Teleological argumentation to and from motives

Douglas Walton†

Centre for Research in Reasoning, Rhetoric and Argumentation, University of Windsor, Windsor, Ontario N9B 3Y1 Canada

This paper uses tools from argumentation and artificial intelligence to build a system to analyse reasoning from a motive to an action and reasoning from circumstantial evidence of actions to a motive. The tools include argument mapping, argumentation schemes, inference to the best explanation and a hybrid method of combining argument and explanation. Several examples of use of relevant motive evidence in law are used to illustrate how the system works. It is shown how adjudicating cases where motive of evidence is relevant depends on a balance of argumentation that can be tilted to one side or the other using plausible reasoning that combines arguments and explanations.

Keywords: abductive reasoning; stories; Carneades; evidence; relevance.

1. Introduction

The problem of other minds has long been a central difficulty in philosophy, not only in philosophy of law, but also in ethics and philosophy of mind. We can observe a person's external actions, and thereby have empirical evidence to confirm or refute the claim that this person carried out a particular action. But since we cannot directly observe a person's motive, intention or desire, how can we confirm or refute any claim that a person acted on the basis of such an internal state of mind? The problem is particularly acute in legal reasoning about evidence in criminal law, because so much of it is built on assumptions about *mens rea*, the guilty mind. This paper surveys recent developments in argumentation-based artificial intelligence and law to address the problem by studying the logical structure of reasoning about motives in law.

This paper extends the theory of evidential reasoning about motives set forth by Walton and Schafer (2006), which provided a teleological framework for reasoning forward from motive to action, and reasoning backward from action to inferred motive. Bex *et al.* (2009) showed that this account of motives was not consistent with that of Wigmore (1931, pp. 146–147) who defined a motive as an emotion or passion that is likely to lead to a specific act. The analysis in this paper extends the one of Walton and Schafer, bringing it closer to Wigmore's account of a motive as an emotion. The extension of this earlier theory combines top-down and bottom-up models of teleological practical reasoning using argumentation schemes in a belief–desire–intention (BDI) model of practical reasoning (Searle, 2001). In this paper, following the Walton and Schafer model, one intelligent agent reconstructs the motive of another agent by drawing an inference from facts and commitments of the other agent using abductive reasoning. However, another agent can reasonably infer that this first agent has a particular motive by using circumstantial evidence about the first agent's statements

† Email: dwalton@uwindsor.ca

and actions. On this new approach, motives are defined as immediate internal desires that impel an agent towards carrying out an action, but in a different way than goals.

It is shown in this paper how argument visualization tools can be used to model such backward and forward reasoning by showing (1) how a case can be made for arguing that a motive led to an action and (2) how a motive can be attributed to an agent based on circumstantial evidence from his actions and speech. It is also shown how typically in a criminal case the issue turns on two competing stories, and that for this reason in order to evaluate claims about motives it is necessary to go to a deeper level of analysis in which explanations are embedded within arguments. To analyse the deeper complexities of such evidential situations, it is shown how attributing a motive to an agent needs a special type of teleological explanation based on what is called a story scheme (Bex, 2011). Such an explanation is based on the factual evidence of the case, and therefore attributing a motive to an agent is also based on arguments. This structure is used to analyse arguments from a motive to an action, and from an action to an inferred motive.

2. Some short examples and an introductory survey

Motive cannot be proved directly because it is part of an agent's state of mind. It has to be proved indirectly by inference using circumstantial evidence (Wigmore, 1940, section 385, p. 327). Circumstantial evidence of an agent's motive comes from actions, either committed by the agent or by other agents, e.g. from an injury which another party has done to the agent. Once the existence of the motive has been established, it can lead to a second inferential step (Leonard, 2001, p. 447) in which it is used to conclude that the agent committed a particular act, that the act in question occurred or that the agent had some state of mind (in criminal cases, a guilty mind).

In the following example (Leonard, 2001, p. 447), circumstantial evidence of the defendant's theft activity was taken as relevant evidence of his motive. The defendant was charged with the murder of the victim, but claimed not to have been involved. However, the prosecution had evidence that the defendant had been involved in a car theft prior to the killing, that the victim knew about the theft and that the victim had threatened to reveal the theft to the police. Leonard (p. 448) structured the inference from evidence to motive in this case as follows.

> **EVIDENCE:** Defendant stole a car, victim was aware of the fact, and victim threatened to inform the police.

> **INFERENCE:** Defendant had a motive to prevent victim from revealing the theft to the police.

> **CONCLUSION:** Defendant murdered victim to prevent victim from revealing the theft to the police.

Walton and Schafer (2006) showed how the reasoning used in this example is a combination of practical reasoning and abductive reasoning, or inference to the best explanation (IBE). IBE infers a conclusion from a set of observed or given facts or data by selecting the best one among several explanations that could account for the facts of a case. Typically, in such a case, the two sides have presented two opposed accounts, or stories, at trial, and IBE is used to point to the one as the better explanation (Bex *et al.*, 2009).

Bex *et al.* (2009) have also used the argumentation scheme for practical reasoning, along with a more extensive matching set of critical questions, and a technical apparatus called an action-based alternating transition system to model the evidential reasoning in a criminal case where one person
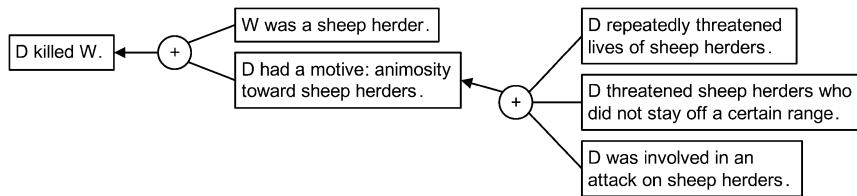
FIG. 1. Argument map of argument from motive to action.

was suspected of killing another person by pushing him off a bridge. Their analysis goes beyond the simpler one provided in this paper by using a more fine-grained set of critical questions for choice of explanation. Their analysis is more technically powerful than the one presented here, and it shows several ways in which the simpler model presented here could be extended. However, it will be argued below that the simpler model also has some advantages as a representation of evidential reasoning about motives.

Another example of argumentation from motive to action is the case of *Idaho* v. *Davis* (53 P. 678 Idaho 1898), which concerned the struggle between sheep herders and cattlemen to control land. The prosecution offered three pieces of evidence to prove that D, a cattleman, killed W, a sheep herder, shown in the three text boxes on the right in Fig. 1. The plus in the node denotes a pro argument, an argument that provides positive support for its conclusion.

The argument shown in the map in Fig. 1, drawn using the graphical user interface for the Carneades argumentation system, concludes in an action drawn from the postulation of a motive, which is in turn supported by an argument from factual evidence. Carneades is a mathematical model consisting of mathematical structures and functions on these structures (Gordon and Walton, 2009; Gordon, 2010). It is also a computational model with a graphical user interface.[1] The Carneades argumentation system uses argumentation schemes and models the critical questions matching a scheme as premises of the scheme (Gordon *et al.*, 2007).

The part of the argument composed of the two premises and the conclusion shown in the left of Fig. 1 is an instance of argument from motive to action. Here the argumentation scheme for argument from motive to action is formulated below based on the comparable form of inference described by Leonard 2001, p. 59).

Conditional Premise: If agent *a* had a motive to bring about *A* then *a* is somewhat more likely to have brought about *A* than another agent who lacked a motive.

Motive Premise: *a* had a motive to bring about *A*.

