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Argumentation Schemes for Argument from Analogy

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Argumentation Schemes for Argument from Analogy (D. Walton) *CRRAR*

Systematic Approaches to Argument from Analogy, ed. H. J. Ribeiro, Heidelberg, Springer, 2014, 23-40.

There is such a huge literature on argument from analogy that during the early stages of my career I avoided work on the subject because so many scholars in so many fields had already written so much about it. When asked by a group of graduate students whether it would be a good idea to start a research project on argument from analogy some time ago, I cautioned them against it, or at least warned them about the dangers inherent in such a project, simply because of this huge existing literature they would have to go through. The fields that comprise this literature include not only argumentation studies, but also logic, cognitive science, ethics, law, literature, philosophy of science, computer science and the social sciences generally (Guarini et al., 2009). However, it is an important type of argument for us in the field of argumentation studies to deal with, if only because it is such a common and pervasive form of argument almost everywhere, but also because many logic textbooks have emphasized how it is an important informal fallacy by citing examples of improper uses of argument from analogy (Kienpointner, 2012). So recently I too, yielding to necessity, have taken up writing on argument from analogy.

After surveying the literature on argument from analogy in some recent work, I came to the conclusion that there are two different types of argument from analogy, each represented by its own argumentation scheme (Walton, 2010; Walton, 2012). This was very puzzling at first, because normally we would just like to have one scheme representing such a basic and distinctive type of argument. But it appears that there is wide disagreement on precisely what form the argument from analogy should be represented by, and below I will try to explain why in the end the hypothesis that argument from analogy has two separate schemes is not such a bad one and how this double scheme approach can be justified.

The first section of the paper uses some standard argument diagrams to explain how the first scheme represents argument from analogy as proceeding from a source case to a target case. The second section shows how this scheme applies to a famous case of argument from analogy in philosophy. The third section introduces the second argumentation scheme, based on comparing factors in two cases. The fourth section shows how factors are weighed in systems of case-based reasoning. The fifth section presents a famous case of argument from analogy in legal rhetoric. The sixth section models a notion of similarity using script-based technology from artificial intelligence. The last section provides conclusions on how to evaluate argument from analogy.

1. The First Scheme

The following scheme (Walton, Reed and Macagno, 2008, 315) represents what is probably the most widely accepted version of the scheme for argument from analogy advocated in the logic textbooks and other relevant sources. C_1 and C_2 represent two cases.

Similarity Premise: Generally, case C_1 is similar to case C_2.

Base Premise: A is true (false) in case C_1.

Conclusion: A is true (false) in case C_2.

This scheme requires that in order for something to qualify as an argument from analogy it must have one premise asserting that there is a similarity between two cases. A second requirement is that a proposition A must hold in the first case, or must be a conclusion that can be drawn in the first case. The conclusion drawn by the argument from analogy is that that A also holds in the second case. This version of the scheme for argument from analogy is the one used in the textbook (Walton, 2006, 96).

The above version of the scheme conveys the basic idea behind it very well, but its ease of applicability to real cases can be improved (as will be shown below) by modifying it slightly. In the sequel, we will use this modified version.

Base Premise: A situation is described in C_1.
Derived Premise: A is plausibly drawn as an acceptable conclusion in case C_1.
Similarity Premise: Generally, case C_1 is similar to case C_2.
Conclusion: A is plausibly drawn as an acceptable conclusion in case C_2.

It doesn't matter too critically which scheme you use. Using either one is better than using none at all. Whether a conclusion is plausibly drawn from a case depends on the audience to whom the argument was supposedly directed. The modified version brings out better how the derived premise is drawn as a conclusion by the audience from the source case. This modification makes the base premise slightly more complex and wordy, but as the reader will shortly see, it fits cases in a more natural way. Let us henceforth call this modified scheme the basic scheme for argument from analogy.

It is part of every argumentation scheme that it must have a matching set of critical questions that can be used to probe into weak parts of the argument of the type represented by the scheme The following set of critical questions according to the account given (Walton, Reed and Macagno, 2008, 315) matches the basic scheme for argument from analogy.

CQ$_1$: Are there respects in which C_1 and C_2 are different that would tend to undermine the force of the similarity cited?
CQ$_2$: Is A the right conclusion to be drawn in C_1?
CQ$_3$: Is there some other case C_3 that is also similar to C_1, but in which some conclusion other than A should be drawn?

The first critical question relates to differences between the two cases that could detract from the strength of the argument from analogy, but respects in which two cases are similar could also be used to support the argument from analogy. The second critical question rather nicely paves the way to indicating why the reformulated version of the scheme is an improvement. A third critical question is associated with a familiar type of counterargument called the argument from counter-analogy. The function of this critical question is to suggest doubt that could lead possibly to a plausible counterargument that could be used to attack the original argument.

It will also help us to use the standard terminology in the literature on argument from analogy to talk about the structure of argument from analogy.
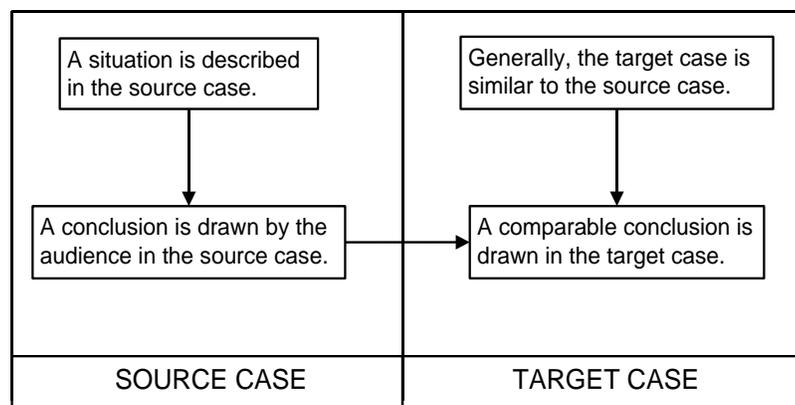

Figure 1: The Transition from the Source Case to the Target Case

In the argumentation scheme above, the original case C_1 used to set up the argument from analogy is called the source case. The case C_2 to which the situation in the first case is compared is called the target case. How argument works as a transfer of data from one case through an argument to another case is graphically shown in figure 1.

