Modeling Critical Questions as Additional Premises

DOUGLAS WALTON

CRRAR
University of Windsor
2500 University Avenue West
Windsor N9B 3Y1
Canada
dwalton@uwindsor.ca

THOMAS F. GORDON

Fraunhofer FOKUS
Kaiserin-Augusta-Allee 31
10589 Berlin, Germany
thomas.gordon@fokus.fraunhofer.de

ABSTRACT: This paper shows how the critical questions matching an argumentation scheme can be modeled in the Carneades argumentation system as three kinds of premises. Ordinary premises hold only if they are supported by sufficient arguments. Assumptions hold, by default, until they have been questioned. With exceptions the negation holds, by default, until the exception has been supported by sufficient arguments. By "sufficient arguments", we mean arguments sufficient to satisfy the applicable proof standard.

KEYWORDS: argumentation schemes, critical questions, artificial intelligence, Carneades system, shifting initiative in dialogue, argument from expert opinion, argument evaluation,

1. INTRODUCTION

Recently there has been a lot of interest in argumentation schemes because they provide a way of analyzing and evaluating many common defeasible forms of argument that would not be possible to evaluate using only deductive and inductive forms of reasoning. The use of schemes takes a different approach to argument evaluation from the standard way of applying forms of reasoning to arguments that we are familiar with in deductive and inductive methods of evaluating reasoning. Matching each scheme is a standardized set of critical questions representing different ways of critically probing into the weak points of an argument so that the arguer can improve his original argument by adding refinements. In this paper it is shown how schemes and critical questions are used together to analyze and evaluate examples of arguments in a way that depend on the notion of an initiative shift. As a critical question is asked, the initiative shifts onto the arguer who originally put forward his argument so that he must either respond appropriately to the critical question or his argument is defeated. However, if he is able to answer the critical question successfully, the initiative shifts back to the questioner to ask another question, or otherwise the argument is judged to be tentatively acceptable.

We regard the concept of burden of proof as complex (Gordon and Walton, 2009), and so we replace it here with the simpler concept of an initiative, taken from (Hamblin, 1970, 274). As explained by Hamblin, a shift of initiative takes the requirement to support some proposition with evidence from one party in a dialogue and puts it on the

other party. The general principle is that he who asserts must prove. Shifts of initiative take place as the argumentation proceeds in a case where the parties take turns making moves. They do not represent what is called burden of persuasion in law, but are more like tactical burden of proof (Prakken and Sartor, 2009).

Precisely how this back-and-forth process works, and how it provides some kind of useful mechanism for helping us to evaluate an argument that fits the scheme, are matters that some still seem to be unclear and hesitant about. After all, using a question to shift an initiative does not seem like a method of argument evaluation that is exact and subject to calculation by precise methods of the kind we are familiar with using formal deductive logic or Bayesian methods of calculation. Although there are now computational argumentation systems using argumentation schemes (Verheij, 2003; Bex et al., 2003; Reed and Walton, 2005; Walton and Gordon, 2005), there remain some fundamental questions about how these formal models of defeasible argumentation can be applied to real examples of arguments in a way that would make them helpful for those of us in the field of argumentation study. The purpose of this paper is to offer some clear and helpful answers to these questions.

The central arguments of the paper are that (a) by clarifying these critical questions and reformulating them, to some extent, so that they fit into a standardized format, we can bring out the deeper structure of each argumentation scheme, and (b) once this process of restructuring has been carried out, the schemes along with their matching critical questions so reformulated can be used in the Carneades argumentation model (Gordon, Prakken and Walton, 2007; Gordon and Walton, 2009) as tools for argument analysis, evaluation and construction.

The example of a scheme chosen for illustration to show how the method of reformulation works is the one for argument from expert opinion. This scheme is introduced, along with its matching set of critical questions, in section 1. The two theories about how the initiative shifts when a critical question is asked are presented in section 2. The problem of judging what should happen when apportioning initiative in real cases is discussed in section 3. In section 4 it is shown how managing the shifting of initiative in some of the critical questions better fits the one theory, while managing others better fits the other theory. The Carneades model of argumentation is introduced in section 5, and applied to the problem of reformulating the critical questions in section 6. The conclusions are in section 7.

