

## VISUALIZATION TOOLS, ARGUMENTATION SCHEMES AND EXPERT OPINION EVIDENCE IN LAW

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Current research in artificial intelligence is developing new models of evidential reasoning that have advanced beyond constraints imposed by traditional logical models of reasoning. In these new models, evidential reasoning is seen as defeasible, and as based on argumentation schemes that carry evidential weight in the larger evidential context of a dispute that needs to be resolved. The new models of evidential reasoning have been closely tied in with the development of visualization tools, both in informal logic and artificial intelligence, especially automated systems for argument diagramming. This paper presents a look at some points where the two technologies intersect, stressing the mutual benefits, especially as applied to legal argumentation. The central focus of this paper is on working toward a better understanding of how evidence can support a claim and how evidence can go against a claim. As a case in point, the paper will study expert opinion evidence, but the lessons apply to all kinds of evidence and to all argumentation schemes, or very many of them. We can model the reasoning used to support or undermine all kinds of evidence using various argumentation schemes.

There is already a considerable literature in the field of argumentation studies on the argumentation scheme for argument from expert opinion, and in particular how this form of argument can be rebutted or undercut by the asking of critical questions. In this paper, the problem is put in a legal perspective. In the argumentation literature, the problem has been posed as one of how to evaluate and argument from expert opinion when one of the critical questions matching the argumentation scheme is asked (Walton and Reed, 2003). In its legal formulation, the argument from expert opinion may need to have a different scheme from the one currently accepted in argumentation studies. The legal scheme may have to be more precisely formulated in certain respects to fit the needs of its use in a trial format as a form of evidence.

### 1. Argumentation Schemes Introduced

Argumentation schemes are stereotypical patterns of reasoning used in everyday conversational argumentation, and other contexts, notably legal and scientific argumentation (Walton and Reed, 2003). They are the historical descendants of the so-called topics of Aristotle, traditionally thought to be useful for inventing arguments as well as for analyzing them. Quite a few schemes have been identified and studied in the recent literature - see Hastings (1963), Perelman and Olbrechts-Tyteca (1969), Kienpointner (1992), Walton (1996), and Grennan (1997). Independently, some schemes especially fundamental in scientific reasoning have been studied in artificial intelligence. Pollock's OSCAR (1995), identified a few of these schemes and Josephson and Josephson (1994) provided an analysis of abductive reasoning that can be easily be seen as representing an argumentation scheme. Increasingly schemes are being recognized in computational domains like multi-agent systems as holding potential for making

significant improvements in the reasoning capabilities of artificial agents used as argument assistants for lawyers (Verheij, 2005). Most of the schemes that are of central interest in argumentation theory represent forms of plausible reasoning that are inherently that do not seem to fit very well into the traditional deductive and inductive models. Such schemes are called “presumptive” in (Walton, 1996). However, it is quite possible to treat familiar deductive and inductive forms of reasoning as schemes as well (Grennan, 1997).

Some of the most common presumptive or plausible reasoning schemes are the following: argument from witness testimony, argument from position to know, argument from expert opinion, argument from popular opinion, argument from example, argument from analogy, practical reasoning (from goal to action), argument from verbal classification, argument from vagueness of a verbal classification (a rebuttal to the previous scheme), argument from sign, argument from popular practice, argument from sunk costs, argument from appearance, argument from ignorance (lack of evidence), argument from cause to effect, argument from correlation to cause, abductive argumentation scheme, argument from consequences, argument from alternatives, argument from threat, argument from fear appeal, argument from pity, argument from commitment, *ad hominem* argument (various subtypes), argument from inconsistent commitment, argument from bias (a rebuttal), argument from gradualism, slippery slope argument (various types), argument from an established rule, argument from an exceptional case, argument from precedent.

Each scheme has a set of critical questions matching the scheme that represent standard ways of critically probing into and argument to find its potential weak spots. The original motivation of schemes was to help teach university students skills of critical thinking, of the kind needed to write an essay, for example. Thus they are typically expressed in a way that needs more cleaning up if they are to be formalized in a manner that would make them more useful for artificial intelligence (Verheij, 2003). Another problem with schemes concerns the distinction between merely questioning an argument and what could be called rebutting it, meaning to attack the argument by offering evidence against it. This distinction is fundamentally important for informal logic, where we have to counsel students that it is possible to merely question an argument critically without trying to refute it by posing a counter-argument. We have noted above also that some schemes, like argument from bias, are inherently negative in nature, in that they are used as rebuttals of other schemes.

Pollock (1995) drew an important distinction between two kinds of arguments that can attack and defeat another argument, calling them rebutting defeaters and undercutting defeaters. A rebutting defeater (rebutter) gives a reason for denying a claim (Pollock, 1995, p. 40), and therefore it can be said that a rebutter attacks the claim, or conclusion of the argument it is aimed at. An undercutting defeater (undercutter) has a different aim. It attacks the inferential link between the claim and the reason rather than attacking the claim (p. 41). This distinction seems clear enough in principle, but it is very easy to get in trouble with. It is best to cite Pollock’s leading example (1995, p. 41).

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).

The object may still be red, for all we know, despite the undercutter stated above. The new data undercuts the original argument by removing the support of the inferential link between the premises and the conclusion. But it does not rebut the original argument by showing that the conclusion is false.

Schemes for defeasible argumentation are being widely applied to example of everyday conversational argumentation in studies on informal logic. But can they be applied to law, where the management of expert opinion evidence is not only fundamentally important but also highly controversial, and subject to considerable ongoing controversy? Verheij (2003) showed that schemes are potentially useful in law and AI, but they have many rough edges that need to be smoothed out before they can be formalized in a manner that would make them useful for computing. He chose *argumentum ad hominem* as his example scheme for analysis, but many of the same basic points can be made about any scheme, as will be shown by considering argument from expert opinion.

