausible reasoning. However, the two examples also have different features. The example of the weak and strong man rests on implicit premises about the way things normally work in a situation familiar both to the proponent who put forward the argument and the audience to whom the argument is directed. The arguer and the audience share common knowledge and it is because both have this common knowledge in their minds that the example of the weak and strong man is a plausible pair of arguments.

According to Rescher (1976, 2), the task of his theory of plausible reasoning is to deal with the perplexity arising from the inconsistency posed by conflicting information. Deductive logic provides no help because although it can identify inconsistencies, it does not tell us what needs to be given up in order to resolve the inconsistency and move forward. Standard probabilities also do not provide help because they are only defined relative to a consistent database. Rescher's theory of plausible reasoning is designed to deal with information provided by sources. He tells us (1976, 6) that the term 'source of information' needs to be understood in a very wide sense, including persons who make claims, such as experts or eyewitnesses, historical sources including newspaper accounts and common knowledge, data based on perception and memory, intellectual resources such as conjecture and hypothesis, and principles such as simplicity or uniformity. Such a theory should naturally apply to evidential reasoning of the kind commonly found in law, based on sources of information such as witness testimony and expert opinion evidence.

The assignments of such plausibility ratings would understandably have to be based on the legal system in a culture in the specific circumstances of the given case. Ancient Athenian law courts used very large juries, upwards of 200 chosen randomly by lots. If there is relevant information about these matters, that kind of additional common knowledge would have to be factored in. For example, in circumstances where the punishment for violent assault is immediate execution, the example would have to be evaluated differently. Such plausibility arguments are defeasible, meaning that they can be overturned by new evidence that comes into a case. Such arguments are inherently presumptive in nature, according to Rescher's system. In this particular case the only factual evidence given is that W was visibly weaker and S was visibly stronger.

The Carneades Argumentation System, named after the ancient philosopher Carneades, is a formal and computational argumentation system<sup>4</sup> that displays the pro and con arguments in an argument diagram in a given case. Carneades uses standards of proof as part of its argument evaluation system (Gordon and Walton, 2009). The standard of proof can be set by the user in order to assist with the evaluation of a given argument modeled as a graph showing an argument diagram. Below, four examples are given of standards of proof used by Carneades.

- Scintilla of Evidence
  - There is at least one applicable argument.
- Preponderance of Evidence
  - The scintilla of evidence standard is satisfied, and
  - the maximum weight assigned to an applicable pro argument is greater than the maximum weight of an applicable con argument.
- Clear and Convincing Evidence
  - The preponderance of evidence standard is satisfied,
  - the maximum weight of applicable pro arguments exceeds some threshold  $\alpha$ , and

---

<sup>4</sup> Carneades is open source software, available at <http://carneades.github.com/>.

- the difference between the maximum weight of the applicable pro arguments and the maximum weight of the applicable con arguments exceeds some threshold  $\beta$ .
- Beyond Reasonable Doubt
  - The clear and convincing evidence standard is satisfied, and
  - the maximum weight of the applicable con arguments is less than some threshold  $\gamma$ .

Notice that on this way of defining the standards of proof, the threshold  $\gamma$  is left open, and is not given a fixed numerical value, but depends on the jurisdiction and the circumstances.

In the current setting in the common law, the standard of proof applicable in a criminal trial is that of beyond reasonable doubt. Whether such a standard was used or not in ancient Greek trials would be an altogether different question. But what is interesting in relation to the strong and weak man example is that it is a reverse eikotic argument. If the case went to trial and the strong man was charged, let's say that the other side would have to present an argument for guilt that met some standard of proof. If that standard was comparatively high, the defense side could win by presenting a weaker argument that would plausibly suggest enough skeptical doubt to prevent that standard from being met by the argumentation of the other side. But in the context of an ancient Greek trial, the preponderance of evidence standard would seem to be the one applied to the argumentation. In relation to the weak and strong man example, this would suggest that the argument of each side is pitted against the other so that the stronger argument would win. Otherwise the outcome would be a deadlock.

#### 4. Plausible Reasoning and Generally Accepted Presumptions

Early Greek notions of persuasive arguments made much of the point that such arguments make their claim acceptable to an audience by being based on a congruence between a speaker's claim and how he supports it by appealing to the pre-established commitments of the audience (Kraus, 2007). According to Tindale (2015), the link between the arguer and the audience in persuasion dialogue rests on the capability of an orator to identify with commitments and values of the audience to whom his argument is directed. Here there is an element of common ground shared by the speaker and the audience that is the key to persuasion by argumentation.

Common knowledge has also been recognized as important in informal logic textbooks. According to Govier (1992, 120), a proposition is a matter of common knowledge if it states something known by virtually everyone. She uses examples such as 'Human beings have hearts' and 'Many millions of civilians have been killed in twentieth-century wars' (120). According to Freeman (1995, 269), a proposition is common knowledge if many, most, or all people accept it.

The need for agreement on some basis of common knowledge in argumentation suggests the feature called commonsense knowledge in artificial intelligence. The commonsense knowledge problem posed for artificial intelligence is how to create a database that contains the general knowledge parties to a conversation are expected to have, represented in an accessible way to artificial intelligence programs that use natural language. Artificial intelligence systems designed to capture common knowledge for use in logical reasoning include the open mind common sense system (OMCS). The proposition 'If you hold a knife by its blade then it may cut you' is an example (Singh et al., 2002, 3). Common knowledge refers to contextual information that individuals in a shared conversation can be assumed to know about and use when appropriate.

But common knowledge can be expected to vary in different settings of argument use (Hosseini et al., 2014).

Indeed, plausible reasoning is meant to be applicable in cases where there is lack of knowledge or evidence to resolve a dispute by merely looking at the factual evidence, and where there is a fundamental inconsistency. There are arguments on both sides of the issue, so the reasonable way to resolve the dispute is to examine the arguments on both sides. This dialogue approach has much in common with the kind of argumentation Aristotle identified with dialectical reasoning (Slomkowski, 1997).

The term *endoxon* is ambiguous in the way Aristotle uses it (Vega Renon, 1998, 95). In one sense it means ‘famous’ or ‘illustrious’, in a way that can be applied to persons or cities. In a second meaning, a more specialized sense that has to do with argumentation, it applies to views, or propositions held, that have a weight or degree of approval. The famous sentence in the *Topics* (100b20-21) appears to bring both meanings together in the same sentence: “Those things are *endoxa* which seem so to everyone, or to the majority, or to most notable and reputable [*endoxois*] among them” (Vega Renon, 1998, 95). The *endoxa*, in the more specialized second sense, are propositions put forward or granted in a dialectical argument (*Topics* 100a29-30). In Aristotelian dialectic, one agent engages in argumentation with another on a controversial issue (a problem) through a sequence of questions and answers, arguing from accepted or acceptable premises. At the beginning of the *Topics*, Aristotle writes “Our treatise proposes to find a line of inquiry whereby we shall be able to reason from *endoxa* about any subject presented to us, and also shall ourselves, when putting forward an argument, avoid saying anything contrary to it” (100a-20-23). This technical sense of the term is the one that is important for us here.

In this second sense, an *endoxon* is a proposition that can be tentatively accepted as occupying a ground in argumentation on a controversial issue (Vega Renon, 1998, 96). In this sense, an *endoxon* could be described as a kind of presumption that holds a premise of an argument in place, because it is uncontroversial with respect to the controversial issue currently being discussed. It’s not that this presumptive premise is beyond dispute. It is only that it can be taken for granted for practical purposes because it is uncontroversial. Your audience will be inclined not to dispute it, so it can reasonably be anticipated that you will not have to defend it. Thus such propositions have the role of acceptable premises in dialectical argumentation.

One can find some ideas that appear to be similar to the Aristotelian notion of an *endoxon* in contemporary writings on argumentation theory. Van Eemeren and Grootendorst (1992) write about what they call common starting points, propositions that comprise agreements on background knowledge necessary to resolve a difference of opinions through argumentation. According to their definition (van Eemeren and Grootendorst, 1992, 154), a common starting point is an extensive range of mutually presupposed knowledge and opinion that has been agreed to by both parties at the opening stage as a “joint point of departure”. Van Eemeren and Grootendorst (2004, 145) have a method of solving this problem in the framework of a critical discussion as follows. In their account, the two participants must explicitly spell out “which list of propositions they both accept and how they will decide together on the acceptability of other propositions” (145). Where do these lists come from? The answer is that “the discussants are completely free to draw up a list of propositions accepted by both parties”, the only restriction being that the list must be consistent (145). But propositions generally accepted as common knowledge can be shown to generate inconsistencies, once logical inferences are drawn from them by logical rules of inference (Rescher, 2009).



Loosely speaking we can call this implicit information about how things can be expected to work in familiar situations ‘common knowledge’, but as we will see below, it is not always common and it is highly controversial in philosophy whether it is a kind of knowledge. A better term for it would be ‘propositions generally accepted by the majority and the experts that are not in dispute in relation to an issue being discussed’. In this paper let us use the shorter and more familiar expression ‘common knowledge’ to stand for this notion. In this technical sense, whether a given proposition can be accepted as common knowledge or not can vary, depending on the issue being disputed in a given case and the audience. It can also depend on how you interpret the argument, as will be shown when we return to the weak and strong man example.

