

# **Legal Stories and the Process of Proof**

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# 1 INTRODUCTION

In research on legal reasoning in the field of AI & law, models of reasoning from proven facts to legal consequences are well developed [26][16]. Recently there is also a rise in attention for evidential reasoning [7][8][20][30]. However, there is not much recent work that aims at modelling the full pathway from evidence via proven facts to legal consequences (except maybe [32], see section 5). Providing a model of that full pathway is the focus of this paper.<sup>1</sup>

We will argue that the factual and legal part of a case (the steps from evidence to proven facts, and from proven facts to legal consequences, respectively; Figure 1) cannot be separated. The phenomenon of legal shifts is a case in point: the legal perspective on a case changes as a result of what can be proven, but at the same time this perspective also determines exactly what needs to be proven. We provide an example based on a murder case set in the provincial Dutch town of Wamel (as carefully analyzed by Israëls [19]). In this case it was impossible to successfully convict the suspect for murder, as the key question of ‘who shot the gun?’ is never clarified. However, the suspect was convicted (after appeal and withstanding cassation by the Supreme Court) as an accomplice to murder.

We extend our previous work on reasoning with evidence [5][7], in which we mainly concerned ourselves with the factual part of trials, the evidence and the facts that can be inferred from it. In this work it was not specified how exactly, once the facts have been established, the reasoning towards the legal consequences proceeds. Also, the exact way in which the law might influence the reasoning about the facts and the evidence is an open question.

The contribution of the paper is as follows. We propose an extension of our hybrid narrative-argumentative approach to evidential reasoning [5][7] in order to incorporate the complete reasoning process in a case: from evidence via facts to legal consequences. In this extended hybrid theory we introduce the idea of *legal stories* and *legal story schemes*, which can be used to establish the legal coherence (as opposed to the factual coherence) of a case, is required.<sup>2</sup> These legal stories steer what needs to be proven, but are also selected on the basis of what can be proven and can thus be used to model shifts in legal perspectives. Furthermore, we will argue that a combination of legal stories and factual stories allows for a natural modelling of reasoning with circumstantial evidence. This is especially useful in cases where there is no direct evidence for the “guilty act” that has to be proven (e.g. the suspect shot the victim), and for proving motive which is often hard to find reliable direct evidence.

Factual and legal story schemes make explicit that a holistic, coherent perspective underlies all reasoning and argumentation. Factual story schemes are important to determine which accounts of the facts are plausible, and which gaps

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<sup>1</sup> This paper adapts and extends our [10].

<sup>2</sup> There exist other formal approaches to coherence, e.g. [17][4][30].

need to be filled by further evidence in order to form a full picture of what happened. Legal story schemes show which sets of (legally qualified) facts and events are recognized as coherent wholes by the law, in the sense that a legal consequence such as a conviction can be based on them. We will show how both factual and legal story schemes are a tool to reduce the risk of tunnel vision.

In the following, we start with a discussion of the theoretical background used (Section 2). This comprises a discussion of the theory construction view on legal reasoning on the basis of evidence via facts to legal consequences. We also provide a brief overview of the Wamel murder case that we use as an illustration. Then follows a review of the evidential part of our hybrid theory (Section 3). This review also contains a discussion of the story schemes which were previously discussed in [5]. In Section 4, the hybrid theory is extended to include the legal step in the pathway from evidence via facts to legal consequences. In Section 5, we put our approach in perspective by a discussion in the light of related research. We conclude our paper in Section 6, pointing out some issues for future research.

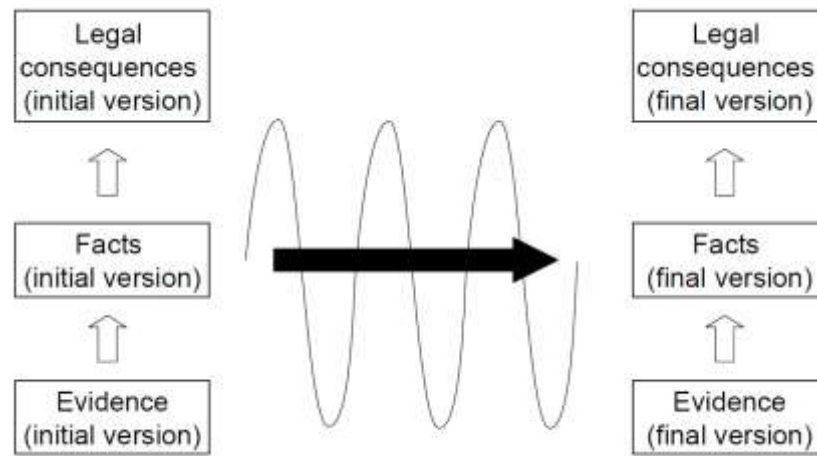
## 2 FROM EVIDENCE VIA FACTS TO LEGAL CONSEQUENCES (AND BACK)

Reasoning in a criminal case is a complex process in which the available *evidence* determines which *facts* can be proven, and hence also which *legal consequences* follow. As we already indicated above, this also works the other way: the law often regulates which facts have to be proven, which in turn determines which of the evidence is relevant. As a result, a theory construction perspective, in which the overall reasoning about a legal case (from evidence, via facts to legal consequences) is gradually constructed is in place (Figure 1, adapted from [31], p. 10). The figure not only suggests that evidence, facts and legal consequences are gradually constructed from an imperfect initial version, but also there is an influence both upward (from evidence via proven facts to legal consequences) and downward (from legal consequences via proven facts to evidence).

Reasoning in a criminal case is a complex process in which the available *evidence* constrains which *facts* can be proven, which in turn are the grounds for *legal consequences* on the basis of the applicable legal rules (Figure 1, adapted from [31], cf. also [27]’s legal-theoretic and [21]’s AI & Law take on theory construction). The path of justification is from evidence via facts to legal consequences (visualised as the white upward arrows). However, there is also an influence in the other direction. This influence is not about justification but rather has to do with the discovery or *exploration* of new facts and evidence: the legal perspective on a case (in the form of the legal consequences that are at issue) steers which facts need to be proven for the legal consequences to actually follow, while the facts that have to be proven guide the search for evidence.

To sum up, we view legal (evidential) reasoning from a theory construction perspective. Figure 1 not only suggests that evidence, facts and legal

consequences are gradually constructed from an imperfect initial version, but also that there is an influence both upward (from evidence via facts to legal consequences) and downward (from legal consequences via facts to evidence).



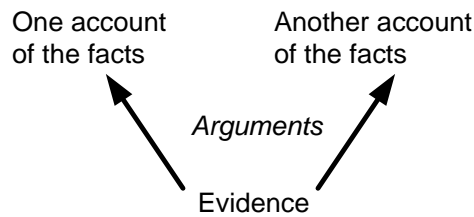
**Figure 1: A theory construction perspective on legal reasoning**

As for terminology, with *evidence* we mean the evidential data, the primary sources of evidence the existence of which are not an issue (e.g. witness statements made in court, forensic expert reports handed to the jury). As is usual in law, we use the term *fact* to denote descriptions of states or events, the truth of which are currently unknown and have to be proven (cf. the terms “fact-finder”, “question of fact”).<sup>3</sup> By *legal consequences*, we mean the legal states of affairs that the law attaches to the facts (e.g. the punishability for murder and the ensuing sentence of imprisonment; cf. the German jurisprudential term *Rechtsfolge*).

In previous work [5][7] we focused on the bottom part of Figure 1, that is, *evidential reasoning* about the evidence and the (real-world) facts. We argue that this evidential reasoning is best modelled in a *hybrid theory* that uses both stories and arguments. In the hybrid theory, facts are organised into multiple hypothetical stories, coherent accounts of what (might have) happened in the case. Arguments based on evidence can then be used to justify these stories, as these arguments can be used to support elements in a story with evidence or, in other words, to anchor the story in the evidence (cf. [33]). Ultimately, the alternative stories in a case should be compared and the best one (i.e. the most coherent one that best fits the evidence) should be chosen.