2. ARGUMENTATION SCHEMES AND CRITICAL QUESTIONS

Argumentation schemes represent stereotypical patterns of reasoning used in everyday conversational argumentation, and in other contexts as well, like forensic debating and legal argumentation. They are patterns of defeasible reasoning that have long been studied in argumentation theory. Indeed, they could be described as recent descendants of the long tradition of study of the so-called topics of Aristotle. Hastings (1963), Perelman and Olbrechts-Tyteca (1969), Kienpointner (1986), Walton (1996), Grennan (1997) and Walton, Reed and Macagno (2008) have identified and studied many schemes of kinds found in examples of everyday conversational arguments and legal arguments. Recently there has also been considerable interest in argumentation schemes in computer science, especially in the field of artificial intelligence, where they are increasingly being

recognized in computational domains like multi-agent systems as holding potential for making significant improvements in the communication capabilities of artificial intelligent agents in the semantic web (McBurney and Parsons, 2009; Prakken, 2010).

The scheme representing argument from expert opinion was formulated in (Walton, 1997, p. 210), with some minor notational changes, as shown below, with two premises and a conclusion. *E* is an autonomous agent of a kind that can possess knowledge in some subject domain. The domain of knowledge, or subject domain, is represented by the variable *F* for field of knowledge. It is assumed that the domain of knowledge contains a set of propositions.

Major Premise: Source *E* is an expert in field *F* containing proposition *A*.
Minor Premise: *E* asserts that proposition *A* (in field *F*) is true (false).

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

As shown in (Walton, 1997) any given instance of an argument from expert opinion needs to be evaluated in a dialogue where an opponent (respondent) can ask critical questions. The six basic critical questions matching the appeal to expert opinion (Walton, 1997, p. 223), with some minor modifications, are the following.

CQ_1: *Expertise Question*: How knowledgeable is *E* as an expert source?
CQ_2: *Field Question*: Is *E* an expert in the field *F* that *A* is in?
CQ_3: *Opinion Question*: What did *E* assert that implies *A*?
CQ_4: *Trustworthiness Question*: Is *E* personally reliable as a source?
CQ_5: *Consistency Question*: Is *A* consistent with what other experts assert?
CQ_6: *Evidence Question*: Is *E*'s assertion based on evidence?

CQ_1 refers to the expert's level of mastery of the field *F*. CQ_4 refers to the expert's trustworthiness. For example, if the expert has a history of lying, or is known to have something to lose or gain by saying *A* is true or false, these factors would suggest that the expert may not be personally reliable. The assumption made in (Walton, 1997) was that if the respondent asks one of the six critical questions the initiative shifts back to the proponent's side to respond to the question appropriately. The asking of the critical question defeats the argument temporarily until the critical question has been answered successfully. This approach was a first pass to solving the problem of how to evaluate an argument from expert opinion. More specifically, it was designed to offer students in courses on critical argumentation some direction on how to react when confronted with an argument from expert opinion. Although the critical questions stated in (Walton, 1997) were meant to be useful for this purpose, they were also meant to be open to formulation in a more precise manner that might make formalizations of argumentation schemes possible.

Argumentation schemes representing the structure of defeasible types of arguments, like argument from expert opinion, are proving to be very useful in artificial intelligence. However, an initial problem with applying such schemes is that the arguments they represent are evaluated using a set of critical questions matching each scheme. Part of the problem is that it is not easy to represent questions in a tree structure

of the sort standardly used for argument evaluation. However, if questions could be treated as additional premises that are implicit in the argument, this problem could be easily solved. But an additional problem is that the critical questions do not behave in a uniform way in this regard. If the mere asking of a critical question was enough to defeat the argument put forward, in every instance of a question matching a scheme, the procedure of treating critical questions as additional premises would work. However, some of the critical questions cannot be fitted into this format. The method of evaluating an argument like one from expert opinion is by a shifting of initiative in a dialogue (Walton, 1997). When the respondent asks one of the six critical questions an initiative shifts back to the proponent's side, defeating or undercutting the argument temporarily until the critical question has been answered successfully. But things do not always work this way. In some instances, the asking of an appropriate critical question is not sufficient by itself to defeat the original argument, unless the critical question is backed up by evidence that increases its force.

3. TWO THEORIES ABOUT INITIATIVE SHIFTING

As will be shown in this section, there are differences between the critical questions on how strongly or weakly asking the question produces such a shift of initiative. Such observations have led to two theories about requirements for initiative shifting when critical questions matching the argument from expert opinion are asked (Walton and Godden, 2005). According to one theory, in a case where the respondent asks any one of these critical questions, the initiative automatically shifts back to the proponent's side to provide an answer, and if she fails to do so, the argument defaults (is defeated). In other words, merely asking the question is enough to defeat the argument, at least temporarily. Of course, if the proponent provides some appropriate answer to the question, the argument retains its status.