Conclusion: *a* brought about *A*.

This form of inference as structured by Leonard with two premises and a conclusion can be modelled as an argumentation scheme for argument from motive to action. So far then, we have seen how an argument that goes from a motive to an action can be configured as an argumentation scheme. But

---

[1] http://carneades.github.com/

we are still left with the problem of how to argue the other way around, from facts about actions and circumstances to a motive. Teleological reasoning can be used to establish the existence of a motive by drawing an inference from premises concerning facts of a case to a conclusion that a motive exists (Walton and Schafer, 2006; Bex *et al.*, 2009). It was shown to be a sequence of teleological reasoning that leads from a set of circumstances in a case to a hypothesis that postulates the existence of a motive. To see how this was done in Walton and Schafer (2006), we have to put this scheme into a broader argumentation framework by introducing the argumentation scheme for practical reasoning.

In the scheme below, the first-person pronoun 'I' represents a rational agent that has goals, some (though possibly incomplete) knowledge of its circumstances, the capability of acting to alter those circumstances and the capability of perceiving the consequences of acting. The simplest form of practical reasoning, called practical inference, is represented by this scheme (Walton *et al.*, 2008, p. 323).

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.
These are the critical questions matching this scheme (Walton *et al.*, 2008, p. 323).

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 should also be considered?
CQ$_3$: Among bringing about A and these alternative actions, which is the most efficient?
CQ$_4$: What grounds are there for arguing that it is practically possible for me to do A?
CQ$_5$: What consequences of my bringing about A should also be taken into account?

The last critical question, CQ$_5$, is very often called the side effects question. It often concerns potential negative consequences of a proposed course of actions. For a more complex and powerful system of practical reasoning see Atkinson *et al.* (2005). Practical reasoning can move forward, from a goal to an action, as part of agent-based deliberation, but it can also be used backwards, to reconstruct a plausible motive based on an agent's actions and words.

3. Relevance of motive evidence and character evidence

The Federal Rules of Evidence allow character evidence to be admissible only in certain instances.[2] Rule 401 defines relevant evidence as evidence having any tendency to make the existence of any fact 'that is of consequence to the determination of the action more probable or less probable than it would be without the evidence'. Relevance, according to the account given in the Federal Rule of Evidence is defined in terms of what is called probative weight or probative value. An argument is admissible as relevant in a trial only if it makes the ultimate proposition to be proved more probable or less probable. However, 'probability' is not to be understood here in the narrower sense of statistical probability, but in a broader sense meaning that factual evidence can combine with logical reasoning to make a conclusion carry more or less probative weight than it did without the evidence.

---

[2] The latest version of these rules can be found on the web at www.uscourts.gov/rules/newrules4.html.

According to Rule 403, relevant evidence (according to the requirements of Rule 401), may be excluded if its probative value 'is substantially outweighed by the danger of unfair prejudice, confusion of the issues, or misleading the jury, or by considerations of undue delay, waste of time, or needless presentation of cumulative evidence'. Even if evidence is relevant, it may be inadmissible if it might tend to prejudice a jury. The worry about character evidence expressed by Rule 403 is that it may be too persuasive in its leading a jury to give it too much weight. Character attack, in the form, 'He is a bad person, therefore he must be guilty', is a powerful form of argument, because we do not trust people who are thought to have committed crimes. The character attack form of argument, called the *ad hominem* argument in logic, basically refuting someone's argument by attacking their character, is sometimes reasonable, but can often have so much undue impact on an audience that it has traditionally been considered to be fallacious (Walton, 2006).

Rule 404 states that character evidence is not admissible for the purpose of proving conduct. Rule 404(b) says that evidence of other crime, wrongs or acts is not admissible to prove the character of a person in order to show action. But there are exceptions. One is that if character evidence is introduced by the defence, the prosecution can then use character evidence in rebuttal. Another is that character evidence can be used in examining witness testimony. It can also be used if character is an essential element of a charge or defence. For example, character of a person would be relevant to the issue of whether the defendant was negligent in hiring or entrusting property to an unfit person. Evidence of crimes or bad acts may also be admitted if the evidence is offered, not to show character, but for some narrower purpose such as showing motive, opportunity, intention, preparation, plan, knowledge, identity or absence of mistake or accident.

The problem introduced now is how to distinguish between motive and character. However, since this task has already been commented on and dealt with in Golden (1994), Leonard (2001), Sartor (2005) and Walton (2006), it will be set aside here. The other large problem set aside for further work is the difference between motive and intent. Leonard (2001) is very helpful here, even providing an argument scheme for argument from motive to intent. These problems are set aside for future research.

4. Inference to the best explanation

Abductive reasoning, very important for scientific discovery, is here equated with IBE. According to Josephson and Josephson (1994, p. 14), abductive inference has the following form, showing its structure as IBE. H is a hypothesis.

- D is a collection of data.

- H explains D.

- No other hypothesis can explain D as well as H does.

- Therefore H is probably true.

One of the key questions in analysing abductive reasoning as IBE is to analyse the notion of explanation that it depends on. In IBE, multiple explanations are generated and comparatively evaluated according to the criteria that express the degree to which they conform to the evidence and their plausibility. Three criteria are defined using the argumentation theory.

1. Arguments based on evidence can be used to show that an explanation is consistent or inconsistent with the evidence.
2. Arguments may also be used to reason about the plausibility of an explanation, as the validity and applicability of causal rules can become the subject of an argumentation process.
3. Arguments about the plausibility of explanations are based on plausible reasoning (PR), carried out by using commonsense knowledge about how the world generally works in familiar situations.

PR is based on common knowledge, it is defeasible, it is based on the way things generally go in familiar situations, it can be used to fill in implicit premises in incomplete arguments, it is commonly based on appearances (perception), it can be tested against facts, and by this means confirmed or refuted. Probing into PR in a critical examination is another way of testing it.

An example from Wigmore (1940, p. 420) shows how he analysed cases of in legal evidence as instances of IBE.

> The fact that *a* before a robbery had no money, but after had a large sum, is offered to indicate that he by robbery became possessed of the large sum of money. There are several other possible explanations—the receipt of a legacy, the payment of a debt, the winning of a gambling game and the like. Nevertheless, the desired explanation rises, among other explanations, to a fair degree of plausibility, and the evidence is received.

The evidence put forward in this example has the form of IBE. It shows the conclusion as arrived at by means of a choice among several competing explanations of the given facts.

The abduction scheme for an abductive argument is based on two variables. The variable F stands for a set of facts. The variable E stands for an explanation. The concept of explanation is dialectical. An explanation is a response to a question in dialogue. Below is the argumentation scheme for abductive argument (Walton, 2006, p. 167).

> F is a finding or given set of facts.
> E is a satisfactory explanation of F.
> No alternative explanation E' given so far is as satisfactory as E.
> Therefore, E is plausible as a hypothesis.

This form of argument is defeasible. It can be defeated by asking appropriate critical questions.

CQ$_1$: How satisfactory is E itself as an explanation of F, apart from the alternative explanations available so far in the dialogue?

CQ$_2$: How much better an explanation is E than the alternative explanations available so far in the dialogue?

CQ$_3$: How far has the dialogue progressed? If the dialogue is an inquiry, how thorough has the search been in the investigation of the case?

CQ$_4$: Would it be better to continue the dialogue further, instead of drawing a conclusion at this point?