Figure 2 visualises the basic idea behind the hybrid theory. This way of hybrid reasoning with stories and arguments is particularly close to the analytic and evaluative thinking of the professionals that actually perform the reasoning in a criminal case, in particular criminal investigators and judges ([21], [33], [5]).

<sup>3</sup> We assume a rough distinction between “real-world” facts, which tell us something about the (physical) reality (e.g. *Francis was angry with Kevin*, *Francis shot Kevin*) and legal facts, facts which tell us something about the legal reality (e.g. *Francis' killing of Kevin was premeditated*, *Francis is punishable for murder*).



**Figure 2: Hybrid narrative-argumentative evidential reasoning**

At first view, *legal reasoning* – reasoning about the (legal) facts and legal consequences (the top part of Figure 1) – seems quite different from evidential reasoning (cf. the dichotomy between a “question of fact” and a “question of law” and Wigmore’s separation of factual proof and legal admissibility in evidential reasoning). Whilst the content and context of evidential reasoning are different from those of legal reasoning, the reasoning mechanisms employed are related.

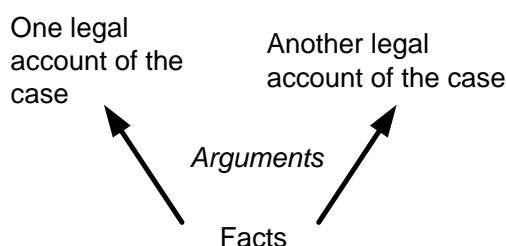
In legal reasoning, the legal consequences are organised into clusters of legal facts that provide legally coherent perspectives on a case. In our opinion, such a legally coherent perspective can be seen as a “legal story” about what happened in the case, a legally qualified account of what happened. This is particularly apparent in Dutch cases, where the indictment is usually phrased as a small legal story (intermixed with their legal qualification). For example, a murder charge in our case could read as follows: “On the 5<sup>th</sup> of January 1997, Francis intentionally and with malice aforethought killed Kevin by shooting him repeatedly with a semi-automatic weapon, which caused multiple severe injuries to Kevin, as a result of which Kevin died”.

In every case, there are at least two legal accounts representing the “guilty” and “innocent” perspectives.<sup>4</sup> Here the “guilty” perspective will normally be very detailed (as per the requirements for the prosecution’s indictment), whereas the “innocent” perspective sometimes is not much more than a denial of the “guilty” perspective. Arguments can be used to reason from the (real-world) facts to the legal consequences, that is, to justify the legal accounts with the facts of the case which are themselves justified by the evidence. Ultimately, the alternative legal accounts should be compared and the best one (i.e. the one that best fits the proven facts) should be chosen. Figure 3 shows how legal accounts follow from the facts of the case in a similar way as the facts follow from the evidence in the case.

Now, the combination of evidential reasoning (Figure 2) and legal reasoning (Figure 3) gives us all the machinery we need for the reasoning in a criminal case (Figure 1). Because of the similarities between evidential and legal reasoning, we think that this combination can be modelled without introducing too much new conceptual and logical machinery. However, the exact connection and similarities between the evidential and the legal layer will have to be made more clear, particularly if we not only consider the upward, justificatory influence of evidence

<sup>4</sup> In practice, there might be more alternative legal accounts in a case and the alternatives will be more specific.

on legal consequences but also the downward, exploratory influence of legal consequences on evidence.



**Figure 3: Hybrid narrative-argumentative legal reasoning**

## 2.1 The Wamel case

Below we will briefly discuss the key concepts of stories and arguments. We will illustrate these concepts using examples inspired by the Wamel case [19], which also serves as a running example throughout the paper. In the Wamel case, there are three key actors: Kevin Moyson, the victim, Sander Mornie, the main witness and friend of Kevin's, and Francis Liebrand, the prime suspect and an acquaintance of Kevin's. All three are members of a loosely connected community of petty criminals often related to soft drugs and theft, but not normally associated with big organized crime.

On January 6, 1997, Kevin's body is found some 50 kilometres from his home town Uden, near two barns in the village of Wamel. He has been shot dead. Later that day, Sander contacts the police and states that he was also at the scene of the crime, allegedly trying to escape. According to Sander's initial, later denied, statements, Francis was also at the barns and an argument developed between Kevin and Francis (allegedly over a 5000 guilders debt that Francis owed Kevin). Kevin then walked to the back of one of the barns. When Francis followed him, there was a sudden firing of shots, after which Sander fled.

Francis was ultimately convicted both in first and second instance to 13 years imprisonment, as an accomplice to the murder of Kevin and the attempted murder of Sander.<sup>5</sup> This was later confirmed at the Supreme Court.

## 3 REASONING WITH THE HYBRID THEORY

The hybrid theory is essentially a theory of Inference to the Best Explanation (IBE). Given a set of facts that have to be explained, we hypothesize various causally connected stories from which these facts follow. We then use arguments based on evidence to reason about these stories in order to determine which story is the best explanation (i.e. the one that is best supported by evidence). Thus, the formal hybrid theory is a combination of a *causal theory* for building hypothetical

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<sup>5</sup> In this paper, we generally assume a Dutch legal framework. Even though the use of legal terms in different jurisdictions has many pitfalls, such terms will be translated more or less literally and where necessary we will briefly sketch the legal context. For example, a relevant distinction here is that the principal is the primary actor of a crime and the accomplice an active participant.

stories about the facts, and an *evidential theory* for building arguments from the evidence to the facts. More specifically, the formal hybrid theory is a combination of a formal model of causal-abductive reasoning *CT*, which is inspired by model-based approaches to causal-abductive inference (e.g. [13]) and an evidential argumentation theory *ET*, which takes its inspiration from standard accounts of structured and abstract argumentation ([26], [23], [14]).

The hybrid theory combines reasoning with causal and evidential rules formalised with a connective for defeasible implication  $\Rightarrow$ , which only satisfies the defeasible modus ponens inference rule.<sup>6</sup> A causal rule  $e_1 \Rightarrow_C e_2$  stands for ‘ $e_1$  (presumably) caused  $e_2$ ’; a specific causal relation between events can then be formalised as a rule, e.g. Francis shot Kevin  $\Rightarrow_C$  Kevin died. Similarly, an evidential rule  $e_1 \Rightarrow_E e_2$  means that ‘ $e_1$  (presumably) is evidence for  $e_2$ ’, and specific evidential relations can be formalised as rules, e.g. Sander says “Francis shot Kevin”  $\Rightarrow_E$  Francis shot Kevin. As usual, a rule with (meta)variables is a scheme standing for all its ground instances. Thus, for instance, a specific causal link can be generalized as a *causal generalization* (e.g.  $x$  shoots  $y \Rightarrow_C y$  dies, which means so much as “if you shoot someone, this may cause them to die”) and a specific evidential link can be generalized as an *evidential generalization* (e.g. witness  $x$  says “ $p$ ”  $\Rightarrow_E p$ , interpreted as “witnesses usually speak the truth”).

### 3.1 Abductive reasoning with stories and story schemes

A criminal case usually starts when some initial evidence is found that points to the possibility that a crime has been committed. In the Wamel case, the investigation started with Sander contacting the police and telling them that Kevin had been shot near the barns in Wamel; Kevin's body was found the same day near the barns. On the basis of this preliminary evidence, we can formulate one or more initial *explananda*, facts that have to be explained. These explananda can be observations or they can be other facts that are considered important (this will be further discussed in section 4.3 when we look at the connection to the legal reasoning layer). In the Wamel case, the most important initial explanandum is the fact that Kevin died due to multiple gunshot wounds.

Explananda can be explained by constructing *stories* – coherent sequences of states and events – about what might have happened. A coherent story (cf. [21], [30]) is *causally connected* in that the individual events are connected by (sometimes implicit) causal links. This allows us to perform *abductive reasoning* in order to infer what happened to Kevin. Abductive reasoning involves “guessing” new hypotheses that explain some data (i.e. Kevin’s body). The basic idea of such reasoning is that if we have a general rule ‘ $c$  is a cause for  $e$ ’ and we observe  $e$ , we are allowed to infer  $c$  as a possible hypothetical explanation of the effect  $e$ . This cause  $c$  which is used to explain the effect can be a single state or

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<sup>6</sup> See also David Poole’s work (e.g. [24]) for a combination of causal and evidential reasoning.

event, but it can also be a causally connected chain of events, a story. One explanation for Kevin's death is that Sander and Kevin went to the barns in Wamel to meet Francis and that Francis shot Kevin, which caused Kevin's death.