On this theory, only if the proponent does provide an appropriate answer is the plausibility of the original argument from expert opinion restored. This could be called the shifting initiative theory, or SI theory. How it works in determining whether the respondent has to accept the argument as plausible is shown in table 1.

Table 1: The SI Theory

Proponent	Respondent	Effect on Initiative
Puts forward argument fitting scheme	Asks appropriate critical question	Initiative shifted to proponent to reply
Fails to answer question	Does not have to accept argument	Initiative not shifted, so argument defaults
Answers critical question	Must accept argument	Initiative Shifted

According to the other theory, asking a critical question should not be enough to make the original argument default. The question, if questioned, needs to be backed up with some evidence before it can shift any burden that would defeat the argument. This could be called the backup evidence theory, or BE theory. How it works is shown in table 2.

Table 2: The BE Theory

Proponent	Respondent	Effect on Initiative
Puts forward argument fitting scheme	Asks appropriate critical question	No initiative shifted onto proponent to reply
Replies to question without giving backup evidence	Must accept argument anyhow	No initiative shifted, so argument stays in place
Asks for backup evidence to support question	Fails to present appropriate backup evidence	Initiative shifts to respondent
Asks for backup evidence to support question (again)	Provides evidence to support question	Initiative shifts to proponent
Fails to question evidence	Does not have to accept argument	Proponent's initiative not met, so argument defaults

In Table 2, it is shown how the original argument stands even if the proponent replies to the critical question by simply saying 'yes' or 'no' without providing any evidence to back up her reply. Only if the respondent specifically cites evidence of the sort that would back up the question does the proponent's argument default. These theories can be tested by examining the precise formulations each of the critical questions. It may be that some of the questions fit one theory or the other better.

4. RECONSIDERING THE CRITICAL QUESTIONS

Look back to the six critical questions matching argument from expert opinion and ask yourself what would happen in a dialogue as each question might be put to the proponent of the argument by the respondent. Look at the field question first. It already states in the major premise that E is an expert in the field that A is in. Thus asking the field question is merely asking whether the premise in the original argument is true. The respondent merely questions the premise. When critically questioning any argument, like one from expert opinion, one avenue of attack that is always available is to question any one of the premises.

Now look at the expertise question. It asks how credible E is as an expert source. In other words, it asks about E's level of expertise, or mastery of the field that the proposition at issue is in. Is E merely a beginner, a rookie, or has she been a working expert in this field for a lifetime, winning advanced degrees and awards, perhaps even a Nobel Prize? Such differences will affect how strong the argument from expert opinion is taken to be. The expertise question seems to ask for a comparative rating, a matter of degree. The higher the rating of credibility of the expert source, the stronger the argument from expert opinion will be. What if the proponent can't give an appropriate answer to this question? It seems hard to judge what should happen on initiative, as it is not made clear precisely what sort of answer is required. Maybe the proponent could say, "E is fairly credible". Would that be enough to answer the question, or should the proponent have to give some reason to back up the claim that E has enough credibility to satisfy the question, by offering some evidence, like "E has been practicing in the field for twenty years"? It seems difficult to decide.

Let's next look at the opinion question. It asks what E asserted that implies A. This could be A itself (since A implies A), or it could be some other proposition that E asserted that implies A. If the former is the case, the question is redundant, because the minor premise already tells us that E asserted A. If the former is the case, the original argument from expert opinion fails, because E failed to meet the requirement stated in the premise.

This dichotomy leaves us without a decision, however, when it comes to dealing with real arguments from expert opinion, of the kind most commonly encountered. In such cases, the critic is trying to judge the worth of the argument based on what the expert said. In such a case the expert made some pronouncement, and the claim attributed to her needs to be extracted from that text by directly quoting the text or reporting it. There are two types of cases. First, the claim, the proposition at issue, can be found in the text by quoting it. Second, an inference can be drawn from what was quoted to the proposition claimed as attributable to the expert. In reality, there can be all kinds of problems in such cases, because the expert could be misquoted, or correctly quoted, but the claimed proposition may only be implicitly contained in what she said, rather than being explicitly contained in the text. Still, despite all these complications, maybe it is sufficient to rule that if the proponent supplies some specific proposition allegedly implied by what the expert said, that this should be enough to satisfy the questioner. On this view, the initiative shifts back to the respondent once the proponent supplies such a proposition. What should happen, however, if the proponent fails to supply such a proposition? Should her argument default or not? It seems like she should have to supply a proposition meeting the request, or the argument should default, but the issue remains open of how to judge whether the proposition needs to match exactly what the expert said.

