Dialectical arguments and case comparison

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Abstract. The basis of legal case-based reasoning is the doctrine of *stare decisis*: decisions in new cases should follow decisions in similar old cases. This paper takes as a starting point the 'case comparison' interpretation of the *stare decisis* doctrine. In this interpretation one establishes by case comparison which previously decided cases are sufficiently similar to a new case, after which the old conclusions are adopted in the new case. The paper shows how one can formally account for case comparison in terms of the dialectical arguments that cases give rise to. An innovation over previous work is that dialectical arguments are now formally defined, yielding a more transparent formal treatment of case comparison.

1. Introduction

This paper is about dialectical arguments in the context of legal case-based reasoning, and its main claim is that the comparison of the dialectical arguments in cases provides a solid basis for the formalising of case-based reasoning in the law.

Case-based reasoning is a technique to draw conclusions about cases, by comparing them to cases already settled. If some decided case is sufficiently similar to the case at hand, then under the doctrine of *stare decisis* one should not depart from that decision, and the same conclusion should hold. Case-based reasoning is a widespread practice in areas of common law, but it is becoming more and more popular under statutory law as well (MacCormick *et al.* 1997, pp. 11-12; Wiarda 1999, pp. 125-127). In order to decide whether a settled case can be followed it needs to be compared to the case at hand. As said this paper claims that this comparison can be formalised by using the notion of dialectical arguments.

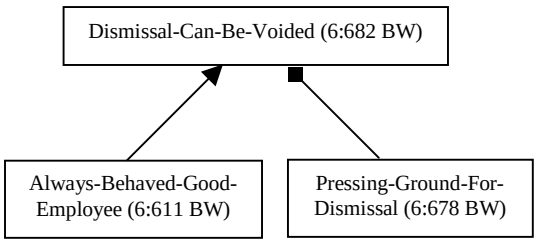
The paper is a follow-up of collaborative work by the authors that was reported by Roth (2003).[1] The present paper summarizes the central points of that work. In addition, the main definitions (viz. those leading to case comparison) have been simplified. By using an explicit definition of dialectical arguments, their role in case comparison becomes more transparent. Our definition of dialectical arguments is put in perspective by discussing similar definitions in related research.

2. Dialectical arguments

To arrive at a systematic analysis of cases, it is convenient to have a graphical representation of the argumentation in the cases. In particular, it is handy to represent graphically that statements support or attack conclusions.

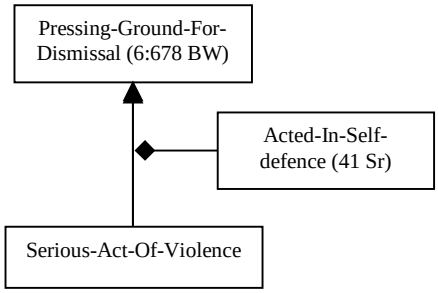
[1] Roth wrote his dissertation (2003) under Verheij's supervision. Cf. also Roth (2000; 2001a; 2001b) and Roth and Verheij (2004).

To this end tree-like structures are introduced, called *dialectical arguments*; cf. Verheij's (1999; 2003b) dialectical arguments and Loui's (1997) and Loui and Norman's (1995, p. 164) records of disputation. Dialectical arguments consist of statements that support or attack other statements. Support is represented by arrows, attack by arrows ending in a solid square. In the following figure one finds an example of this, again from the domain of Dutch dismissal law.



Here the conclusion that the dismissal can be voided is supported by the statement that the dismissed person has always behaved like a good employee (art. 6:611 BW) and attacked by the statement that there is a pressing ground for dismissal according to article 6:678 of the Dutch Civil Code (art. 6:678 BW).