## 5. Enthymemes, Schemes and Common Knowledge

The word ‘enthymeme’ as used in this section will conform to the meaning of the traditional doctrine of the enthymeme in the logic textbooks. As explained in section 2, an enthymeme in this sense is taken to be an argument in which one or more of the premises (or possibly the conclusion) of an argument was not stated explicitly. Walton (2001) showed how enthymemes of this sort are often based on implicit premises that can be classified as falling under the heading of common knowledge. The ensuing research in (Walton and Reed, 2005; Walton, 2008) did not yield a general solution to the problem of enthymemes, but did analyze many examples of them found in ordinary conversational argumentation. By analyzing these examples using argument diagrams and other tools of informal logic, this research showed how important common knowledge is for identifying implicit premises and conclusions.

As mentioned above, common knowledge is widely regarded as important in artificial intelligence. One method of representing common knowledge in computing is called a frame. A *frame* is a data structure that represents a stereotyped situation, such as going to a child’s birthday party, as a sequence of actions and events that we can recognize in comparable examples (Minsky, 1974, 2). A frame can be a source of common knowledge used to fill in gaps in an enthymeme. In the widely influential theory of Schank and Abelson (1977), common knowledge is based on what is called a script. A *script* is a body of knowledge shared by language users concerning what typically happens in certain kinds of stereotypical situations. A script, much in the manner of a frame, enables a language user to fill in gaps in inferences not explicitly stated in a natural language text. Hence scripts or frames are potentially very useful for showing us how to reconstruct arguments with implicit premises or conclusions based on common knowledge. Such unstated assumptions are needed for us to grasp the missing parts of an argument to allow it to make sense.

For the purpose of analyzing the argumentation in the weak and strong man example, we will need two familiar argumentation schemes and three new ones. The first one is already known in the argumentation literature (Verheij, 1999; Walton, 2002; Walton, Macagno and Reed, 2008; Walton and Gordon, 2015). It is called defeasible *modus ponens*, and can be introduced by comparing it with deductive *modus ponens*, a basic form of argument in deductive logic. It can be called *Strict Modus Ponens*.

*Major Premise:* As a general rule  $R$  (not subject to exceptions), if  $P$  then  $Q$ .

*Minor Premise:*  $P$

*Conclusion:*  $Q$

This scheme for strict *modus ponens* can be contrasted with the one for defeasible *modus ponens*.

*Major Premise:* As a general rule  $R$  (subject to exceptions), if  $P$  then  $Q$ .

*Minor Premise 1:*  $P$

*Minor Premise 2:* No exceptions to the rule  $R$  are known at this time.

*Conclusion:*  $Q$  is tentatively acceptable as a hypothesis.

These two rules can be applied to two kinds of cases, ones having rules of inference that are strictly universal, where they can be represented by the universal quantifier of deductive logic, and ones having rules of inference that are defeasible. Accordingly, Verheij (1999, 114) adopts the following interpretation policy: in a case where both strict rules and rules admitting of exceptions might both be applicable, defeasible *modus ponens* should always be used, but in a case in which only absolutely universal rules are applicable, only strict *modus ponens* should be used as the appropriate rule of inference.

The next scheme looks at first sight very similar to the well-known scheme for argument from negative consequences. This defeasible form of argument, traditionally called *argumentum ad consequentiam*, is now familiarly known in argumentation studies as argument from consequences (Walton, Reed and Macagno, 2008). Argument from consequences has a positive and a negative scheme. In argument from positive consequences, a proposed action is supported by citing good consequences of carrying it out. In argument from negative consequences, a proposed action is attacked by citing bad consequences of carrying it out. The two schemes are shown below

*Major Premise:* If  $A$  is brought about, then consequences  $C$  will occur.

*Minor Premise:* Consequences  $C$  are negative.

*Conclusion:* Therefore  $A$  should not be brought about.

*Major Premise:* If  $A$  is brought about, then consequences  $C$  will occur.

*Minor Premise:* Consequences  $C$  are positive.

*Conclusion:* Therefore  $A$  should be brought about.

The terms ‘positive’ and ‘negative’ indicate that both schemes are based on another simpler scheme called argument from values (Walton et al., 2008, 321).

Three critical questions matching the scheme for argument from negative consequences (Walton, Reed and Macagno, 2008, 332-333) can be applied to all four schemes.

CQ1: How strong is the likelihood that the cited consequences will (may, must) occur?

CQ2: What evidence supports the claim that the cited consequences will (may, must) occur, and is it sufficient to support the strength of the claim adequately?

CQ3: Are there other opposite consequences (bad as opposed to good, for example) that should be taken into account?

The first new scheme below is a sub-scheme of the scheme for argument from negative consequences, the scheme for argument from values and another scheme called argument from classification (Walton, Reed and Macagno, 2008, 332). This new scheme is called Argument

from Classification of Consequences Valued as Negative. It is the second one we will need. It takes the following form as a defeasible argument

*Major Premise:* If agent  $a$  were to carry out action  $A$ , consequence  $C$  would likely come about

*Minor Premise:* Consequence  $C$  can be classified as negative.

*Conclusion:* If agent  $a$  carried out action  $A$ , there would likely be negative consequences

We will call the scheme above  $cn$  for short.

In order to model the argumentation in the weak and strong man example, we will need another new scheme for arguing retroductively whether it was likely for an agent to have carried out a particular action based on reasons he or she might have had for carrying out this action or not. I will call this second new scheme Argument from Foreseeing of Negative Consequences of an Agent's Likely (or Unlikely) Action. For short it can be called the foreseeing of negative consequences ( $fn$ ) scheme.

*Major Premise:* If an agent does  $A$ , there will likely be negative consequences.

*Minor Premise:* Foreseeing negative consequences is a reason for not doing  $A$ .

*Conclusion:* Therefore, it is not likely that the agent will do (or has done)  $A$ .

These two new schemes are subtle variations on the schemes for argument from negative consequences.

The third new scheme needed will be called  $ak$  for short.

Argument from an Agent's Knowledge of Circumstances

*Major Premise:* For any agent  $x$ ,  $x$  would not carry out  $A$  unless  $x$  knows that condition  $C$  is met.

*Minor Premise:* In these circumstances, agent  $a$  knows that condition  $C$  is not met.

*Conclusion:* In these circumstances,  $a$  is not likely to carry out  $A$ .

These five schemes are parts of the technology required to interpret, analyze and evaluate the argumentation in the ancient example of the weak and strong man. But before we can do that, it will be helpful to briefly survey the literature on plausible reasoning. This will give us some background on an approach to current proposals for evaluating plausible reasoning.

## 6. Plausible Reasoning

Plausible reasoning depends on the assumption that sources can be graded for reliability (Rescher, 1976, 7). 1 represents "maximal reliability", accorded to sources such as logic or mathematics, sources taken to have "absolute solidity". An ordering from the highest degree of reliability to the lowest is defined as follows:  $1 = n/n, n-1/n, n-2/n, \dots, 1/n$ . This ordering represents a scale of decreasing degrees of reliability. A source  $1/n$  is still somewhat reliable, even though it may have a very low grade of reliability. Sets of statements claimed by a group of sources can then be evaluated as more or less plausible based on the comparative reliability of each source. In general, the greater the reliability of the source of a statement, the greater is the plausibility of the statement it asserts (Rescher, 1976, 11).

The most important general rule for deriving plausibility values of statements in the system is the least plausible premise rule (Rescher, 1976, 15): when a group of mutually consistent premises deductively implies a conclusion in the system, the conclusion cannot be less plausible than the least plausible premise. Another important feature of the system is that there is no negation rule, meaning that for any statement *A* which has a plausibility value, the system does not have an automatic way of calculating the plausibility of negation of *A*. As Rescher notes (1976, 31), this means it is possible in the system for a proposition *A* and its negation to both be highly plausible.

Rescherian plausible reasoning can be contrasted with Bayesian probabilistic reasoning in three fundamental respects (Cohen, 1979, 50):

1. Plausible reasoning only ranks statements being evaluated in an ordering as more or less plausible. It does not assign numerical measures such as standard probability values.
2. Plausible reasoning never evaluates a conjunction of two statements as having a lower value than either of the two conjuncts has, each considered individually.
3. In contrast to probability theory, the plausibility value of a statement does not automatically determine the plausibility value of its negation.

Rescher's theory of plausible reasoning seems to fit very well with the eleven characteristics of plausible reasoning given above. Some of its rules for evaluating plausible reasoning are different from those of formal argumentation systems used in artificial intelligence.

Another approach to weighing the plausibility of argumentation in the type of example we are interested in is to use an ordering of plausibility weights. As applied to medical diagnostic systems that use physicians' judgements as a basis for setting confidence values for hypotheses, Josephson and Josephson (1994, 267) adopted a seven-step scale using values such as "highly plausible" and "very implausible". A comparable way of evaluating plausible argumentation in legal reasoning (Walker et al., 2011) was based on lessons learned from a vaccine injury project. Using this system (Walker, et al., 2011, 298), a proposition was judged to be (1) highly plausible, (2) very plausible, (3) slightly plausible, (4) undecided, (5) slightly implausible, (6) very implausible or (7) highly implausible. According to the observations of Josephson and Josephson (1994, 266) this kind of plausibility talk comes naturally to scientists and physicians when they evaluate evidence and weigh hypotheses by saying things like "because it's the only plausible explanation", or make comparative judgements by saying that one hypothesis is "a little" or "a lot" more plausible than another.

These developments give us some hope that there could be some ways of approaching the problem of evaluating plausible reasoning in real texts by means of some numerical way assigning plausibility values to the premises of an argument (prior plausibility), then using this input to produce a plausibility value to the conclusion as an output (posterior plausibility).