Now let's look back at the trustworthiness question. It refers to the reliability of the source as one that can be trusted. It would be a powerful attack on an argument from expert opinion if the expert was shown to be biased or a liar. But unless there is some evidence of this, the proponent could simply answer 'yes', and that would seem to be enough to answer the question appropriately. To plausibly question whether an expert might be biased or dishonest, and to make the charge stick, the questioner needs to produce at least some putative evidence of bias or dishonesty. On the other hand, there do seem to be two theories about the force of this question. Some might say that if the respondent asks this question, it does seem to reasonably shift the initiative back to the proponent to offer some assurance that the expert is trustworthy. If the proponent were to merely reply, 'You prove that she isn't personally reliable as a source!', that would seem to be evasive. On this view then, if the trustworthiness is asked, it should shift the initiative back the proponent to offer some evidence of trustworthiness, or else the argument form expert opinion should default. But if the respondent fails to give any evidence that the expert is untrustworthy, the proponent could reply, "There is no evidence of that at all", shifting the initiative to the respondent's side to back up his question with evidence. Thus two approaches seem open.

Now let's turn to the last two questions, the consistency question and the backup evidence question. In both these instances, the question needs some evidence to back it up before it makes the argument default. Any claim that what the expert said might not be consistent with what other experts in the same field say needs to be shown by telling us

what the other experts said, and how these statements conflict with what our expert said. Otherwise, the proponent can simply answer 'yes' to the question, and that should be enough to preserve the argument from expert opinion. Similarly, if the backup evidence question is asked, the answer 'yes' seems sufficient. If the question were expressed differently, the response required might also be different. For example, if the question were, 'What evidence was *E*'s assertion based on?', then the proponent would have to supply some such evidence in order to answer the question successfully.

5. SUMMARY OF THE DISCUSSION

The results of this discussion of how each of the six critical questions fits the SI theory or the BE theory can be summarized as follows.
1. *The Expertise Question*. It expresses as a quantitative question asking how strong the expert's mastery of the field is. The expert presumably needs to have some mastery of the field for the argument from expert opinion to have any worth. Can it be assumed that if someone is an expert they have at least some mastery of the field? If so, failure to give a specific answer should not be enough to make the argument default. But if the argument can be very weak, depending on the context, it could default. Thus it does not seem to be easy to arrive at a general rule on whether the expertise question fits the SI theory or the BE theory.
2. *The Field Question*. It is part of the minor premise, even though it is not a full premise. On the assumption that it is a required part of a premise, failure to back it up adequately means that the argument should default. This analysis supports classifying the field question under the SI theory.
3. *The Opinion Question*. Here the discussion was not conclusive. If the proponent fails to supply a proposition supposedly representing what the expert claimed, her argument should default. But the discussion remained open on the issue of how to judge whether the proposition needs to match exactly what the expert said, or whether it could be implied by logical inference from what the expert said. It seemed like there is more room for specific criteria to apply to these kinds of cases. Still, if the proponent gives no answer at all to the question, it would be a bad failure, suggesting that the argument should default. This analysis would suggest that the SI theory applies.
4. *The Trustworthiness Question*. As shown in the discussion above, there are two approaches to deciding whether this question better fits the SI theory or the BE theory. Unless the respondent gives some evidence indicating that the expert is untrustworthy, the proponent could simply reply, "There is no evidence of that at all", shifting the initiative to the respondent's side to back up his question with evidence. This interpretation supports the BE theory. But if the proponent offers no evidence to back up the expert's trustworthiness, his argument seems weak. This interpretation supports the SI theory.
5. *The Consistency Question*. To make this question have any force, presumably some evidence to support it is required. Thus it fits the BE theory better.
6. *The Evidence Question*. Generally it is assumed that what a genuine expert claims is backed up by some evidence in the field or domain of knowledge of the expert. This would seem to be a generally reasonable assumption in the case of a scientific expert. If so, to make the evidence question shift the burden of proof against the proponent, some

evidence backing up the question is required. Thus this question fits the SI theory better as well.

The above discussion of these critical questions suggests that it can be argued that some of them fit the SI theory better while others fit the BE theory better. But much depends on the standards of argument acceptance that are appropriate in a given case, and on factors of the context of the dispute, including the general standard of burden of proof in the dialogue. While the same argumentation schemes are used in different contexts of dialogue, how the critical questions should be managed with respect to burden of proof is a factor that can be stabilized in a systematic way, depending on the standard and burden of proof for argumentation in a type of dialogue.