It is a key feature of the present model that it can also be supported and attacked that a statement supports or attacks a conclusion. Cf. Toulmin's (1958) warrants and Pollock's (1987) undercutters. A step forward to deal with this is to treat it as a statement itself that the conclusion is supported or attacked (Verheij 1999; 2000; 2003a; 2003b). Accordingly, one can represent by an arrow pointing at another arrow that it is supported or attacked that a statement supports or attacks a conclusion. This gives rise to a kind of entanglement of dialectical arguments that can be the basis for comparing cases in legal case-based reasoning (Roth 2001b, pp. 31-33). An example is in the following figure.



The conclusion that there is a pressing ground for dismissal is supported by the statement that the employee committed a serious act of violence. However, it is attacked that having committed a serious act of violence supports that there is a pressing ground for dismissal. The attacking statement is that the employee acted in self-defence, which is a general ground of justification according to article 41 of the Dutch Penal Code (art. 41 Sr).

It can also be supported that a statement supports or attacks a conclusion.

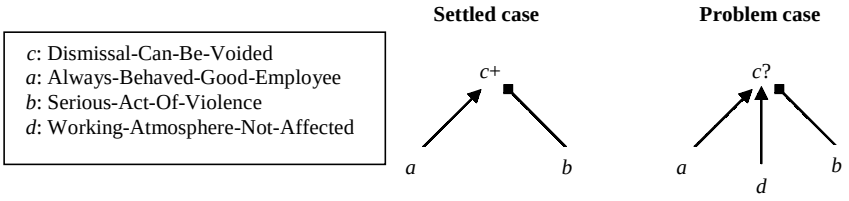
3. Case comparison

It is the purpose of case comparison to determine whether a settled case can be followed in a problem case. Intuitively one can certainly follow a settled case where a conclusion was drawn, if there is at least as much support for the conclusion in the problem case.

The support for a conclusion is determined by the dialectical argument for it. In this connection the present theory will use the term *dialectical support* for a conclusion, and

case comparison will come down to comparing dialectical arguments regarding the dialectical support for their conclusion.

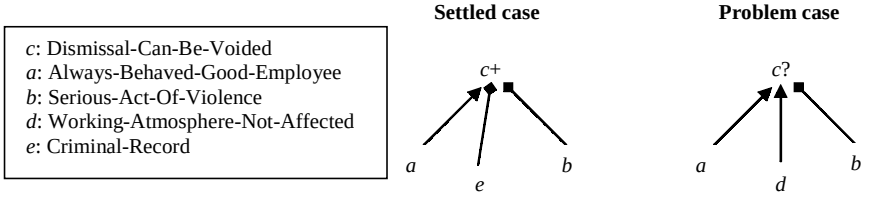
In the following a number of examples of increasing complexity are given.



In this figure there is a settled case on the left where the conclusion (*c*) was drawn that a person's dismissal could be voided, as indicated by the plus sign. On the right there is a problem case where this conclusion is an issue, as indicated by the question mark.

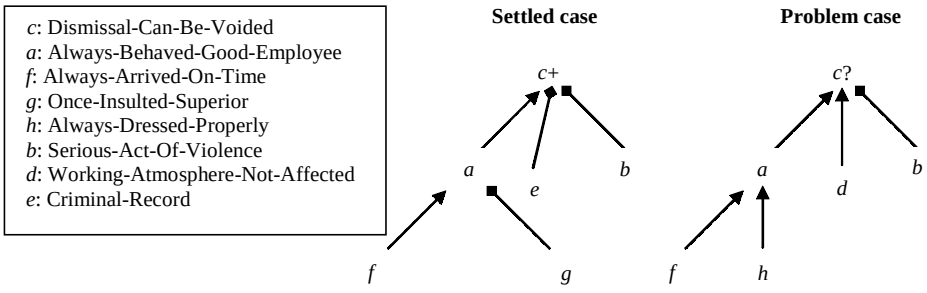
In both cases the conclusion (*c*) that the dismissal can be voided is supported by the statement (*a*) that the person has always behaved like a good employee, and attacked by the statement (*b*) that the employee committed a serious act of violence. In the problem case the conclusion *c* is also supported by the statement (*d*) that the working atmosphere has not been affected by the dismissal. As a result, there is more dialectical support for *c* in the problem case, so that it should follow there as well.

