Explanations and Arguments Based on Practical Reasoning

Douglas Walton

University of Windsor, Windsor ON N9B 3Y1, Canada,
dwalton@uwindsor.ca,

Abstract. In this paper a representative example is chosen that is meant be fairly simple for illustrating the point that in a very common kind of instance, argument and explanation are mixed in together in a text of discourse. The example is a short text found on the Internet that explains to the reader how to attach a flagpole bracket to the vinyl siding on the side of your house. The example uses practical reasoning (goal-directed reasoning) of a kind widely studied in AI and logic. While the text appears to be mainly a "how-to" explanation, it also contains argumentation woven into it, as shown by applying argumentation schemes (defeasible argument structures) representing common forms of argument. The problem is one of distinguishing between explanation and argument.

1 The Nature of the Problem

One of the most elementary problems in defining the concept of an explanation is to provide criteria to distinguish clearly (in particular cases) the difference between an argument and an explanation. This distinction is vitally important from a logical point of view, as it would be a fundamental error to criticize an argument as falling short of standards for acceptability or validity of a rational argument, when in fact the locution that was put forward was meant as an explanation, and not an argument. It is an error to criticize something as a bad argument if it is not really an argument at all. For example, a circular sequence of reasoning could commit the fallacy of begging the question if it is meant to be part of an argument, whereas if it is meant to be part of an explanation, the circle might be benign feedback rather than a vicious circle.

Fontan and Saint-Dizier [4] have analyzed what they call procedural texts, in which the text is aimed at convincing the reader to carry out a procedure for reaching a certain goal. They collected a large corpus of texts oriented towards action, including such common tasks as cooking, gardening, and do-it-yourself projects. The two main structures they identify are called facilitation, described as responses to 'How to do X?' questions, and argumentation, described as described as responses to 'Why do X?' questions. What they call facilitation appears that it could be classified as a species of explanation, while what they call argumentation is clearly meant to be classified as a species of practical argument, designed to convince the reader do something. Their research is designed to identify linguistic markers for these structures.

Kassens and Kofod-Petersen [3] distinguish a species of explanation they call justification explanation. From a point of view of AI, it may be useful to single out certain kinds of explanations categorized as justification explanations. However, from the viewpoint of logic, this way of describing such explanations is potentially confusing, because the term 'justification' either means the same thing as 'argument' or something close to it. A justification is a kind of argument used to support a claim that is in doubt. In contrast, as described above, an explanation is something that has the rationale of conveying understanding throwing light on some fact, action, or event, the existence or truth of which is to not in doubt. Admittedly however, it is not easy to find another word for 'justification' that fits in front of the term 'explanation' in a way that easily conveys the meaning of this type of explanation. Perhaps it could be called a goal-action explanation or something of this sort. In this paper, an example of such an explanation that relates goals to actions will be considered.

The example chosen for study here is an explanation, but it also uses a kind of practical reasoning that can be identified, a chain of reasoning in which premises are used to derive conclusions. Such reasoning can even be described as practical argument in many instances [1]. Indeed, the analysis presented below will show how the reasoning in the case can be modeled by means of devices called argumentation schemes. On the contrary, however, it will be argued that the case chosen for study both is an explanation and can have such argumentation schemes applied to it in a useful and illuminating way. Thus the case raises issues about certain kinds of common explanations and how they should be classified as arguments or explanations.

2 The Flagpole Example

The following example is an explanation of how to mount a flagpole bracket to vinyl siding of the kind commonly used in house construction. The text of the example, along with pictures that illustrate the parts and the actions required can be found at this site: `http://www.homeconstructionimprovement.com/2008/07/install-flag-pole-bracket-on-vinyl.html`. The text begins with an initial explanation of how to attach the bracket.