## 2. Argument from Expert Opinion

Expert opinion evidence has itself been very controversial within law as a form of argument to be judged as admissible and to be evaluated in trials (Kaye, Bernstein and Mnookin, 2004). Standards are still in a process of evolution, and some fundamental issues appear still not be resolved. An open question is the extent to which argumentation schemes need to be tailored to specific domains, and in particular whether argument from expert opinion might be much more manageable in evidential reasoning in law if the scheme were to be expressed in a format compatible with the framework of a legal system like that of the American law and the standards and methods currently being developed in that framework for managing this kind of evidence in trials (Godden and Walton, 2006). Some moves in this direction would be extremely useful to explore, and would greatly enrich the value of argument visualization tools as applied to evidential reasoning in law.

The scheme representing argument expert opinion as a form of argument was formulated in (Walton, 1997, p. 210) as follows.

### Scheme for Argument from Expert Opinion

Major Premise: Source *E* is an expert in subject domain *D* containing proposition *A*.

Minor Premise: *E* asserts that proposition *A* (in domain *D*) is true (false).

Conclusion: *A* may plausibly be taken to be true (false).

The six basic critical questions matching the appeal to expert opinion, as indicated in (Walton, 1997, p. 223), are listed below.

### Critical Questions for Argument from Expert Opinion

1. *Expertise Question*: How credible is *E* as an expert source?

2. *Field Question*: Is *E* an expert in the field that *A* is in?
3. *Opinion Question*: What did *E* assert that implies *A*?
4. *Trustworthiness Question*: Is *E* personally reliable as a source?
5. *Consistency Question*: Is *A* consistent with what other experts assert?
6. *Backup Evidence Question*: Is *E*'s assertion based on evidence?

The expertise question is based on the assumption that the expert has knowledge in a field or practical mastery of a skill. In the conventional formulation of the argumentation scheme for argument from expert opinion used in argumentation studies, one of the critical questions is the trustworthiness question. The trustworthiness question concerns the general have ethical trustworthiness of the expert as a source that can be relied upon to tell the truth.<sup>1</sup> Asking it casts doubt on the assumed honesty and objectivity of the expert as a source. Each critical question can have critical subquestions under it.

One of the subquestions of the trustworthiness question is the bias question. This question asks whether the expert is biased to one side or the other in the dispute at issue. For example, it might be questioned whether an expert is biased based on the claim that the expert has something to gain, for example financially, by supporting one side or the other of the issue being disputed. According to Kaye, Bernstein Mnookin (2004, p. 335), one of the most frequent criticisms of experts in trials is that they exhibit undue partisanship. They are even said to become “the hired my mouthpieces for the parties’ points of view instead of objective spokesmen for scientific truth”. Since experts are generally paid to testify by a side, they are often criticized as hired guns, sometimes with very good justification. It was pointed out by Kaye, Bernstein and Mnookin (2004, p. 341) that even though the “true” expert for hire may not be all that common in the courts, there are still a number of more subtle problems that stem from partisan expert opinion evidence, including selective presentation of evidence, and testimony shaded to support the party paying the expert.

It should be noted as well that argument from expert opinion can be seen as resting on a defeasible generalization *DGE*: whenever source *E* is an expert in subject domain *D* containing proposition *A* who asserts that proposition *A* (in domain *D*) is true (false), generally (but subject to exceptions), *A* may plausibly be taken to be true (false). Such a generalization can be seen as an implicit premise of the scheme for argument from expert opinion.<sup>2</sup> Corresponding to every defeasible argumentation scheme is a generalization of this sort that links the premises to the conclusion. This generalization rests on the presumption in favor of expert opinion. In Toulmin terminology, the generalization is the warrant of the inference.

How a generalization provides support for a warranting an argument from expert opinion can be illustrated in the Araucaria diagram in figure 1 below.

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<sup>1</sup> Schum (1994, p. 107) treats factors like previous convictions related to dishonesty, other misconduct related to dishonesty, character evidence regarding honesty, and testimonial bias, under the heading of veracity. He treats objectivity as a separate factor in assessing witness credibility.

<sup>2</sup> See Anderson, Schum and Twining (2005, chapter 10) on generalizations in legal reasoning about evidence.