In figure 2 we see the characteristic movement from one case to another that is the basic mechanism of argument from analogy. But the structure of the argument as a sequence of reasoning where the basic scheme links the premises to the conclusion has not been revealed yet.

Figure 2 shows how argument from analogy, and also argument from counteranalogy poised to attack an argument from analogy that was originally set forth, can be visually represented using an argument diagram. In this diagram the propositions composing the premises and conclusion are shown in text boxes, and the inferential link leading from a premise or a set of premises to a conclusion is drawn by an arrow leading to the conclusion on a set of lines leading to the premises. In the intersection of these lines there is a node representing the argument itself, which is shown on the diagram containing annotation representing the name of the argumentation scheme.
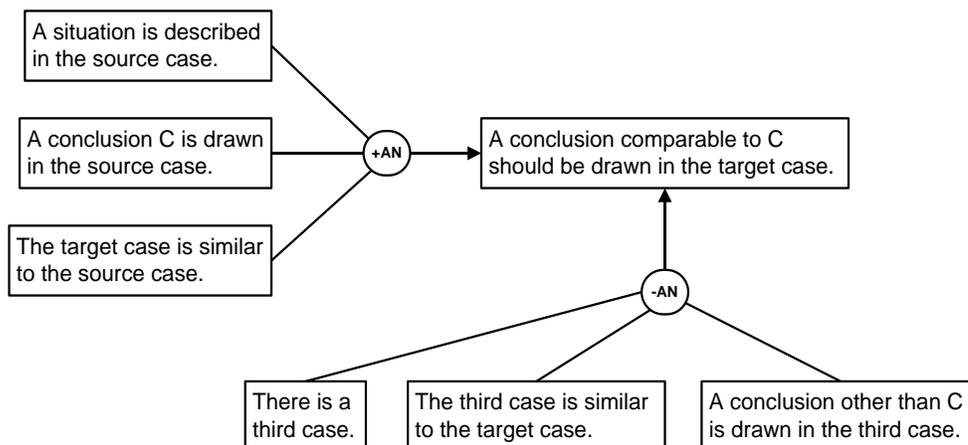

Figure 2: Argument from Analogy with Argument from Counteranalogy

The diagram has been drawn in the style of an argument map constructed with the Carneades Argumentation System, where every argument is represented as a pro or con argument. A pro argument has a plus sign in its argument node while a con argument has a minus sign in its argument node. Accordingly, in figure 2, the argument from analogy at the top is represented as a pro argument supporting conclusion on the right. The argument at the bottom is represented as a con argument that attacks the conclusion of the prior argument.

It is often said in argumentation studies that there are three basic ways an argument can be attacked. You can attack one or more of the premises, you can attack the conclusion, or you can attack the inferential link between the premises and conclusion. In this instance the argument from counteranalogy is used to argue that the conclusion of the prior argument from analogy is not acceptable. The type of attack represented in figure 2 is of the second type where the attack is against the conclusion of the prior argument.

2. The Violinist Example

Possibly the most famous use of argument from analogy argument from analogy in twentieth-century philosophy was the violinist example of Thomson (1971, 48-49), quoted below.

> You wake up in the morning and find yourself back to back in bed with an unconscious violinist. A famous unconscious violinist. He has been found to have a fatal kidney ailment, and the Society of Music Lovers has canvassed all the available medical records and found that you alone have the right blood type to help. They have therefore kidnapped you, and last night the violinist's circulatory system was plugged into yours, so that your kidneys can be used to extract poisons from his blood as well as your own. The director of the hospital now tells you, "Look, we're sorry the Society of Music Lovers did this to you - we would never have permitted it if we had known. But still, they did it, and the violinist now is plugged into you. To unplug you would be to kill him. But never mind, it's only for nine months. By then he will have recovered from his ailment, and can safely be unplugged from you."

This argument was deployed by Thomson to support the thesis that a woman should have the right to terminate her pregnancy, by arguing that the person in the example should have the right to unhook the violinist. The basis of the argument is that the situation of the violinist is similar to the situation of a pregnant woman. The conclusion that will plausibly be drawn by anyone presented with the situation of the violinist, as Thomson rightly supposed, is that the person in the example should have the right to unplug himself from the violinist, even though the violinist will die as a result. But since this source case is similar to the target case of a woman who is pregnant, the conclusion suggested in the target case is that a pregnant woman may terminate her pregnancy, even though the fetus will die as a result.

How the refined version of the basic scheme for argument from analogy applies to the violinist argument can be shown visually in figure 3.
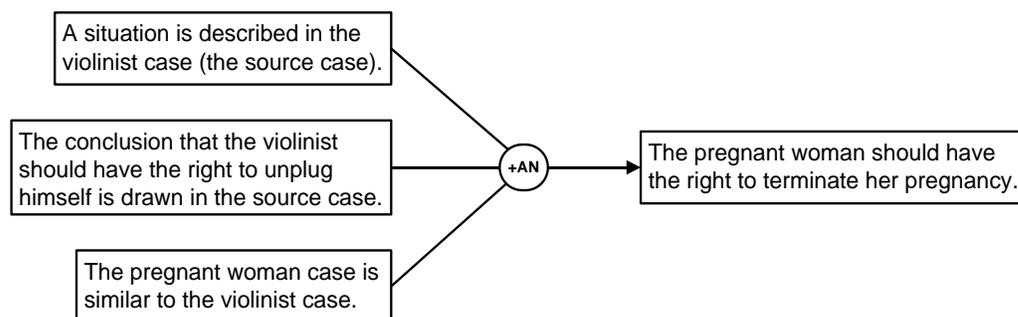

Figure 3: Argument from Analogy in the Violinist Case

There are many ways to support or attack this argument. Some might want to extend it further by claiming that it justifies abortion. However, this particular issue has been so widely and hotly disputed that it also turns on how the term 'abortion' is defined. The pro-choice side defines it as removal of the fetus whereas the pro-life side defines it as the killing of a person. So there are all kinds of controversial counterargument moves surrounding this case, but this paper is not the place to comment on these. Nevertheless, the case can be used to illustrate how some types of arguments from analogy work, precisely because it is a powerful and clever argument, and probably the best-known use of argument from analogy in recent philosophy.