This scheme is dialectical, meaning that it is evaluated in a dialogue in which one puts forward a conclusion based on an argument, and the other asks critical questions or puts forward counter-arguments that may defeat the argument (Prakken and Sartor, 2006).

5. Stories and explanations

In the research on reasoning with criminal evidence, two main trends are the argumentation approach and the narrative approach. Arguments are constructed by taking items of evidence and reasoning towards a conclusion respecting facts at issue in the case. It has been characterized as evidential reasoning because of the relations underlying each reasoning step: 'a witness testifying to some event is evidence for the occurrence of the event'. Hypothetical stories based on the evidence can be constructed, telling us what might have happened in a case. Alternative stories about what happened before, during and after the crime can then be compared according to their plausibility and the amount of evidence they explain.

A story is a set of statements, offered by one party in a dialogue in answer to questions put by the other. A story could be a set of statements that links some statements to others by causal relations connecting an agent's goals to his actions. A story does not have to be internally consistent, but if an inconsistency is found, questions can be asked, and the story might have to be repaired or given up. If one of a pair of competing stories is more plausible, the more plausible one should be accepted as the better explanation. The dialogue process of examining a story starts with a database representing the facts so far collected in an account. Examination is a complex process that typically begins with an explanation, but can shift to a critiquing phase in which the story in it is probed for questionable gaps and apparent inconsistencies. The questioner asks a question to achieve a better understanding of some or all of these facts. The respondent replies by putting forward a story offered to explain the facts that were asked about. Alternative stories that serve to explain the same facts may also be given. The comparative plausibility of each story is judged by how well each stands up to critical questioning.

There are five factors that can be used to judge how good a given story is as an explanation compared to another story: (1) how well it performs its function of helping the questioner to make sense of something, (2) whether it is internally consistent or not, (3) whether an alleged inconsistency can be dealt with, (4) how well it is supported by the factual evidence and (5) how plausible the account is generally. More generally, an explanation can be tested by examining it critically in a dialogue.

Pennington and Hastie (1993) showed how actions carried out in criminal cases can be explained by competing explanations that each provides a story connecting the facts into a sequence that seems plausible based on the evidence. They argued that understanding actions carried out in criminal cases is done by constructing competing stories about what supposedly happened using the evidence in the case. Such a plausible story describes a general pattern of actions and events of kinds that we are all familiar with. One story can be more plausible than another. However, a plausible story may not be very well supported by the evidence, whereas a less plausible story may be supported by more evidence. To solve this problem Wagenaar *et al.* (1993) devised a special type of story used to represent legal reasoning called an anchored narrative. Bex (2009) has proposed a hybrid framework for reasoning with arguments, stories and criminal evidence, a formal framework that shows how the plausibility of the story can be evaluated by giving arguments that ground the story on evidence that supports or attacks it.

Bex (2011) modelled a story as an ordered list of events or types of events that can be more abstract or more specific, using the following example (Bex, 2011, p. 59). H was a drug addict who needed money and decided to rob a supermarket. He got the money, jumped into his car and sped away, but then he saw the police, and parked his car in a park. He then abandoned the car and jumped into a moat to hide. When the police searched the park they found him soaking wet from water in
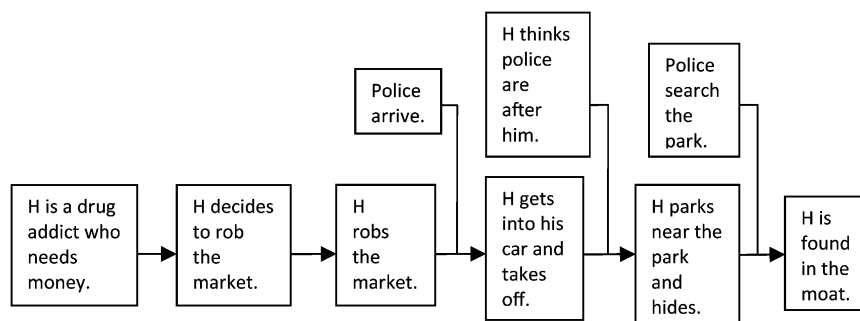
Fig. 2. Structure of the H story.

the moat. Bex (2011, p. 59) showed how a visual representation of the story relations can display the ordered structure of the events in it, using a picture like the one shown in Fig. 2.

The story visually represented in Fig. 2 shows how the actions of H are combined with what are taken to be his mental states. Because he is a drug addict who needs money, we can infer that he decided to rob the market to get the money. After he robbed the market and took off in his car, we can infer that he went to the park to hide because he thinks the police are after him. From his actions and from evidence of what he has said, we can draw plausible conclusions about his mental states and how they fitted in with the sequence of actions that he carried out.

H was found hiding in a moat in the park after the robbery, and the prosecution's explanation was that he had fled there after the robbery to avoid arrest. H's explanation was that he was hiding in the moat because he had an argument with a man over some money, this man had drawn a knife, and he had fled to escape this man. Here we have two competing stories, the problem is to try to judge which is the more plausible, based on the facts.

Bex and Prakken (2008, p. 5) showed how two competing explanations in a criminal case can be evaluated by criteria to judge which is the better. One criterion they use is evidential coverage, meaning how many arguments can be used to support claims that are parts of the explanation. Another is the internal consistency of each story. Bex and Prakken provide a formal dialogue model that can be used to evaluate the arguments on each side, and pose critical questions to test the plausibility of a story. Bex *et al.* (2003) showed how evidential reasoning in law is typically based on general knowledge accepted in a community, codified in defeasible generalizations. In Bex *et al.* (2009, p. 126), a story scheme is defined as a collection of propositions and generalizations with a set of inference rules for classical logic with a defeasible *modus ponens* rule for a conditional operator $\Rightarrow$ that represents defeasible generalizations (Bex *et al.*, 2009). A generalization has the form $p_1 \,\&\, p_2 \,\&\ldots\&\, p_n \Rightarrow q$. A generalization with free variables is a scheme for all its ground instances, and a literal scheme is a scheme for all its ground instances. For example (Bex *et al.*, 2009, p. 126), 'x robs y' is a scheme for 'Hal robs supermarket' and also a scheme for 'Bob robs bank'. A story scheme can contain links of the following kind: {motive $\Rightarrow$ goal, goal $\Rightarrow$ action, action $\Rightarrow$ consequence}.

6. Who shot the sheriff?

In the case of *State* v. *Brown* (398 So. 2d 1381 (La. 1981)), the defendant was charged with attempted first-degree murder of a deputy sheriff who had stopped the defendant's car for speeding. A car driven

by B, with W in the front passenger's seat, was stopped for speeding by Deputy Sheriff G. G got out of his car and walked towards the stopped car, but as he reached a point close to the rear of the car, he saw the defendant pointing a shotgun through the car window. It appeared to him that B was trying to fire the gun at him, but it had misfired, so he turned and ran away, and was shot in the shoulder from behind. He then jumped into a ditch and fired six times with his revolver as the car sped away. B and W abandoned the car after a short distance and tried to escape by running across a levee, where they were apprehended by police.