In our formal model, abductive reasoning is done using a causal theory  $CT$ .

**Definition 2 [Causal Theory]** A causal theory is a tuple  $CT = (R_C, H, F, FSS)$  where

- $R_C$  is a set of causal rules of the form  $\varphi_1, \dots, \varphi_n \Rightarrow_C \psi$ ;
- $H$ , the *hypotheticals* or *hypothetical events*, is a set of ground literals;
- $F$ , the *explananda* which have to be explained, is a consistent set of ground first-order literals.
- $FSS$  is a set of *factual story schemes* (Definition 5).

The causal rules  $R_C$  are the generalizations we discussed above. Given these causal rules and the set of hypothetical events  $H$ , we can build a story, a finite sequence of events and rules expressing the causal relations between these events.

**Definition 3 [Story]** A story  $S$  based on a causal theory  $CT$  is a finite sequence  $[\varphi_1, \dots, \varphi_n]$ , where  $n > 0$ , such that for all  $\varphi_i$  ( $1 \leq i \leq n$ ):

- $\varphi_1 \in H$ ; and
- $\varphi_i \in H \cup R_C$ ; or
- $\varphi_i$  follows from  $\psi_1, \dots, \psi_n \in \{\varphi_1, \dots, \varphi_{i-1}\}$  by application of defeasible modus ponens.

The reason we model a story as a sequence is that many stories have a chronological structure that give it a sequential character of some kind. Note that, however, the sequentiality of a story is not its prime characteristic, it is not what makes a story coherent; rather, coherence is governed by whether a story “has all its parts” (definition 6). More specific issues pertaining to, for example, temporal reasoning and the fact as to whether causal relations can be pinned down to one specific point in a sequence are hence left implicit in our model.

Thus, a story starts with an event and further events in the story are either events from  $H$  or events which are causally inferred from the rest of the story.  $Stories(CT)$  denotes the set of all stories that can be constructed from a theory  $CT$ . As an example, consider the story  $S_1$ :

[Kevin was at the barns, Francis was at the barns, Francis shot Kevin, Francis shot Kevin  $\Rightarrow_C$  Kevin died, Kevin died].

Notice that in order to provide a more holistic flavour to the causal theory, not all causal relations in a story will be made explicit: the causal coherence of a story then depends on *implicit* causal relations, which will be discussed below when we look at story schemes.

In the causal theory, the “explains” relation between a story and the explananda is defined through a notion of logical consequence  $\vdash_C$ , where  $\vdash_C$  stands for logical consequence according to the set of all deductive inference rules extended with modus ponens for  $\Rightarrow_C$ .



**Definition 4 [Explanation]** A story  $S$  is an *explanation* for a set of explananda  $F$  iff for all  $f \in F$ :

- $S \vdash_c f$ ; and
- $S$  is consistent.

As is usual in model-based reasoning, we consider only subset-minimal explanations. For our initial explanandum Kevin died, we can thus abductively infer  $S_1$  as an explanation, as Kevin died follows from  $S_1$ .

Note that using causal rules, we can also perform *predictive reasoning*, where one assumes a hypothesis and tries to predict what will be the case as a consequence of this hypothesis. For example, if we hypothesize that Francis shot Kevin, there should be (Kevin's) blood at the scene of the crime, as we would normally expect that being shot causes one to bleed quite heavily. This predictive reasoning can then be used in the search for new evidence (Section 3.3).

In our earlier work [7], explicit causal rules played a larger role. Following standard accounts of logical causal-abductive reasoning, the explanatory stories in the previous version of the hybrid theory were represented as fully connected causal networks. While certain explicit causal generalizations play an important role in causal-abductive reasoning, they are atomistic in flavour. Explicit causal relations are used to link small clusters of facts and events; these clusters are considered separately and the case is not considered 'as a whole'.

In contrast, a holistic perspective on story coherence is provided by *story schemes*, abstract scenarios that can serve as a scheme for particular stories. As is argued by [28], the knowledge that is used when thinking about stories often does not have the form of individual causal generalizations but is more naturally thought of as a collection of generalized events or event types, abstract renditions of how things generally happen in the world. One example of such a story scheme is [22]'s story scheme for intentional actions: given some initial states of affairs, a *motive* may lead to an *action* with certain *consequences*.

For our formal definition of story schemes we basically follow the definitions given in [5]. We assume a set  $FSS$  containing the relevant factual story schemes in  $CT$ .<sup>7</sup> Because story schemes are in effect abstract stories, the structure of story schemes is very close to that of specific stories. Basically, a story scheme  $G$  is a sequence containing literal schemes (literals with variables that act as schemes for all their ground instances) that denote event types and causal rules that denote types of causal links.

**Definition 5 [Factual Story Scheme]** A factual story scheme  $G \in FSS$  is a finite sequence of literal schemes and causal generalizations (i.e. causal rule schemes).

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<sup>7</sup> Factual story schemes are schemes about real-world facts. They are different from legal story schemes, which will be discussed in section 4.2.

As with stories, the sequence represents a basic idea of chronological succession. As an example of a story scheme, take the simple scheme for murder (in a non-legal sense):

[ $x$  is at place  $p$ ,  $y$  is at place  $p$ ,  $x$  has motive  $m$  to kill  $y$ ,  $x$  shoots  $y$ ,  $x$  shoots  $y \Rightarrow_c y$  dies,  $y$  dies].

Note that there is an explicit causal generalization in this scheme, which says that  $x$  shooting has to be the cause of  $y$  dying (otherwise  $y$  would not have been killed by  $x$ ). This scheme is a concrete version of the scheme for intentional actions (in the sense that murder is an intentional action). A specific story can now be matched to a story scheme by instantiating the variables in the story scheme with constants in the story. In our example, the story  $S_1$  is an instance of a motivated killing: both Kevin and Francis were in the same place  $p$  (the barns) and Francis shot Kevin, which caused Kevin's death.

Notice that in our example there is an element in the story scheme which is not in the story, namely  $x$  has motive  $m$  to kill  $y$  (which would be Francis has motive  $m$  to kill Kevin in the story). Even though the events in the story correspond to some element of the scheme, not all elements of the scheme have a corresponding event in the story. This leads us to the notion of a complete story.

**Definition 6 [Complete Story]** A story  $S = [\varphi_1, \dots, \varphi_n]$  is *complete* w.r.t. a story scheme  $G = [\psi_1, \dots, \psi_n]$  iff every  $\varphi_i$  is a ground instance of  $\psi_i$ .

In the above example, the missing motive makes the story incomplete (w.r.t. the murder scheme). Note that here, we define only one measure of completeness: a story either fully instantiates a story scheme or it does not. In [5], other measures of completeness (e.g. whether a story has extra elements that are not in the scheme) are defined.

The concept of completeness can be used to determine the coherence of a story. Recall that a coherent story is causally connected. In our previous work, this causal connectivity was modelled using individual, explicit causal links. In this paper, however, we define coherence through the use of story schemes. More specifically, we consider a scheme to be *coherent* if it is complete w.r.t. some plausible story scheme. This ensures that the story “has all its parts” (e.g. no murder story with a missing motive, cf. [35]). Furthermore, if we assume that story schemes only present coherent views on how things generally work in the world around us, we accept that by completing a scheme the story adheres to the scheme's implicit causal coherence.

Matching a part of a story to a scheme allows for (abductive and predictive) causal reasoning without explicit causal rules. For example, if we have a scheme  $[e_1, e_2, e_3]$  and we observe (a ground instance of)  $e_3$ , we can infer a story instance of  $[e_1, e_2, e_3]$  as a possible abductive explanation of  $e_3$ ; in our example, Francis has motive  $m$  to kill Kevin can thus be abduced from story  $S_1$  using the story scheme for murder. Similarly, we may perform predictive reasoning using a story

scheme; if we extend the murder scheme to include [... $x$  shoots  $y$ ,  $y$  bleeds heavily...], we can use this extended scheme to infer that Kevin bled heavily. Here, the abductive and predictive inference steps are not justified by an explicit causal connection between the original hypothesis and the new hypothetical event, but rather by the implicit causal connections in the story scheme.