There are many ways to support or attack Thomson's argument in the huge literature it provoked, but that is not our subject here. All we need to observe is that CQ_2 is possibly the critical question that an audience who is not so enthusiastically pro-choice or pro-life would be most naturally inclined to raise. In the source case the violinist and the person to whom he was attached are presumed to be unrelated, while in the abortion case the woman and the fetus are arguably related. There is also another aspect of the argument to be careful about. Because it is true in the source case that the person in the example was kidnapped and so did nothing himself to cause the violinist to be attached to him, the argument from analogy is only applicable to cases where the woman had no choice about becoming pregnant, for example, cases of rape. This narrowing of the range of the argument detracts considerably for the weight of its support for the conclusion that abortion should be generally acceptable if a woman chooses it.

From a point of view of argumentation theory, the most interesting aspect of the example is how the notion of similarity in the similarity premise can be defined or analyzed. I have previously put forward a theory that provides an answer to this question, but before introducing it, let's go on to consider another very different but equally interesting kind of example.

3. The Second Scheme

The second scheme proposed to model analogical argument is the dominant one in the logic textbooks. It is advocated in the two most widely used logic textbooks. It treats the argument from analogy as an inductive form of argument that requires no reference to similarity. In this respect, it can be sharply contrasted with the first scheme.

Copi and Cohen (1990, 358) offer the example of a conjecture on whether the planets Saturn, Jupiter, Mars, Venus and Mercury, might have living creatures on them. This example is an old one that has been superseded by the advance of science, but it is at least clear enough to be used to try to grasp how Copi and Cohen's form of analogical argument is supposed to fit some more or less realistic case. The premises are the observations of similarities between these planets and earth. All these planets revolve around the sun, collect light from the sun, revolve around their axis, have a succession of day and night, and so forth. They all share all these characteristics with planet Earth. There are also certain respects in which they differ from Earth. Some of them revolve around their axis in a manner like Earth, while others do not. Some have moons, while others do not. According to the example, the conclusion drawn from these similarities, despite the differences, is that it is reasonable to think that these planets may, like Earth, exhibit the habitation of various orders of living creatures.

To represent the structure of argument from analogy in this example Copi and Cohen (1990, 360) offer the following form they call analogical argument.

Entities a, b, c, d all have the attributes P and Q.

a, b, c all have the attribute R.

Therefore d probably has the attribute R.

Copi and Cohen (1990, 357) state that arguments of this form are inductive, not deductive. They (363-365) offer six criteria for appraising analogical arguments. Four are worth mentioning here: the number of entities compared, the number of respects in which the things compared are said to be analogous, the number of disanalogies or points of differences between the entities compared and the entity in the conclusion, and whether the analogies are relevant.

Let's try to see how their form of argument fits their planets example. Start with the conclusion. Earth fits in for the variable d, and R means having habitation of living creatures,

since the conclusion is the statement that Earth, exhibits the habitation of various orders of living creatures. But that is not the conclusion. As noted above, the conclusion is the statement that it is reasonable to think that these other planets may, like Earth, exhibit the habitation of various orders of living creatures. How the form fits the example is unclear.

Hurley (2003, 469) offers the following structure to represent the form of argument from analogy.

Entity A has attributes a, b, c and z.

Entity B has attributes a, b, c.

Therefore, entity B probably has z also.

This format of this structure for argument from analogy is different from the one offered by Copi and Cohen, but the motivating idea behind it seems to be pretty much the same. Hurley also classifies argument from analogy as an inductive form of argument. Also in a manner quite similar to Copi and Cohen's approach, Hurley, 469-470 offers six criteria for appraising analogical arguments: (1) relevance of the similarities, (2) number of similarities, (3) nature and degree of disanalogy, (4) number of primary analogues, (5) diversity among the primary analogues, and (6) specificity of the conclusion.

Hurley (2003, 469-470) illustrates these criteria using with a leading example. In this example a woman called Lucy is deciding on which new car to buy. She decides in favor of the Chevrolet because she wants good gas mileage and she has observed that her friend Tom has a new Chevrolet and it gets good gas mileage. But some other similarities might be irrelevant. Both cars have a padded steering wheel, vinyl upholstery, tinted windows and white paint. Additional similarities which would support the argument from analogy might include such things as the weight of the car, whether it has an aerodynamic body, and the kinds of tires that are on it. Differences between the two cars might be that Tom's car has overdrive but Lucy's does not, or that Lucy's car is equipped with a turbocharger and Tom's is not. The number of analogues might include additional cases known to Lucy. Three of her friends drive cars similar to Tom's and all three get good gas mileage. The factor of diversity among the cases cited is illustrated by the example of Lucy's four friends who all do their driving on level streets in a cautious manner that minimizes fuel consumption. The sixth criterion of specificity of the conclusion is less easy to explain, but what Hurley is telling us is that we have to pay attention to the way the conclusion is stated because a more specific conclusion will be harder to prove and easier to falsify than one that is less specific.

How Hurley's proposed form of the argument from analogy fits his example is clearer. The conclusion is the presumably the statement that if Lucy buys a Chevrolet, this car will get good gas mileage According to Hurley (470), Lucy's conclusion is that her car will get good gas mileage, but technically it is not her car until she buys it. The argument is also an instance of goal-directed decision-making on what to do under conditions of uncertainty. The argument supporting this conclusion is that Tom's Chevrolet (assumed to share many attributes with the one Lucy will buy), has the attribute of good gas mileage. The variable B represents the car Lucy is considering buying, and the variable z represents the attribute of getting good gas mileage. The example can then be expanded to take other Chevrolet owners in to account. If they get good mileage this evidence supports the argument from analogy. If there are some Chevrolets that do not get good gas mileage, this evidence undermines (weakens) the argument from analogy.