Another example is in the following figure.



In the settled case the conclusion *c* is attacked by the statement (*e*) that the employee has a criminal record. Together with the difference *d* already discussed, this means that there is more dialectical support for *c* in the problem case. As a result, the conclusion (*c*) that the dismissal can be voided can hold there as well.

Dialectical arguments can have a more complex structure:

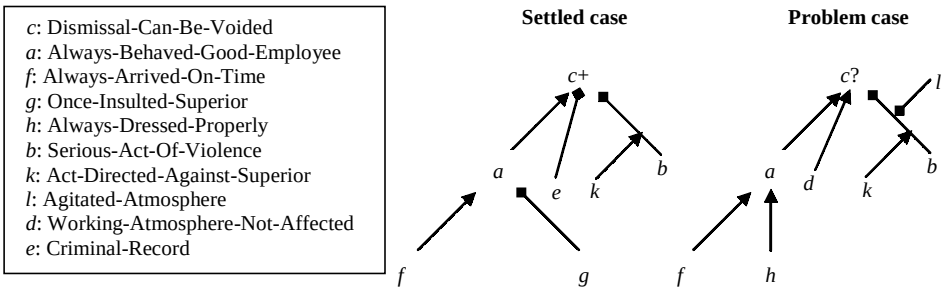


In both the settled case and the problem case, the statement (*a*) that the person has always behaved like a good employee is supported by the statement (*f*) that the person always arrived on time. In the problem case the statement *a* is also supported by the statement (*h*) that the employee was always dressed properly. Moreover, in the settled case the statement *a* is attacked by the statement (*g*) that the employee once insulted a superior.

As a result, there is more dialectical support for the statement *a* in the problem case. In accordance with this, there is more dialectical support for conclusion *c* in the problem case than in the settled case, so that the conclusion can follow in the problem case as well.

Note that for concluding to the outcome that there is more dialectical support for *c* in the problem case, it does not matter how the conflict with regard to the intermediate *a* is to be resolved.

It can itself be supported or attacked that one statement supports or attacks another:



The difference with the previous situation is that in the problem case it is subject of argumentation whether the conclusion (*c*) that the dismissal can be voided is attacked by the statement (*b*) that the employee committed a serious act of violence. That *b* attacks *c* is supported in both cases by the statement (*k*) that the violent act was directed against a superior. Moreover, the attack by *b* is attacked in the problem case by the statement (*l*) that the violent act took place in an agitated atmosphere. As a consequence, the problem case provides more dialectical support for conclusion *c* than the settled case, so that the conclusion can follow in the problem case as well. Note that for concluding to this result it is not necessary to resolve the conflict with regard to the attack by *b*.

4. Formalising case comparison with dialectical arguments

In this section dialectical arguments will be formally defined first. Then the conditions are stated under which a settled case can be followed. Intuitively, these conditions are that there is at least as much dialectical support for the conclusion in the problem case. Formally, the conditions involve the notion of maximal dialectical arguments and the statements pro and con the conclusion that appear in these maximal dialectical arguments.

4.1 A language for support and attack

Dialectical argumentation involves making *statements*, and to this end sentences are used. Statements can *support* or *attack* other statements, and it can itself be a statement that such a relation of support or attack holds. An example is the statement that being highly esteemed as a colleague supports the conclusion that the dismissal can be voided. Another example is the statement that having caused considerable damage attacks the conclusion that the dismissal can be voided.

Support and attack are expressed by means of a special connective ↗. The conditional sentence $a \nearrow b$, for instance, informally expresses that the statement that *a* supports the statement that *b*, or '*a* supports *b*' for short. Instead of '*a* supports *b*' one can also say 'if *a* then *b*', provided that it is kept in mind that the support relation is not intended as a standard material implication.

To express attack the connective ↗ is combined with negation, denoted ¬. Thus the sentence $d \nearrow \neg b$, for instance, has the informal reading that '*d* attacks *b*' or 'if *d* then not *b*'. An example is that having a criminal record (*d*) attacks the statement that one's dismissal can be voided (*b*).