6. THE CARNEADES SYSTEM

As we all know, sophisticated automated techniques of searching for a designated conclusion from a given set of premises in a knowledge base are now widely employed in computing. We can use this technology along with argumentation schemes to chain forward from a given argument to see if it can be extended by other arguments connected to it that enable the chain to reach a designated conclusion. Once the premises and the conclusion of the given argument have been identified, we can apply the search engine, and it will recursively apply all the rules of inference to the premises, chain toward the conclusion, and either reach the designated conclusion or not. This feature is typical of rule-based systems. To be of practical use, however, the rules of inference used in the system need to be comprehensive enough to include widely used forms of argument, like argument from expert opinion, argument from analogy, argument from appearance, and argument from witness testimony.

Carneades uses argumentation schemes, and applies them to argument construction (invention) as well as to argument analysis and evaluation. Carneades is a mathematical model consisting of definitions of mathematical structures and functions on these structures (Gordon, Prakken and Walton, 2007). It is also a computational model, meaning that all the functions of the model are computable. Carneades defines mathematical properties of arguments that are used to identify, analyze and visualize real arguments. Carneades models the structure and applicability of arguments, the acceptability of statements, burdens of proof, and proof standards, for example preponderance of the evidence. Carneades has been implemented using a functional programming language, and has a graphical user interface (http://carneades.github.com/).

The screen shot shown in Figure 1 gives the reader an idea of how argument from expert opinion can be represented in the graphical user interface. In figure 1, the text boxes contain statements that are premises or conclusions in the argument. Each statement has a status, and a symbol appears in the box for each statement indicating its status as follows. If a statement is accepted, a check mark appears in front of it and the text box has a green fill. If a statement is rejected, an X mark appears in front of it, and the text box has a red fill. If a statement has merely been stated, but not accepted or rejected, there is no symbol in front of it, and the text box has no fill. The question mark indicates that the statement has been called into question but has not been accepted or rejected. Each circle that appears on the line represents an argument. The ultimate conclusion of the argument appears on the left. In this case, that is the statement that A

may be taken to be true. A pro argument is indicated by a plus sign in its node. A con argument is indicated by a minus sign in its node. The example shown in figure 1 is merely meant to give the reader some idea of how arguments are represented graphically in the system.
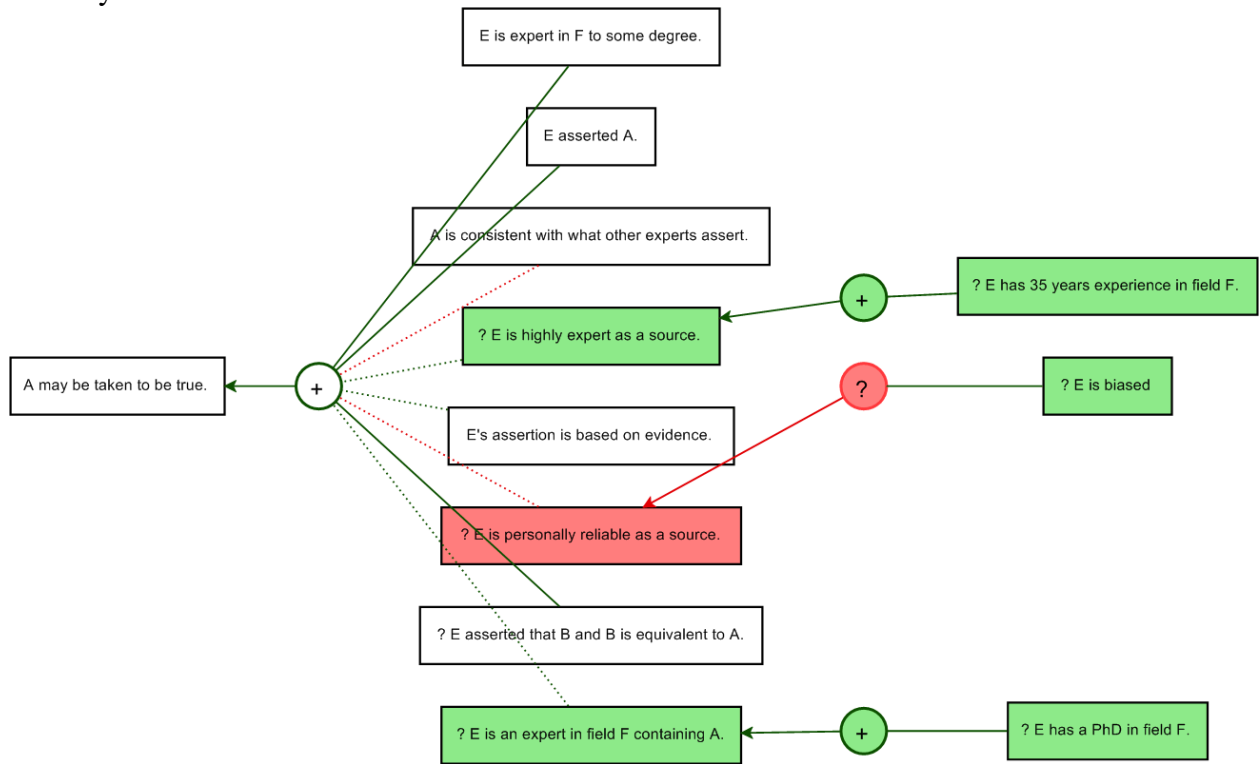