### 3.2 Evidential reasoning with arguments

In the previous section, we were mainly concerned with constructing hypotheses based on our general knowledge of the world, encoded as either atomistic causal rules or holistic story schemes. In reality, however, the process will also be driven by evidence. Here, arguments play an important role as they can be used to connect the evidence to a story: given some evidence, we can infer conclusions through defeasible argumentative inferences until we arrive at some event in our hypothesised story. Thus, we can support a story with evidence.

Our evidential argumentation theory  $ET$  takes its inspiration from the ASPIC+ framework [25], which integrates [26] and [23]’s ideas on rule-based argumentation and structured arguments within [14]’s abstract approach.

**Definition 7 [Evidential Theory]** An evidential theory is a tuple  $ET = (R_E, K)$  where

- $R_E$  is a set of evidential rules of the form  $\varphi_1, \dots, \varphi_n \Rightarrow_E \psi$ ;
- $K$ , the *evidence*, is a set of ground literals.

Arguments can be built by taking evidence from  $K$  and rules from  $R_E$  as premises and chaining applications of defeasible modus ponens into tree-structured arguments (similar to the well-known Wigmore charts from the literature [2]).

**Definition 8 [Argument]** An *argument* based on an evidential theory  $ET$  is a finite sequence  $[\varphi_1, \dots, \varphi_n]$ , where  $n > 0$ , such that for all  $\varphi_i$  ( $1 \leq i \leq n$ ):

- $\varphi_i \in K \cup R_C$ ; or
- $\varphi_i$  follows from  $\psi_1, \dots, \psi_n \in \{\varphi_1, \dots, \varphi_{i-1}\}$  by application of defeasible modus ponens.

As an example of a simple argument, consider the following simple argument  $A_1$ :

1.  $e_1$ : Sander says "Francis shot Kevin" ( $K$ )
2.  $r_{e1}$ : witness  $x$  says " $p$ "  $\Rightarrow_E p$  ( $R_E$ )
3. Francis shot Kevin (1, 2,  $DMP$ )

We say that  $Args(ET)$  denotes the set of all arguments that can be constructed from a theory  $ET$ .

Arguments are a tool to deal with the contradictory evidence that is often available in a case. In the Wamel case, for instance, the main witness Sander is unreliable. He has reported two versions of what happened. In the first report, to his girlfriend and her mother, he says that Francis was at the crime. In the second

report, to the police, he denies Francis was there. A careful argumentative analysis can help to find out how to handle such conflicting information.

In our formal model, conflict between arguments is modelled as defeat. Here, we use the common notation  $\bar{\varphi}$  for the complement of a formula  $\varphi$  (the complement of  $\varphi$  is  $\neg\psi$  if  $\varphi = \psi$  and  $\psi$  if  $\varphi = \neg\psi$ ).

**Definition 9 [Defeat]** Given two arguments  $A$  and  $B$ :

- $A$  *rebut*  $B$  iff  $\exists\varphi \in A$  and  $\exists\psi \in B$  such that  $\varphi \in \bar{\psi}$  and  $\psi \notin K$ .
- $A$  *undercuts*  $B$  iff  $\exists\varphi \in A$  and  $\exists r \in R_E$  such that
  - $\varphi \in \bar{r}$  ; and
  - there is an application of defeasible modus ponens to  $r$  in  $B$ .

$A$  *defeats*  $B$  iff  $A$  either rebuts or undercuts  $B$ .

So an argument rebuts another argument if they have an opposite (intermediate) conclusion, and an argument undercuts another argument if the application of defeasible modus ponens to a rule in the second argument. Here,  $\neg r$  generalises the two cases where a rule is invalid (inapplicable in all cases) and where there is an exception to the rule (inapplicable in some cases), cf. [16]. As an example, take the following argument:

1.  $e_2$ : Sander gave contradictory statements (K)
2.  $r_{e2}$ : witness  $x$  gives contradictory statements  $\Rightarrow_E \neg r_{e1}$  ( $R_E$ )
3.  $\neg r_{e1}$  (1, 2, DMP)

Here, it is argued that a situation where a witness gives contradictory statements is an exception to the generalization that witnesses normally speak the truth (rule  $r_{e1}$ ). This argument undercuts argument  $A_1$  for Francis shot Kevin.

An advantage of formal models of argumentation is that they can be used to evaluate a particular argument given a complex mass of other evidential arguments. In other words, given a collection of arguments and their binary defeat relations, the *dialectical status* of the arguments can be determined. Following [25], we assume that our theory for arguments instantiates one of [14]’s semantics. For present purposes, the exact type of semantics is not important and we simply assume that, depending on the semantics chosen, arguments can be *justified*, *overruled*, or *defensible*.

### 3.3 Combining stories and arguments in a hybrid theory of IBE

In [5][7], it is argued that arguments and stories need to be combined into one *hybrid theory*. In this hybrid theory, explanatory stories are used to explain the explananda, and arguments based on evidence are used to support and attack these stories. In this way, the evidence is used prove or disprove different stories about the facts in a case.

Now, the formal *hybrid theory* is a combination of an evidential theory and a causal theory.

**Definition 10 [Hybrid Theory]** A *hybrid argumentative-narrative theory* is a tuple  $HT = (ET, CT)$ , where

- $ET$  is an evidential theory
- $CT$  is a causal theory such that every  $f \in F$  is the conclusion of a justified argument  $A$  in  $Args(ET)$  based on evidence.

An important part of the hybrid narrative-argumentative theory is the consideration of alternative stories. Although in principle the mere contradiction of the story proposed by the prosecution, e.g. by a solid alibi for the suspect, suffices for the preclusion of a conviction, in most cases there are alternative stories, for each of which there is some support (but not conclusively justifying) and for each of which there is some attack (but not conclusively defeating). Moreover, a serious search and consideration of alternative stories is a good tool to lessen the danger of too narrow *tunnel vision*.

In the Wamel case, a natural suspect (in addition to Francis) might be Sander. Sander was also at the barns and he could have tried to incriminate Francis because he himself has something to do with Kevin's death. Moreover, Sander gave contradictory testimonies, first stating that Francis was the killer and later saying he does not know who was the shooter; it could be that Sander could be lying because he himself is the killer, viz. [Kevin was at the barns, Sander was at the barns, Sander shot Kevin, Sander shot Kevin  $\Rightarrow_c$  Kevin died, Kevin died]. Note that this story is almost the same as  $S_1$ , only with Sander as the shooter.

In addition to the search for alternatives, the stories themselves also have to be thoroughly analysed and compared. In this analysis, it is important to look at the extent to which the alternative stories conform to the evidence as well as their coherence, the extent to which the story conform to our knowledge of the world. In the work on the hybrid theory [5][7] a number of criteria are defined that determine the quality of a particular story. These criteria are mostly defined using a combination of arguments based on evidence and stories. Two important concepts are evidential support and the evidential contradiction, that is, how evidence supports or contradicts stories via arguments.

**Definition 11 [Evidential Support]** Evidence  $\varphi \in K$  supports a story  $S \in Stories(CT)$  iff there is a justified argument  $A \in Args(ET)$  such that  $\varphi$  is a premise of  $A$  and  $\psi \in S$  is a conclusion of  $A$ .

Here, the element of the story  $\psi$  can be either an event or a causal rule.<sup>8</sup> In our example, the evidence  $e_1$ : Sander says "Francis shot Kevin" supports the story  $S_1$ , as  $e_1$  supports the event in the story Francis shot Kevin through the evidential argument. Note that evidence only supports a story through a justified argument: if the argument is defeated, the evidence does not support the explanation as the link between the evidence and the story is effectively "cut".