For purposes of ease of applicability to cases, I would say that Hurley's version is an improvement on Copi and Cohen's. But the main thing we need take from these observations is that the two leading logic textbooks both present a fundamentally similar account of the form of

the argument from analogy. Both have this same sort of underlying structure as arguments, which can be formulated succinctly as a rule of inference. To grasp the rule of inference, begin with the instance of it in Hurley's example. If Lucy's car shares a set of properties with other Chevrolets, and the other Chevrolets also exhibit some new property not included in the original set, then Lucy's car is likely to have this new property as well. The general rule of inference can now be formulated as follows: if one designated entity shares a set of properties with other entities, and the other entities also exhibit some new property not included in the original set, the designated entity is likely, on a balance of considerations, to have this new property as well.

The most important thing to notice about this way of representing the logical form of argument from analogy is that it makes no reference to the notion of similarity. The textbook accounts make argument from analogy seem highly objective. It looks like it represents a type of argument that can be evaluated in a scientific and objective manner using inductive reasoning to count up the properties shared by a set of entities to provide positive evidence supporting the argument from analogy and subtract the negative evidence of entities that fail to share common properties. There is no need for students to ask embarrassing questions about similarity.

4. Weighing Factors Using the Second Scheme

Now we turn to the second scheme for argument from analogy. The problem with this scheme, as set forth in the standard textbook treatments, is that it is unclear in many respects how it fits real examples, and hence trying to apply schemes offered in the textbooks was somewhat confusing. Luckily this scheme has been formulated in a simpler way that is more useful. Guarini (2004, 161) offered a scheme for argument from analogy that he calls the core scheme, where a and b are individual objects.

Premise 1: a has features $f_1, f_2, \ldots, f_n$.
Premise 2: b has features $f_1, f_2, \ldots, f_n$.
Conclusion: a and b should be treated or classified in the same way with respect to $f_1, f_2, \ldots, f_n$.

It would seem plausible that the features $f_1, f_2, \ldots, f_n$ can be treated as representing the factors that were discussed above in relating case-based reasoning to the second scheme. The Chevrolet case we looked at from Hurley showed how the second scheme is applied to cases by identifying pro and contra factors, factors in which the two cases at issue are similar or different. In the discussion above we already identified the rule underlying this scheme. The rule basically states that the argument from analogy is supported by factors both cases share, but at the same time the argument from analogy is undermined by factors that both cases fail to share. This rule is fine as far as it goes, but the problem is that it is not just counting up of the factors that make the argument from analogy weaker or stronger. In addition some level of importance or weight has to be attached to each factor. In case-based reasoning, the more a factor is "on point" (relevant), the greater weight it carries. Any factor that is irrelevant carries no weight.

The methods of evaluating an argument from analogy in standard case-based reasoning (CBR) uses respects in which two cases are similar or different called dimensions and factors. The HYPO system (Ashley, 2006) uses dimensions. A dimension is a relevant aspect of the case that can take a range of values that move along the scale with values that support one side on a disputed issue at one end and the opposed party at the other end. CATO is a simpler CBR system (Aleven, 1997) that uses factors.

Factors in Hurley's case of Lucy buying the car would include the following: the model of car, the size of the motor, having overdrive, having a turbocharger, the weight of the car, what kinds of tires are on the car, having a padded steering wheel, having tinted windows, and paint color. Some factors are relevant while others are not. Factors can also be seen as arguments favoring one side or the other in relation to the issue being disputed. Having more relevant factors in common between the source case and the target case supports the argument from analogy. Having more relevant factors not in common between the source case and the target case detracts from the argument from analogy.

Factors can also be seen as arguments favoring one side or the other in relation to the issue being disputed. On this approach, argument from analogy is seen as a defeasible form of argument in which pro factors represents similarities that support the argument while con factors represent dissimilarities undermine or detract from the argument. Typically in argument from analogy some factors support the argument, while other factors undermine it. Then to weigh the strength of the argument from analogy, we have to weigh the pro factors against the con factors. To do this numerically we have to attach a positive or negative number to each factor providing a measure of how relevant that factor is one way or the other. If we could use numbers of this sort to calculate the strength of an argument from analogy, the argument could rightly be classified as inductive, as they advocate. But if this numerical approach does not seem promising, there is also another approach. On this approach, argument from analogy can be seen as dialectical.

Typically, in this kind of format, we have an argument from analogy that supports a claim *A* made by one side, and then on the other side an opposed argument from analogy that supports claim not-*A*. To comparatively weigh up the strength of the one argument as compared to the strength of the opposed argument, we have to bring in factors that identify the respects in which one case is similar to the other, and have some device for estimating how similar one is to the other by attaching weights to similarity. But there is always the problem of how misleading it might be to attach numbers to the weight of importance each factor should have in a given case. There may be a way we can use argumentation methods to solve this problem however. We can get a clue how it should work by looking at CBR.

HYPO evaluates arguments from analogy in a three-step method called three-ply argumentation (Ashley, 1988, 206), which can also be modeled as a series of moves in a formal dialogue. At the first move, the proponent puts forward an argument from analogy by finding a comparable past case in which the outcome closely matches that of the proponent's thesis because the two cases share one or more factors. At the second move, the respondent can reply to the original argument from analogy in one of the following ways, corresponding to critical questions matching the scheme for argument from analogy. She can reply by finding a counter-analogy, a past case that matches the current case but which has the opposite outcome. Another reply is to "distinguish" the case (as this move often called) by pointing to factors present in the new case that are absent in the previous one. At the third move, the proponent can reply in one of several ways. These might include distinguishing counterexamples, pointing out additional factors, or citing other cases showing that the respondent's attack does not really rebut his argument from analogy. The three-ply argumentation could be used to effectively set up the pre and post conditions for a formal dialogue model of a critical discussion in which one type of move is the bringing forth of an argument from analogy by citing factors common to the source case and the target case, and another type of move allows an appropriate critical response of the kinds outlined above.