One way could be to apply a seven-valued system to the task of evaluating arguments such as the example of the strong and weak man expressed in Aristotle's account of it. On this approach, a proposition can be rated as going from most plausible to least plausible on the following comparative plausibility scale: (1) highly plausible, (2) fairly plausible, (3) slightly plausible, (4) neither plausible nor implausible, (5) slightly implausible, (6) fairly implausible, or (7) highly implausible. More details on how such a plausibility rating can be applied to real cases by using tools from artificial intelligence, such as scripts, have been provided by the Josephsons (1994).

Other ways could be to use Rescher's system or Bayesian rules, already familiar from statistics. But before we can move ahead to these projects, it is necessary to figure out how to interpret the argumentation in the weak and strong man example. The Carneades Argumentation

System is a place to start. It represents arguments as graphs that are similar to argument diagrams of the kind we are familiar with in informal logic and has schemes hard-wired into the system.

## 7. Modeling the Reverse Eikotic Argument with Carneades

Instead of using negation Carneades uses pro and con arguments. As shown in Fig. 1, a1 and a2 are con arguments, indicated by the minus signs in their circular nodes, whereas all the other arguments are pro arguments, as indicated by the plus signs. The two evidential propositions are shown with a green background (grey, if printed without color), showing that they are accepted by the audience or the jury. Propositions that are rejected are shown with a red background (darker grey, if printed without color). Propositions that are neither accepted nor rejected are shown with no background (white). The pair of propositions joined by the yellow node represents the so-called *stasis* (Hohmann, 1989), the ultimate issue to be resolved in a trial. A rectangle with a dashed border contains an implicit premise.

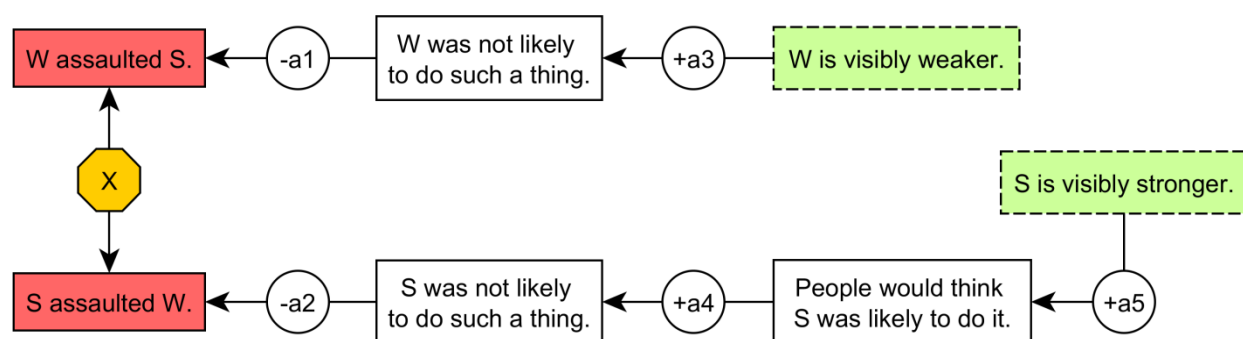


Fig. 1: The Reverse Eikotic Argument in Carneades

The original eikotic argument is shown at the top. W (the weak man) argues against the contention that he assaulted S (the strong man) on the ground that he was not likely to do such a thing. Further argument is given to support this claim, since there is some evidence that is relevant. W is visibly weaker, as anyone could see, so we have put this statement in as an implicit premise of an additional argument +a3. The reverse eikotic argument is shown along the bottom. S argues that he was not likely to do such a thing because people would think he was likely to do it. Again there is evidence supporting this proposition, namely the visible evidence that he is the stronger man. It is interesting for the reader to note that plausible arguments of the sort studied in this paper can be supported (or attacked) by evidence.

Next we have to turn to the issue of how the reverse eikotic argument is related to the prior eikotic argument. The former argument attacks the latter argument, but it remains to be seen more precisely how this works. Carneades uses defeasible reasoning of the kind advocated by Pollock (1995), which draws a distinction between rebutting defeaters and undercutters. A rebutting defeater attacks the conclusion of the target argument. An undercutting defeater attacks the inferential link joining the premises to the conclusion by citing circumstances in which the inferential link fails to hold, even though it may hold generally. There can also be a third way of attacking an argument - by attacking one or more of its premises.

It is the first way that is illustrated by the sequence of argumentation shown in Fig. 1. Indeed, in a reverse eikotic argument, each of the pair of arguments attacks the conclusion of the other.

To represent such an eikotic argument a new notation is introduced. Looking at the left part of Fig. 1, it can be seen that there is an X in the yellow hexagonal node pointing to the proposition above it and the proposition below it. This node represents a conflict (opposition) between a pair of propositions. What it represents in this instance is that each argument attacks the other. The context of the argumentation is that there are two parties involved, the weak man and the strong man, and each of them has his thesis to be proved. It is to be expected that the weak man will present arguments supporting his thesis and the strong man will present arguments supporting his thesis. These arguments are opposed to each other, in a sense illustrated by the argument diagram in Fig. 1. The weak man is expected to put forward his arguments supporting his thesis, and the strong man is expected to put forward his arguments supporting his thesis. This is a characteristic argumentation framework for a trial, and indeed the words ‘accused of assault and battery’ indicate that this framework is part of the context of the use of the argumentation in the example.

Now we are in a better position to understand the relationship between the original eikotic argument and the reverse eikotic argument. When the original argument was put forward against the conclusion that W assaulted S, its conclusion holds that S is guilty of the crime of assault. Hence it is to be expected that S will deny this conclusion and will attack it by posing counterarguments. Hence the reverse eikotic argument is an attack on the conclusion of the original argument. First there was an argument put forward by one side making a claim as its conclusion, and then there was an opposed claim made by the other side with an argument supporting an opposed claim.

Next we come to the question: what makes the second eikotic argument the reverse of the first one? Essentially it is that the original argument is eikotic, the responding argument is also eikotic, and the second argument attacks the first.. This reverse feature is what makes the argumentation interesting and somewhat unusual. Notice however that evidence is involved, so that if the case were more deeply analyzed to take this evidence into account, additional arguments that could be eikotic or not, could be brought in to support the arguments of either side. This is made clear once the example of the weak and strong man is more deeply analyzed, such as is done in Fig. 2 and in the subsequent diagrams analyzing the argumentation. You see that more evidence has come in through additional argumentation, and it is perfectly possible that some of the additional arguments could be eikotic.

## 8. Interpretations of the Argumentation in the Example

Let’s reconstruct the argumentation in Aristotle’s account of the example using the tools outlined in the previous sections. Carrying out this exercise will show that the argumentation can be interpreted in (at least) two ways. The first way is shown in Fig. 2. The arguments against the claim that W is open to the charge of assault are shown along the top of Fig. 2. Argument a1 is a con argument against the claim that W assaulted S, based on the premise that W was not likely to do such a thing. The next argument to the right fits the scheme for argument from foreseeing negative consequences (fn). The top premise of this argument is supported by two other arguments, each citing likely negative consequences. Note that all of the premises of the arguments to the right of the conclusion ‘W was not likely to do such a thing’ are implicit, indicated by the dashed boundaries of the rectangles.

The reconstruction of the argument against the claim that S assaulted W is based on the comments of Kraus (2007, 3), where he describes the reverse eikotic argument of the strong man.

The strong man in his turn may plead that he is equally unlikely [to have committed the crime] because he was likely to appear guilty. His argument is based on the belief that nobody would commit a crime without any reasonable hope of getting away with it unsuspected and undetected.

These remarks suggest using the generalization that nobody would commit a crime without any reasonable hope of getting away with it unsuspected and undetected as a key implicit premise. This has been done in Fig. 2, as shown at the bottom right.

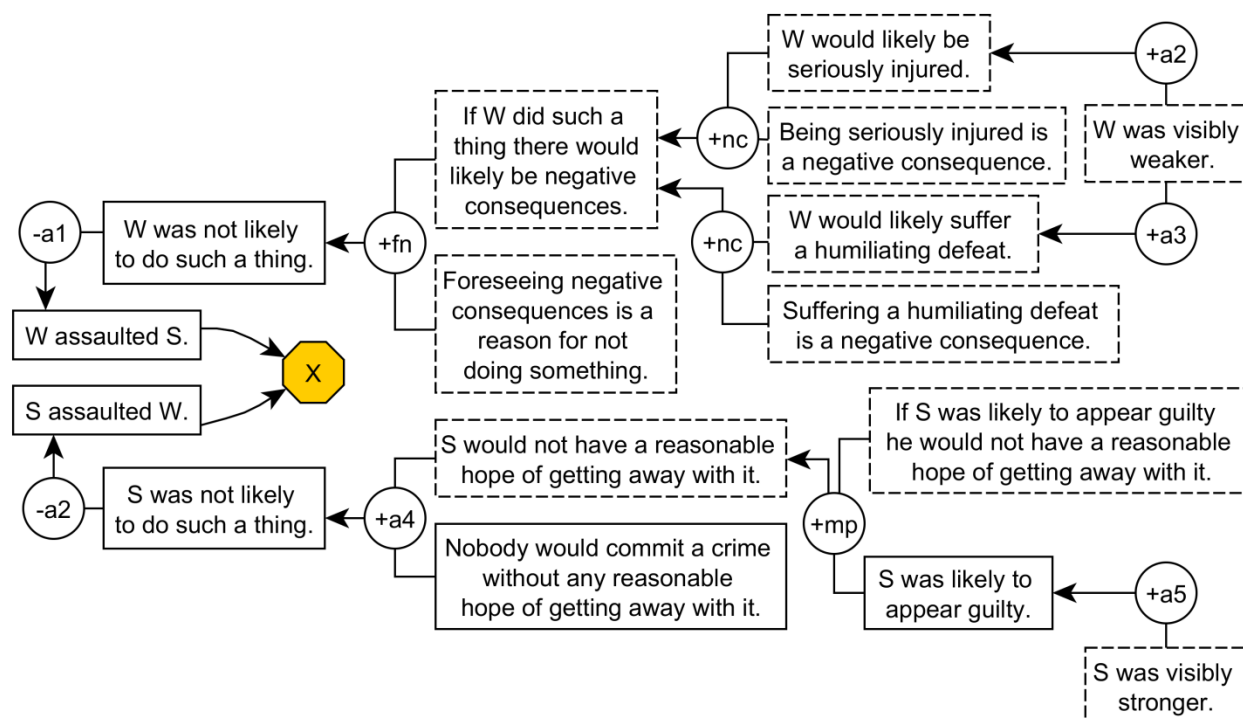


Fig. 2: First Interpretation of the Weak and Strong Man Example

The words ‘unsuspected and undetected’ are understood to be included at the end of the sentence in three of the text boxes at the bottom that are premises of a4 and mp (*modus ponens*).