Recall that it is a key element of the present model that support and attack are not restricted to statements using atomic sentences in simple small letters, but are also possible

for compound statements (see Footnote 2). To express the support or attack of such statements, a nested notation is used that involves brackets. The sentence $a \nearrow (b \nearrow c)$, for instance, then informally says that *a* supports that *b* supports *c*. An example of this mechanism is that having children planning to go to university (*a*) supports that having a family to maintain (*b*) supports that there are substantial interests in keeping the job (*c*). Likewise the sentence $d \nearrow \neg(b \nearrow c)$, for instance, expresses that *d* attacks that *b* supports *c*. An example of this mechanism is that having a wife with a good income (*d*) attacks that having a family to maintain (*b*) supports that there are substantial interests in keeping the job (*c*).

The language of support and attack is called the *case representation language* (abbreviated CRL), and defined concisely as follows. The convention is adopted that small Greek letters in italics are metavariables for sentences of this language, for example α. A set of atomic sentences is presupposed, all of which are by definition sentences of CRL. Furthermore, if α and β are sentences, then $(\alpha \nearrow \beta)$ and $\neg\alpha$ are sentences too. The formal definition of the case representation language is as follows.

Definition 1 (Case representation language, CRL)

Given a set of atomic sentences, the case representation language, abbreviated CRL, is defined as the smallest set of sentences such that conditions 1. and 2. hold:

1. if α is an atomic sentence, then α is a sentence, and
2. if α and β are sentences, then $(\alpha \nearrow \beta)$ and $\neg\alpha$ are sentences.

A doubly negated sentence is treated as equivalent to the sentence itself. The sentence $\neg\neg a$, for instance, is equivalent to the sentence *a*. In accordance with this, the convention is adopted that double negations ($\neg\neg$) vanish everywhere. Thus $\neg\neg c$, for instance, becomes *c*, and $a \nearrow \neg\neg c$ becomes $a \nearrow c$. Note that as a result, the opposite of the opposite of a statement is treated as being equal to the statement itself. Accordingly, attacking a conclusion's opposite is the same as supporting the conclusion.

4.2 Dialectical arguments

In this subsection a formal definition of dialectical arguments is presented. The definition concerns the set of dialectical arguments that can be constructed given a set of premises. As will be seen later on, for case comparison regarding a disputed conclusion one needs only one dialectical argument from this set for each case, namely the maximal dialectical argument for the conclusion.

Formally, dialectical arguments are triples (*Pros*, *Cons*, *Conclusion*), where *Pros* and *Cons* are sets of sentences of the case representation language CRL, and *Conclusion* is a sentence of that language. Informally, *Pros* contains the statements in support of *Conclusion*, while *Cons* contains those involved in attacks.

Dialectical arguments are constructed using sentences in a case as their 'premises', and that's why they are formally defined relative to a set of sentences (*S*). A characteristic of dialectical arguments is that they can be combined to construct larger ones. This can be done in three ways, corresponding to clauses 2, 3 and 4 of the definition below.

The first is by a variant of modus ponens involving the connective $\nearrow$ for support. Suppose, for instance, that one has a dialectical argument for the conclusion (*a*) that a person always arrived on time, and a dialectical argument for the conclusion ($a \nearrow c$) that this supports that (*c*) one's dismissal can be voided. Then by combining the premises of both dialectical arguments, one can obtain a dialectical argument for the conclusion (*c*) that the dismissal can be voided.

The second way of combining dialectical arguments is by taking two arguments for the *same* conclusion together as 'branches' of a larger dialectical argument. This is achieved by taking the union of the premises pro and con of each individual argument, respectively.