5. The Silkwood Case

The next example is a use of argument from analogy by attorney Gerry Spence in the case of Silkwood v. Kerr-McGee Corporation. Karen Silkwood was a technician who had the job of grinding and polishing plutonium pins used to make fuel rods for nuclear reactors. She was active in union activities and had investigated health and safety issues at the plant. She had testified before an atomic energy commission that Kerr-McGee had violated safety regulations. Tests in 1974 showed that she that she had been exposed to dangerously high levels of plutonium radiation. High levels of radioactive contamination were found in her apartment. After she died from radiation poisoning, her father brought an action against Kerr-McGee in which the Corporation was held to be at fault for her death on the basis of strict liability. According to strict liability law, a person can be held accountable for the harmful consequences of some dangerous activity he was engaged in, without having to prove that he was aware of or intended the outcome, or even that he was negligent. The standard example is that if a zookeeper has a dangerous lion in a cage, if the lion escapes and causes harm to some person, the zookeeper is strictly liable for the harm that was caused.

Spence's closing argument in this case used the analogy of the escaping lion with great rhetorical effect on the jury. In his speech to the jury he emphasized and repeated this statement "If the lion got away, Kerr-McGee has to pay" (Lief et al., 1998, 129).

> Some guy brought an old lion on his ground, and he put it in a cage - and lions are dangerous -and through no negligence of his own through no fault of his own, the lion got away. Nobody knew how - like in this case, ''nobody knew how''. And, the lion went out and he ate up some people - and they sued the man. And they said, you know: ''Pay. It was your lion, and he got away''. And the man says: ''But I did everything in my power - I had a good cage - had a lock on the door - I did everything that I could - I had security - I had trained people watching the lion - and it isn't my fault that he got away''. Why should we punish him? They said: ''We have to punish him - we have to punish you - you have to pay''. You have to pay because it was your lion - unless the person who was hurt let the lion out himself.

In this instance Spence used the lion analogy during his closing argument, a part of the trial for summing up one's argument in a case. In his opening statement, Spence had also used the example of the escaping lion to illustrate to the jury how strict liability works, showing them how cases of this kind had originated in English common law. In his closing argument, he was using the same argument about the lion over again with great rhetorical effect. Spence's argument in this famous case has been said to be "as fine a closing argument as has ever been delivered in an American courtroom" (Lief et al., 1998, 123-124).

Spence was using an analogy to compare what happened in the Silkwood case to what happened in the lion example that is described in simple and graphic terms. The lion example is the source case in the argument from analogy. Spence used the example to illustrate that strict liability law would hold the lion owner responsible for the harm that took place when the lion attacked some innocent person and injured her, even though the lion keeper had taken great care to have proper security, including trained people watching the animal. The target case is similar to the source case. The plutonium escaped from Silkwood's workplace, so to speak, and caused harm to her, and this sequence of events is similar to the ones in the lion case. Therefore all

Spence had to prove is that Karen Silkwood was harmed by the plutonium. In his summary argument, Spence reminds the jury that this claim has been proved during the trial by the evidence brought forward, and that there is no need to repeat the facts that were used to prove it. All that needs to be proved, Spence maintains, in parallel with the lion case, is that the plutonium got away and that Karen Silkwood was damaged. This argument was a rhetorically powerful one. It persuaded the jury to find the Kerr-McGee Corporation liable for over ten million dollars.

In this case, the argument from analogy does all the work. The problem is to grasp how it does that. As a first attempt, we can visualize the argument as shown in figure 4.
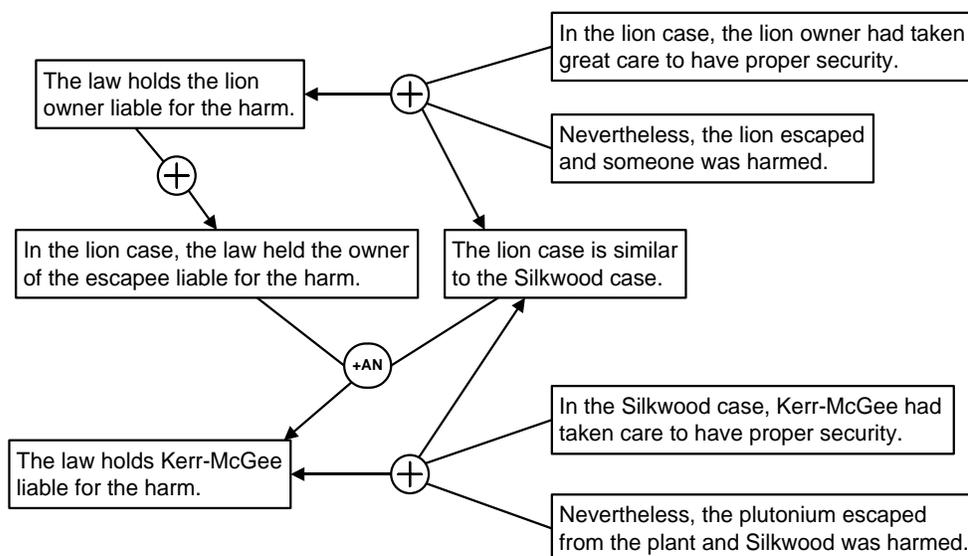

Figure 4: How the Source Case Supports the Argument of the Target Case

To get a clue how Spence's argument in the Silkwood case could be represented using the scheme for argument from analogy, we need to recall how in section 1 the argument from analogy was described as a two-step argument from the base premise to a derived premise, and from there to a conclusion. Using this scheme, argument from analogy represents a two-step type of argument. This two-step configuration is shown in figure 4. At the top the lion argument is shown, representing the source case. At the bottom the Silkwood case is shown, representing the target case. In the middle, an argument from analogy goes from a premise derived from the conclusion of the source case, along with the similarity premise, to the ultimate conclusion that the law holds Kerr-McGee liable. In the source case, as well as the target case, the argument is also at taken to support the similarity premise of the argument from analogy.