Note that the generalization at the bottom of a4 is not an absolute universal generalization, such as the one modeled by the universal quantifier in deductive logic. It has been expressed in wording that attempts to make clear that it is a defeasible generalization (Bex et al., 2003). Also note that five of the arguments are represented as linked arguments in the standard sense that the two premises of each argument go together to support the conclusion, whereas in a convergent argument each premise supports the conclusion independently of the other(s). Two of the linked arguments have +nc in their argument nodes, indicating that both arguments are instances of the scheme for argument from negative consequences.

In order to more deeply analyze the argumentation in the bottom part of Fig. 3, it is useful to also apply some schemes to that part. In this interpretation, as shown in Fig. 3, the arguments on both sides are based on the argumentation scheme for the scheme for argument from foreseeing negative consequences. As shown in Fig. 3 two arguments are marked +fn, referring to this scheme. So now we have one argument from foreseeing negative consequences supporting the

conclusion that W was not likely to do such a thing and another supporting the claim that S was not likely to do such a thing.

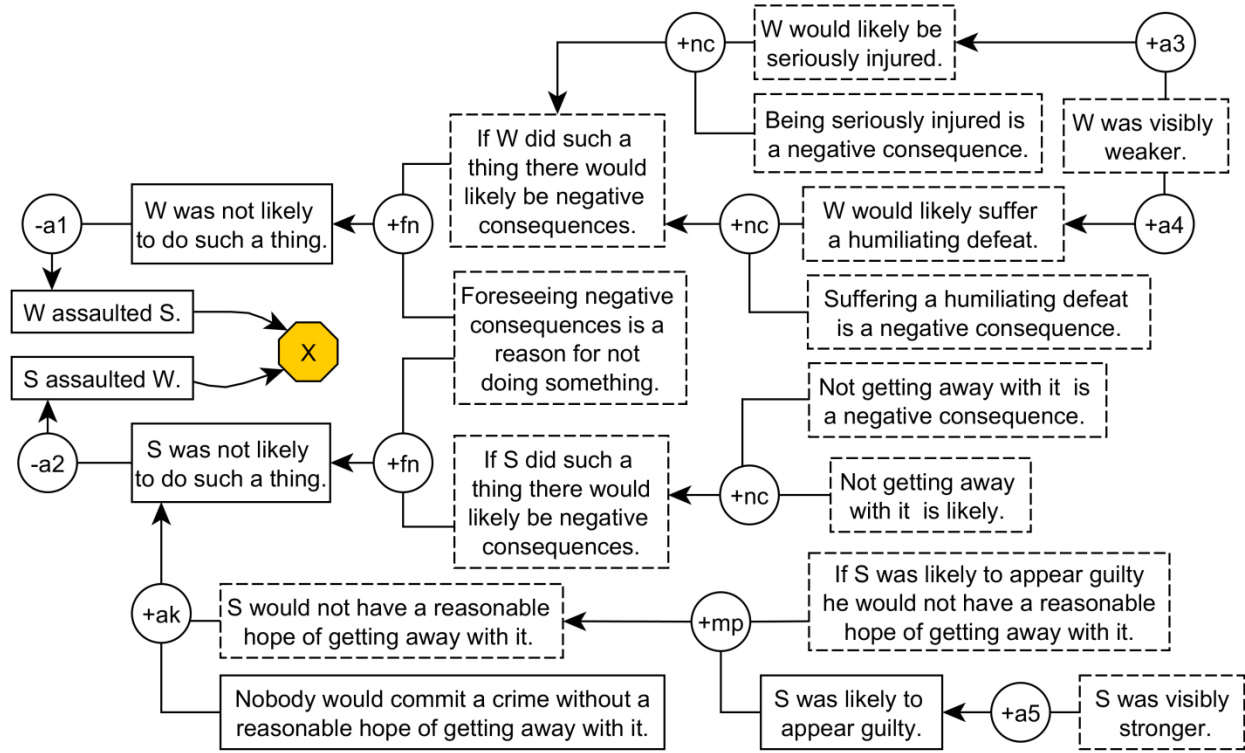


Fig. 3: Second Interpretation of the Weak and Strong Man Example

Looking to the middle of Fig. 3, we see that the two arguments marked +fn share a common premise. This capability for arguments to share one or more premises is a characteristic feature of the Carneades Argumentation System. Note that the interpretation given in Fig. 2 is simpler than the one for Fig. 3, but an interesting feature of Fig. 3 is that both eikotic arguments fit the scheme for argument from foreseeing negative consequences. This feature will turn out to be important when we come to confront the problem of how to weigh the plausibility of the weak man's argument against the argument of the strong man.

There is also a third interpretation to be considered. This interpretation is different in regard to how it models the argumentation at the bottom supporting the conclusion that S assaulted W. Instead of relying on the key premise that a person would not commit a crime without reasonable hope of getting away unsuspected and undetected, it relies on the statement that people would think that S was likely to do it as a key premise. This latter premise was stated explicitly in the Aristotelian text (quoted from the English translation in section 2) where Aristotle wrote that the defense is that S would be likely to do such a thing, since he could be sure that people would think that he was likely to do it. This interpretation is mapped out in Fig. 4.



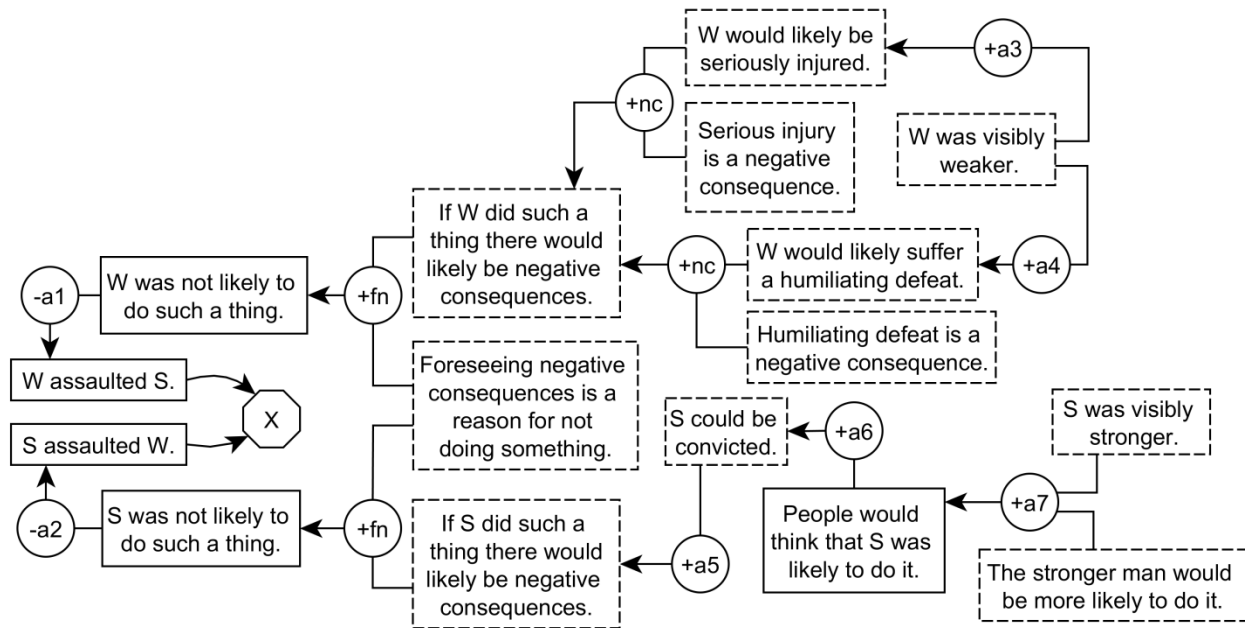


Fig. 4: Third Interpretation of the Weak and Strong Man Example

The differences between Fig. 3 and Fig. 4 are to be found in the bottom part of the diagram representing the argument against the ultimate claim that S assaulted W. As shown in Fig. 3, this part of the argumentation depends on the explicit premise stating that nobody would commit a crime without a reasonable hope of getting away with it, a defeasible generalization based on common sense. As shown in Fig. 4, that part of the argumentation uses only the one explicit premise, the statement that people would think that S was likely to do it. All the rest of the premises, except the explicit statement that S was not likely to do such a thing, are implicit. This difference will turn out to be important when it comes to evaluating the argumentation by weighing the plausibility of the two opposed arguments.