B later testified that W, who owned the gun, handed it to B and told him to shoot G. He also testified that W later took the gun and shot G, and that W told him to leave the scene after the shooting. Later testimony of a used car dealer presented clear and convincing evidence that B had stolen the car. An issue was whether this evidence was admissible. As character evidence it would not be admissible, however, as motive evidence, it could be used as part of the evidence to prove that B had committed the crime of second-degree murder. The problem was whether evidence that the defendant had stolen the car was admissible as an exception to the general rule barring admissibility of evidence of previous crimes. If this evidence was being used to show that the defendant had a motive for shooting the sheriff, it could be considered relevant. The link between such a motive and the shooting was drawn by the court in the following words: 'If defendant had stolen the automobile, a crime for which he could be sent to prison for many years, it was most important for him to avoid having the crime discovered, a very likely probability in the event he was arrested on the speeding charge'. The court admitted the evidence that the defendant had stolen the vehicle on the grounds that it established a motive for the defendant to fire on a deputy sheriff in order to avoid being arrested on the speeding charge.

To analyse the evidential reasoning in this case, we have to go back to try to reconstruct the state of mind of the defendant when his car was stopped for speeding. The consequences of being given a speeding ticket are not too serious, probably paying a fine. However, the consequences of stealing a car are likely to be much more serious in comparison. As the court stated, it is a crime for which the defendant could be sent to prison for many years. The defendant, we may presume, knew about these probable consequences and their comparative seriousness. When making a decision on what to do, taking these negative consequences into account, it is plausible that he acted impulsively to avoid the more serious negative consequences, but there was a kind of practical reasoning involved (Fig. 3).

It almost seems inappropriate to call avoiding arrest for car theft a goal because that way of classifying it seems to suggest a kind of foresight, planning or rational calculation that perhaps should not be attributed to an action that appeared to be impulsive. But if we can classify a motive as a goal, something that provides a mainspring of action and therefore leads to action by prompting action immediately, we could replace the goal text box in Fig. 1 with a box containing a motive 'We don't have a name for this motive, but it could be called "discovery avoidance"'. Discovery avoidance could be a lively mainspring for action, and hence could act as a motive. Shooting a deputy sheriff is an action that is also very likely to have serious negative consequences, even going to prison for a long time, so if we saw the motive as acting as a kind of goal, we could see it is fitting the practical reasoning scheme along with its critical questions.

So far, we are just at the start point of the analysis of this case by trying to structure it as motivated action in the mind of the agent at the time he carried it out. Next, we need to look at it from the point of view of the court trying to connect motives to an action at issue in the trial. To do this, we represent it as an instance of argument from motive to action using Carneades.
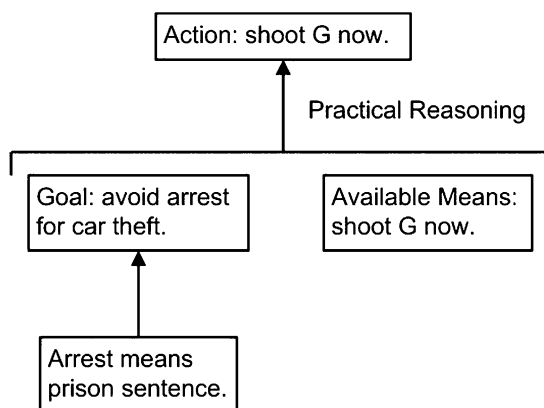
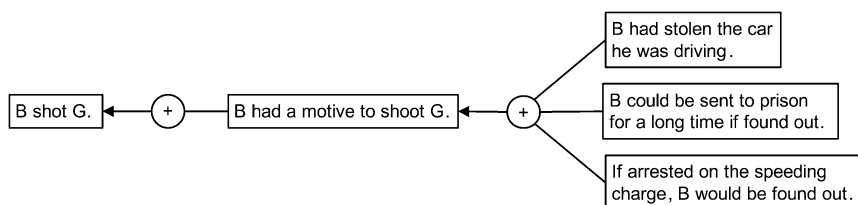FIG. 3. Structure of practical reasoning in the sheriff example.

FIG. 4. Argument from motive to action in the sheriff case.

The argument shown in Fig. 4 has three premises at the right that are linked together to support the proposition that *B* had a motive to shoot *G*. This proposition in turn leads to the conclusion that *B* shot *G*. This figure shows us how the circumstantial evidence supported the conclusion that there was a motive as the basis for an action.

Another aspect that is important is relevance. What made the argument from motive to action relevant is that there was a balance in the case and insufficient evidence to resolve the issue (Fig. 5). The argumentation is on a balance because each party claims the other shot *G* and there was no circumstantial evidence or witness testimony to show which party was the shooter.

There is no circumstantial evidence that tilts the balance. Since *G*'s back was turned when he was shot, he could not see which man in the car fired the shot. The balance situation can be represented better by comparing two argument maps representing the evidence on each side. This is shown in Fig. 6.

When trying to reconstruct a motive, it is not a matter of balancing values and probabilities to determine what is or was a rational course of action. Rather it is a matter of reconstructing the line of PR of the agent so that we can understand what gave him a reason to act in a certain way, even though we think that the way he actually acted was irrational, unethical, illegal or otherwise subject to condemnation or criticism.

So far, our analysis of the example seems superficial, and perhaps even not very convincing, because, as we will now show, it only looks at the surface of the argumentation. To get further,
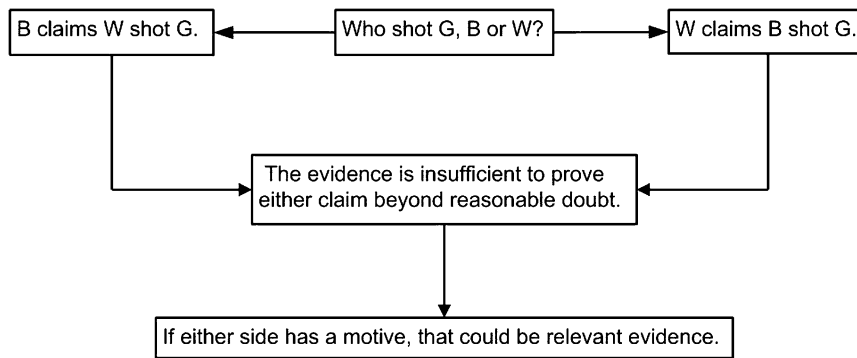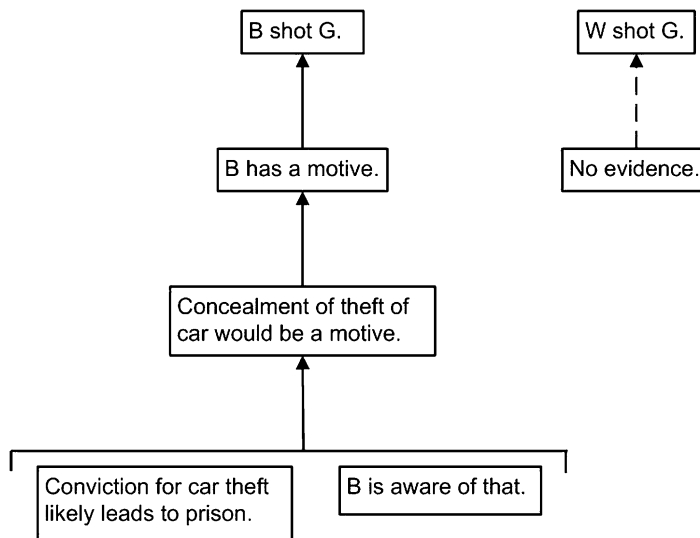
FIG. 5. Two competing claims on a balance.

FIG. 6. Argument maps for the evidence on each side.

we have to bring in explanation as well as argumentation and see how the two can be combined to produce an IBE model of the evidential reasoning.