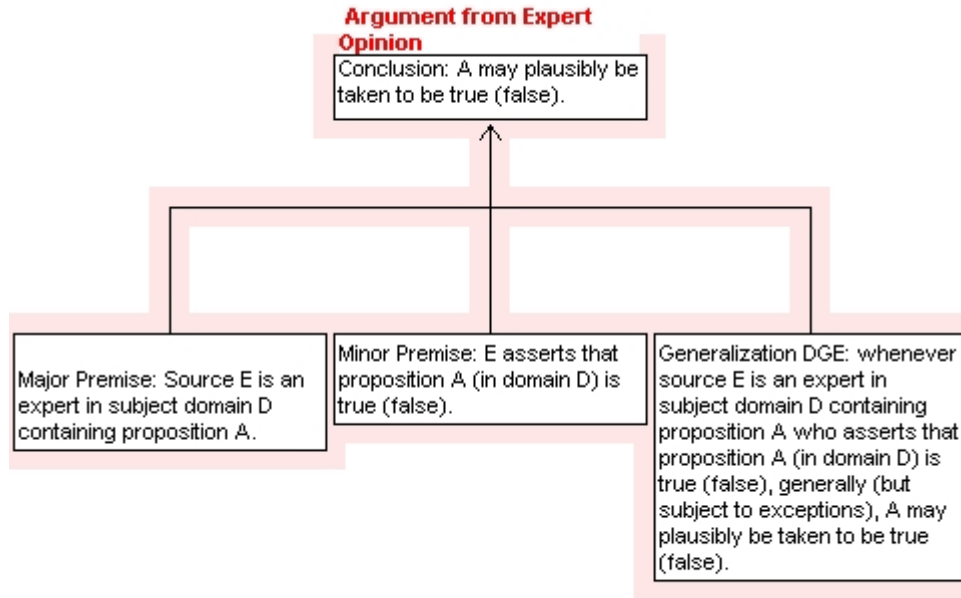


Figure 1: Argument from Expert Opinion with Scheme and Generalization

The structure in figure 1 shows how the generalization provides an additional premise for the argumentation scheme for argument from expert opinion. The defeasible generalization holds as a premise in a normal kind of case, but it can default in an exceptional case, and the argument from expert opinion will fail, once the case is shown to be exceptional by a critic.

There has been a problem with how the set of critical questions matching a scheme should be handled as a device that can be used in an automated system of argument analysis and evaluation. In 2001 Chris Reed posed the question of whether the critical questions can be represented on an argument diagram as implicit premises of the argument. The other critical questions can be seen as implicit premises, because the argument doesn't hold up without these assumptions being part of it. Questions 4 and 5 are different. If there is evidence that the cited expert is biased or dishonest, for such claims, that attacks the argument, but to advance such an attack, the questioner surely has to produce some evidence of bias or dishonesty. And if the expert's assertion can be shown not to be inconsistent with what other experts in the same field say, that allegation is only an effective criticism if it is backed with some evidence concerning what these other experts have said. The difference between the other critical questions and questions 4 and 5 could be described as one of burden of proof. You could say that critical questions 4 and 5 have a positive burden of proof attached, whereas the other critical questions demand a response once asked, even if not evidence is given to back them up. Thus the problem of how to manage critical questions relates to the more general problem of burden of proof in argumentation.

### 3. The Problem of Making Schemes More Precise

Verheij (2003) has investigated how argumentation schemes could be formalized in such a way that they could be used in computing systems for argumentation. He began (p. 176) by noting that any argumentation scheme has the following general form. Verheij suggested that it may be useful to treat some of the questions in a different way from others. Critical questions that point to exceptions to a general rule only undercut an argument while others could be seen refuting the argument by denying implicit assumptions on which it rests, or by pointing to counter-arguments. He began by showing that critical questions can have four different kinds of roles.

- 1.They can be used to question whether a premise of a scheme holds.
- 2.They can point to exceptional situations in which a scheme should not be used.
- 3.They can set conditions for the proper use of a scheme.
- 4.They can point to other arguments that might be used to attack the scheme.

Verheij's formalization of the roles of critical questions depends on the well-known distinction in the literature due to Pollock (1995, pp. 40-41), cited above, between undercutters and rebutters. This distinction can be tricky, but it would seem that a rebutter does not have to be a stronger argument than the one it attacks, so it actually does defeat (refute) it. It only has to be any argument with a conclusion that is opposed to that of the original argument. In other words, the rebutter would defeat the opposed argument if it is the stronger argument of the two. Still, the undercutter seems to be the weaker form of attack, since it only undermines the inferential link whereby the original argument supported its conclusion.

Verheij pointed out that the critical questions that criticize the premises of a scheme can be seen as redundant, from a computational point of view, because they merely ask whether the premise is true. It is a condition of the use of any argument that the premises are true, or at least are acceptable. Thus he argued that critical questions that merely restate a premise of an argumentation scheme are redundant, and can be ignored. For example, the field question, in the list of critical questions matching argument from expert opinion above, could be said to be redundant, because the major premise already says that *E* is an expert in field *F* containing proposition *A*.

In Verheij's method of argument diagramming, called ArguMed, undercutters are drawn by a device called entanglement. An undercutter is represented diagrammatically as a line that points from a text box to another line, indicating that an undercutter attacks the inferential link between the premises and conclusion of the original argument depicted. An example of entanglement is an argument from expert opinion is given in figure 3 below. A key difference between *Araucaria* and ArguMed is that entanglement is not possible in *Araucaria*. Lines can only go from nodes to a node, but never from a node to a line connecting nodes.

#### 4. The Problem of Diagramming Schemes with Critical Questions

*Araucaria* represents arguments from expert opinion using a different kind of diagram that models arguments based on an important distinction. A linked argument is one where both (or all) premises are needed to support the conclusion, whereas a convergent argument is one where each premise supports the conclusion independently of the other(s). *Araucaria* also has a tool for displaying selected argumentation schemes on the diagram. For example, the *Araucaria* diagram shown in figure 2.

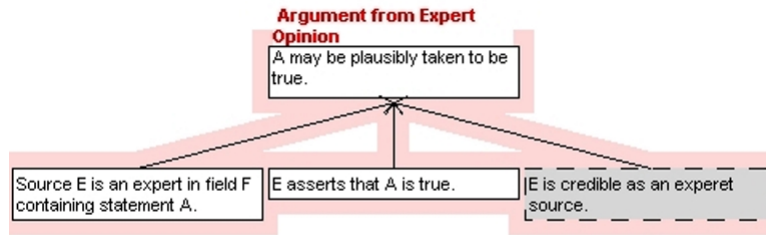


Figure 2: *Araucaria* Diagram with Implicit Credibility Premise as Rebutter

What is displayed in figure 2 is a linked argument with its two explicit premises in the two bottom boxes at the left linked together with a third premise. The third premise, shown in the darkened box with the dashed lines around it, is an implicit premise that has been added in. The conclusion of the argument is shown in the top box. The inference from all three premises to the conclusion is warranted by the argumentation scheme for argument from expert opinion. The scheme is displayed by its name above the conclusion at the top and its scope by the colored outline around the argument.