The final way of combining dialectical arguments occurs when one dialectical argument attacks the conclusion of another, that is, it supports the *opposite* conclusion. Formally this is captured by treating the pros of the attacking argument as cons of the attacked one, and vice versa. Suppose, for instance, that the conclusion (*c*) that a dismissal can be voided is supported by the statement (*a*) that one has always behaved like a good employee, and attacked by the statement that one has committed a serious act of violence (*b*). Then the arguments involving *a* and *b* can be combined into one dialectical argument where they are a supporting and attacking statement, respectively.

The formal definition is as follows.

Definition 2 (Dialectical arguments)

Let *S* be a set of sentences. Then the *set of dialectical arguments* with premises in *S* is the smallest set such that the following conditions hold:

1. For all sentences α in *S*, ($\{\alpha\}$, $\emptyset$, α) is a dialectical argument;
2. *Modus ponens*
   Let ($Pros_2$, $Cons_2$, $Conclusion_1$) and ($Pros_1$, $Cons_1$, $Conclusion_1 \nearrow Conclusion_2$) be dialectical arguments. Then ($Pros_1 \cup Pros_2$, $Cons_1 \cup Cons_2$, $Conclusion_2$) is a dialectical argument;
3. *Support (accrual)*
   Let ($Pros_1$, $Cons_1$, *Conclusion*) and ($Pros_2$, $Cons_2$, *Conclusion*) be dialectical arguments. Then ($Pros_1 \cup Pros_2$, $Cons_1 \cup Cons_2$, *Conclusion*) is a dialectical argument;
4. *Attack*
   Let ($Pros_1$, $Cons_1$, *Conclusion*) and ($Pros_2$, $Cons_2$, *OppositeConclusion*) be dialectical arguments, such that *Conclusion* and *OppositeConclusion* are opposites (i.e., one is the negation of the other). Then ($Pros_1 \cup Cons_2$, $Cons_1 \cup Pros_2$, *Conclusion*) is a dialectical argument.

When (*Pros*, *Cons*, *Conclusion*) is a dialectical argument with premises in *S*, then by definition the elements of *Pros* and *Cons* are called the argument's *premises*, *Conclusion* is called its *conclusion*. Moreover, the elements of *Pros* are called *pro* conclusion *Conclusion* in *S*, and the elements of *Cons* are called *con* conclusion *Conclusion* in *S*.

If dialectical arguments are to be used for formalising case comparison, one must be sure that all relevant premises that can be involved are included in them. It is obviously not a good thing, for instance, to ignore statements that attack the disputed conclusion in the problem case and not in the settled case. If an employee committed a serious act of violence in the problem case while this did not happen in the settled case, then this is a relevant distinction between the two cases. As a result of the distinction, the settled case cannot be followed then.

To make sure that all relevant premises are included the notion of a maximal dialectical argument is introduced next, as in the following definition.

Definition 3 (Maximal dialectical arguments)

> Let *S* be a set of sentences and *Conclusion* a sentence. Then the *maximal dialectical argument for Conclusion* with premises in *S* is the dialectical argument (*Pros, Cons, Conclusion*) with premises in *S* such that the argument's set of premises is maximal with respect to set inclusion.

Note that property 3 of the definition of dialectical arguments guarantees the uniqueness of maximal dialectical arguments for finite sets of premises *S*, since the sets *Pros* and *Cons* of the maximal dialectical argument with premises in *S* can be obtained simply by taking the union of the corresponding sets of all dialectical arguments with premises in *S*.

The above definition of dialectical arguments involves only premise sets and conclusions, without taking intermediate conclusions into account. In general, however, the reasoning in cases can consist of multiple steps involving intermediate conclusions. An example is the intermediate conclusion (*a*) that a person has always behaved like a good employee. This supports the conclusion (*c*) that one's dismissal can be voided, but can itself be supported, for instance, by the statement (*f*) that the person always arrived on time for work.

The following definition gives a formal account of intermediate conclusions of dialectical arguments.