Attaching a flagpole bracket to vinyl siding is an easy home improvement project that will allow you to show your patriotism on your home. It's important to install the bracket properly so you don't damage your vinyl siding. The easiest way to install a flagpole bracket (or hanging flower pot bracket or similar) is to screw the bracket to a vinyl surface mount block. The surface mount block has a profile routed out of the back so that it will fit the siding profile. The trick to successfully installing the bracket and surface mount block is to pre-drill holes in the siding. You want to drill a hole slightly larger than the screws you're going to use so that the siding can move as it expands and contracts due to temperature.

This explanation is then filled in with this text that gives additional details.

Vinyl siding moves a LOT when it heats and cools throughout the year. If you put a screw right through the vinyl siding it will prevent the siding from

moving and therefore cause it to buckle. So I pre-drilled the surface mount block first. This allowed me the ability to pre-mark the siding. Then I drilled a 1/4" diameter hole in the siding where each of the three screws would go. Then it's as simple as installing three long screws to attach the bracket and surface mount block at the same time. Make sure you use screws that won't be so long that they hit some wires.

This second part quoted above offers a description of how the author carried out the job himself. It amplifies the explanation so the novice reader can see a few more specific steps to take, and offers some warnings about what might happen if some things are done in a different way than the one being proposed.

It is fairly obvious that much of the reasoning in the flagpole example is means-end reasoning of the kind known as practical inference or practical reasoning [10]. The simplest form of practical reasoning below is an argument with two premises and a conclusion of the following form [12].

MAJOR PREMISE: I have a goal G.
MINOR PREMISE: Carrying out this action A is a means to realize G.
CONCLUSION: Therefore, I ought (practically speaking) to carry out this action A.

How can this form be applied to the bracket case to exhibit the structure of the reasoning in it? The two premises easily fit the form, as indicated below. Major Premise: I have the goal of attaching a flagpole bracket to vinyl siding. Minor Premise: using a vinyl surface mount block is the means to realize this goal.

But the conclusion does not appear to immediately fit the case. The reason is the person who has the goal of attaching the flagpole bracket to his house is not reasoning the problem through by himself. The person writing the text is offering an explanation of how to do it to another a person. What makes this case especially interesting is that the practical reasoning is being used in an explanation by one party to tell another party how to do something.

Before we can go further, we also have to be aware that typically practical reasoning takes the form of a complex sequences of basic practical inference chained together. In this case we can easily recognize this feature by specifying the sequence of actions.

A1: Screw the bracket to a vinyl surface mount block.
A2: Pre-drill the surface mount block.
A3: Pre-mark the siding.
A4: Pre-drill the holes in the siding.
A5: Drill the holes slightly larger than the screws you're going to use.
A6: Install three long screws to attach the bracket and surface mount block.
A7: Make sure you use screws that won't be so long that they hit some wires.

So we see that even in a relatively simple example like the bracket case, many actions can be involved, and there are other considerations that need to be taken into account before jumping to the conclusion, in addition to the two premises

given in the basic scheme. A1 is a general description of the action that is being recommended as the means to achieve the goal of mounting the flagpole bracket. The actions A2, A3, A4 and A6 are all specific actions that should be carried out in the order indicated by the numbering. A5 and A7 are pieces of advice concerning the size of holes that should be drilled in the siding and the length of screws that should be used to attach the bracket to the siding. The general pattern of practical reasoning that is exhibited is a chaining of steps in a sequence rather than a single action put forward as the single means to achieve the goal.

3 Argumentation Schemes

There are other forms that practical reasoning can take, in addition to the simplest form cited in the previous section. Also, there are other forms of reasoning closely related to the simple practical reasoning that is used in the flagpole example. In the current literature on argumentation and AI, these forms of reasoning are called argumentation schemes [12]. The study of so-called argumentation schemes, or forms of argument that capture stereotypical patterns of human reasoning, is at the core of argumentation research. Argumentation schemes have been put forward as a helpful way of characterizing structures of human reasoning that have proved troublesome to view deductively. Appealing to an authority during an argument, for example, may be valid (if the authority is appropriate), or may be fallacious. Attempting to deductivize the valid examples, by viewing the major premise as an implication (e.g. if X says Y then Y is true) fails, as it only holds in certain circumstances. The motivation for research into argumentation schemes has been this tension between forms of argument which clearly work, but which cannot be analyzed as deductively (or even inductively) valid. The basic method of analyzing and evaluating arguments based on practical reasoning is to use a set of critical questions that match the scheme. The following set matches the scheme for practical reasoning [12].