7. Going from argument to explanation to motive

We can get a deeper appreciation of evidential reasoning about motives if we look beneath the layer of argumentation to the layer of explanation that lies underneath it. From an explanation point of view, you need to look at how the example begins with an anomaly, an unusual or puzzling set of circumstances that calls for an explanation. This first stage of the analysis is shown above the line labelled explanation in Fig. 7. Once the anomaly is posed, the explanation below the line in Fig. 7
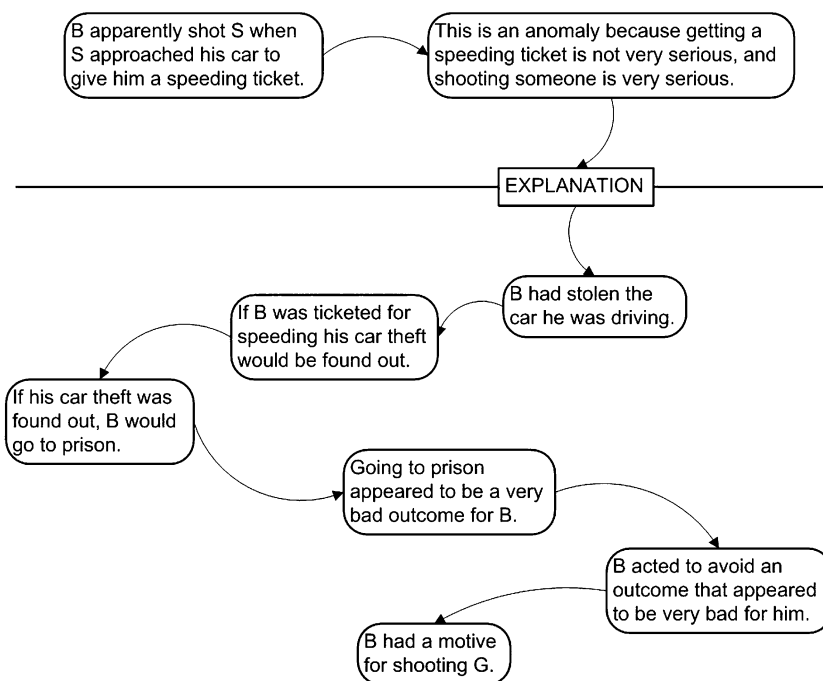
FIG. 7. An explanation leading to a motive.

purports to resolve it. The structure represented in Fig. 7 shows a sequence of events represented as propositions in the nodes joined by arrows that represent transitions from one node to the next.

The part of Fig. 7 below the line labelled explanation is a story that links several events together into a sequence so that we can understand it as a coherent whole because of our common knowledge of how actions are connected in a script. Pennington and Hastie (1993) devised the notion of an episode scheme which can be seen as a script that describes the general pattern of events like those in the famous restaurant script. Bex (2009) combined the episode schemes of Pennington and Hastie with the scripts of Schank (1986) and his colleagues Schank and Abelson (1977) to form what are called story schemes. These are modelled as an ordered list of events or types of events that can be more abstract or more specific. Bex (2009, p. 59) used the example shown in Fig. 2, where H is a drug addict who needs money and decides to rob a supermarket. H carries out other actions that fit into an episode sequence that includes his jumping into a moat. Later the police search the park and find him soaking wet from the water in the moat. The sequence shown in Fig. 7 is a story scheme of the kind shown earlier in Fig. 2. However, it is a special kind of story scheme that represents the structure of an explanation starting from an anomaly and ending in a motive. Let's call it an IBE motive story scheme.

To complete the analysis of the role of motives in the evidential reasoning in the case of who shot the sheriff, we also have to look at the story scheme on the other side.

The evaluation of the evidence in a typical case, according to the theory presented here, proceeds by examining the stories on both sides and deciding which is the more plausible or best explanation
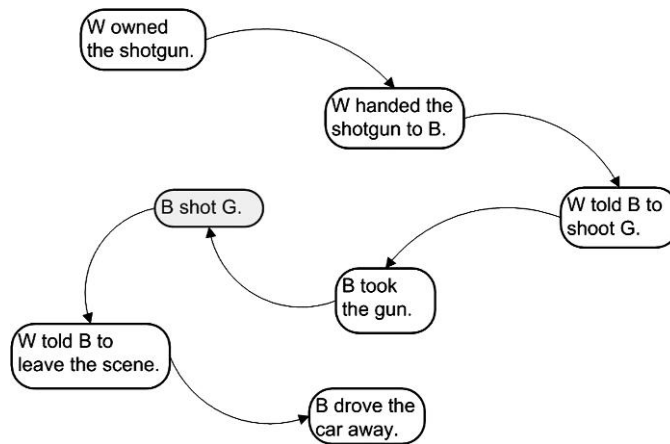
FIG. 8. *W*'s Story as an explanation leading to an action.

of the facts in the case. *B*'s story was that *W* shot *G*, but *W*'s story was that *B* shot *G*, visually represented in the episode scheme shown in Fig. 8. By using stories schemes to represent the competing explanations on both sides, we have been able to give an analysis of the evidential reasoning in the case of who shot the sheriff that shows why consideration of motive is relevant.

Bex *et al.* (2009, p. 96) provided an even deeper analysis of Leonard's car theft case (Section 1) that takes into account not only reasoning backward from the circumstances in this case to the motive, but also considers motives for several alternatives. Their analysis takes into account better ways for the defendant of achieving his goal of not being punished. The alternatives they consider are paying the victim to keep silent, or leaving the country. They use a technical system called a value-based argumentation framework to look for evidence that tells a story to explain why the defendant is the sort of person who could not afford to pay the victim, who values life cheaply, who accepted the risk of getting caught for murder and who preferred killing the victim to leaving the country. This technical system is so powerful that it could be used as a method of argument invention that could be used to tell a lawyer searching for evidence where to look next. However, it also has implications for admissibility of evidence because it can show us where evidence of character and past actions become relevant.

8. Matters of argument evaluation

The focus of this paper has been on admissibility of the motive evidence in the case of *State* v. *Brown*. However, there is an issue concerning the evaluation of the evidence in the case that raises a problem. As shown in Fig. 5, the evidence in the case is insufficient to prove either of the two competing claims to the standard of beyond a reasonable doubt. The charge in this case was that of attempted first-degree murder, and because it is a criminal case, to convict the defendant the trier must prove the charge beyond reasonable doubt. Examining the motive evidence in the case using the analysis above, it looks very much like this evidence is insufficient to meet the beyond reasonable doubt standard of proof. However, whether the evidence is sufficient or not to meet that standard

may depend on how the beyond reasonable doubt standard is defined. Standards of proof are built in burdens of proof.

Prakken and Sartor (2009, p. 228) have built a logical model of burden of proof in law. The burden of persuasion specifies which party has to prove some proposition that represents the ultimate *probandum* in the case, and also specifies what proof standard has to be met. The burden of persuasion is set at the opening stage of a trial and is a global burden that applies through the whole sequence of argumentation to the closing stage, where it is used to determine the winner and loser of the case. The burden of production specifies which party has to offer evidence on some specific issue that arises during a particular point during the argumentation stage of the trial. Both the burden of persuasion and the burden of production are assigned by law. The tactical burden of proof is a determination made by the advocate in building a sequence of argumentation and is an estimate of whether her present argument will fail if she fails to support it further. This is not set by law, but it is only an estimate made by the arguer. Only the tactical burden of proof can shift back and forth from one party to the other (Prakken and Sartor, 2009). The beyond reasonable doubt standard represents the burden of persuasion in a criminal case.