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<sup>8</sup> This is important, as in criminal cases this sort of evidence is often provided (e.g. a forensic report stating that "the victim's death was caused by a bullet").

Given the evidential support, we can determine what the evidential coverage of a story [22] is, namely all pieces of evidence in  $K$  that support the story. The higher this coverage, the better the story. However, for each story we must also consider falsifying evidence; a story may cover a lot of the evidence but if there is one important piece of evidence that contradicts it or if the story is contradicted on an important element we must be careful not to accept the story too readily.

**Definition 12 [Evidential Contradiction]** Evidence  $\varphi \in K$  contradicts a story  $S \in \text{Stories}(CT)$  iff there is an argument  $A \in \text{Args}(ET)$  such that  $\varphi$  is a premise of  $A$  and  $\psi, \neg$  is a conclusion of  $A$ , where  $\psi \in S$ .

So, for example, if Francis denies shooting Kevin in his testimony, this contradicts the story  $S_1$ .

Related to evidential support and contradiction is the concept of *evidential gaps*, elements of a story for which there is no evidence.

**Definition 13 [Evidential gaps]** An *evidential gap* in a story  $S$  is some  $\psi \in S$  which is not supported or contradicted by evidence  $\varphi \in K$ .

Evidential gaps are hypothesised events for which there is no direct evidence. Even without direct evidence we may still believe some fact if we consider it in conjunction with other facts. If a fact fits a coherent story that has enough evidential support (where the evidence supports other facts in the story), the circumstances detailed in the story make it more plausible that the hypothesized fact happened. This is the ‘gap-filling’ function of stories [2]: gaps in the evidence are filled with events that fit the total picture painted by the story.

Evidential gaps also play an important role in the investigative phase, as they point to new avenues of investigation. Given a basic story, we can use abduction or prediction to infer *story consequences*, events which follow from the story. In section 3.1, we already showed two examples of such story consequences, namely Francis has motive  $m$  to kill Kevin and Kevin bled heavily. Now, evidential gaps that have been inferred as story consequences are relevant as they guide the search for new evidence; after inferring that Francis should have a motive, we might want to look for evidence for such a motive. Thus, the reasoning about the facts acts out its influence on the (search for) evidence in the case (i.e. the “downward” influence in Figure 1).

Evidential support and gaps concern the connection (or lack thereof) between the story and the evidence. In a case, however, we often also have to consider the inherent *coherence* of a story, that is, whether it conforms to our expectations and knowledge of the world (see definition 6 and below in section 3.1). In previous work, the causal coherence of stories was often explicitly represented by requiring a story to be fully causally connected. The causal links could then be questioned with arguments based on general knowledge (cf. [8]) and thus the coherence of a story could be supported or contradicted (e.g. by asserting that ‘it is general knowledge that  $x$  shoots  $y \Rightarrow_c y$  dies’). In this paper, however, we use the

modelling technique of story schemes to gauge coherence, that is, a story is coherent if it completes a story scheme (definition 6).

A story's coherence plays an important part in guiding the investigative process; the police would not, for example, want to pour all its resources into pursuing a clearly implausible and incoherent hypothetical story. However, one has to be wary of the danger of preferring a “good” story (i.e. plausible) to a “true” story (i.e. supported by strong evidence): [21][33] show that in some cases, the incoherent story is actually better supported by the evidence.

Criteria like coherence, the total evidential support and the number of evidential gaps can be used to judge the quality of explanatory stories. Thus, they allow for the comparison of explanations in the overarching process of Inference to the Best Explanation. For example, [7] rank stories according to their total evidential coverage (i.e. the more evidence supports a story, the better the story). [11] have further shown how standards and burdens of proof influence the comparison of explanations. For example, the ‘beyond a reasonable doubt’ standard requires that for a story to be accepted, there is no coherent alternative available (where this coherent alternative then represents the reasonable doubt).

In addition to the ranking of stories, there are of course other factors that influence the legal decision-making process. For example, it may be a perfectly valid strategy for the defense to simply deny the prosecution's allegations without presenting a story. If the judge or jury then accepts the defense's denial and acquits, they have not performed inference to the *Best Explanation*. However, we think that in general a coherent story can provide a stronger case against the other side's story than a simple denial or an imperfect story, and that providing the best explanation is the most sound strategy available.

## 4 LEGAL REASONING IN THE EXTENDED HYBRID THEORY

The basic hybrid theory allows for both reasoning from the evidence to the facts as well as from the facts to the evidence. However, it does not include explicit legal reasoning, that is, the reasoning from the facts to the legal consequences and the influence the (desired) legal consequences may have on the various accounts of the facts. In this section, we extend our hybrid theory in order to include such legal reasoning. We introduce two new types of rules, namely legal rules and qualification rules.

One type of *legal rules* (cf. [16][26][32]) warrant the step from legally relevant operative facts to a legal conclusion. An example is the Dutch legal rule that someone can be sentenced for murder, when he has killed someone, intentionally and with premeditation:  $r_{L1}: x \text{ killed } y \wedge x \text{ intended to kill } y \wedge x \text{ killing } y \text{ was premeditated} \Rightarrow_L x \text{ murdered } y$ . Another type of legal rules, which we will call *qualification rules*, allow for the qualification of a fact under a legally relevant term. An example of such a rule is that if there are signs that the murder

weapon was prepared, then the killing was premeditated  $r_{q1}$ :  $x$  prepared the murder weapon  $\Rightarrow_Q x$  killing  $y$  was premeditated. Note that both types of legal rules are what Searle XX calls constitutive rules, rules of the form “X counts as Y in context C”. From a continental legal perspective it makes sense to distinguish qualification rules In a continental legal system, non-qualification legal rules are usually given by law (e.g. murder is rule 289 in the Dutch Criminal Code), whereas qualification rules are often based on, for example, linguistic conventions or jurisprudence, as it does not make sense for the lawgiver to explicitly enumerate all the possible ways of killing (e.g. “stabbing which causes death is killing, shooting which causes death is killing, etcetera”).

These new rules are part of a legal theory (cf. the causal, evidential and hybrid theories of definitions 2, 7 and 10), which also contains the legal story schemes. Combining these rules and legal story schemes with an existing hybrid theory provides us with all the tools necessary to reason from evidence to legal conclusions as in Figure 1.

**Definition 14 [Legal Hybrid Theory]** A *legal hybrid theory* is a tuple  $LHT = (HT, R, LSS)$ , where

- $HT$  is a hybrid theory (definition 10);
- $R = R_L \cup R_Q$  is a set of rules that contains legal rules ( $R_L$ ) and qualification rules ( $R_Q$ ) of the form  $\varphi_1, \dots, \varphi_n \Rightarrow_L \psi$  and  $\varphi_1, \dots, \varphi_n \Rightarrow_Q \psi$ , respectively;
- $LSS$  is a set of *legal story schemes*.

#### 4.1 Legal reasoning with arguments

Whereas evidential arguments are used to establish the facts of a case, the next step is to determine the legal conclusions that can be based on these facts. First, the real-world facts have to be qualified as legal facts or, in other words, the factual stories have to be interpreted as legal stories on which a conviction can be based. Here the qualification rules of a legal theory  $LT$  (specified in  $R_Q$ ) are guiding. Then these legal stories lead to a legal conclusion (on the basis of the legal rules in  $R_L$ ), which leads to the relevant legal consequences.

The argumentative reasoning with qualification and legal rules (in the form of legal arguments) is modelled along the lines of existing work on this subject ([15][16][26]). We specifically base our formal model of arguments on [25]. Legal arguments can be built by taking elements from a story  $S$  in the relevant hybrid theory and rules from  $R_L$  and  $R_Q$  as premises and chaining applications of defeasible modus ponens into tree-structured arguments.

**Definition 15 [Legal Argument]** A *legal argument* based on a story  $S$  is a finite sequence  $[\varphi_1, \dots, \varphi_n]$ , where  $n > 0$ , such that for all  $\varphi_i$  ( $1 \leq i \leq n$ ):

- $\varphi_i \in S \cup R_L \cup R_Q$ ; or
- $\varphi_i$  follows from  $\psi_1, \dots, \psi_n \in \{\varphi_1, \dots, \varphi_{i-1}\}$  by application of defeasible modus ponens.