CQ_1 What other goals do I have that should be considered that might conflict with G?
CQ_2 What alternative actions to my bringing about A that would also bring about G should be considered?
CQ_3 Among bringing about A and these alternative actions, which is arguably the most efficient?
CQ_4 What grounds are there for arguing that it is practically possible for me to bring about A?
CQ_5 What consequences of my bringing about A should also be taken into account?

In this instance, the example is simple one, in that no alternative goals or means are being considered, and the impossibility of carrying out the task is not an issue. However, the fifth critical question is relevant.

Consequences are being considered in the flagpole example, as shown by the two more general pieces of advice in the list of actions cited above, A5, the

advice to drill the holes slightly larger than the screws you're going to use, and A7, the advice to make sure you use screws that won't be so long that they hit some wires. The evidential support behind A7 is made clear in the text of the example. The first part is the factual statement that vinyl siding moves a lot when it heats and cools throughout the year. The second part is a conditional: if you put a screw right through the vinyl siding it will prevent the siding from moving and therefore cause it to buckle. The third part is the recommendation that will supposedly prevent this damage from occurring: you want to drill a hole slightly larger than the screws you're going to use so that the siding can move as it expands and contracts due to temperature. The upshot of the reasoning in both these pieces of advice is that bad consequences can occur if the screws are put in without paying attention to some factors a novice might easily overlook. Since the explanation is directed to novices especially, this part of it is relevant and important.

These observations show that the fifth critical question is relevant, and also that another argumentation scheme can be brought to bear to bring out aspects of the reasoning used in the explanation. There are two schemes of this sort that we need to be aware of, argument from positive consequences and argument from negative consequences. The scheme below is that for argument from positive consequences

PREMISE: If A is brought about, good consequences will plausibly occur.
CONCLUSION: Therefore A should be brought about.

The next scheme is that for argument from negative consequences

PREMISE: If A is brought about, bad consequences will plausibly occur.
CONCLUSION: Therefore A should not be brought about.

Practical reasoning is often combined with argument from values. In the present example, two values play implicit roles in the reasoning. First, it is assumed that the outcome of the siding buckling would be a negative value. We are not told why, but it might look unpleasant and it might allow for water to come in under the siding, which could cause damage to the house. Second, it is assumed that having the screws hit some wires would also be a bad outcome.

Both versions of argument from consequences depend on an evaluation of some consequences as good (positive) or bad (negative). Damage or unpleasant appearance would be negative values in relation to a house. Having screws hit some wires is a safety issue. Safety is a value, and the lack of safety a negative value. Hence arguments from consequences, a shown in this example, are commonly built on arguments from values. The versions of the two schemes for argument from values presented below are from Walton, Reed and Macagno [12]. The one just below is the scheme for argument from positive value.

PREMISE 1: Value V is *positive* as judged by agent A (judgment value).
PREMISE 2: The fact that value V is *positive* affects the interpretation and therefore the evaluation of goal G of agent A (If value V is *good*, it supports commitment to goal G).
CONCLUSION: V is a reason for retaining commitment to goal G.

The next scheme is the one for argument from negative value.

PREMISE 1: Value V is *negative* as judged by agent A (judgment value).
PREMISE 2: The fact that value V is *negative* affects the interpretation and therefore the evaluation of goal G of agent A (If value V is *bad*, it goes against commitment to goal G).
CONCLUSION: V is a reason for retracting commitment to goal G.

The example shows how the scheme for argument from values and the scheme for practical reasoning are combined to produce a typical chain of argumentation of the kind used in deliberation.