It is generally regarded as very dangerous for a judge to try to define 'beyond reasonable doubt' in a criminal trial, as there is judicial hostility to attempting any precise definition, and there is a very real danger of appeal, because such a precization is not established in precedent (Tillers and Gottfried, 2006). There is a vocal acceptance in law of the view that the beyond reasonable doubt standard cannot be quantified by using numbers. That does not mean it cannot be modelled using computational tools. Pardo and Allen (2007, p. 238) argue that it can modeled using IBE. On their view, in criminal cases, rather than inferring the best explanation from the potential ones, factfinders ought to convict when there is no plausible explanation consistent with innocence, assuming there is a plausible explanation consistent with guilt. On this model, a plausible explanation for innocence creates reasonable doubt, while a plausible explanation can be a basis for conviction on the beyond reasonable doubt standard if every competing explanation is so weak that it fails to raise a reasonable doubt. These circumstances include the case where is only one plausible explanation, and there are no competing explanations that have been offered.

Standards of proof are formalized in the hybrid theory. Definitions of standards of proof formulated in the Bex and Walton (2010) model, are set on a basis of how much better one explanation is than another, and how good an explanation is in itself. Following (Gordon and Walton, 2009) standards of proof are not given fixed values but left open to be set by an argument evaluator when the model is applied to a case. An explanation *EX* is said to meet the scintilla of evidence (SE) standard if there is a supporting argument based on evidence ($es(EX) \geqslant 1$). An explanation *EX* meets the preponderance of evidence (PE) standard if it meets the SE standard and it is better than each alternative explanation *EX'*. In other words, all else being equal, *EX* is either supported by more evidence ($es(EX) > es(EX')$) or contradicted by less evidence ($ec(EX) < ec(EX')$). For clear and convincing evidence, an explanation *EX* should be good in itself as well as much better than each competing explanation *EX'*, meaning it should have a high evidential support and low evidential contradiction. Finally, an explanation can meet the beyond a reasonable doubt standard if it is plausible and each of its competing explanations is implausible. How plausible it needs to be, or how implausible the competitors need to be is left open, but it is assumed that it needs to be highly plausible, and if there are competitors, they need to be not plausible at all. But precise evaluations of how plausible an explanation needs to be, and how much evidence there needs to be supporting it, is not specified numerically in the model. This approach provides a way of

modelling standards of proof based on IBE in such a way that burdens of proof can be determined by evaluating how plausible an explanation is in relation to competing explanations that can be given in a particular case by using the factual evidence in that case.

This approach is different from the usual one, in that the usual or standard approach to the evaluation of evidence is to consider a chain of argumentation that supports or attacks an ultimate probandum that is at issue in case, and to see how strongly the premises and conclusions in that chain are supported by the evidence. A burden of persuasion has to be set for the ultimate probandum and burdens of production and tactical burdens of proof have to be set for the individual arguments in the chain. The hybrid approach is different. It looks at the stories given by both sides to explain the facts of a given case and evaluates these stories as more plausible or less plausible than competing stories. But in addition to the plausibility and coherence of explanations, it also takes into account how well the factual evidence supports or detracts from the story on each side.

Using this approach, the evidential reasoning about motives in the case of *Brown* v. *Alabama* should be evaluated in relation to the comparative explanations of what supposedly happened, as shown in Figs 5–8. Given all the circumstantial evidence in the case, and the testimony of the deputy sheriff, it is known beyond a reasonable doubt that one or the other of the two suspects shot the sheriff. However, as shown in the balance represented in Fig. 5, this circumstantial evidence does not tilt decisively to one side or the other. On the one side, we have a story that is more plausible because it is supported by motive evidence. On the other side, we have a story that is less plausible because there is no comparable motive evidence supporting it. The problem then is whether the motive evidence should be strong enough as a basis for convicting the defendant using the beyond reasonable doubt standard. The analysis of motive evidence presented in this paper requires that there be a sufficiently plausible explanation on one side, and a sufficiently implausible explanation on the other side, in order to prove the proposition that B shot the sheriff on the beyond reasonable doubt standard of proof. Whether the case was decided on this or some other basis is a matter for speculation.

In any event, enough has been shown here to see how the beyond reasonable doubt standard is modelled by the hybrid theory in a way different from the usual approach. The usual approach, as indicated above takes only into account the evidence supporting the arguments, and the proof standard the chain of argumentation has to meet in order to prove the conclusion at the end of it. The hybrid approach works differently by evaluating the plausibility of competing explanations, but taking into account how each competing explanation is more strongly or weakly supported by the evidential facts in a case. In the case of *State* v. *Brown*, there was a good deal of evidence on both sides, and since the motive evidence was admissible, it acted as a tiebreaker.

Finally, we return to the question of how the two explanations in the case of *State* v. *Brown* can be visualized on the hybrid model. We recall that in Fig. 7 the story that explains B's presumed motive for shooting the sheriff was represented as an episode scheme. The problem now is how to factor in evidence that was available in the case that could be used to support the plausibility of this explanation. There is some explicit evidence given in the court summary of the case, but if we were to look at an expanded account of the transcript of the court proceeding, there might be other evidence as well that could be taken into account. Also, there is other implicit evidence in the form of implicit premises that are always significant in order to piece together the sequence of events using scripts to build stories that make sense. For example, one of the assumptions in the explanation is that B going to prison would be a very bad thing for him. How do we know this? There is no explicit evidence given, but it seems reasonable assumption based on common knowledge that once somebody has been to prison, they now realize that it is an experience they would care to avoid in future if possible.
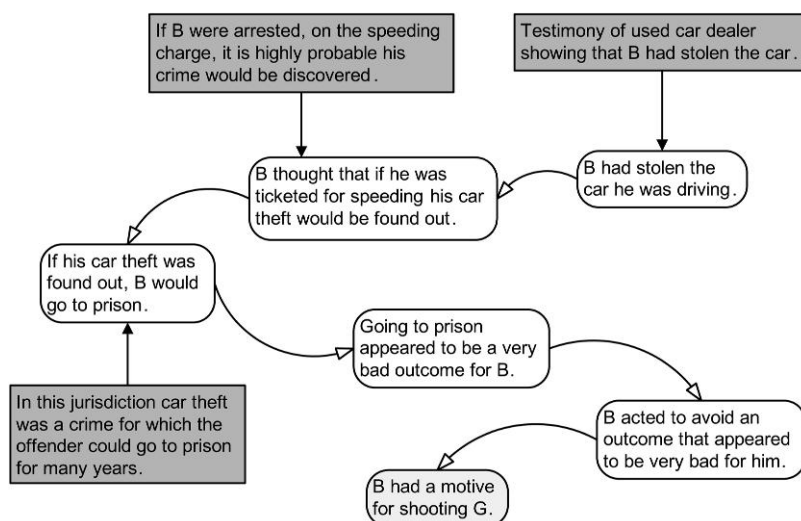
FIG. 9. Evaluation of the explanation in the sheriff case.

As noted in the discussion of Fig. 7, an episode scheme describes the general pattern of events, like those in the restaurant script, based on common knowledge about the way we can expect things normally to go in familiar situations.

In Fig. 8, none of these implicit premises have been represented. Only the explicit items of knowledge extracted from the details of the case known from the description of it have been inserted as items of evidence that support parts of the explanation. In Fig. 8, the story is represented as a se-quence of rounded boxes with no darkened fill. The propositions that appear in the rectangular boxes that have darkened fill represent items of evidence. The lines with filled arrowheads, leading from a rectangular box, represent arguments from evidence. The lines with open arrowheads connecting the rounded boxes represent explanatory connections.