This structure is a rather complicated one, however, and not very helpful in giving us a clear and easily understandable analysis of how the argument from analogy works in transferring evidence from the source case to the target case. Hence we need to look for another method of modeling structure of the argument from analogy in the Silkwood case. It is a simple and powerful argument, and that is part of what accounts for its rhetorical success when used by Spence. But we still haven't been able to model the structure of that simple and powerful argument in a satisfactory way. So now we turn to an altogether different approach.

6. Scripts and Similarity

The first scheme is most markedly different from the second one in that it had a premise stating that one case is similar to another. The main problem with applying the first scheme to any realistic examples of arguments from analogy is to define the notion of similarity. There can be different kinds of similarity, but there is a way of defining one kind that can be shown to be important in building a method for evaluating arguments from analogy.

The notion of a script has been around for a while in artificial intelligence (Schank and Abelson, 1977). According to the theory of scripts put forward here, a script is defined as a sequence of states where one state follows naturally from another so that a sequence of states can be chained together. The scripts we are concerned with in this paper are comparable to sequences of actions of the kind studied in the branch of philosophy called action theory. An example is the following sequence: Bob swings his golf club, he hits a golf ball, the golf ball flies through the air, the golf ball lands on the grass, the golf ball rolls towards the cup, the golf ball stops at a point six inches short of the cup. We can see from the example that each state in the sequence is represented as a proposition in which an agent carries out an action. All of us understand that in order for the sequence to be comprehensible the propositions fall naturally into a certain ordering so that it can be established by a participant in an argument using common knowledge what that ordering is. A script can be defined as a set of states and a set of so-called links. A script in this sense is (1) a finite sequence of states, $S_1, S_2, . . ., S_n$, and a set of links, $L_1, L_2, . . , L_n$, joining each state to the one before and one after it, excluding only the first state L_1 and the last state, L_n , (2) such that it is clear to participants in an argument which is the first member of the sequence, which is the last member of the sequence, and for any member of the sequence between the first and the last member, which is the one before and the one after it. The ordering is not necessarily a temporal one, but it often is, and it is not necessarily a causal one but it often is. Links can be of different kinds, so that the sequence is not defined by any one kind of link. Rather the sequence is defined by the way it hangs together in common knowledge we all have about the way things can be normally expected to go in a kind of situation familiar to us from past experiences.

A sequence of this sort is often called a story or narrative. Pennington and Hastie (1992) studied many examples to show how juries in trials use story structures to organize and interpret evidence in a legal case at trial, enabling them to make sense of the evidence as a whole by organizing it into a mental representation. Stories are different from argumentation schemes, but they are often based on argumentation schemes, especially the scheme for practical reasoning. In practical reasoning an agent has a goal, and sees that carrying out an action would be a means to realize the goal. For this reason the agent concludes that it ought practically speaking to carry out the action. This kind of reasoning is very common in legal cases, for example in criminal cases where an action is presumed to have a goal.

Bex (2011) built a hybrid theory of reasoning with stories to reconstruct complex networks of evidence in criminal cases. His theory is called a hybrid system because it combines story-based explanations with arguments. One feature of it is that evidence in the form of arguments can support parts of an explanation that can be modeled with a script. Another aspect of Bex's theory that will be applied here is that something called a story scheme can be derived from the events in a script through a process of applying abstractions. By this means a script that links together a sequence of events or actions described in the story can also be represented at a more abstract level by means of a story scheme. Bex and Prakken (2010) have shown how stories can be investigated and evaluated in a formal dialogue game.

The device of the story scheme can be applied to Spence's argument from analogy in the Silkwood case to map the sequence in the source case to the sequence in the target case. If we put the lion in for x, the person who was injured in for y, and the lion owner in for z, we get the story of the lion that escaped and attacked the person who was harmed. But we can also fill in the variables as shown in figure 5, and then we get the Silkwood story. It is this abstract story scheme that shows how the target case is similar to the source case in the most significant respect. The script in the two cases can be seen to be similar by the audience (in this instance, the jury), and because of their common knowledge of the way things generally work, they are impressed by the analogy and draw the conclusion that Spence wants them to.
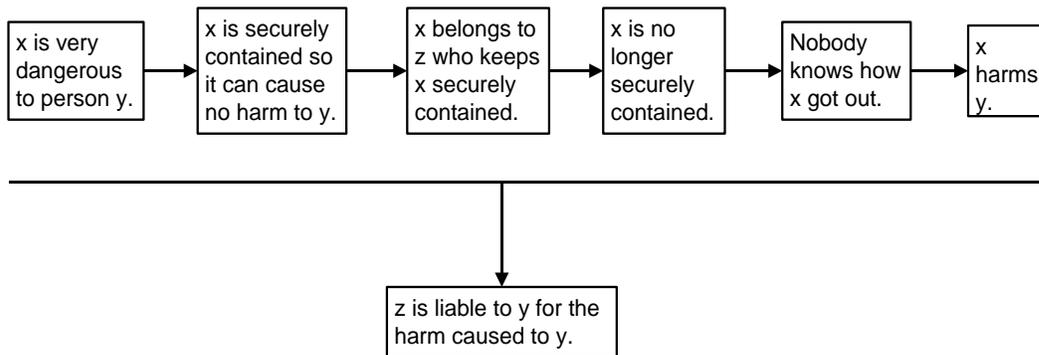