Figure 1: An Example Argument in the Carneades Graphical User Interface

In the example shown in figure 1, additional evidence supporting three of the premises is shown in the column of three boxes on the right. The middle column of boxes represents premises, assumptions and exceptions.

The original motivation of the Carneades system was to accommodate two different variations on 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 the proponent's argument until the respondent offers some evidence to back it up. Carneades approaches this distinction by distinguishing three types of premises in an argumentation scheme, called ordinary premises, assumptions and exceptions. The ordinary premises are represented as lines from a text box to a node (circle) in figure 1. They appear as solid green lines on the screen. The exceptions are represented as dashed lines. They appear as dashed red lines on the screen. The assumptions are represented as more finely dashed (dotted) lines. They appear as dotted green lines on the screen. Assumptions are assumed to be acceptable unless called into question. Exceptions are modeled as premises that are not assumed to be acceptable and which can block or undercut an argument as it proceeds. Ordinary premises of an argument, like assumptions, are assumed to be acceptable, but they must be supported by further arguments in order to be judged acceptable.

The Carneades method of determining the acceptability of an argument can be summarized as follows (Gordon and Walton, 2009). At each stage of the argumentation process, an effective method (decision procedure) is used for testing whether some proposition at issue is acceptable, based on the arguments of the stage and a set of assumptions. The assumptions represent undisputed facts, the current consensus of the participants, or the commitments or beliefs of some agent, depending on the task. This determination may depend on the proof standard applicable to the proposition at issue, given the dialogue type and its protocol. What is used is a decidable acceptability function provided by the Carneades model of argument. This method of modeling argumentation can be applied to argument reconstruction and argument invention.

The Carneades system for reasoning with argumentation schemes is a computational model that builds on ontologies from the semantic web. It defines structures for representing various elements of argumentation, and shows how they function together in arguments. These elements include propositions, arguments, cases, issues, argumentation schemes and proof standards. Arguments in the Carneades system are visualized as a directed graph, as shown in Figure 1, in which the nodes (circles) in the middle represents the argument and the leaves in the tree (text boxes) represents the premises and conclusions in the argument.

7. HOW CARNEADES HANDLES CRITICAL QUESTIONS

In the Carneades system, critical questions matching an argument can be classified into three categories, depending on whether they are treated as ordinary premises, assumptions or exceptions. Defeaters (rebuttals) are modeled as arguments in the opposite direction for the same conclusion. For example if one argument is *pro* the conclusion, its rebuttal would be another argument *con* the same conclusion. Premise defeat is modeled by an argument *con* an ordinary premise or an assumption, or *pro* an exception (Gordon, 2005, 56).

This system enables a distinction to be drawn between two ways an argument from expert opinion should be critically questioned, and thus enables the critical questions to be represented as implicit premises of an argumentation scheme represented on an argument diagram. The two assumptions that (1) the expert is trustworthy and (2) that what she says is consistent with what other experts say, are assumed to be false. It is assumed, in other words, that (1) and (2) are false until new evidence comes in to show that they are true. The two assumptions that (1) the expert is credible as an expert and that (2) what she says is based on evidence, are assumed to be true, until such time as new evidence comes in showing they are false. Also assumed as true are the assumptions that (1) the expert really is an expert, (2) she is an expert in the subject domain of the claim, (3) she asserts the claim in question, and (4) the claim is in the subject domain in which she is an expert.