As the hybrid diagram in Fig. 9 shows, there is evidence supporting the story that explains B's motives for shooting G. Evaluating how good the story is as an explanation of the facts of the case depends on the seven factors cited in Section 4. First, we have to ask how well the story performs its function of helping questioner makes sense of the facts that were known to have taken place. The story appears to perform well in this regard. It makes sense as a coherent whole that we can understand. Second, it is internally consistent. Third, there appeared to be no inconsistencies among the components that make it up, including both the evidential boxes and the story boxes, and their relationships. Fourth, since there are no inconsistencies, the criterion that any alleged inconsistency can be dealt with is satisfied. Fifth, the story is generally a plausible account. Sixth, it appears to be comprehensive and detailed enough to account for the events and actions known in the case. Seventh, we do not know how well it stood up during the trial to critical questioning an examination. However, as far as we know from the court summary, no problems were found in the story during cross-examination at trial.

9. Wigmore's theory

Wigmore (1931, p. 146) analysed motives as emotions that leads to action. Examples he gave are desire for money that led to the action of robbery, and angry hostility that led to a violent criminal act. On his view, evidence of motive is usually circumstantial, consisting of the conduct of the person and the events in the particular situation tending to excite the emotion. He added (p. 147) that there is an unfortunate ambiguity in the word 'motive', illustrating it with an example in which a defendant is accused of burning down a plaintiff's house. The plaintiff contends that the defendant's motive for burning down his house is his prior prosecution of a lawsuit against the defendant. Writers would sometimes cite the external fact of the plaintiff's lawsuit as the motive. But there is another description that is very common as well. They might also, more properly (Wigmore, 1931, p. 147) refer to the defendant's hostile and vindictive emotion arising from the lawsuit as the motive. Wigmore allows that the term 'motive' may have either meaning. It can be a particular event or fact (set of circumstances) known to an agent, or it can be the lively emotion of that agent arising from that event.

In some cases, we do not have any description of the particular circumstances that constitute a motive, even though we have evidence of an agent's past actions that support the existence of the motive. For example, in the sheep herders and cattlemen case, we know some past actions of the defendant, like threatening the lives of sheep herders, but the only way we can describe the motive is as an animosity towards sheep herders. If we have a known set of circumstances that led to the agent's action, we can use the model of practical reasoning described in Walton and Schafer (2006).

In cases where we only have the motive described as an emotion, a different model of practical reasoning model works better. In this model, practical reasoning takes the following form: I (an agent) desire to achieve end E; I believe that the best way to achieve E is to do M; therefore I do M (Searle, 2001, pp. 244–246). The major premise in the commitment-based argumentation scheme is a statement that the agent has a goal, whereas the major premise in the BDI scheme is the statement that the agent has a desire or want. Desires (wants) are deeply psychological entities, more so than goals. Goals are meant in the standard argumentation scheme for practical reasoning to be statements designated as ultimate points in an agent's plan towards which the actions contemplated in the plan are directed to bringing about. Desires represent an agent's emotional attachment to an object or state of affairs that the agent wants to bring about and may even be strongly impelled to bring about, although he may resist that impulse.

In the literature on practical reasoning, the BDI model tends to be dominant, but there is also a minority who advocate the commitment-based model. It has been perceived as a problem with the BDI model that because it expresses the premises of the practical inference in terms of beliefs and desires, it is too psychological in nature to make the practical inference rationally binding (Walton, 1990, 26–31). Also, the commitment-based model fits very well into the logical structure of the technology of planning, a well-developed branch of artificial intelligence.

A nice feature of the BDI model, however, is that precisely because of its deeply psychological nature, it fits extremely well into the study of how emotions can act as motivating factors in deliberations on how to carry out actions. (Wigmore, 1931, p. 147) shows that despite the ambiguity in the word 'motive', for use in legal reasoning he prefers the meaning that the motive should be a state of mind as opposed to an external fact. He wrote: 'that which has value to show the doing or not doing of the act is the inward emotion, passion, feeling, of the appropriate sort' (p. 147). It is clear that he saw emotion as a deeply psychological concept.

10. General framework of motive evidence

The general system of reasoning to or from a motive on either model has the structure of a five-tuple $\{M, F, A, S, D\}$. M is a motive. F is a set of statements representing the facts in a case. A is a set of argumentation schemes, most notably including the schemes for practical reasoning and abductive reasoning, used to draw conclusions. S is a set of story schemes. D is a set of dialogues of different types, including deliberation dialogue and persuasion dialogue. A dialogue has rules (protocols), moves, speech acts and commitment sets, of the kinds illustrated in (Walton and Krabbe, 1995). The system is applied in a standard case as follows (Walton, 2006). The primary agent has carried out some actions and made some statements that are known by the secondary agent. The secondary agent can observe or hear them directly, or can come to know them through sources, like testimony. Using F and S, the secondary agent uses story schemes to produce explanations. The inferred conclusions are fitted into S using the dialogue D to test an explanation. The secondary agent uses IBE to construct plausible hypotheses about the desires and actions of that other agent, and then judges which explanation is the most plausible, according to the given data (Walton, 2004). The secondary agent can reconstruct the plans and actions of the primary agent because both agents have a grasp of familiar kinds of story scripts that are common in everyday experience.

What makes the explanation comprehensible is that both participants are agents. The primary agent deliberates on how to act in a given situation, facing a problem. The secondary agent knows facts describing what the primary agent did, and understands how that agent was trying to solve a problem. The explanation is based on IBE story schemes. The process of simulative and abductive reasoning used to draw inferences from or to a motive takes place at two levels. At the primary level, the primary agent is engaged in deliberation on how to act by choosing among alternative courses of action in a given situation. At the secondary level, the secondary agent is engaged in asking questions about what the primary agent's reasons were for his actions. The shift from the one level to the other is possible because both participants are agents familiar with stereotypical stories who can seek out a solution to a practical problem by the same process of reasoning.

What the primary agent actually did and said is described. The secondary agent then takes the set of facts F and asks various kinds of questions about F. Under the list of six critical questions matching the scheme for practical reasoning given in Section 1, subquestions can also be asked (Walton, 1990), producing a much more extensive list. It can be conjectured here that the questions given by Bex *et al.* (2009, p. 84) are particularly useful, as they can serve as a general set of critical questions when applying either the commitment-based scheme or the BDI scheme to evidential reasoning about motives.

CQ$_1$: Are there alternative ways of explaining the current circumstances S?
CQ$_2$: Assuming the explanation, is there something which takes away the motivation?
CQ$_3$: Assuming the explanation, is there another motivation which is a deterrent for doing the action?
CQ$_4$: Can the current explanation be induced by some other motivation?
CQ$_5$: Assuming the previous circumstances R, was one of the participants in the joint action trying to reach a different state?
CQ$_6$: Are the current circumstances true?
CQ$_7$: Could the action have had the stated preconditions?
CQ$_8$: Were the previous circumstances the same as the current circumstances?
CQ$_9$: Could the explanation for the current state provide the motivation?

CQ$_{10}$: Assuming the previous circumstances, would the action have the stated consequences?
CQ$_{11}$: Assuming the previous circumstances, would the action have any consequences?
CQ$_{12}$: Are the current circumstances S possible?
CQ$_{13}$: Is the joint action possible?
CQ$_{14}$: Are the previous circumstances R possible?
CQ$_{15}$: Is the motivation indeed a legitimate motivation?