Finally, we need to see how arguments from values can be combined with practical reasoning to build another argumentation scheme that is familiar in the literature called value-based practical reasoning [12].

PREMISE 1: I have a goal G.
PREMISE 2: G is supported by my set of values, V.
PREMISE 3: Bringing about A is necessary (or sufficient) for me to bring about G.
CONCLUSION: Therefore, I should (practically ought to) bring about A.

This scheme has the following set of seven critical questions matching it.

CQ_1 What other goals do I have that might conflict with G?
CQ_2 How well is G supported by (or at least consistent with) my values V?
CQ_3 What alternative actions to my bringing about A that would also bring about G should be considered?
CQ_4 Among bringing about A and these alternative actions, which is arguably the best of the whole set, in light of considerations of efficiency in bringing about G?
CQ_5 Among bringing about A and these alternative actions, which is arguably the best of the whole set, in light of my values V?
CQ_6 What grounds are there for arguing that it is practically possible for me to bring about A?
CQ_7 What consequences of my bringing about A that might have even greater negative value than the positive value of G should be taken into account?

Now we have a grasp of these argumentation schemes and how they work, we can return to the flagpole example.

4 Analysis of the Flagpole Example

A complication of the flagpole example is that even though the main part of it is an explanation, it begins with a sentence that is an argument: "Attaching a flag pole bracket to vinyl siding is an easy home improvement project that will allow you to show your patriotism on your home". The sentence puts forward an argument. The conclusion is the statement that attaching a flagpole bracket to vinyl siding is a good home improvement project to consider. Each of the two premises gives a separate reason to support the claim made in the conclusion. This argument can be represented by the diagram in figure 1. The argument

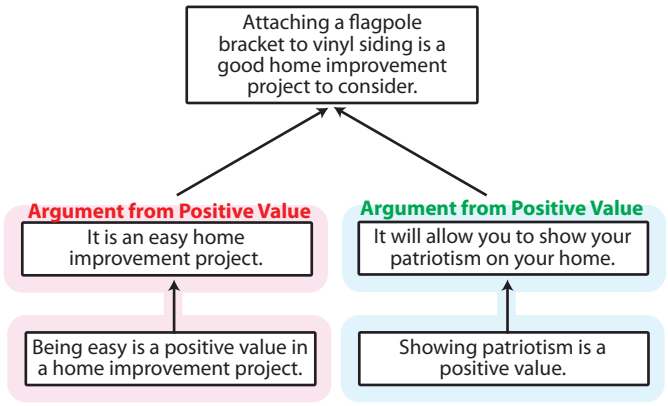

Fig. 1. Argument Diagram of the First Sentence in the Flagpole Example

mapping tool used to construct the argument diagram shown in figure 1 is called *Araucaria* [8]. It aids a user when constructing a diagram of the structure of an argument using a simple point-and-click interface, which may be then saved in a portable format called AML, or Argument Markup Language, based on XML. Could this tool also be used to represent the sequence of reasoning an explanation?

After the first sentence, the example shifts to an explanation, when the author says: "It's important to install the bracket properly so you don't damage your vinyl siding". The author is now beginning to tell the reader how to install the bracket. The indicator-word 'so' seems to suggest an argument that could be reconstructed as follows: damaging your vinyl siding would be a bad thing; to avoid damaging your vinyl siding, you will need to install the bracket properly; therefore [by argument from negative consequences], you should install the bracket properly. But is the author concluding that is important to install the bracket properly, based on some premise? Or is he is explaining to the reader that the installation must be done properly in a way that does not damage the

reader's vinyl siding? This way he will then explain further. Presumably, it will be a way that does not have the negative consequence of damaging the reader's vinyl siding. The interpretation of this sentence is tricky then. It looks like it could be taken as expressing an argument from negative consequences. However, I think it is a kind of general statement that prefaces the more detailed explanation given below it, and that can be taken as part of the explanation that can be found there.