Now let's look once again at the expertise question, to see how it could be classified. It is about *E*'s depth of knowledge in the field *F* that the proposition at issue lies in. As noted above, the expertise question seems to ask for a comparative rating. What if the proponent fails to answer by specifying some degree of expertise, like "very credible" or "only slightly credible"? As noted above it seems hard to decide what the effect on the original argument should be. Should it be defeated or merely undercut? It

seems like it should only be undercut, because even if we don't know how strong the argument from expert opinion is, it might still have some strength. It might even be very strong, for all we know.

The field and opinion questions can be modeled as ordinary premises of the arguments from expert opinion scheme in Carneades. Now let's look back at the trustworthiness question, which refers to the reliability of the expert as a source who can be trusted. If the expert was shown to be biased or a liar, that would presumably be a defeater. It would be an *ad hominem* argument used to attack the original argument, and if strong, would defeat it. But unless there is some evidence of ethical misconduct, as noted above, the proponent could simply answer 'yes', and that would seem to be enough to answer the question appropriately. As noted above, to make such a charge stick, the questioner should be held to supporting the allegation by producing evidence of bias or dishonesty.

According to the discussion above, only the consistency and backup evidence questions need some evidence to back them up before the mere asking of the question defeats the original argument. Hence only these two of the critical questions are treated as exceptions. The results of how the critical questions should be classified as premise on the Carneades model can be summed up as follows.

Premise: *E* is an expert.
Premise: *E* asserts that *A*.
Premise: *A* is within *F*.
Assumption: It is assumed to be true that *E* is a knowledgeable expert.
Assumption: It is assumed to be true that what *E* says is based on evidence in field *F*.
Exception: *E* is not trustworthy.
Exception: What *E* asserts is not consistent with what other experts in field *F* say.
Conclusion: *A* is true.

The distinction between assumptions and exceptions, on the Carneades model, tells us which answer to a critical question can be assumed, if the critical question has not been asked yet. The expertise question and the backup evidence question can be modeled as assumptions in Carneades. This tells us that it can be assumed that it is true that the expert is a credible source who has knowledge in some field, and that the expert's evidence was based on some evidence in the field. The way these questions are modeled fits the burden of proof dialogues displayed in table 1 above. Carneades models the trustworthiness question and the consistency question as exceptions, telling us that the initiative does not shift until the criticisms that the expert is biased or dishonest, or otherwise is not personally reliable as a source are backed up by further evidence. It also tells us that the criticism that what the expert said is inconsistent with what other experts said must be backed up by further evidence. The way these questions are modeled fit the dialogues displayed in table 2 above.

7. CONCLUSIONS

In this paper we chose the argumentation scheme for argument from expert opinion to illustrate a particular way of managing any argumentation scheme in relation to its set of appropriate critical questions. However, we could have chosen any of the set of 65 or so schemes presented in the compendium of schemes in (Walton Reed and Macagno, 2008).

The method of handling the critical questions works the same way with each of these schemes. The special feature of the Carneades system in this regard is that it solves the problem of burden of proof posed by the dichotomy between the SI theory and the BE theory by reconfiguring the notion of an argument through its use of the three-way distinction: ordinary premises, assumptions and exceptions. Ordinary premises have to be supported by further arguments even if they have not been questioned. In the case of exceptions, however, the opponent who would attack the argument is the one who has to offer evidential support to make his criticism defeat the argument.

Through the illustration of the argumentation scheme for argument from expert opinion, it was shown why it did not seem to be initially possible to solve the shifting initiative problem by dealing with the critical questions in a uniform way. But then it was shown how using the Carneades system makes it possible to manage critical questions matching the schemes by using resources already available in logic and computational modeling of arguments. In the usual way of representing arguments that has now become standard, the propositions that play the roles of premises and conclusions in the argument are displayed as text boxes that form the leaves of a tree. It is not easy to see how critical questions matching scheme could be represented in this format, because questions are different from propositions. Carneades solves both these problems at one stroke by representing the critical questions as different kinds of premises. The assumptions and the exceptions are treated as implicit premises that, once made explicit, fill out the structure of an argumentation scheme. This process of reconfiguring each of the argumentation schemes and its matching set of critical questions provides us with a new way of evaluating defeasible arguments of the kinds that fit the schemes.