Definition 4 (Intermediate conclusions)

> Let (*Pros*, *Cons*, *Conclusion*) be a dialectical argument with premises in *S*. Then a sentence α is an *intermediate conclusion* of the dialectical argument if and only if it occurs in a sequence (α_1, α_2, ..., α_n) for which the following hold:
>
> 1. *Conclusion* is equal to α_n, or
> 2. For all *i* from 1 to *n*, at least one of the following holds:
>   a. α_i is a premise of the dialectical argument (i.e., is an element of *Pros* $\cup$ *Cons*).
>   b. There exist *j* and *k* smaller than *i* such that α_j equals $\alpha_k \nearrow \alpha_i$.
>   c. There exist *j* and *k* smaller than *i* such that α_j equals $\alpha_k \nearrow \beta$, where β is the opposite of α_i.

Note that the set of intermediate conclusions grows monotonically with *Pros* and with *Cons*. This means that when $Pros_1$ is a subset of $Pros_2$ the set of intermediate conclusions of ($Pros_1$, *Cons*, *Conclusion*) is a subset of that of ($Pros_2$, *Cons*, *Conclusion*) and that when $Cons_1$ is a subset of $Cons_2$ the set of intermediate conclusions of (*Pros*, $Cons_1$, *Conclusion*) is a subset of that of (*Pros*, $Cons_2$, *Conclusion*).

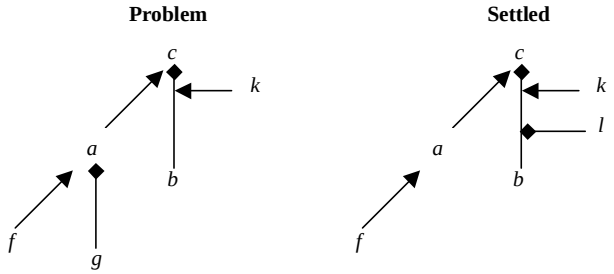
4.3 Case comparison

In this subsection the formal conditions are stated under which a problem case provides at least as much dialectical support for conclusion as a settled case. Thanks to the formal definition of dialectical arguments in the previous subsection, these definitions will take the form of simple set inclusions involving sets of statements pro and con the conclusion.

In one respect the present account of case comparison is – for reasons of brevity - a simplification of one given in earlier work (Roth 2003). In the earlier account a distinction was made between factors and non-factors among case features, whereby only factors were considered relevant for case comparison (pp. 50f.). Among other things this allowed for an account of interesting argument moves in case comparison, such as emphasising a distinction (pp. 92f.). As said the distinction between factors and non-factors is presently

not made, however. Cases are treated accordingly as if they readily provide the premises of dialectical arguments, without first having to derive the 'applying' factors (pp. 55-56).

Recall from above that a settled case can be followed as a precedent, if and only if the problem case provides at least as much dialectical support for the conclusion. See the following example.



In general there are two conditions under which one case provides at least as much dialectical support as another case. In words, these conditions say that the set of premises *pro* the conclusion in the first case is a (strict or non-strict) superset of the corresponding set of premises in the second case. At the same time the set of premises *con* the conclusion in the first case is a (strict or non-strict) subset of the corresponding set of premises in the second case. The formal definition is as follows.

Definition 5 (At least as much dialectical support)

For any case ***Case***, let $\text{Pro}_\gamma(\textbf{\textit{Case}})$ denote the set of premises of the maximal dialectical argument with conclusion γ and premises in ***Case***, which are pro γ in ***Case***. Likewise, let $\text{Con}_\gamma(\textbf{\textit{Case}})$ denote the set of premises of the maximal dialectical argument with conclusion γ and premises in ***Case***, which are con γ in ***Case***.

Then ***Case1*** provides *at least as much dialectical support for* γ as ***Case2***, if and only if 1. and 2. hold:

1. $\text{Pro}_\gamma(\textbf{\textit{Case1}}) \supseteq \text{Pro}_\gamma(\textbf{\textit{Case2}})$, and
2. $\text{Con}_\gamma(\textbf{\textit{Case1}}) \subseteq \text{Con}_\gamma(\textbf{\textit{Case2}})$.