Figure 5: Story Scheme for Spence's Argument from Analogy in the Silkwood Case

A notion of similarity that can be used to model many cases of argument from analogy can be modeled using this hybrid theory of scripts (Walton, 2012). Gerry Spence's argument from analogy in his closing argument in the Silkwood case can be used as an illustration.
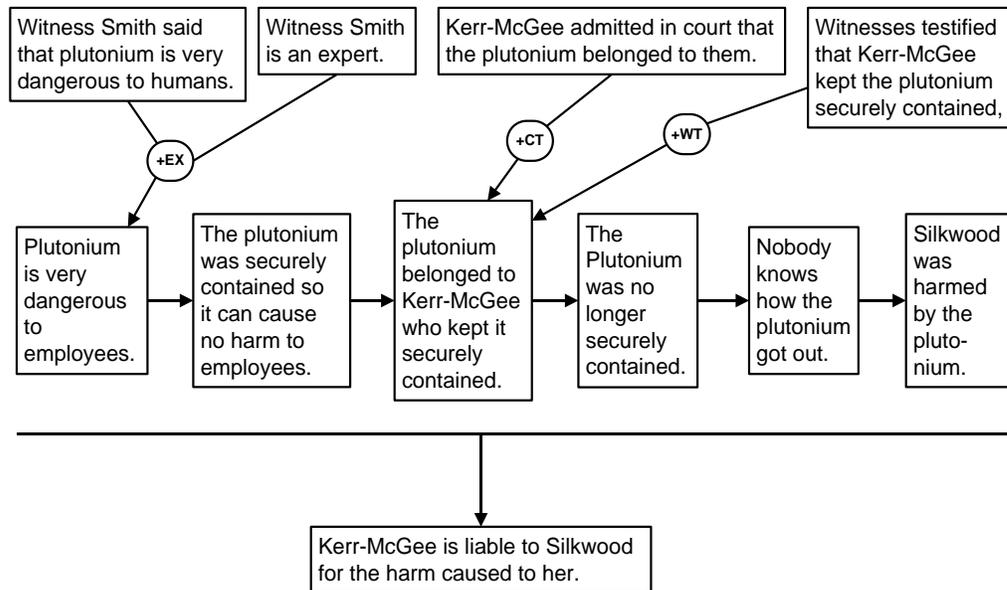
Figure 6: The Silkwood Case Modeled as a Story with Evidential Backing

If we look along the middle row of figure 6, we see this story in the Silkwood case instantiated as an instance of the story scheme shown in figure 5. While the story scheme shown in figure 5 is an abstract sequence, the Silkwood story shown along the middle row of figure 6 represents the actual sequence of events representing the story in the case. To show how the similarity between the two cases is modeled, we could also make a figure of the similar story in the lion case: the lion is very dangerous, the lion was securely contained so it could cause no harm, the lion belong to the lion owner who kept it securely contained, the lion was no longer securely contained, nobody knows how the lion got out, a person was harmed by the lion after it escaped. What explains the similarity is that both the sequence of events in the lion case and in the Silkwood case is the abstract story scheme shown in figure 5.

It could be stressed that what is especially interesting here is that the matching of the two stories shows that the similarity between the two cases holds not just because each state in the one case matches a comparable state in the other case. Over and above this matching of single states, the matching of two stories represents the kind of similarity that supports an argument from analogy because it is the same story scheme applicable to both cases that makes the one case similar to the other in the most important respect.

There are some other aspects shown in figure 6 that are also important to comment on. One is the conclusion drawn from the sequence of states shown in the middle row. This conclusion is the proposition that Kerr-McGee is liable to Silkwood for the harm caused to her. According to the theory advocated here, this conclusion is the one drawn from the sequence of states shown above it. Another important aspect of figure 6 is that four statements appear in text boxes along the top row of the diagram, displaying three arguments that are used as evidence to support some of the elements in the sequence of propositions in the middle row. In each case the name of the argumentation scheme is shown in the node of the argument. The argument on the left is a pro argument from expert opinion. The argument in the middle is a pro argument from commitment. The argument on the right is a pro argument from witness testimony.

Thus we can see that figure 6 displays the five characteristic elements of the theory of similarity put forward. The first one is that there is a sequence of propositions (a set of states and links joining them), that makes up the story in the target case, and is an instance of a story scheme. The second one is that there is a conclusion drawn from the story. The third one is that evidence in the form of arguments can be used to support the elements of the story, make it more plausible. The fourth one is that the story in the target case is an instance of an abstract story scheme. The fifth one is that the story in the source case fits the same story scheme.

7. Conclusions

The solution to the problem is to combine the two argumentation schemes for argument from analogy. The first scheme can be applied to a text to identify an argument from analogy and explain its initial impact. The second scheme allows for deeper analysis and evaluation of the argument by weighing the pro against the con factors.

The first scheme is simple enough. It simply says that if two cases are similar, and a particular conclusion can be drawn in the first case, then the same conclusion (or a comparable one) can be drawn in the second case. That conditional represents the rule of inference (the so-called warrant) behind the first scheme. The problem with the first scheme was to define the

notion of similarity. Above a script-based model of how to represent similarity was presented and illustrated using the argument from analogy put forward by Gerry Spence in Silkwood case.

Now we can see how the same script-based theory of similarity can also be applied to the violinist case. Figure 7 shows how the abstract story script that displays the similarity between the case of the violinist and the case of the justification of abortion leads to the abstract conclusion that is applicable to both cases.
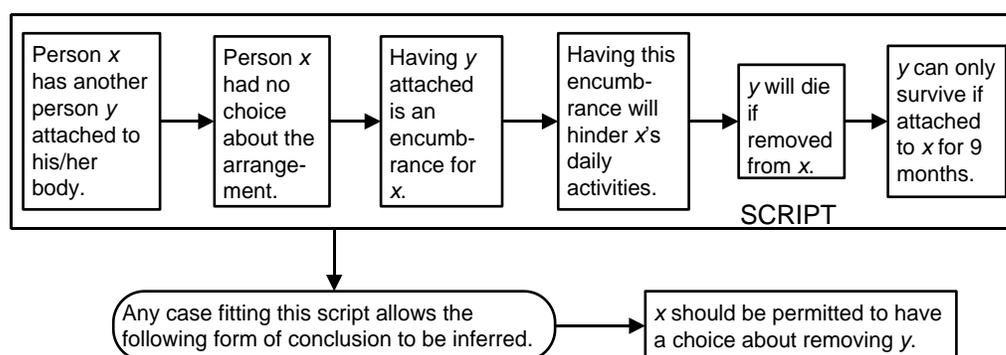

Figure 7: The Story Scheme Supporting the Argument from Analogy of the Violinist Case

What the diagram in figure 7 shows in an abstract way is the similarity underlying the two cases that is the basis of the argument from analogy from the source case to the target case. The story scheme representing the similarity in an abstract manner supports the similarity premise of the basic argumentation scheme for argument from analogy.