The set of all legal arguments that can be constructed from a legal hybrid theory  $LHT$  is denoted as  $Args(LHT)$ . As an example, take the argument  $A_2$  below, which says that if one person shoots another person and this causes the victim's death, then this counts as a killing (in the legal sense as required by one of the conditions of  $r_{L1}$ ).

1. Francis shot Kevin (story  $S_1$ )
2.  $r_{c1}$ : Francis shot Kevin  $\Rightarrow_c$  Kevin died (story  $S_1$ )
3. Kevin died (story  $S_1$ )
4.  $x$  shoots  $y \wedge r_{c1} \wedge y$  dies  $\Rightarrow_Q$   $x$  killed  $y$  ( $R_Q$ )
5. Francis killed Kevin (1-4 DMP)

This argument can be extended to form an argument  $A_3$  that Francis murdered Kevin, on the basis of the rule  $r_{L1}$ .

1. Francis killed Kevin (argument  $A_2$ )
2. Francis intended to kill Kevin (argument ?)
3. Francis' killing of Kevin was premeditated (argument ?)
4.  $x$  killed  $y \wedge x$  intended to kill  $y \wedge x$  killing  $y$  was premeditated  $\Rightarrow_L$   $x$  murdered  $y$  ( $R_L$ )
5. Francis has murdered Kevin (1-4 DMP)

Note, however, that this argument requires separate arguments for premeditation (item 3 on the list) (based on, e.g., rule  $r_{q1}$ ) and for intention to kill (item 2), both of which should also be based on the same story  $S_1$ .

Like in the evidential argumentation theory, counterarguments may be given to legal arguments. One may argue, for example, that if the weapon was prepared not for killing someone but rather for a sporting activity, the preparation of the weapon does not count as premeditation; this would then undercut any inference based on the qualification rule  $r_{q1}$ .

## 4.2 Legal stories and legal story schemes

In purely argumentative approaches to legal reasoning (e.g. [26]), the operative legal facts in the case are considered as conditions of legal rules (e.g. in argument  $A_3$ ). We argue that these conditions provide a *legally coherent perspective* on a case. In this sense, they can be thought of as a legal stories, analogous to factual stories, which provide a factually coherent perspective on a case.

A *legal story scheme* is a cluster of legally qualified, generic states and events.

**Definition 16 [Legal Story Scheme]** A legal story scheme  $G_L \in LSS$  is a set of literal schemes.

In Dutch law, the definition of an offense in the criminal code can be used to extract a legal story scheme. An example of a legal story scheme is that for murder (in the legal sense):  $\{x$  killed  $y$ ,  $x$  intended to kill  $y$ ,  $x$  killing  $y$  was premeditated $\}$ . Each element of the legal story scheme is one of the conditions of the legal rule for murder  $r_{L1}$ . Note that when rules contain disjunctions as

antecedents, there will be multiple legal story schemes, each containing one or multiple of these disjuncts.

A legal story (e.g. an indictment) is then a specific instantiation of a legal story scheme.

**Definition 17 [Legal Story]** A legal story  $LS$  is a set of literals  $\{\phi_1, \dots, \phi_n\}$  such that every element  $\phi_i \in LS$  is a ground instance of some  $\psi \in G_L$ , where  $G_L$  is a legal story scheme in  $LSS$ .

So an example of a legal story is  $LS_1 = \{\text{Francis killing Kevin was premeditated, Francis intended to kill Kevin, Francis killed Kevin}\}$ , an instantiation of the legal story scheme proposed above. As discussed above, it is possible to present multiple legal stories, for example when dealing with a rule that has disjunctive premises. A similar situation is when the prosecution performs reasoning in the alternative, that is, they argue that either the accused killed the victim or, alternatively, he helped someone else kill the victim. With such reasoning the prosecution pre-emptively performs a legal shift: consider this factual and legal story first, but if that is not convincing enough consider a different interpretation of the case. We further discuss legal shifts in section 4.3.

Legal story schemes are similar to factual story schemes in that they contain general event types, the relevant operative legal facts. However, a major difference is that in the particular context of criminal law the set of legal story schemes will be finite and knowable (because they are the conditions of legal rules; cf. the legality principle in criminal law), whereas factual story schemes are part of our implicit and potentially infinite ‘stock of commonsense knowledge’. Further formal distinctions are that factual story schemes are sequences and legal story schemes are sets (legal stories usually do not need an explicit notion of chronology (sequence), whereas factual stories do), and that legal story schemes and stories do not contain causal rules (when a causal connection is an element of a legal condition, as for instance in criminally negligent manslaughter, that element will have to be made explicit as a proposition in the legal story scheme).

The idea of legally coherent perspectives on a case is not new, and other approaches to formalising legal coherence have been proposed [17][4]. Furthermore, as we showed in [6], legal story schemes are very similar to the *cases* – coherent clusters of legally relevant facts – in the AI and Law literature on case-based reasoning (e.g. [3]) and, as we discussed above, these clusters of legal facts serve as the conditions to legal rules. The reason we use the terms “legal stories and story schemes” is that this emphasizes the similarities between reasoning at the factual level and reasoning at the legal level.

Similar to factual stories, legal stories can complete legal story schemes.

**Definition 18 [Complete Legal Story]** A legal story  $S$  is *complete* w.r.t. a legal story scheme  $G$  iff every  $\phi_i \in LS$  is a ground instance of some  $\psi \in G_L$ .

Factual stories have varying degrees of coherence depending on how well they complete a story scheme: a story with a missing motive is slightly incoherent, a story with a missing motive and action and consequence in the wrong order is more incoherent, and so on. Furthermore, it is possible to make a decision (e.g. to convict) on the basis of an incomplete story as it is possible to, for example, convict for murder even if there is no clear motive.

For legal stories, it is not so much a question of a gradual scale of coherence but rather a question of whether the story meets the required conditions for application of a legal rule or not; it is not possible to make a decision on the basis of an incomplete legal story, as one cannot, for example, convict for murder if intention has not been proven. So in the decision-making stage, legal stories always have to be complete. Incomplete legal stories, however, are very well possible at various points in an investigation. For example, a legal story that contains Francis killed Kevin but no other information fits various legal story schemes (for murder, manslaughter etcetera), but does not complete any of them. The investigation may then be steered by this incomplete legal story as the investigators look for ways to prove, for example, premeditation or intention (cf. the phenomenon of legal shifts in section 4.5).

### 4.3 Connecting evidential and legal reasoning

If a valid and acceptable conclusion is to be drawn on the basis of a legal story, the individual elements of that legal story need to be proven. This, in turn, can be done by showing that there is a factual story based on the evidence that meets the standard of proof, and that this factual story qualifies as a commonsense interpretation of the legal story. In other words, the factual account of the case has to *support* the legal account of the case.

**Definition 19 [Supporting a Legal Story]** Elements  $\varphi_1, \dots, \varphi_n$  of a factual story  $S$  support an element  $\psi$  of a legal story  $LS$  iff there is a justified argument  $A \in \text{Args}(LHT)$  such that  $\varphi_1, \dots, \varphi_n$  are premises of  $A$  and  $\psi$  is a conclusion of  $A$ .

Notice that this definition is similar to definition 11 for evidential support: the evidence supports events in the factual story, and these facts in turn support the elements of the legal story. As an example, consider the subsequence [Francis shot Kevin, Francis shot Kevin  $\Rightarrow_c$  Kevin died, Kevin died] from story  $S_1$ . This part of  $S_1$  supports the element Francis killed Kevin of legal story  $LS_1$ , because there is an argument ( $A_2$ ) which has these events as its premises and Francis killed Kevin as its conclusion.

Figure 4 shows the complete reasoning from evidence to legal conclusions via facts. Notice that there are four separate levels: evidence, factual story, legal story and legal conclusion. Each of these levels depends on the level directly below it: legal conclusions are inferred from legal stories, legal stories are inferred from factual stories and factual stories are inferred from evidence.