As shown in figure 2, the implicit premise ‘E is credible as an expert source’ functions as kind of critical question. This premise is part of a linked argument. If any premise in a linked argument is questionable or fails to hold, the support of the argument as a whole for its conclusion falls down. Thus the implicit premise as shown in figure 2 functions like a rebutter. Once made explicit, it shifts a burden of proof onto the proponent of the argument from expert opinion to support it, or the argument falls down. Thus this diagram can be seen as a way of representing the credibility critical question as a rebutter. If the implicit assumption that E is credible as an expert source fails, the whole argument from expert opinion is defeated.

Another way of representing a critical question as an additional implicit premise of an argumentation scheme is shown in figure 3. In figure 3, the trustworthiness critical question is represented as an implicit premise. Recall that the bias question is regarded a subquestion of the trustworthiness question. Hence in figure 3, the implicit premise that E is trustworthy is shown as backed up by another implicit premise stating that evidence can be given showing some sort of bias by the proponent of the argument.

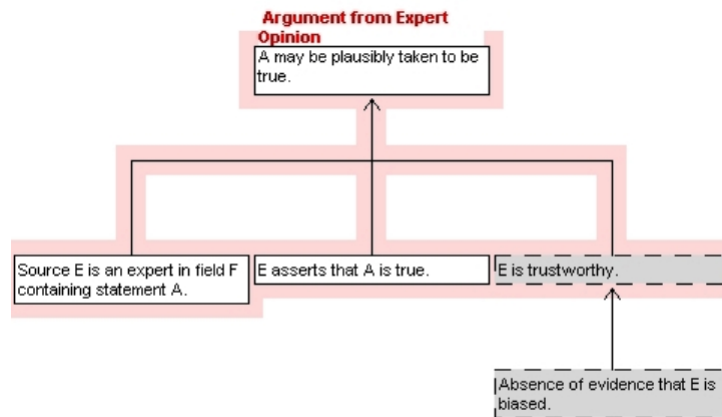


Figure 3: *Araucaria* Diagram with Implicit Trustworthiness as Undercutter

Here there is a contrast with figure 2, where the critical question functioned as a rebutter. Here, the premise that E is trustworthy needs to be backed up by evidence of some sort of bias before the original argument from expert opinion is defeated. As long as there is absence of any bias shown, the expert remains trustworthy, and the argument holds up. Only if specific evidence of bias is given does the argument fail. Merely asking the critical question is not enough to defeat the argument. Hence the trustworthiness question acts as an undercutter, as opposed to a rebutter.

In both figures 2 and 3, the scheme for argument from expert opinion has been represented in a guise where each critical question is represented as an additional implicit premise, supplementing the original premises of the scheme. But still, even though we can represent critical questions as additional implicit premises, on either system of argument diagramming, this method still fails to distinguish very well between those critical questions that functions as undercutters versus those that function as rebutters. For the argument in figure 3 is still defeated if the premise that the expert is trustworthy fails to hold. The contrast between the argument structures shown in figures 2 and 3 still does not seem to be enough to model the distinction between types of critical questions that rebutters and types that are undercutters.<sup>3</sup>

The argument diagramming method is an excellent way of representing arguments made up of premises and conclusions (propositions), but it seems to reach its limits when it comes to representing critical questions. *Araucaria* does represent refutation as a special type of argument on a diagram, and it does represent owners of arguments, but that is about as far as it goes in representing dialogue notions. Modeling questions in argumentation, as opposed to propositions and inferences on sets of propositions, is something this kind of diagramming technology is not meant to do, lest it become too complex and thereby less useful. We seem to have reached some limits at this point, and what is needed to supplement it is some formal representation of moves in a dialogue between two parties, a more adequate model for displaying the subtler nuances of shifts in the burden of proof from one side to the other in argumentation. *Carneades* took the next step forward by representing the critical questions on the argument diagram, and distinguishing between different kinds of effects on defeating the original argument that different kinds of critical questions have.

## 5. How *Carneades* Models Evidence

The original motivation of the *Carneades* system was to accommodate posed the two different theories of what happens when a respondent asks a critical question (Walton and Gordon, 2005). On the one theory, as indicated above, when a critical question is asked, the burden of proof shifts to the proponent's side to answer it. On the other theory, merely asking the question does not defeat proponent's argument does not fail until the respondent offers some evidence to back it up. *Carneades* approaches this distinction by

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<sup>3</sup> Note that there is at least one other option for representing the kind of argument shown in figure 3. An implicit premise stating that there is evidence that E is biased could be drawn as a refutation of the premise that E is trustworthy. The trustworthiness premise would seem to function as undercutter, because evidence of bias needs to be given to defeat the argument. But much the same comments apply to this case.

distinguishing three types of premises, called ordinary premises, assumptions and exceptions. Ordinary premises behave like assumptions at issue. An assumption holds if it is undisputed or accepted, but not if it is rejected. An undisputed ordinary assumption holds if its statement is acceptable, given its proof standard, or if it has been accepted, but not if it has been rejected. Exceptions hold unless the statement of the exception has been proven acceptable.

In Araucaria a premise is diagrammed as a statement in a box, and the role of the premise is displayed, like major or minor premise, is displayed in the box. An example is shown in figure 1. In Carneades a premise is a relation between a statement and an argument, shown as a link in the diagram. An example is given in figure 4 below. This is a key difference between the two diagramming systems. In Araucaria, each statement can be used as a premise in only one argument. In Carneades, a statement can be used as a premise in any number of arguments.