According to this definition the comparison of cases is done in terms of premises of dialectical arguments. In this respect the present account is similar to Roth's earlier one (2003, p. 66), where only basic factors were involved in the definition of comparison outcomes.

5. Related work on dialectical arguments

Roth (2003) extensively discusses how the approach to the formal modelling of case-based reasoning of the present paper compares to related work (Ashley 1990; Aleven 1997; Prakken and Sartor 1998; Bench-Capon and Sartor 2003; Branting 2000; Hage 1997). Since in this paper the focus is on the role of dialectical arguments in case-based reasoning, the next discussion of related research is limited to research addressing notions similar to our dialectical arguments.

Toulmin (1958) has presented an influential argument scheme, distinguishing for instance between warrant, backing and rebuttal. A warrant is a rule-like inference license. A backing provides support for the warrant. A rebuttal provides conditions of exception for the argument. By the inclusion of rebuttals in Toulmin's scheme, it can be regarded as an early variant of the notion of dialectical argument. Toulmin's backing and warrant are

related to our nested statements of the form $a \nearrow (b \nearrow c)$, that express that statement *a* supports that statement *b* supports statement *c*. In contrast with the definition of the present paper, Toulmin does not discuss the chaining of his scheme. For instance, a claim in one instance of his scheme can itself be the datum of a second instance. Toulmin's account of rebuttal does not provide much detail about its nature. As a result, he does not distinguish between attacking a statement and undercutting attack (cf. Pollock 1987).

Pollock's inference graphs (1987) are related to the dialectical arguments defined here. His graphs are however constructed from sequents (i.e., pairs of premises and conclusions) and not of statements. In our dialectical arguments, statements can be supported by different reasons, allowing a variant of accrual of reasons: an argument containing more reasons for a statement can provide more dialectical support. Pollock has explicitly argued against the idea of accrual of reasons.

Vreeswijk's argumentation theory (1997) is a theory of defeasible argumentation, but his arguments are not dialectical in our sense: they cannot contain both pros and cons. In Vreeswijk's theory, arguments are constructed using strict and defeasible rules of inference. When arguments have incompatible conclusions, they can become defeated.

In Prakken & Sartor's framework (1996), arguments are sequences of rules. Just as in Vreeswijk's approach, attack occurs between arguments. Arguments do not themselves contain reasons for and against a conclusion. As a result, their arguments are not dialectical in our sense. Rules are givens and cannot be nested.

Dung (1995) studied the attack relation between arguments and how it leads to defeat. He discusses different kinds of attack semantics. His arguments are unstructured.

Verheij's CumulA (1996) arguments are trees of reasons and conclusions. A conclusion can be supported by more than one reason, as in our dialectical arguments. In this way, CumulA allows a variant of accrual of reasons. CumulA's arguments are not dialectical in our sense, since they do not contain reasons for and against a conclusions. Attack occurs between arguments. Rules are givens and cannot be nested.

Verheij's ArguMed and DefLog (2003a, 2003b) use a notion of dialectical argument that is structurally the same as the one used here. In contrast with other approaches it is sentence-based and not argument-based. Statements can be supported and attacked in one argument and there can be more than one reason for a conclusion. There is a subtle difference in semantics: ArguMed and DefLog use dialectical negation, expressing the defeat of statements, while the negation used here is closer to standard negation.

6. Conclusion

In this paper, we have shown how the comparison of the dialectical arguments in cases can be used for the formal modelling of case-based reasoning in the law. With respect to our previous formalism (Roth 2003), this paper adds an explicit definition of dialectical arguments. This yields a more transparent formal account of case comparison than in earlier work. Finally, the notion of dialectical arguments in this paper has been compared with related notions in other research. Our conception of dialectical arguments, which is structurally the same as the one of Verheij's ArguMed and DefLog (2003a, 2003b) is sentence-oriented and not argument-oriented. Moreover it combines support and attack, accrual of reasons and entanglement (i.e., the nesting of rules). In this way, our conception differs from other approaches to dialectical arguments.

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