## 9. Judging Comparative Plausibility of the Arguments Using Carneades

In this section it will be shown how the argumentation in the example on both sides can be comparatively evaluated using a procedure in which the pro evidence is weighed against the con evidence using the Carneades Argumentation System (Gordon, 2010). The examples analyzed will further support the hypothesis of section 8 that the plausible reasoning displayed in the weak and strong man example rests on shared eikotic common knowledge which fits in as implicit premises and conclusions in an argument diagram. Both parties, the speaker and the audience (the broader public audience, the judge or the jury), contribute to comprehending and evaluating the enthymematic argument. Showing this provides additional support for the observation of Kraus (2006, 141) that in eikotic arguments, “audience adherence is secured by the coherence of the speaker’s arguments with what an audience can reasonably be expected to assume as natural, with their own everyday experience, their own preconceived opinions about nature and human life, their own emotional predispositions and behavioral habits”.

Aristotle’s presentation of the weak and strong man example offers a clue as to how he judged which of the pair of opposed arguments in the example to be the more plausible: “Both

alternatives seem likely, but only one really is likely, the other not generally, only in the circumstances mentioned.”(*Rhetoric* 1402 a20). Aristotle’s remark suggests that both arguments are plausible (seem likely) but that the argument of the weak man is more plausible than the argument of the strong man. Let’s investigate whether there might or might not be any basis to support this way of evaluating the argumentation based on the analyses of the argument given so far. Carrying out this evaluation procedure will bring out how plausible each of the two arguments can comparatively be evaluated using Carneades.

As the beginning point for evaluating the argumentation on both sides and weighing the one side against the other, let’s start with the interpretation displayed in Fig. 5. As indicated in Fig. 1, the evidential propositions are shown with a green background. Carneades will automatically show any conclusions derived from such an initial premise as output (posterior plausibility) after accepted premises are put in by the user (prior plausibility). Schemes also play a role, such as *mp* (deductive or defeasible *modus ponens*) and *ak* (argument from agent’s knowledge).

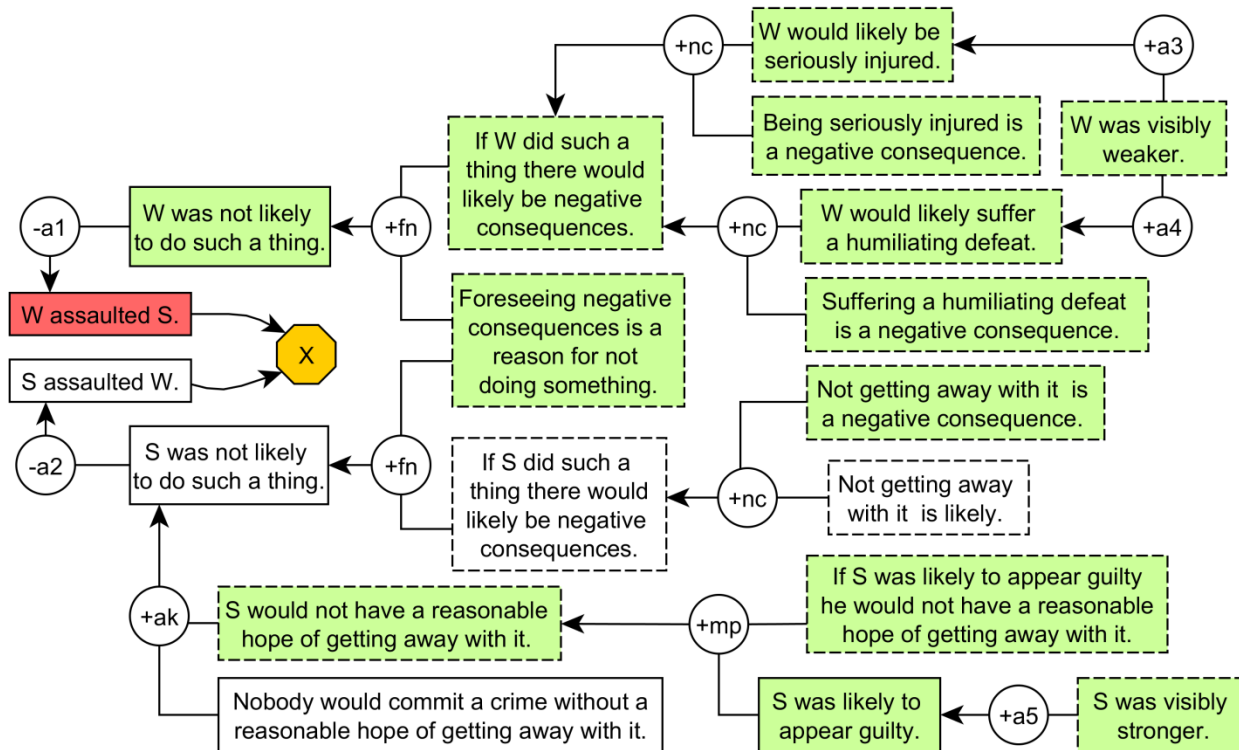


Fig. 5: The First Evaluation of the Weak and Strong Man Argument

Let’s start with the top argument against the conclusion that W assaulted S. It begins with the evidential proposition that W was visibly weaker shown at the top right. This proposition, which can be taken to be accepted, based on the visual evidence available to a jury or other audience, supports one premise in each of the two arguments from negative consequences shown to the left of it. The remaining premise in each of these two arguments can also be accepted, based on its prior plausibility to the audience. This means that there are two strong arguments supporting the proposition that if W did such a thing there would likely be negative consequences. Using the *fn* scheme, this argument supports the conclusion that W was not likely to do such a thing, which in turn provides a plausible posterior con argument against the conclusion that W assaulted S. So

far then, following the propagation of the propositions that would likely be acceptable to the audience or jury, there has been a strong argument to rebut the conclusion that W assaulted S. This chain of evidential reasoning supports W’s side of the case.

On the one side, it is argued that the weak man would be likely to be seriously injured, and to suffer a humiliating defeat. As we would normally expect such an encounter to go, these consequences would ensue as a result of any direct violently aggressive action by the weak man provoking a reaction. The consequences of such an attack by the strong man are more indirect. While it is true that he might face the danger of conviction because people would think he was more likely to be the aggressor, the likelihood of conviction is more indirect. The other party would have to lay charges and then argue his side of the case in court, and since there are plausible arguments for both sides, it is far from automatic that the stronger man would be convicted. A lot of events might occur between the time of the violent encounter and the time of the trial, and during the trial. In contrast, the negative consequences of an attack by the weak man would be much more immediate, more likely, and more directly fearful. On this basis, if you evaluate the two arguments from foreseeing negative consequences to an action side-by-side, the argument for the claim that W was not likely to do such a thing could be rated as more plausible than the argument for the claim that S was not likely to do such a thing.

This weakness is shown at the bottom left of Fig. 5 by leaving the proposition that nobody would commit a crime without a reasonable hope of getting away with it in a rectangle with a white background. Because this proposition would be very likely have some plausibility if presented to a jury or other audience familiar with the details of the case, a justifiable way to assign it a prior plausibility for the audience would be to rate it as slightly plausible.

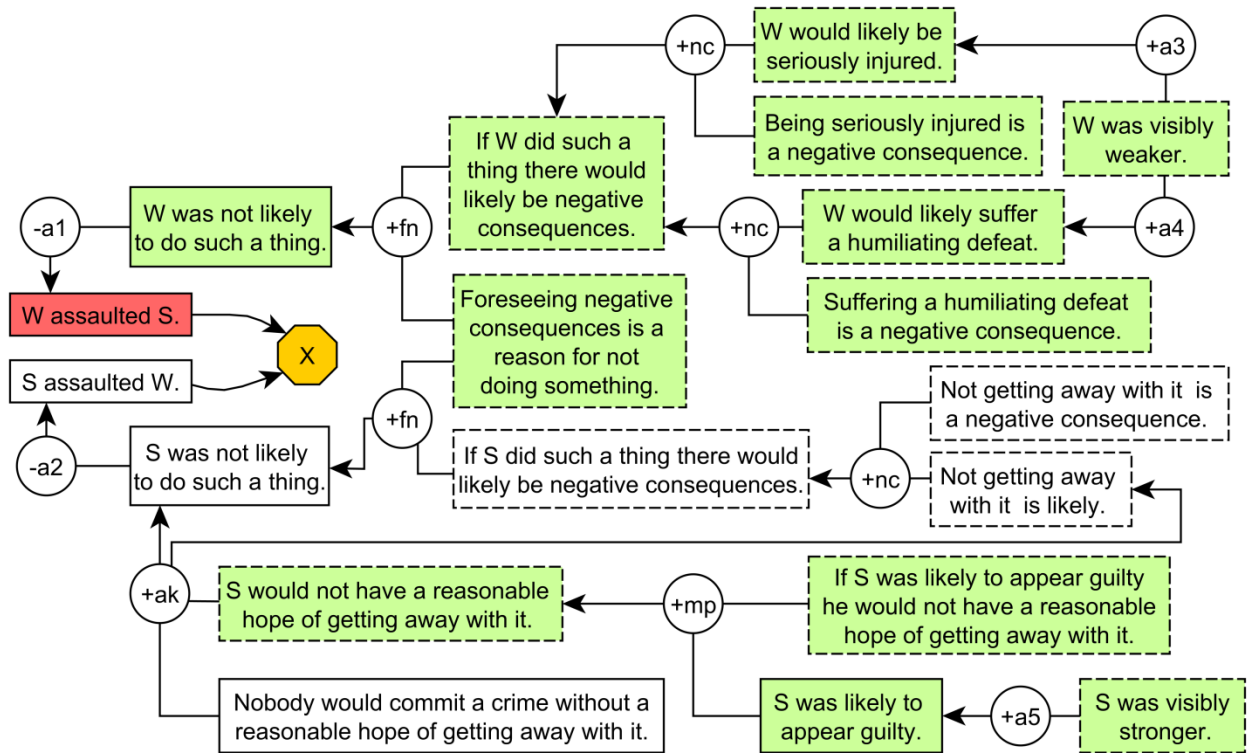


Fig. 6: The Second Evaluation of the Weak and Strong Man Argument

But there is another weakness in the bottom argument. Basically this weakness is that the proposition stating that not getting away with it is likely, one of the premises in the bottom *nc* argument, also does not seem very plausible unless it could be provided with evidential support of some kind. The question is whether there is some source of evidential support available from the text of the example, or from what can be inferred from it by plausible reasoning.