Pollock-style rebutters are modeled as arguments in the opposite direction for the same consequent. For example if one argument is *pro* the consequent its rebutter would be another argument *con* the same consequent. Premise defeat is modeled by an argument *con* an ordinary premise or assumption, or *pro* an exception (Gordon, 2005, p. 56).

Undercutters are modeled as arguments *pro* exceptions

The diagram in figure 4 shows how the argument in Pollock's red light example works as an undercutter in Carneades, reformulated as an instance of a scheme for argument from appearance.<sup>4</sup> Figure 4 shows three arguments. The first, a1, is an instance of the new version of the scheme for argument from appearance (below).

Scheme for Argument from Appearance

Major premise: If the object looks x then the object is x.

Minor premise: The object looks x.

Better explanation exception: There is a better explanation for the object's appearance.

Conclusion: The object is x.

An especially notable feature of the new scheme is that it develops the earlier version of the scheme (Walton, 2006) to include an abductive component.

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<sup>4</sup> Prakken (2003, p. 858) presented a legal example suggesting how common such forms of argument are in law: this object looks like an affidavit, therefore it is an affidavit. This type of argument has been represented as an argumentation scheme (Walton, 2006) called argument from perception or 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 defeasible argument 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 using critical questions. During a report of a convenience store robbery (*Radio News*, November 9, 2004), the convenience store clerk stated: "The handle of what appeared to be a handgun was visible in his [the robber's] pocket". By argument from appearance, if the item visible in the pocket appeared to be the handle of a handgun, then the tentative conclusion can be drawn that it is the handle of a handgun. One reason for invoking such a presumption is safety. It may prudent to assume that the concealed object is a handgun, based on what appears to be its visible handle, even though the assumption may be wrong.

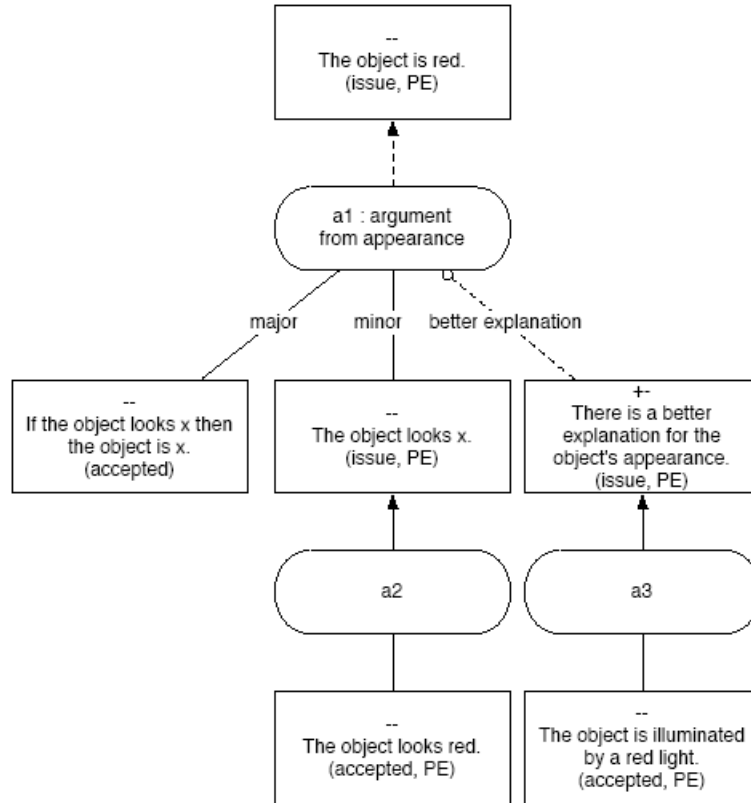


Figure 4: Pollock's Red Light Example in Carneades

As shown in figure 4, the second argument a2, is an argument pro the minor premise, 'The object looks red'. The third argument a3, is an argument pro the exception, 'The object is illuminated by a red light'.

Figure 4 also illustrates some further features of Carneades as a diagramming method. The argument pro the exception, a3, causes the premise for the exception to not hold. This is shown on the diagram with the dotted line from the exception to a1. This in turn causes argument a1 to fail, also shown with a dotted line from a1 to the main conclusion, 'The object is red'. Given the selected proof standard of "preponderance of the evidence" (shown as PE on the diagram, the statement), 'The object is red' is not acceptable, as shown with the -- label at the top of the box for this statement. The second - in -- means it is also not rejectable. At this point in the discussion, there are no sufficient grounds for either accepting or rejecting the statement. The exception undercuts a1, but does not provide an argument for the negation of the main claim. That is, the arguments are not sufficient to support the claim that the object is not red.<sup>5</sup>

Witness testimony as a form of evidence is based not only on schemes for witness testimony and argument from expert opinion, but underlying these schemes, often argument from appearance can be found. In particular, critical questions for witness

testimony evidence, for example of the kind questioning observational sensitivity (Schum, 1994, p. 104), may relate to argument from appearance.<sup>6</sup>

## 6. How Carneades Models Argument from Expert Opinion

The following syntax suggests how Carneades analyzes the scheme for argument from expert opinion, where the conclusion is statement A.