To try to get answers to these questions, the secondary agent uses IBE to reason backwards as a practical inference. To carry out this abductive task of questioning and inference, the secondary agent must try to reconstruct the deliberations of the primary agent, as they presumably took place at the primary level. By using IBE story schemes, the secondary agent can infer that the primary agent had a motive in mind when he acted the way he did. Of course, this conclusion is only one explanation, based on IBE from the given evidence. The secondary agent cannot know for sure what the primary agent had in mind. But the conclusion drawn can be drawn as a more or less plausible explanation of the facts.

11. Conclusion

The conclusion of this paper is that the BDI model is the best one suited for reasoning abductively in legal argumentation from an agent's actions to a hypothesis about the motive that may have led to the action. When practical reasoning is used for this purpose, its structure can be defined using the following argumentation scheme, the BDI scheme, where the pronoun 'I' refers to an autonomous agent capable of carrying out action based on its knowledge of a given situation.

Major Premise: I have a desire *D*.

Minor Premise: Carrying out this action *A* is a means to realize *D*.

Conclusion: Therefore, I carry out action *A*.

In this model, an emotion is a particular desire that is singled out in the abductive reconstruction of an agent's action as that special desire or want that was the mainspring of the action. In other words, a motive is a particularly lively desire or want that causes an agent to carry out particular action to fulfill that desire.

The difference between desires and goals is that goals can be set or withdrawn deliberately, whereas desires are subject to control in a less direct way. A goal can also provide evidence for a motive in cases of deliberate planning to execute an action, but in many of the most typical cases in criminal law the action may be impulsive, not characterized by planning and careful comparison of the alternatives before taking action. In such cases, the motive can provide evidence that the person who is taken to have that motive has carried out particular action. As such, motives sometimes conform better to the practical reasoning structure of the BDI model because a motive can be so lively just before the carrying out of the action that it explains inference to a conclusion to act. The use of the BDI model is connected with heuristics, fast ways of arriving at a conclusion that can often be reasonable but that in some instances are associated with fallacies, biases and errors (Walton, 2006).

The general system outlined above can accommodate the ambiguity noted by Wigmore. In one meaning of the term noted by Wigmore, the plaintiff might contend that the defendant's motive for burning down his house is the fact of the plaintiff's prior prosecution of a lawsuit against him. But as

noted by Wigmore, someone might also properly refer to the defendant's hostile and vindictive emotion arising from the lawsuit as the motive. The commitment model can be applied to a description of a motive of the former type, while the BDI model can be applied to the latter type.

The two models, the commitment model and the BDI model, can be applied in tandem. The commitment model displays the structure of practical reasoning in planning and rational deliberation where goals have been formulated and proposals for action are put forward, and where these actions are recommended as means to achieve the goals. The BDI model can be applied in cases like those in the law, where a lively emotion can function as an explanation why an agent presumably carried out some action, and then secondarily it can function as a means of using circumstantial evidence to infer backwards to the presumed motive on which an action was based. Wigmore clearly thought that the view of motive as emotional desire that drives an agent to action is the deeper theoretical approach to evidential reasoning about motives in law.

Acknowledgements

References

Atkinson, K., Bench-Capon, T.J.M. and McBurney, P. (2005). Arguing About Cases as Practical Reasoning. *Proceedings of the 10th International Conference on Artificial Intelligence and Law*, ed. G. Sartor. New York: ACM Press, 35–44.

Bex, F. (2009). Analysing Stories Using Schemes. *Legal Evidence and Proof: Statistics, Stories, Logic*, ed. H. Kaptein, H. Prakken and B. Verheij. Farnham: Ashgate, 93–116.

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

Bex, F., Prakken, H., Reed, C. and Walton, D. (2003). Towards a Formal Account of Reasoning about Evidence: Argumentation Schemes and Generalizations. *Artificial Intelligence and Law* 11, 125–165.

Bex, F., Bench-Capon, T. and Atkinson, K. (2009). Did He Jump or Was He Pushed? Abductive Practical Reasoning. *Artificial Intelligence and Law* 17, 79–99.

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

Bex, F. and Walton, D. (2010). Burdens and Standards of Proof for Inference to the Best Explanation. *Legal Knowledge and Information Systems: Proceedings of JURIX 2010*. Amsterdam, IOS Press, 37–46.

Golden, H. L. (1994). Knowledge, Intent, System and Motive: A Much Needed Return to the Requirement of Independent Relevance. *Lousiana Law Review* 55, 179–216.

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. and Walton, D. (2009). Proof Burdens and Standards. *Argumentation and Artificial Intelligence*, ed. I. Rahwan and G. Simari. Berlin: Springer, 239–260.

Gordon, T. F., Prakken, H. and Walton, D. (2007). The Carneades Model of Argument and Burden of Proof. *Artificial Intelligence* 171, 875–896.

Josephson, J. R. and Josephson, S. G. (1994). *Abductive Inference: Computation, Philosophy, Technology*. New York: Cambridge University Press.

Leonard, D. P. (2001). Character and Motive in Evidence Law. *Loyola of Los Angeles Law Review* 34, 439–536.

Pardo M. S. and Allen, R. J. (2007). Juridical Proof and the Best Explanation, *Law and Philosophy* 27, 223–268.

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.

Prakken, H. and Sartor, G (2006). A Dialectical Model of Assessing Conflicting Arguments in Legal Reasoning. *Artificial Intelligence and Law* 4, 331–368.

Prakken, H. and Sartor, G. (2009). A Logical Analysis of Burdens of Proof. *Legal Evidence and Proof: Statistics, Stories, Logic* eds. H. Kaptein, H. Prakken and B. Verheij. Farnham: Ashgate Publishing, 223–253.

Sartor, G. (2005). *Legal Reasoning: A Cognitive Approach to the Law*. Springer: Berlin.

Schank, R. C. (1986). *Explanation Patterns: Understanding Mechanically and Creatively*. Hillsdale: Erlbaum.

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

Searle, J. (2001). *Rationality in Action*. Cambridge: The MIT Press.

Tillers, P. and Gottfried, J. (2006). Case comment United States v. Copeland, 369 F. Supp. 2d 275 (E.D.N.Y. 2005): A Collateral Attack on the Legal Maxim That Proof Beyond A Reasonable Doubt Is Unquantifiable?. *Law, Probability and Risk* 5, 135–157.

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. (1990). *Practical Reasoning: Goal-Driven, Knowledge-Based Action-Guiding Argumentation*. Savage: Rowman and Littlefield.

Walton, D. (2004). *Abductive Reasoning*. Tuscaloosa: University of Alabama Press.

Walton, D. (2006). *Character Evidence: An Abductive Theory*, Berlin: Springer.

Walton, D. and Krabbe, E. C. W. (1995). *Commitment in Dialogue*. Albany, SUNY Press.

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

Walton, D. and Schafer, B. (2006). Arthur, George and the Mystery of the Missing Motive: Towards a Theory of Evidentiary Reasoning about Motives. *International Commentary on Evidence*, 4, 1–47.

Wigmore, J. H. (1931). *The Principles of Judicial Proof*, 2nd ed. Boston: Little, Brown and Company.

Wigmore, J. H. (1940). *Evidence in Trials at Common Law*. Boston: Little, Brown and Company.