The explanation of how to mount the bracket really begins with the sentence that the easiest way is to screw the bracket to a vinyl surface mount. This sentence fits the simplest form of practical reasoning as an argument with two premises and a conclusion. The main part of the argument is the practical reasoning with one premise as the statement that your goal is to install a flagpole bracket, and the other premise as the statement that using a vinyl surface mount is a way for you to achieve this goal. However, that is not all of the argument based on practical reasoning. A critical question is also involved. The critical question whether there are other ways that should be considered could also be asked. Answering this critical question is the statement that of the alternative ways, using a vinyl surface mount is the easiest.

Araucaria does not have the capability of representing critical questions as part of the argument mapped in an argument diagram. However, it does have a device called refutation, similar to negation.

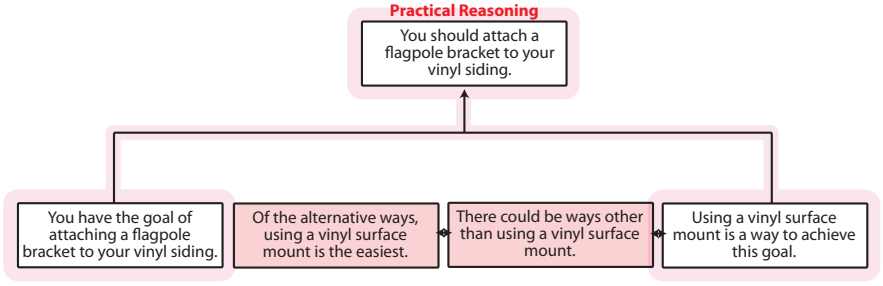

Fig. 2. Practical Reasoning Used as an Argument in the Flagpole Example

In figure 2, the statement 'There could be ways other than using a final surface mount' is shown as a refutation of the statement that appears to the right of it, 'Using a vinyl surface mount is a way to achieve this goal'. The statement performing the refutation appears in a darkened text box, and is attached to the statement it is meant to refute by an X, in figure 2. In figure 2 the critical question is represented as a refutation. In the flagpole example, the critical question is answered by replying that using a vinyl surface mount is the easiest way. In figure 2, this statement is represented as a refutation of the previous refutation.

But is it proper to treat this part of the text as an argument, or should it be represented as an explanation? Consistent with a presentation of the flagpole example as an explanation in section 2, it appears that may better be taken to be part of an explanation rather than as an argument. One way of reconstructing this interpretation can be carried out by viewing it as the sequence reasoning shown in figure 3. This way of representing the reasoning shows part of it as

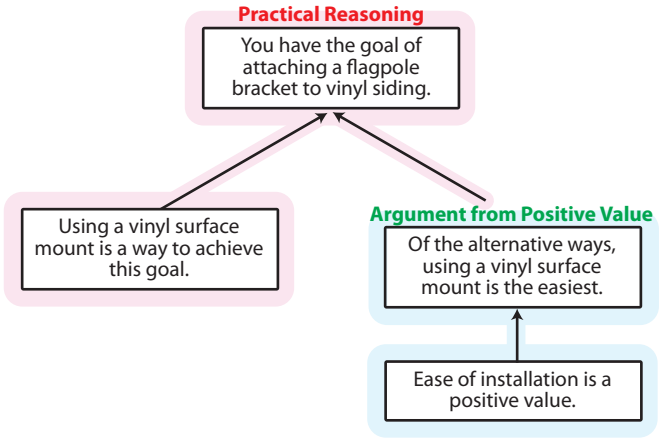

Fig. 3. Practical Reasoning Used as an Explanation in the Flagpole Example

an instance of practical reasoning, and another part as argument from positive value. But the components are not put together, as they are in figure 2, to make up an argument. The author is beginning with the reader's presumed goal of attaching a flagpole bracket to the vinyl siding on his house, and telling him how to do it. The way to do it, he proposes, is to use a vinyl surface mount. In response to the possible objection that this may not be necessary, he is telling the reader that this is the easiest way to it. This part seems to be an argument, because it is a response to an objection. But the part above it using practical reasoning seems better classified as an explanation. On this reconstruction of the discourse, the author is offering an explanation of how to attach a flagpole bracket to vinyl siding, something he is presuming the reader wants to do. He is not arguing that the reader should install such a mount, for this is not something he doubts. He is assuming he wants to it, and explaining to him how to do it.