### Argument from Expert Opinion in Carneades

```
(argument arg-1
  (scheme argument-from-expert-opinion)
  (premises
    (domain e d)
    (asserted e a)
    (within a d)
    (assuming (credible e))
    (assuming (based-on-evidence (asserted e a)))
    (unless (not (trustworthy e)))
    (unless (not (consistent-with-other-experts e))))
  (conclusion (pro a)))
```

The three ordinary premises are that the expert is an expert in the subject domain of the claim, that she asserted the claim in question, and that the claim is in the subject domain in which she is an expert, are assumed to hold. The two assumptions are that the expert is credible as an expert and that what she says is based on evidence, are taken to hold. The additional two premises, that the expert is not trustworthy, and that what she says is not consistent with what other experts say, are assumed to not hold, until such time as new evidence comes in showing they are acceptable. The exceptions are like exceptions to a rule in defeasible reasoning.

In Carneades, the key differences concerning burden of proof between the different kinds of critical questions can be represented on the argument diagram in figure 5.

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<sup>6</sup> Unfortunately there is no space to dwell on this interesting point here.

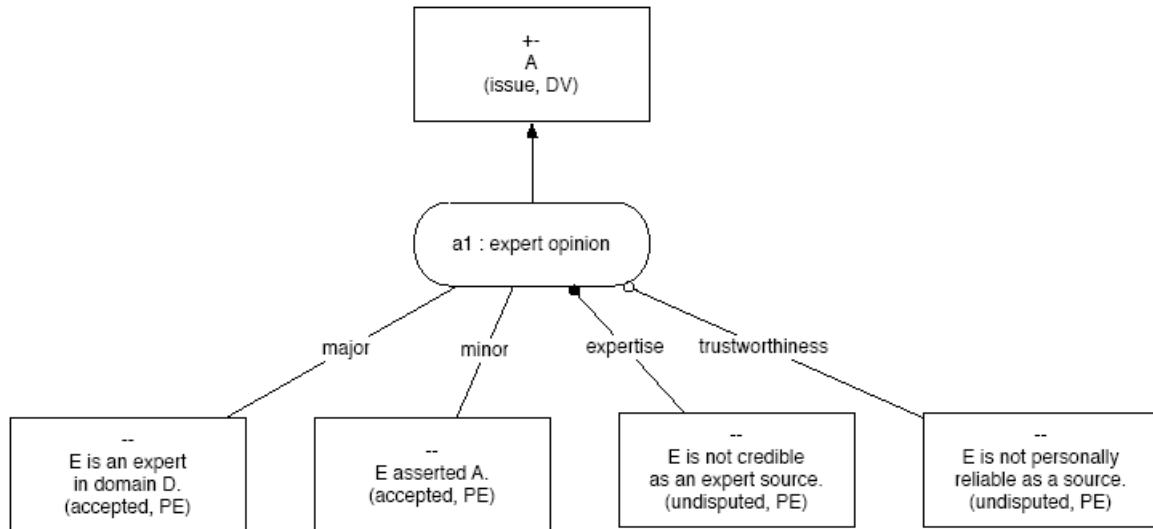


Figure 5: Argument from Expert Opinion in Carneades

Exceptions hold unless the statement of the exception has been accepted or proven acceptable. It is assumed, for example, that expert E is trustworthy unless some evidence can be given that E is not trustworthy. This if a critic asks, ‘Is E trustworthy?’, merely asking the question is not enough to defeat the argument until some evidence is given that shows that E is not trustworthy. The proponent does not have to offer evidence to support the original argument. Instead, the burden of proof has shifted to the critic. Both assumptions and ordinary premises are assumed to not hold, however, unless the proponent can cite evidence showing such a premise does hold. This is the normal situation of burden of proof with any argument put forward by a proponent. If questioned about a premise, the proponent must offer some evidence that it holds or the argument is defeated. Merely asking the question is enough to defeat the argument temporarily.

The solution of Carneades to the problem of critical questions is helped by its capability to support dialogue structures that enable implicit premises to be revealed dynamically as a dialogue proceeds. The status of statements as accepted or not can change during the course of a dialogue. The acceptability of a statement also depends on its proof standard. The four proof standards are: scintilla of evidence, preponderance of the evidence, dialectical validity, and beyond a reasonable doubt (Gordon and Walton, 2006). In response to an argumentation scheme, each critical question is modeled as a presumption placing a burden of proof on the proponent, or as an exception placing the burden on the respondent. Even after the respondent has made an issue out of the statement in an exception, the statement continues to hold until sufficient evidence has been presented to show that it does not hold. Thus Carneades allows the burden of proof to be assigned to either the proponent or the respondent in a dialogue, depending on how the premises of a given argumentation scheme are classified.

## 7. Bias and the Trustworthiness Question

The bias critical question is a subquestion of the trustworthiness critical question matching the argumentation scheme for argument from expert opinion. The trustworthiness critical question is classified as an exception, meaning that when the respondent asks this critical question, it will not defeat the original argument from expert opinion unless some reason is given to support the claim that the expert witness is not trustworthy. One such reason might be the statement that the expert is biased. However, another response might be to ask if the expert is biased. This critical question is itself best classified as an exception. So it will not defeat the argument from expert opinion unless some reason is given that supports the claim that the expert witnesses biased. In either case, we get the chain of argumentation shown in figure 6.