To consider an interesting possibility of this sort, look at Fig. 6. There you can see a source available. The *ak* argument at the bottom left of Fig. 6 has two premises. One is that S would not have a reasonable hope of getting away with it. This premise is part of a linked argument with the other premise stating that nobody would commit a crime without a reasonable hope of getting away with it. This linked argument provides support for the implicit proposition that not getting away with it is likely. To represent this support, there is an arrow from the *ak* argument with its two premises to the conclusion that not getting away with it is likely. This has made the argument diagram in Fig. 6 more complex, but it has the important advantage that it provides a route of evidential support to the otherwise unsupported premise that not getting away with committing the assault is likely. This will turn out to be fundamentally important when it comes to evaluating this argument to see if it is strongly enough supported to prevail against its competing counter-argument or not.

There have been three diagrams of the weak and strong man example in section 8. But since the second one (Fig. 3) is a more complete version of the first, in what follows we will only consider it to use as a basis for comparison with the third one (shown in Fig. 7).

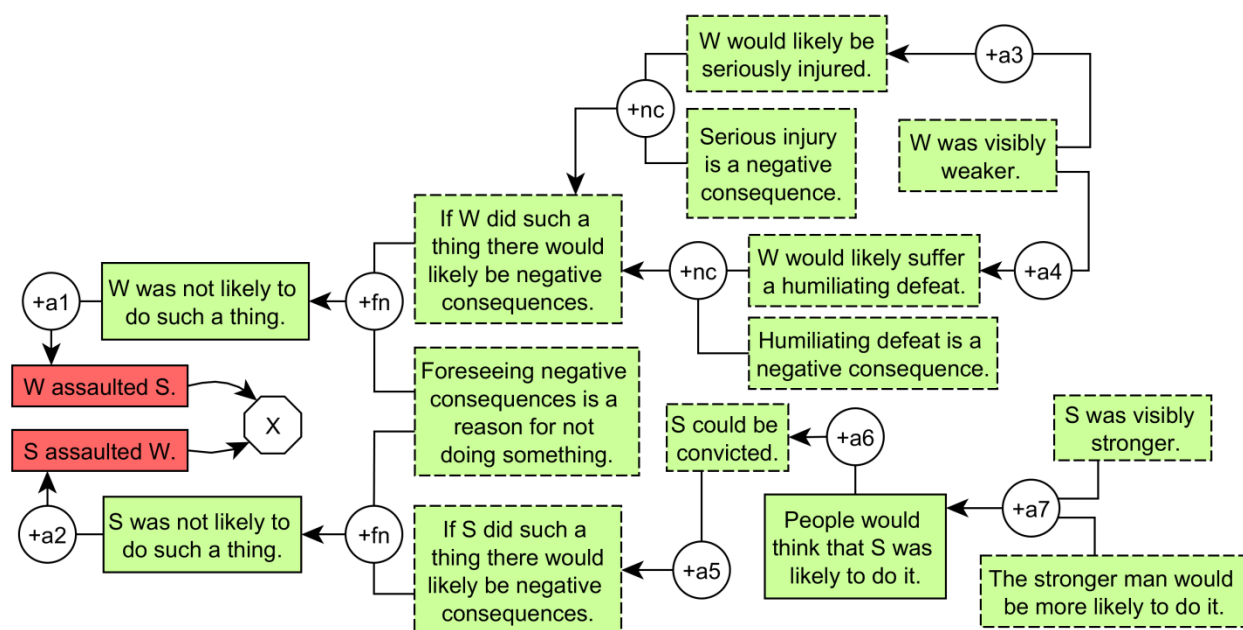


Fig. 7: The Third Evaluation of the Weak and Strong Man Argument

The first interpretation, as shown in Fig. 6, depends on a premise explicitly stated in the Aristotelian text, the defeasible generalization that nobody would commit a crime without reasonable hope of getting away with it. How plausible is this generalization? Looking at it from a point of view of common sense expectations about the way things are normally likely to go in situations of this kind we are familiar with, it would appear that people do commit crimes all the

time even though it would appear to onlookers, such as the police, that they would not have a reasonable hope of getting away with it unsuspected and undetected. So even though this generalization has some plausibility, its plausibility is weak and open to skeptical doubt. Now notice that according to the interpretation shown graphically in Fig. 4, the argumentation sequence on the bottom, supporting the proposition that S was not likely to do such a thing, does not depend on this premise. Instead, it depends on the premises that the stronger man would be more likely to do it and S is visibly stronger. The generalization that the stronger man would be more likely to do it would appear to stand up better to skeptical doubt than the common sense generalization used in the interpretation of the argument shown in Fig. 3.

Next let's look at Fig. 7 to see how in the interpretation of the example in Fig. 4 the opposed arguments can be comparatively evaluated using the Carneades system. Let's start with the part of the argumentation at the top. The evidential proposition that W was visibly weaker, shown at the top right, supports two propositions, each one of which is a premise in the two *nc* arguments just to the left. Since the other two premises of these two arguments would be acceptable to the audience as plausible, the conclusion that if W did such a thing there would likely be negative consequences is automatically computed by Carneades to be plausible as well. With the additional plausible premise that foreseeing negative consequences is a reason for not doing something, the conclusion that W was not likely to do such a thing is automatically drawn by Carneades in a green background. The same sequence of propagation of plausibility values can be carried out in the bottom argument, starting from the premise that S was visibly stronger.

Thus what we have shown in Fig. 7 is a deadlock. Both of the competing arguments are plausible, indicated by two factors. One is that all the arguments are plausible, especially indicated by several of them fitting known argumentation schemes. The other is that all the premises of the arguments are shown with green backgrounds, indicating that the audience accepts them as plausible either because the audience accepted them as plausible to begin with (priors), or because Carneades calculates that they follow plausibly from premises that the audience accepts. Unless the arguments in the circular nodes can be critically questioned or otherwise attacked by additional arguments, the conclusions drawn by inference from the accepted premises are shown by Carneades as accepted by the audience.

So here we have a choice between two plausible interpretations of the weak and strong man example. It has been shown that the one that is most faithful to the Aristotelian text, displayed in Fig. 6, is weaker than the one shown in Fig. 7, at least in a certain respect. Next we have to see what this implies, and whether the weakness could be corrected.

## 10. Conclusions and Suggestions for Further Work

It has been shown in this paper that the reverse eikotic argument used in the weak and strong man example is inherently reasonable, even though it is defeasible, hard to analyze, and open to critical questioning. It has also been shown that the argumentation in it is more complex than it looks, and contains ambiguities that are not easy to resolve.

The comparative evaluations in section 9 are consistent with Aristotle's evaluation of the weak and strong man example when he wrote, as indicated in section 2, that both of the two arguments seem plausible but only the straight eikotic argument is absolutely plausible while the reverse eikotic argument is only plausible under special conditions (*Rhetoric* 1402a-25). The results of this paper show, however, that there can be two ways of interpreting the reverse argument. One interpretation makes the argument open to an objection that the other version is

not open to. But the first way is, in at least a certain respect, closer to Aristotle's text. Which of the three interpretations of the argument in the weak and strong man case is best justified by the text and context of the example could be deepened by further study. The second and third interpretations, however, enable the example to be modeled as a conflict between two instantiations of the argumentation scheme for argument from foreseeing negative consequences of an agent's likely (or unlikely) action.

The justification for this evaluation can be tracked back to two key premises of each of the opposed arguments in the two arguments from foreseeing negative consequences shown in Figs. 3, 4, 5, 6 and 7. At the top of Fig. 6 for example, we have the implicit premise that if W did such a thing there would likely be negative consequences. This could reasonably be assigned, on the basis of the discussion above, a high prior plausibility rating. In the middle of Fig. 4, we have the implicit premise that if S did such a thing there would likely be negative consequences. This could be assigned a lower prior plausibility, again based on the discussion above.

Having reached this point, we are now in a position to give a formal definition of the notion of a plausible (eikotic) argument, based on the eleven characteristics of plausible reasoning from (Walton Tindale and Gordon, 2014) listed at the beginning of section 3, using the seven argument diagrams of the weak and strong man argument as a running example. Each of these seven diagrams took the form of a graph. A *graph*  $G$  is formally defined as an ordered pair  $(N, A)$ , where the set  $A$  is comprised of the two-element subsets of  $N$  (Harary, 1972, 9). A *path* from node  $s$  to node  $g$  is a sequence of nodes  $\{n_0, n_1, \dots, n_k\}$  such that  $s = n_0$ ,  $g = n_k$ , and  $\{n_{i-1}, n_i\} \in A$  (Poole and Macworth, 2011, 75). The graphs shown in Figs 1 through 7 contain three different kinds of nodes. The round nodes are placeholders for arguments that often fit the form of a known argumentation scheme and that can be pro or con a proposition contained in a rectangular node. The rectangular nodes contain propositions that are premises or conclusions of arguments. The octagonal node indicates a conflict, representing a pair of propositions that are logically inconsistent. A *sequence of argumentation* displayed in such an argument diagram is a path made up of the set of these nodes that form the graph.