As shown in section 4, applying the second scheme requires a three-ply case-based dialogue system. How would such a formal dialogue model solve the problem of assigning weights to the factors in an argument from analogy without running afoul of the problem of assigning numerical weights to each factor that might be arbitrary? The solution advocated here is to do this in the normal way we are familiar with in formal dialogue models of argumentation. The claim that a factor is present in a given case, or is not present in a given case, or the claim that the factor is important in deciding the outcome of the case, or is not, can be evaluated by examining the details of the case, or the pair of cases at issue. Such a procedure can be used to see how the arguments in the case support or undermine these claims. The method that CBR uses to weigh factors is to place values on them representing the extent to which factor is "on point". To be on point essentially means that the factor is relevant in relation to the issue being disputed. What this observation reveals is that ultimately CBR depends on an analysis of the notion of relevance. But the best way to model relevance is to use a formal model of the critical discussion requiring that a conflict of opinions is identified at the opening stage. It is this initial conflict of opinions that determines whether a given argument is relevant or not, and it can also be used to determine whether a factor in an argument from analogy is on point or not.

This project can be carried out formally in a number of ways. One way would be to use a formal computational system such as the Carneades Argumentation System (CAS), a three-valued system in which premises and conclusions are assigned one of the following three values: (in) accepted, (out) rejected, or (neither in nor out) stated but not accepted (Gordon, 2010). CAS has an opening stage, an argumentation stage and a closing stage (Gordon, Prakken and Walton,

2007). Relevance of the kind discussed above can be modeled in CAS or comparable knowledge-based argumentation systems. Modeling the evaluation of arguments from analogy in this way has not yet been carried out in any formal dialectical model, but the research project of constructing such a model is within the reach of the current technology of formal dialogue systems. Such a project, at any rate, presents us with an alternative to the Bayesian proposal of treating argument from analogy as an inductive form of argument that can be evaluated using numerical probability values.

Acknowledgements

References

Aleven, V. (1997). *Teaching Case Based Argumentation through an Example and Models*. PhD Thesis, University of Pittsburgh, Pittsburgh, Pennsylvania.

Ashley, K. (1988). Arguing by Analogy in Law: a Case-Based Model. *Analogical Reasoning*, ed. D. H. Helman. Dordrecht: Kluwer, 205-224.

Ashley, K. (2006). Case-Based Reasoning. *Information Technology and Lawyers*, ed. A. R. Lodder and A. Oskamp. Berlin: Springer, 2006, 23-60.

Bex, F. (2011) *Arguments, Stories and Criminal Evidence: A Formal Hybrid Theory*. Dordrecht: Springer.

Bex, F. and Prakken, H. (2010). Investigating Stories in a Formal Dialogue Game. In P. Besnard, S. Doutre and A. Hunter (eds.), *Computational Models of Argument: Proceedings of COMMA 2008*. Amsterdam etc, IOS Press, 73-84.

Copi, I. M. and Cohen, C. (1990). *Introduction to Logic*, 8th ed. New York: Macmillan, 1990.

Goldman, A. (1970). *A Theory of Human Action*. Princeton: Princeton University Press.

Gordon, T. F. (2010). The Carneades Argumentation Support System, *Dialectics, Dialogue and Argumentation*, ed. C. Reed and C. W. Tindale, London: College Publications.

Gordon, T. F., H. Prakken, and D. Walton (2007). The Carneades Model of Argument and Burden of Proof. *Artificial Intelligence* 171: 875–96.

Guarini, M. (2004). A Defense of Non-deductive Reconstructions of Analogical Arguments. *Informal Logic* 24: 153-168.

Guarini, M., Butchart, A., Simard Smith, P., and Moldovan, A. (2009). Resources for Research on Analogy: A Multi-disciplinary Guide. *Informal Logic* 29(2), 84-197.

Hurley, P. J. (2003). *A Concise Introduction to Logic*. Belmont: Wadsworth.

Lief, M. S., Caldwell, M. and Bryce, B. (1998). *Ladies and Gentlemen of the Jury: Greatest Closing Arguments in Modern Law*. New York: Scribner.

Pennington, N. and Hastie, R. (1992). Explaining the Evidence: Tests of the Story Model for Juror Decision-making. *Journal of Personality and Social Psychology*, 62(2), 189-206.

Pennington, N. and Hastie, R. (1993). The Story Model for Juror Decision Making. *Inside the Juror: The Psychology of Juror Decision Making*, ed. R. Hastie. Cambridge: Cambridge University Press, 192-221.

Schank, R. C. and Abelson, R. P. (1977). *Scripts, Plans, Goals and Understanding*. Hillsdale, New Jersey: Erlbaum.

Thomson, J. (1971). A Defense of Abortion. *Philosophy and Public Affairs*, 1(1), 47-66.

Wagenaar, W. A., van Koppen, P. J. and Crombag, H. F. M. (1993). *Anchored Narratives: The Psychology of Criminal Evidence*. Hertfordshire: Harvester Wheatsheaf.

Walton, D. (2006). *Fundamentals of Critical Argumentation*. Cambridge: Cambridge University Press.

Walton, D. (2010). Similarity, Precedent and Argument from Analogy, *Artificial Intelligence and Law,* 18 (3), 217-246.

Walton, D. (2012). Similarity in Arguments from Analogy, *Informal Logic*, 32(2), 190-218.

Walton, D. (2013). Argument from Analogy in Legal Rhetoric, *Artificial Intelligence and Law*, 18(3), 217-246.

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

Abstract: Argumentation Schemes for Argument from Analogy

In this paper I show how there are two different argumentation schemes for argument from analogy, and show by means of examples how each scheme applies to different cases in its own distinctive way. One scheme is based on similarity, while the other scheme is based on factors shared or not shared by two cases that are being compared. The problem confronted in the paper is to study how the two schemes fit together. Are there really two different schemes for argument from analogy, or is the one scheme an extension of the other that applies at a different dialectical stage of the argumentation in a case? Since argument from analogy is fundamental in case-based reasoning and legal reasoning, there is some discussion of how the schemes fit into both topics.