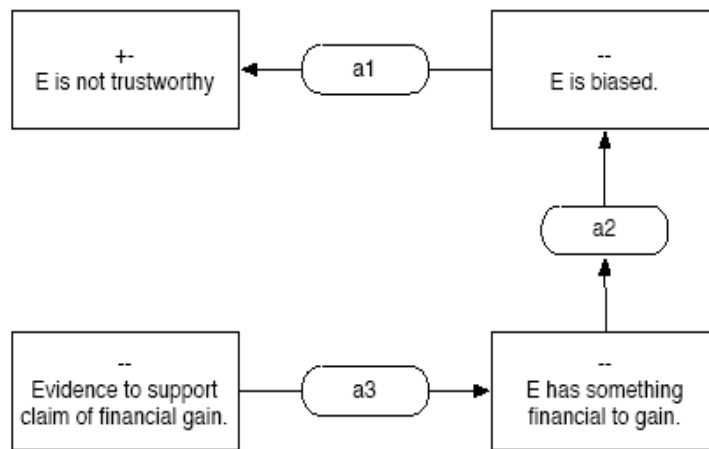


Figure 6: Bias Allegation Supporting the Trustworthiness Question

If in response to expert testimony the question is asked directly whether the witness is biased, since this question too is classified in Carneades as an exception rather than an assumption, it needs to be backed up by further evidence for the asking of the question to defeat the preceding argument from expert opinion. So both kinds of cases, as shown by the two options in the middle box, require some kind of backup evidence in order to defeat the original argument from expert opinion. The kind of evidence required is illustrated in the two boxes on the right.

But it also needs to be pointed out is that there can be many different argument configurations involving questioning and rebuttal based on argumentation questioning trustworthiness and bias. As shown in (Walton 1999 p. 216), such arguments can be a reasonable in some cases but fallacious in others. Fallacious use of argumentation from bias is frequently identified in logic textbooks with the *ad hominem* argument. Many logic textbooks identify a subtype of *ad hominem* argument called the bias *ad hominem* argument. Different categories of personal attack arguments fitting under the general category of *ad hominem* have been identified, but one of these is the bias subtype that attacks and arguer's trustworthiness by alleging that he or she is biased in some way. Bias can be analyzed dialectically as a lack of balance appropriate for the context of dialogue. For example, in a debate on an environmentalist issue, one party may be

attacked as biased when it is found that he works for a coal company, and this has a financial interest at stake in the outcome of the debate. It is argued in (Walton, 1999) that bias, or having a point of view, is normal in many contexts of argumentation, and that when you are attacked on grounds of bias, what is typically meant is that the bias is of a bad type that is an obstacle to the proper progress of the dialogue the participants are engaged in.

## 8. Refining the Expert Opinion Scheme for Use in Law

The original schemes and their critical questions were devised to help students in critical thinking courses identify, analyze and evaluate arguments in everyday conversational argumentation. They can be reconfigured, not only for use in AI, but they may also require special refinements for use in law. Below is a new version of the scheme for argument from expert opinion put forward for use in Carneades.

### Version 1 of Legal Argument from Expert Opinion

Ordinary Premise 1: E is an expert in knowledge domain D.

Ordinary Premise 2: E said that statement S is true.

Assumption 1: S is in D.

Assumption 2: E has depth of knowledge in D.

Conclusion: S may plausibly be taken to be true.

Version 1 is similar to the original scheme, except that the that the statement that S is in D, which was in the major premise of the original version, now becomes an assumption. Another difference is that the domain is now called a knowledge domain instead of subject domain. What the new version makes clear is that the expert E is an expert because E is assumed to possess knowledge. This new version fits with the notion of an expert as a source or data base containing knowledge. The final difference is assumption 2, which speaks of the depth of knowledge in the knowledge domain. This premise is built on the notion that some experts can have more knowledge than others. Thus we can consider an alternative to the assumption 2 premise:

Assumption 2\*: The knowledge of E about D is deep enough to know about S.

This version makes depth a matter of degree. To the extent that E's depth of knowledge is judged deep enough to know whether or not S is true, the argument is made stronger.

Next let's consider two other assumptions attached to the scheme:

Assumption 3: What E asserts is based on evidence.

Assumption 4: What E said asserts or implies S.

There are some questions about the formulation of these two questions. What is meant by the expression "what E asserts"? Does it refer to the precise text of his testimony, quoted, or some interpretation (the statement meant) by this testimony? We take it to

refer mean the text of his testimony. But this leads to the next question. What is meant by ‘implies’ in the premise “What E said asserts or implies S”? If logical implication is meant, the “what E said” would have to be some other statement, i.e. a proposition, not the raw quoted text of this testimony. The issue of logical implication can only be addressed after we have interpreted the testimony, moving from the sentences of the raw text to some proposition. For these reasons it could be suggested that we change this assumption to address the issue of whether S is a reasonable interpretation of his testimony, rather than whether it is implied by his testimony.

Next, there is some uncertainty about the meaning of the expression “what E asserts” as being “based on evidence”. This expression seems ambiguous, because it is not clear whether “what E asserts” refers to his actual testimony or some interpretation of this testimony. Is it meant that there is evidence that E actually said (the quoted text, not some interpretation) what he is claimed to have said? Perhaps he has been misquoted.<sup>7</sup> Or is the question meant to ask whether there is evidence that E based his testimony on further evidence? This could be called second degree evidence. The question is whether E had based his testimony on a careful consideration of evidence? In a legal context, it can be assumed that the latter is meant, since in courts of law, at least, there usually will be no issue about the content of his testimony. The procedures of the court, with their court reporters, are fairly reliable.

Putting all these considerations together, the following alternative scheme might be proposed.

#### Version 2 of Legal Argument from Expert Opinion

Ordinary Premise 1: E is an expert in knowledge domain D.

Ordinary Premise 2: E said the sentence S\*.

Ordinary Premise: S is a reasonable interpretation of S\*.

Assumption 1: S is in D.

Assumption 2: The knowledge of E about D is deep enough to know about S.

Assumption 3: E’s testimony S\* is based on his own careful analysis of evidence in this case.

Exception 1: S is inconsistent with what other experts in D say.

Exception 2: E is not trustworthy.