The notion of a plausible argument can now be formally defined as follows using a graph structure of the kind illustrated by the seven argument diagrams. A *plausible argument* is: (1) a sequence of argumentation containing a subset of prior propositions accepted by the arguer and his or her audience based on their common knowledge, and in some instances on propositions designated as evidential, and (2) a superset containing a set of propositions derived from these prior propositions by a continuation of the sequence of argumentation using enthymemes and argumentation schemes. It is crucial that the argumentation schemes used for this purpose have the capability of representing defeasible arguments of the kinds illustrated by the analyses of the seven weak and strong man argument diagrams.

Finally there is an open issue to be discussed. The reader will recall that, as shown in Fig. 6, the argument on the weak man's side prevailed over the one on the strong man's side because an essential premise in the latter argument was not plausible. This premise was the proposition that nobody would commit a crime without a reasonable hope of getting away with it. As indicated in section 9, this proposition was judged less plausible than the comparable argument on the weak man's side because the consequences are more indirect and hence more uncertain.

Here it needs to be pointed out that the plausibility of the proposition that nobody would commit a crime without any reasonable hope of getting away with it depends on the prior issue of how reasonable we take the strong man to be as an agent contemplating carrying out a criminal act. It may well be true that a rational agent, the way this term is used in multiagent

computing (Wooldridge, 2002), would not commit a crime without a reasonable hope of getting away with it. From a psychological point of view of criminal behavior however, many human agents apparently carry out criminal acts because they only consider the short-term consequences of a crime and do not pay proper attention to the long-term consequences. This distinction suggests that there is an ambiguity in the proposition that nobody would commit a crime without any reasonable hope of getting away with it.

So what is a rational agent? An autonomous intelligent agent (which could be a machine or a human), of the kind studied in multiagent computing (Wooldridge, 2002) may be defined as having several distinctive characteristics that make it a rational agent. Not only does it have the capability for carrying out actions that can change its circumstances, but it also has the capacity to anticipate at least some of the consequences of its contemplated actions. It can form hypotheticals about possible future consequences of its actions, and can value some of these consequences as negative, from a point of view of its own interests and values or those of the group of rational agents to which it belongs.

As noted in section 2, Perelman and Olbrechts-Tyteca (1969) showed how the weak and the strong man argument can lead to pendulum-like back and forth sequence of argumentation that could potentially go on forever. We saw how the sequence proceeds by looking at the first three stages in it (Hoffman, 2003, 505; Kraus, 2011, 368). First there is the straight eikotic argument. Second, there is a reverse eikotic argument that attacks it. Third, there is a reverse reverse eikotic argument that attacks the reverse eikotic argument. From it can be appreciated how this procedure could go on endlessly in what Perelman and Olbrechts-Tyteca (1969, 459) call a *mise en abyme*. *Mise en abyme* is a term used in Western art history for the technique of placing a copy of an image within the image itself, notably in a way that suggests an infinitely recurring sequence. As indicated in section 2, this endless argumentation expansion is worrisome.

This clever analysis of the argumentation in the example is a little hard to figure out at first, but can be explained as follows, using the example of the reverse eikotic argument put forward on the side of the strong man. Where *S* represents the strong man, we can formulate the first three steps of the sequence as follows.

1. *The Straight Eikotic Argument*: *S* is guilty, because *S* is visibly stronger.
2. *The Reverse Eikotic Argument*: *S* is not guilty, since he would foresee that he would be held guilty by everyone because he is visibly stronger.
3. *The Reverse Reverse Eikotic Argument*: *S* is guilty, since he would have foreseen that he would be acquitted, because people would have assumed that he foresaw that he would be held guilty.

Theoretically at least, this sequence could go on and on, comparable to a pendulum shifting back and forth (Perelman and Olbrechts-Tyteca, 1969, 459) as the burden of proof shifts from the one side to the other at each step. One problem is that if this sequence continues infinitely there is no way to determine which party had the burden of proof at the end of the sequence. This means that it cannot be judged on a burden of proof basis which party won the argumentative exchange.

However, if we look at an argument diagram representing these first three stages of the eikotic sequence, it seems to suggest that the hypothesis that at each step in the sequence from the straight eikotic argument to the reverse one to the reverse reverse one, the argument gets weaker and weaker. The reason for this relates to the argumentation scheme for foreseeing of negative consequences (section 5). It relates to the human capability of grasping how far ahead



the steps in the sequence can be foreseen as it progresses through further and further steps. At the first step the argument appears reasonably strong because anyone can plausibly foresee that since S is visibly stronger, it would be easy for him to foresee that he would be held guilty by a jury (a negative consequence for him). The argument at the second step is weaker because neither S nor the jury would be likely to foresee this far ahead. At the third step the argument becomes even weaker for the same reason. One's capability to think ahead and foresee what other rational agents will think at the step in such a sequence continually decreases. The dashed arrows in Fig. 8 represent the downward arguments from each step to the next leading to the *abime*.

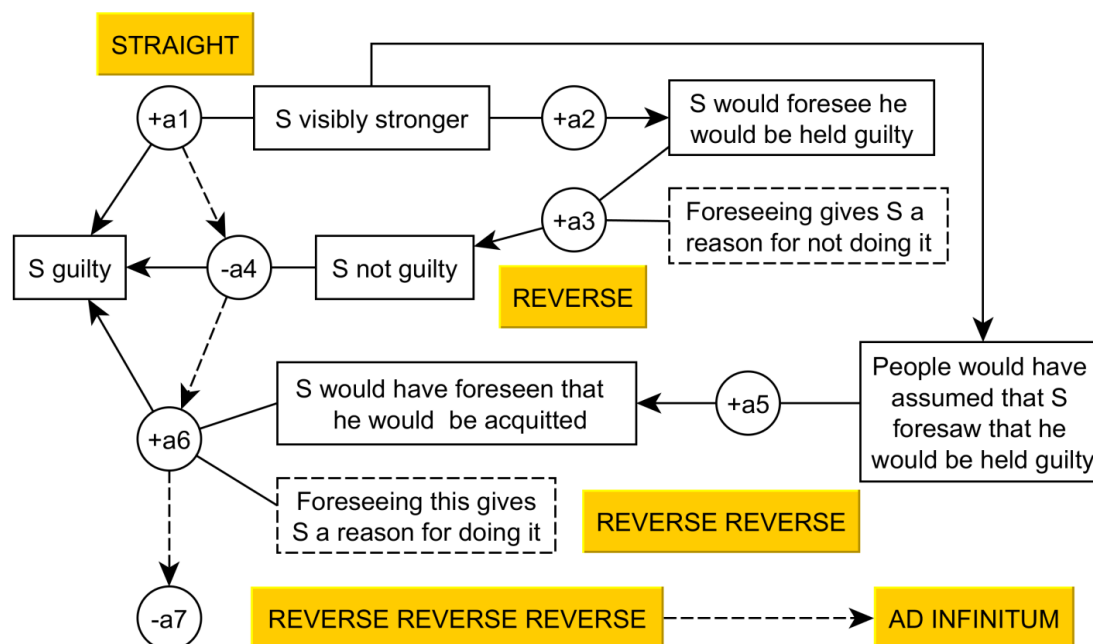


Fig. 8: Toward the *Mise en Abime* in the Strong Man's Argument

The straight eikotic argument is represented as the simple pro argument a1 going from the single premise that S is visibly stronger to the conclusion that S is guilty. The reverse eikotic argument, the pro argument a2, goes from the same premise to the conclusion that S would foresee he that would be held guilty, goes along with an implicit premise, to form a linked argument leading to the conclusion that S is not guilty. This conclusion is of course the negation of the original proposition at issue, the statement that S is guilty, and so argument a4 is a con argument attacking the conclusion that S is guilty. This reverse eikotic argument is a more complex argument than the straight eikotic argument, because it requires the premise that S would foresee that he would be held guilty. But from each step to the next, the plausibility of what S can be presumed to see becomes weaker and weaker as capability for foreseeing becomes weaker.

Finally there is the reverse reverse eikotic argument shown at the bottom. It uses the same premise as the previous two arguments, the statement that S is visibly stronger. It, like the straight eikotic argument, is a pro argument supporting the conclusion at issue, the statement that S is guilty. But this argument seems weaker, because it requires the more complex premise stating that people would have assumed that S foresaw that he would be held guilty.



In general, the goal of this paper was to treat interpretation and analysis of the weak and strong man example as a classic and still very interesting case of plausible argumentation. The informal logic tools so far developed in argumentation and artificial intelligence were shown to support three legitimate interpretations of the argumentation in the example using a connected series of eight argument diagrams. It was shown that the eikotic argument matched against the reverse eikotic argument is an instance of a reasonable use of plausible reasoning of a kind that might be used in many other contexts as well and is still ubiquitously used in all kinds of real arguments.