There are two things that are novel about this analysis. The first is that we have an argument joined to an explanation, that is used to support the explanation. This is an interesting relationship, and presumably very common, as in instances of inference to the best explanation, where an argument might be used to support the claim that one explanation is better than another. The second is that we have used the argument mapping system *Araucaria* to rep-

resent the structure of an explanation, as opposed to its intended application of representing arguments. What is suggested by the analysis is that arguments and explanations are commonly combined in argumentative discourse and interlocked with each other in interesting ways. This observation is a challenge to our introductory logic student, who is being warned of always drawing a careful distinction between argument and explanation when approaching a given text of discourse. It may not be as easy to do this as one might have thought.

5 Another Part of the Flagpole Example

Another part of the text that is not straightforward to interpret is the last sentence of the first part of the text, along with the first two sentences in the second part. The latter two sentences seem to express normal statements of a kind familiar in argument mapping. One is a factual statement, "Vinyl siding moves a LOT when it heats and cools throughout the year." and the other is a conditional statement, "If you put a screw right through the vinyl siding it will prevent the siding from moving and therefore cause it to buckle". The sentence that appears just before them offers a piece of practical advice and gives a reason to back it up (indicated by the word 'so'): "You want to drill a hole slightly larger than the screws you're going to use so that the siding can move as it expands and contracts due to temperature". These three sentences seem to go together, but it is not transparent how they are supposed to do so. It may look like the former two sentences are premises in an argument that has the third sentence as its conclusion. I think this is not so, however. I think that the real conclusion is implicit, and can be inserted in the argument as shown in figure 4. The darkened text box with the dashed borders contains a statement represented as an implicit premise. The conclusion is also implicit, as the reader may recall from the analysis above, but we have not represented it that way in figure 4. It then follows, from this argument alongside what has already been said about the vinyl surface mount block in the previous text of the example, that this kind of block should be used instead of putting a screw right through the vinyl siding.

This part of the text, like the part analyzed in figure 3, seems to be an argument, but if so, it is a good question to try to see how it fits in with the wider text. After this part, the text continues, "So I pre-drilled the surface mount block first". The rest of the text after the word 'so' gives a description of how the author marked and drilled the holes, and then used the screws to attach the bracket to the siding. The description of this sequence of actions is a description of what the author did, but it is meant represent the best way of doing the task, and therefore functions as an explanation to the reader of how he should do it. The last part, "Make sure you use screws that won't be so long that they hit some wires", is a piece of advice, but it too can be counted as part of the explanation of how best to carry out the task. So once again here, we have a curious mixture of argument and explanation, with some advice thrown in, advice that could be represented as an instance of argument from negative consequences.

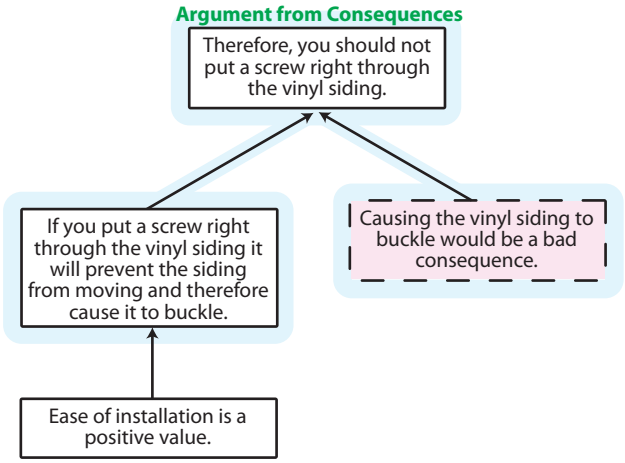

Fig. 4. Another Part of the Argument

6 Conclusions

The analysis of this example shows convincingly that both explanations and arguments can be based on practical reasoning, and that this kind of reasoning, as displayed in the common how-to type of explanation we examined, combines explanation and argument in interesting ways. Of course, we already knew that arguments can be interwoven with explanations, assuming that the analysis of abductive argumentation as inference to the best explanation is reasonable [5]. What would be even more helpful is to distinguish reasoning, argument and explanation, with the idea in mind that reasoning can be used in explanations as well as in arguments.