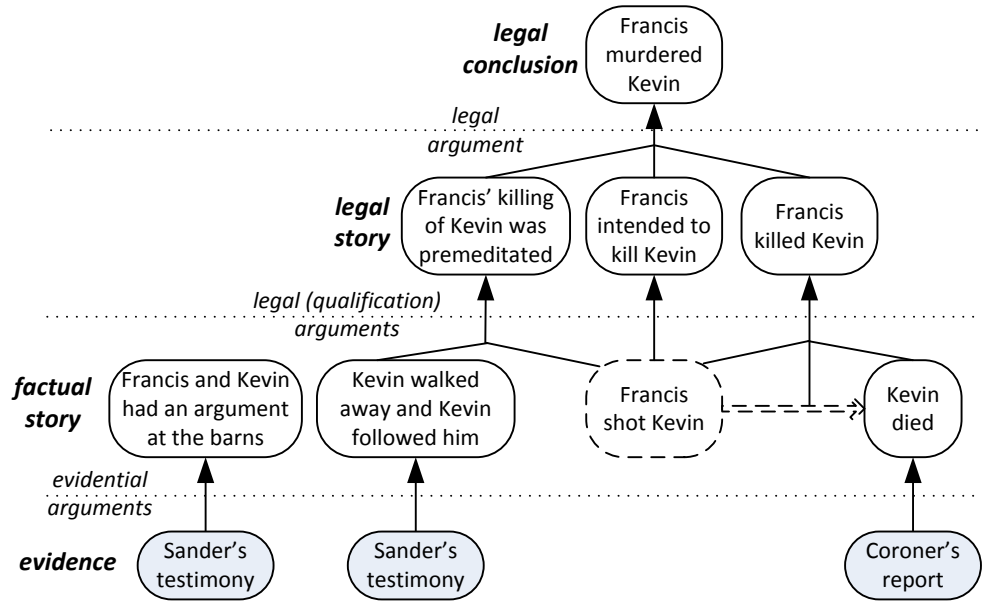


Figure 4: Reasoning from evidence to legal conclusions via stories

#### 4.3.1 Pushing down gaps

The similarity between evidential support (definition 11) and supporting a legal story (definition 19) means that there is also such a thing as *legal gaps*, elements of the legal story which are not supported by a fact from the factual story. However, whilst factual stories may have evidential gaps a legal story cannot have such gaps at the end of a successful investigative process that can lead to a conviction.

**Definition 20 [Supported Legal Story]** A legal story  $LS$  is fully supported by a factual story  $S$  iff every element  $\psi \in LS$  is supported by elements  $\phi_1, \dots, \phi_n \in S$ .

This leads to an interesting phenomenon: since gaps cannot occur at the legal level, gaps can be pushed down from the legal level to the factual level. For instance, as murder requires that one person killed another, the legal story about the Wamel case will have to contain Francis killed Kevin, as otherwise the legal conclusion ‘murder’ will not follow. This element of the legal story has to be supported by a factual concretisation of ‘killing’, as set out in argument  $A_2$ .

Notice, however, that the facts that qualify as ‘killing’ (i.e. [Francis shot Kevin, Francis shot Kevin  $\Rightarrow_c$  Kevin died, Kevin died]) do not necessarily have to be directly supported by evidence, that is, they can remain an evidential gap (rendered in Figure 4 as dotted boxes). Formally there is no legal gap, as the factual story does specify events supporting Francis killed Kevin, but materially there is no direct evidential support for Francis killed Kevin, that is, there is no chain of argumentative reasoning from the evidence to Francis killed Kevin.

This is an example of the ‘gap-filling’ effect of stories, where evidential gaps can still be believed when considered as part of a coherent story that has a lot of evidential support. In general, it is a matter of good judgment which elements of a

story must be directly supported by evidence and which can be assumed in conjunction with the other facts; it is not unusual that a murder conviction does not specify direct evidence for the killing (see [11] for examples of murder convictions in cases where there was no evidence for the killing).

Pushing down gaps to the factual level shows why it is important to connect legal reasoning and factual reasoning with stories. In a purely rule-based approach,  $\text{Francis shot Kevin and Francis shot Kevin} \Rightarrow_c \text{Kevin died}$  would have to be assumed, as they are here. However, in a story-based approach the assumption is made plausible by having it as an element in a plausible, evidentially supported story.

#### 4.3.2 *Legal shifts and legal tunnel vision*

If we compare Figure 4 to Figure 1 it becomes clear how the different levels can influence each other. The legal perspective on a case drives not only what happens in court but also what occurs in the pre-trial investigative phase. In the Wamel case, it was quite clear that the *factual* perspective was murder (in the everyday, non-legal sense of the term): when a criminal is found killed by pistol shots, the conclusion that we are dealing with a murder case is quickly made. Perhaps there is a brief consideration of the possibility of suicide, but the nature of the wounds may swiftly exclude that.

Initially the investigation will then be aimed at finding the killer. This is required by both the factual story scheme for murder and in the corresponding legal murder scheme. When a suitable suspect is found the legal perspective becomes more prominent. The aim then becomes to prove that the suspect is the killer;  $x$  killed  $y$  in the legal story scheme for murder. The factual story scheme (which can include the killer, the circumstances of the killing, the murder weapon, the motive, and perhaps several other more factually oriented elements) remains relevant, but it becomes coloured by the legal perspective that is provided by the legal story scheme. For instance, the amount of detail of circumstances that need to be proven is steered by what is needed to complete the case in the legal sense. For example, intention is in this case quite easily proven: the fact that Francis shot Kevin several times is enough to show that Francis did not intend to merely incapacitate Kevin out of self-defence. This means that the factual story does not need to be further extended in order to show intention.

The explication of the legal perspective on a case allows the modelling of a *legal shift*. If during a case it becomes clear that it is not possible to fully support the legal story that represents the current perspective with a factual story that can be accepted according to the current proof standard, other legal stories and story schemes that can be supported by the factual story will come into view. In the Wamel case, for example, no clear evidence was found that pinpointed Francis as the one who actually shot Kevin (notice in Figure 4 that Francis shot Kevin is an evidential gap). While it is sometimes possible to convict even in the absence of direct evidence for the killing (as discussed in the previous subsection), in the

Wamel case there were too many doubts regarding, among other things, Francis' motive and the reliability of Sander's testimonies. The case hence turned from a murder case (in the legal sense) into a case of accomplicity to murder, in which it is not required to prove 'who pulled the trigger'. The legal murder story {Francis killing Kevin was premeditated, Francis intended to kill Kevin, Francis killed Kevin} was replaced by an accomplicity to murder story {Kevin is killed, the killing of Kevin was intentional, the killing of Kevin was premeditated, Francis participated significantly in the killing of Kevin}. In this scheme, it is unclear who actually killed the victim. Instead the significant participation in a killing becomes the criminally relevant criterion.

The fact that after a legal shift a new factual story is needed (and hence new evidence to support this story is sufficient) is a clear example of a "downward" influence (Figure 1): what happens at the legal level influences the reasoning in the factual level. Another example of such a downward influence is when the legal level – that is, the current legal perspective – determines the coherence of the factual story. At the moment, the factual story in Figure 4 is perfectly coherent. However, say that it needs to be established how long ago the murder took place to deal with a statutory limitation for prosecution. A new element is then added to the legal story, namely the fact that the crime took place within the period of prescription (the maximum time after a crime that legal proceedings based on the crime may be initiated). In order to have a coherent factual story that supports this legal story, a new element should also be added to this factual story; for example, that the killing took place 2 months ago, which is well within the period of prescription.

It was already mentioned that Israël's has provided a careful analysis of alternative stories and their relative merits, thereby avoiding tunnel vision with respect to the facts. Our modelling of the legal perspective in a case shows that there can be a second kind of tunnel vision, namely by neglecting legal story schemes. For instance, an apparent murder case may in fact be a manslaughter case, or even one of negligent homicide. In this connection, we propose to speak of *legal tunnel vision* as opposed to *factual tunnel vision*. In factual tunnel vision, one for instance neglects the consideration of other wrongdoers than one's favourite suspect (here: only considering Francis, and not also Sander). Instead in legal tunnel vision, one focuses too much on finding proof for malice aforethought, whereas in fact it could be true that Francis wanted to frighten Kevin in order to become Uden's criminal alpha male, and in the ensuing fight accidentally shooting Kevin. Indeed such an accident might still legally count as murder, but the assumption of malice aforethought can have led to ignoring the possibility of an accident.