This paper has shown how these tools can be applied to many more examples of the same kind. Not only sophists such as Gorgias, but also orators such as Antiphon, Lysias, Isocrates, and others made ample use of eikotic arguments (Kraus, 2010, 364). Such arguments are still plentiful today. They are commonly used in physician-patient decision-making (Upshur and Colak, 2003; Macagno and Bigi, 2017), are widely studied in computer science (Schank and Abelson, 1977; Hosseini et al., 2014), and are certainly ubiquitous in legal argumentation (Gordon and Walton, 2009; Walker et al., 2011). Comparisons to other noted examples of plausible reasoning in ancient Greek philosophy can be made, such as the famous snake and rope example of the philosopher Carneades. Other examples of this kind, including one of the best-known legal examples of plausible argumentation of the Sophist Antiphon, have also been modeled using the Carneades Argumentation System (Walton, Tindale and Gordon, 2014). Extending the analysis of the weak and strong man example in this paper to other examples can be suggested as another avenue for future research.

#### Acknowledgement

I would like to thank the Social Sciences and Humanities Research Council of Canada Insight for Grant 435-2012-0104 (2012-2019), that helped to support the research in this paper.

#### References

- Aristotle (1926). *Rhetoric* (trans. John Henry Freese). Cambridge, MA: Harvard University Press.
- Bex, F., Prakken, H., Reed, C. and Walton, D. (2003). Towards a Formal Account of Reasoning about Evidence: Argumentation Schemes and Generalizations, *Artificial Intelligence and Law*, 11 (2-3), 125-165.
- Burnyeat, M. F. (1994). Enthymeme: Aristotle on the Logic of Persuasion. In Furley, D. J. and Nehamas, A. (eds.), *Aristotle's Rhetoric: Philosophical Essays*. Princeton, N. J.: Princeton University Press, 3-55.
- Cohen, L. J. (1979). Rescher's Theory of Plausible Reasoning, *The Philosophy of Nicholas Rescher: Discussions and Replies*, ed. E. Sosa. Kluwer: Dordrecht.
- Cole, T. (1991). Who Was Corax?, *Illinois Classical Studies*, 16 (1&2), 1991, 65-84.

- Freeman, J. B. (1995). The Appeal to Popularity and Presumption by Common Knowledge, *Fallacies: Classical and Contemporary Readings*, ed. Hansen, H. V. and Pinto, R. C. University Park, Pa.: The Pennsylvania State University Press, 263-273.
- Gagarin, M. (1990). The Nature of Proofs in Antiphon, *Classical Philology*, 85 (Jan.), 22-32.
- Gagarin, M. (1994). Probability and Persuasion: Plato and Early Greek Rhetoric. In: I. Worthington (Ed.), *Persuasion: Greek Rhetoric in Action* (46-68). London: Routledge.
- Gordon, T. F. (2010). *The Carneades Argumentation Support System, Dialectics, Dialogue and Argumentation*, ed. C. Reed and C. W. Tindale, London: College Publications.
- Gordon, T. F. and Walton, D. (2009). Proof Burdens and Standards, *Argumentation in Artificial Intelligence*, ed. Iyad Rahwan and Guillermo Simari. Berlin: Springer, 239-260
- Govier, T. (1992). *A Practical Study of Argument*, 3<sup>rd</sup> ed., Belmont: Wadsworth.
- Hamilton, W. (1874). *Lectures on Logic*. Edinburgh: William Blackwood and Sons.
- Harary, F. (1972). *Graph Theory*. Menlo Park: Addison-Wesley.
- Hoffman, David C. 2003. Reversing Perceptions of Probability through Self- Referential Argument: Interpretation and Analysis of Protagoras' Stronger/Weaker Fragment. *Proceedings of the Fifth Conference of the International Society for the Study of Argumentation*, ed. F. H. van Eemeren, J. A. Blair, C. A. Willard, and A. F. Snoeck Henkemans. Amsterdam: Sic Sat, 503-507.
- Hohmann, H. (1989). The Dynamics of Stasis: Classical Rhetorical Theory and Modern Legal Argumentation, *American Journal of Jurisprudence*, 34(1), 171-197.
- Hosseini, S. A., Modgil and S., Rodrigues, O. T. (2014). Enthymeme Construction in Dialogues Using Shared Knowledge. In *Computational Models of Argument*. ed. S. Parsons; N. Oren, C. Reed and F. Cerutti. Amsterdam: IOS Press, 325-332.
- Joseph, H. W. B. (1916). *An Introduction to Logic*. Oxford: Clarendon Press.
- Josephson, J. R. and Josephson, S. G. (1994). *Abductive Inference: Computation, Philosophy, Technology*. Cambridge: Cambridge University Press.
- Kraus, M. (2007). Early Greek Probability Arguments and Common Ground in Dissensus, (2007). *OSSA Conference Archive*. 92.  
<http://scholar.uwindsor.ca/cgi/viewcontent.cgi?article=1344&context=ossaarchive>
- Kraus, M. (2010). Perelman's Interpretation of Reverse Probability Arguments as a Dialectical Mise en Abyme, *Philosophy and Rhetoric*, 43(4), 362-382.

- Macagno, F. and Bigi, S. (2017). Understanding Misunderstandings: Presuppositions and Presumptions in Doctor-patient Chronic Care Consultations, *Intercultural Pragmatics*, 14(1): 49.
- Macagno, F., Walton, D. and Reed, C. (2017). Argumentation Schemes, History, Classifications and Computational Applications, *IFColog Journal of Logics and Their Applications*, 4(8), 2493-2556.
- Minsky, M. (1975). A Framework for Representing Knowledge, reprinted in *The Psychology of Computer Vision*, P. Winston, ed., New York: McGraw Hill, 1975: available at <http://web.media.mit.edu/~minsky/papers/Frames/frames.html>
- Perelman, C. and Olbrechts-Tyteca, L. (1969). *The New Rhetoric: A Treatise on Argumentation*. Notre Dame: University of Notre Dame Press.
- Pollock, J. L. (1995). *Cognitive Carpentry*. Cambridge, Mass.: The MIT Press.
- Poole, D. L. and Macworth, A. K. (2011). *Artificial Intelligence: Foundations of Computational Agents*. Cambridge: Cambridge University Press.
- Rescher, N. (1976). *Plausible Reasoning*. Assen: Van Gorcum.
- Rescher, N. (2009). *Aporetics: Rational Deliberation in the Face of Inconsistency*. Pittsburgh: University of Pittsburgh Press, 2009.
- Schank, R. C. and Abelson, R. P. (1977). *Scripts, Plans, Goals and Understanding*. Hillsdale, New Jersey: Erlbaum.
- Schiappa, E. (2005). *Classical Rhetorics and Rhetoricians: Critical Studies and Sources*. Westport, Connecticut: Greenwood Publishing Group.
- Singh, P., Lin, T., Mueller, E., Lim, G., Perkins, T. and Li Zhu, W. (2002), Open Mind Common Sense: Knowledge Acquisition from the General Public, *Proceedings of the First International Conference on Ontologies, Databases, and Applications of Semantics for Large Scale Information Systems*, Lecture Notes in Computer Science. Heidelberg: Springer, 2002.
- Slomkowski, P. (1997). *Aristotle's Topics*, Leiden: Brill.
- Tindale, C. W. (1999). *Acts of Arguing: A Rhetorical Model of Argument*. Albany: State University of New York Press.
- Tindale, C. W. (2010). *Reason's Dark Champions: Constructive Strategies of Sophistic Argument*. Columbia, South Carolina: The University of South Carolina Press.
- Tindale, C. W. (2015). *The Philosophy of Argument and Audience Reception*. Cambridge: Cambridge University Press.

- Upshur, R. E. G. and Colak, E. (2003). Argumentation and Evidence, *Theoretical Medicine*, 24 (4), 283-299.
- Van Eemeren, F. H. and Grootendorst, R. (1992). *Argumentation, Communication and Fallacies*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.
- Van Eemeren, F. H. and Grootendorst, R. (2004). *A Systematic Theory of Argumentation*. Cambridge: Cambridge University Press.
- Vega Renon, L. (1998). Aristotle's *Endoxa* and Plausible Argumentation, *Argumentation*, 12, 1998, 95-113.
- Verheij, B. (1999). Logic, Context and Valid Inference Or: Can There be a Logic of Law? in: H. Jaap van den Herik et al. (eds), *Legal Knowledge Based Systems, JURIX1999, The Twelfth Conference*. Nijmegen: 109-121. <http://jurix.nl/pdf/j99-10.pdf>
- Walker, V. R., Carie, N., DeWitt, C., and Lesh, E. (2011). A Framework for the Extraction and Modeling of Fact-finding Reasoning from Legal Decisions, *Artificial Intelligence and Law*, 19(4), 291-331.
- Walton, D. (2002). Are Some *Modus Ponens* Arguments Deductively Invalid? *Informal Logic*, 22(1), 19-46.
- Walton, D. (2001). Enthymemes, Common Knowledge and Plausible Inference, *Philosophy and Rhetoric*, 34, 93-112.
- Walton, D. (2008). The Three Bases for the Enthymeme: A Dialogical Theory, *Journal of Applied Logic* 6:361-379.
- Walton, D. and Reed, C. (2005). Argumentation Schemes and Enthymemes, *Synthese*, 145, 2005, 339-370.
- Walton, D., Reed, C. and Macagno, F. (2008). *Argumentation Schemes*. Cambridge: Cambridge University Press.
- Walton, D. and Gordon, T. F. (2015). Formalizing Informal Logic, *Informal Logic*, 35(4), 508-538.
- Walton, D. Tindale, C. W. and Gordon, T. F. (2014). Applying Recent Argumentation Methods to Some Ancient Examples of Plausible Reasoning, *Argumentation*, 28(1), 85-119
- Wolf, S. (2010). A System of Argumentation Forms in Aristotle, *Argumentation*, 24(1), 19-40).
- Wooldridge, M. (2002). *An Introduction to MultiAgent Systems*. Chichester: Wiley.