The implications of the findings of this paper are highly significant for further research on argumentation, because what has been proposed is a new way of restructuring the logic of argumentation schemes and their matching critical questions. The old way of formulating the structure of a scheme represented the logic of the argument as fitting the scheme in a simple way that included only the ordinary premises. The new model of the structure of the scheme adds implicit premises that are divided into two categories. The shift from the old to the new model has many implications for the study of fallacies and for the study of proleptic arguments that reply to an objection (or the posing of a critical question) by anticipating it. But more work needs to be done. Only one scheme, the argument from expert opinion, was used to illustrate how the process of reformulation should work in general. The program of research laid out for the future is the project of re-examining the remaining schemes to see how the SI theory and the BE theory apply to them.

REFERENCES

Benoit, W.L. (1989). Attorney argumentation and Supreme Court opinions.*Argumentation and Advocacy* 26, 22-38.

Eemeren, F.H. van, and Grootendorst, R. (1993b).The history of the argumentum ad hominem since the seventeenth century. In: Krabbe, E.C.W., Dalitz, R.J., and Smit, P.A.(eds.). *Empirical Logic and Public Debate. Essays in Honour of Else M. Barth* (pp. 49-68, Ch. 4), Amsterdam/Atlanta: Rodopi.

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*, 12, 125-165.

Gordon, T. F. (2005). A computational model of argument for legal reasoning support systems, ed. Dunne, P. E. and Bench-Capon, T. J. M. (2005). *Argumentation in Artificial Intelligence and Law*, IAAIL Workshop Series, Nijmegen, Wolf Legal Publishers, 2005, 53-64.

Gordon, T. F., Prakken, H. and Walton, D. (2007). The Carneades model of argument and burden of proof, *Artificial Intelligence*, 171, 875-896.

Gordon, T. F. and Walton, D. (2009). Proof burdens and standards. In: *Argumentation and Artificial Intelligence*, ed. I. Rahwan and G. Simari. Berlin: Springer, 239-260.

Grennan, W. (1997). *Informal Logic*. Montreal, Quebec: McGill-Queen's University Press.

Hamblin, C. (1970). *Fallacies*. London: Methuen.

Hastings, A. C. (1963). *A Reformulation of the Modes of Reasoning in Argumentation*. Evanston, Illinois: Ph.D. Dissertation, Northwestern University.

Kienpointner, M. (1986). Towards a typology of argument schemes. In: Frans H. van Eemeren et al. (Eds.), A*rgumentation: Across the Lines of Discipline*. Dordrecht, Holland: Foris, 275-287.

McBurney, P. and Parsons, S. (2009). Dialogue games for agent argumentation. In: I. Rahwan and G. Simari (Editors): *Argumentation in Artificial Intelligence*. Berlin, Germany: Springer, 261-280.

Perelman, C. and Olbrechts-Tyteca, L. (1969). *The New Rhetoric: A Treatise on Argumentation*. Notre Dame: University of Notre Dame Press.

Prakken, H. (2010). On the Nature of Argument Schemes. In C.A. Reed & C. Tindale (eds.) *Dialectics, Dialogue and Argumentation. An Examination of Douglas Walton's Theories of Reasoning and Argument*, 167-185. London: College Publications.

Prakken, H. and Sartor, G. (2009). A logical analysis of burdens of proof. In: *Legal Evidence and Burden of Proof,* ed. H. Kaptein, H. Prakken and B. Verhiej. Farnham: Ashgate, 223- 253.

Reed, C. and Walton, D. (2005). Towards a formal and implemented model of argumentation schemes in agent communication, *Autonomous Agents and Multi-Agent Systems*, 11, 173-188.

Toulmin, S.E. (1958). *The Uses of Argument*. Cambridge: Cambridge University Press.

Verheij, B. (2003). Dialectical argumentation with argumentation schemes: An Approach to Legal Logic, *Artificial Intelligence and Law*, 11, 167-195.

Walton, D. (1997). *Appeal to Expert Opinion*, University Park, Penn State Press, 1997.

Walton, D. and Godden, D. (2005). The nature and status of critical questions in argumentation schemes, In: *The Uses of Argument: Proceedings of a Conference at McMaster University 18-21 May, 2005*, ed. Hitchcock, D., Hamilton, Ontario, 2005, 476-484.

Walton, D. and Gordon, T. F. (2005). Critical questions in computational models of legal argument, In: *Argumentation in Artificial Intelligence and Law*, IAAIL Workshop Series, ed. Dunne. P. E. and Bench-Capon, T. J. M. Nijmegen: Wolf Legal Publishers, 2005, 103-111.

Walton, D., Reed, C. and Macagno, F. (2008). *Argumentation Schemes*. Cambridge: Cambridge University Press.