- Reasoning is a process of inference in leading from certain propositions known or assumed to be true to other propositions in a sequence.
- A dialogical theory [11] models an explanation as a dialog between two parties [7] in which one is presumed by the other to understand something, and the other asks a question meant to enable him/her to come to understand it as well [9].
- An argument may be defined as a social and verbal means of trying to resolve an unsettled issue that has arisen between two parties [10].

According to the last definition, an argument necessarily involves a claim put forward for acceptance by one of the parties, and that the other party doubts. The purpose of an argument is to remove doubt about some statement that is in question. The purpose of an explanation is to convey understanding to the questioner concerning some statement, event or action that is taken to be factual. In such a case, it is presumed that there is no doubt attached to its truth or

existence as a factual event. For example, when the various explanations of the Challenger space vehicle disaster were offered, it was presumed by all parties that the event really happened [6].

The distinction between an explanation and an argument is contextual, i.e. is based on the supposed purpose of the text of discourse of the speech exchange in a given case. Textual indicators can be used to help identify abductively whether some text is meant to be an argument or an explanation, but in many instances, they are insufficient to make a definite classification. Thus it should not be surprising that it is possible, in many instances, to look at the same sequence of practical reasoning in a given text of discourse as either an explanation or an argument. Still, for building logical models in artificial intelligence and argumentation that can help clarify the structure of explanations, the underlying distinction is an important one.

References

1. Katie Atkinson, Trevor Bench-Capon and Peter McBurney, 'Computational Representation of Practical Argument', Synthese, 152, 2006, 157-206.
2. Trevor Bench-Capon, 'Persuasion in Practical Argument Using Value-based Argumentation Frameworks', Journal of Logic and Computation, 13, 2003, 429-448.
3. Jorg Cassens and Anders Kofod-Petersen, 'Designing Explanation-Aware Systems: The Quest for Explanation Patterns', Explanation-Aware Computing: Papers from the 2007 AAAI Workshop, Technical Report WS-07-06, Menlo Park, California, AAAI Press, 2007, 20-27.
4. Lionel Fontan and Patrick Saint-Dizier, 'Analyzing the Explanation Structure of Procedural Texts', STEP Conference, Venice, August 2008.
5. John R. Josephson and Susan G. Josephson, Abductive Inference: Computation, Philosophy, Technology, Cambridge, Cambridge University Press, 1994.
6. David B. Leake, Evaluating Explanations: A Content Theory, Hillsdale, New Jersey, Erlbaum, 1992.
7. Johanna D. Moore, Participating in Explanatory Dialogues, Cambridge, Mass., MIT Press, 1995.
8. Chris Reed and Glenn Rowe, 'Araucaria: Software for Argument Analysis, Diagramming and Representation', International Journal of AI Tools, 2004, 13 (4), 961-980.
9. Roger C. Schank, Explanatory Patterns, Hillsdale, New Jersey, Erlbaum, 1986.
10. Douglas Walton, 'What is Reasoning? What is an Argument?', Journal of Philosophy, 87, 1990, 399-419.
11. Douglas Walton, 'Dialogical Models of Explanation', Explanation-Aware Computing: Papers from the 2007 AAAI Workshop, Technical Report WS-07-06, Menlo Park, California, AAAI Press, 2007, 1-9.
12. Douglas Walton, Chris Reed and Fabrizio Macagno, Argumentation Schemes, Cambridge, Cambridge University Press, 2008.