Conclusion: S may plausibly be taken to be true.

The old version of the expertise question asked how credible E is as an expert source. The term ‘credibility’ was misleading, because it seemed to suggest something more like the trustworthiness question. Now this potential misunderstanding has been removed. The depth of knowledge presumption refers to mastery of the domain of expertise. The trustworthiness exception refers to things like bias or dishonesty. If the expert has a financial gain at stake, or has been known to lie in the past, these are the sorts of questions that come under the general heading of trustworthiness. Thus the ethical or personal trustworthiness is contrasted with depth of knowledge in a field of expertise.

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<sup>7</sup> Quotation as providing a kind of evidence that can sometimes be subject to abuse through misquotation and manipulation is a subject of current research by Douglas Walton and Fabrizio Macagno.

Generally speaking, the original scheme, with its ordinary premises, needs to be simple and thus to have explanatory power. It is useful to keep the basic scheme simple, but at the same time to make it take complications into account so that the premises do defeasibly imply the conclusion. The assumptions and exceptions are then taken as additional factors that need to be taken into account, or may need to be questioned, to be sure that no gaps exist of a kind that would make the basic argument unreliable.

In the new version of the scheme above, the term ‘said’ is meant to be ambiguous. It can refer to two types of cases. One is where the expert actually asserted statement S. The other is the kind of case where the expert did not state S explicitly, but nevertheless, based on the text of discourse recording with the expert actually said, it can be reasonably inferred that the expert is committed to statement S. This kind of distinction is very important, because experts often speak in technical terms, and may express qualifications, so that it is very hard for the lay person user to interpret what the experts said correctly, and draw the right conclusion from it on what the expert is advising. If the expert actually asserted S explicitly, there is not such a big problem. But if the expert said something that logically implies this is true, given other nonexplicit premises, based on common knowledge for example, the critical questioning has to bring out doubts that can be raised about how to interpret the text of discourse of what the experts said.

The distinction to be made clear here is that in some cases, what the expert said is quoted, while in other cases it is paraphrased. Even if what the expert said was quoted word for word, the quotation can be used out of context, and the fallacy of wrenching from context committed. In still other cases, whether the expert’s statement S\* was quoted or not, there remains the question of whether S\* can properly be taken to S, the statement to be proved. One problem posed is what standard of inference is being used to infer S from S\*. This is the question of argumentation schemes.

The reformulation above proposes handling this ambiguity differently, by explicitly distinguishing the expert’s actual testimony, i.e. the sentence of his testimony S\*, from the statement S, which is some interpretation of the meaning of this testimony. Of course this meaning will also be expressed as a sentence, in natural language. And the sentence we choose to “name” the statement may be equal to the text of the expert’s testimony.

## 9. State of the Art

This paper has surveyed several different argument visualization tools that show promise of analyzing evidence in law in a way that promises to be useful for many purposes, including summarization of evidence in cases, assisting lawyers to more systematically present arguments based on evidence in a case, and to assist judges to evaluate evidence. Although these tools share some common features, it has been shown how they also model different aspects of evidence in differing ways. Such differences may not turn out to be a bad thing, as the ways these tools are to be precisely applied is still under development, and they be put to a wide range of differing uses. A common characteristic to many of these visualization systems is they need to be based on argumentation schemes, including not only the traditional forms of argument recognized in deductive and inductive logic, but also defeasible forms of argument that are a central focus of research now in artificial intelligence.

The problem studied in this paper was how to represent the critical questions attached to the scheme for the argument from expert opinion. One of the main conclusions was the proposal to revise this scheme for special use in a legal context. As we did this many issues about how to represent schemes and critical questions in the evolving systems for argument diagramming came up for discussion. We looked at the Araucaria system and the Carneades system, examining in each system how the critical questions can be accommodated to argument visualization technology, and represented somehow in the visually presented analysis of a given argument. Some of the inherent difficulties of this task have been shown in this paper, but some of the progress that has been made is clearly evident as well. It has been shown that the project is not an easy one, because it closely relates to other concepts that are vitally important to the new models of evidential reasoning. These concepts include the notions of argument defeat, rebuttal and undercutting. Although these concepts are fundamental to argumentation theory itself, some grounds have been presented to think they are not altogether clear or uncontroversial. As well, the notions of generalization, burden of persuasion, and presumption are closely tied in to the attempts to deal adequately with the operation of critical questions in argumentation schemes.

There are many advantages to the Araucaria system. It is fairly easy to use with little or training, and has many nice features useful for representing reasoning about evidence in law, and many kinds of legal argumentation. For example, it can represent schemes and implicit premises, it can do Wigmore diagrams, it is free, and it is ready to use. The Carneades system is still under development, but has some special features shown in the treatment of argument diagrams for argument from expert opinion above.

- The role of each premise can be shown: major, minor, etc.
- The name of each critical question can be shown: trustworthiness, etc.
- The type of each premise is shown: ordinary, assumption, exception, negative.
- Other information can be derived and visualized: holding of premises, defensibility of arguments, acceptability of statements.
- The different kinds of critical questions can be shown as different kinds of premises on a diagram in a way that models key differences in burden of proof.
- An argument can be re-evaluated in a context of dialogue as a sequence of argumentation moves along from an original issue to a concluding stage where that issue is resolved.

Thus there are also many advantages to the Carneades system that show its promise, not only as a formal model of argument for plausible reasoning generally, and for legal applications, but also as a method of argument visualization. Not the least of these advantages is its unique capability to use argumentations with their matching sets of critical questions to analyze and evaluate arguments, like argument from expert opinion, that are fundamentally important in legal reasoning about evidence.

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