## 5 DISCUSSION AND RELATED RESEARCH

Our extended hybrid model is not the first formalized proposal that models the full pathway from evidence to legal consequences. A recent proposal is [32] by Walker who speaks of the rule-evidence interface, with 'rule' meaning 'legal rule'. He argues that the two sides of the rule-evidence interface have logical similarities and dissimilarities. He provides visualization techniques – akin to Wigmore charts – showing the path from evidence via proven facts to legal consequences. A similarity is that he uses tree structures for the representation of both the path from evidence to facts ('evidence evaluation'), and from facts to legal consequences ('rule-based deductions'). A difference is that evidence evaluation uses plausibility schemas and plausibility connectives, whereas rule-based deductions are modelled in terms of truth-functional connectives (with three truth values).

[2] also discuss analytic methods for reasoning with evidence in which the role of law is made explicit. They emphasise that the (potential) ultimate probandum (i.e., the legal consequence) needs to be made explicit at an early step in the process of analysing the evidence (step 2, p. 117).

In AI & Law, evidential reasoning has also been addressed to some extent. For instance, although [16] focuses on the role of legal rules, it also discusses the issue of proof (p. 105-106). In this approach, proof is based on epistemic reasons, which can derive from rules of evidence as they are recognized in some jurisdiction. In [17] the model of rules is extended to a theory of qualitative, reason-based comparison of alternatives. In light of this theory, the connection with evidence and proof, and how different accounts of the facts can be compared on the basis of how well they fit the evidence is also discussed. The coherence theory associated with this model is developed in [18] making connections with legal theory (e.g., [1]).

[26] have extensively modeled the legal part of the pathway and they focus on the formal modeling of the assessment and resolution of conflicting arguments as they occur in the law. While evidential reasoning plays a less important role, it is shown how argumentation concerning the admissibility of evidence in a case with forged evidence can be formalized (p. 342). This is one example of a “downward” influence (i.e. legal restrictions on evidence), not discussed in this paper. However, given that our legal theory *LT* is directly based on [25]’s extended version of [26], we think that the admissibility example can be rendered in our hybrid framework.

The above related research is all mainly argumentative in style, as opposed to our hybrid proposal in which also the role of holistic, coherent narratives is made explicit. As is already extensively argued in [5], a hybrid theory in which arguments are combined with stories is best for reasoning about the evidence and the facts. In our opinion, including stories and (legal) story schemes also improves the model for legal reasoning. One case in point is the way in which legal gaps

may be filled using facts which are themselves evidential gaps. Purely argumentative approaches, which do not have stories in the factual, middle layer, have no tools for filling such evidential gaps, that is, they miss the gap-filling function stories fulfil. In such argumentative approaches, the line of reasoning would go from the evidence all the way up to the operative legal facts (conditions of legal rules) and as a result of this, any legal fact that is not supported by evidence cannot be considered proven on the basis of the evidence.

Other relevant research which models the full pathway is the more narrative-oriented work by [22]. They show how coherent (factual) stories that explain the evidence can be matched to “verdict categories”, which are essentially legal story schemes. The ideas provided in this work have been a great influence on the hybrid theory (also indirectly via [33]). A major difference though is that the authors of [22] approach evidential and legal reasoning from a psychological, descriptive stance whilst we also claim to have more normative aims (in [9], for example, we propose a list of pitfalls one should avoid when drafting a rational and intelligible verdict in a case). Furthermore, [22] does not fully formally specify the connection between the evidence, the facts and the law.

In our extended hybrid theory of inference to the best legal explanation, we reason at different layers of abstraction: a factual story is essentially the same as a legal story, but abstracts from the legal qualifications. One influential way of IBE with different layers is [12]’s abductive model, which models a hierarchy of causal networks. The causal networks in different layers are connected to each other using abstraction axioms (e.g. “swine flu is a type of influenza”). High-level concepts are then abductively explained by concepts lower in the hierarchy through abstraction axioms (e.g. if we observe *influenza* this can be *swine flu* or *bird flu*). These lower-level concepts can then be abductively explained through the usual causal rules. In theory, one could model the legal consequences as explananda at the highest level of abstraction and abductively infer the facts. For example, if we take the explanandum Francis killed Kevin, we can abductively infer the facts Francis shot Kevin, Francis shot Kevin  $\Rightarrow_c$  Kevin died, Kevin died using  $r_{q1}$ . Thus, we could have a mainly story-based, causal-abductive theory of legal reasoning.

Both [12] and [22] provide a story-based perspective on (evidential and legal) reasoning. Again, in [5] it was already argued why a hybrid theory which incorporates arguments is preferred to such purely narrative approaches. Briefly, the argumentative machinery (e.g. arguments and counterarguments, argumentation schemes and critical questions) provide a natural model of aspects of both evidential and legal reasoning.

## 6 CONCLUSION AND SUMMARY

In the previous sections, we have extended our hybrid narrative-argumentative approach to evidential reasoning in order to be able to address reasoning towards



the legal consequences that can be attached to a case. Whereas before the hybrid theory was limited to evidential reasoning and stopped at the facts, we now can complete a line of legal reasoning up until the legal decision. We have introduced the notion of a legal story scheme, thereby allowing the explication of the legal perspective taken in a case analysis (formalized as an extended hybrid theory). The legal perspective is relevant in a case analysis as it steers the investigative and decision-making process. In fact, there is a legal analogue of the familiar factual tunnel vision that we dubbed *legal tunnel vision*: when one too strongly focuses on the evidential needs to complete a case in terms of one kind of legal perspective, better alternatives may be pushed out.

Our proposal can be summarized as follows.

1. In our approach, the hybrid narrative-argumentative style of modeling is used for the full pathway of reasoning from evidence via facts to legal consequences. As a result, we use our hybrid approach for a unifying view on both evidential and legal reasoning.
2. Our use of story schemes at the factual as well as the legal level allows for the explicit and natural modeling of a coherent, holistic perspective on a case, as it underlies an investigative and decision making process.
3. At the factual level, story schemes show evidential gaps, emphasising where to strengthen investigative efforts, and point to alternatives, thereby preventing tunnel vision. Factual shifts occur when the perspective on the facts (in the form of a favorite factual story scheme) is changed, by adding and/or removing story schemes that steer the evidence marshaling process.
4. At the legal level, something similar occurs. A legal story scheme provides a holistic perspective that steers the process of reasoning towards legal consequences. The risk of what we have called *legal tunnel vision* can be reduced by the consideration of alternative legal story schemes. Legal shifts can be modeled in the form of the addition or removal of a legal story scheme.
5. But at the legal level, there is no analogue of evidential gaps: every element of a legal story needs to be covered to allow for a successful conviction. This corresponds to the fact that every condition of a criminal legal rule needs to be satisfied in order for the legal consequence to follow (cf. the legality principle that is dominant in criminal law).
6. In our approach, it is made explicit that legal gaps can be pushed down to the factual level. Every legal element that is required to complete a legal story is matched to an element in the factual story. Whether all elements of the factual story are considered to be proven, allowing the possibility of an evidential gap, is then determined at the evidential level.

An issue with our hybrid narrative-argumentative approach is that in its present form we do not provide a deep connection between stories and arguments whereas there seems to be one. For instance, one reasonable story provides a

counterargument to another. In our earlier work, we have suggested that arguments and stories are a kind of ‘communicating vessels’: a change in an argumentative analysis implies a change in an narrative analysis, and vice versa (cf., e.g., [9]). In the present setting of legal story schemes, there is the related issue how the legal conditions of a valid rule are connected to a legal story scheme. One perspective (underlying this paper) is that the legal conditions provide the atomistic building blocks for a legal story scheme. As a result of the holistic character of legal story schemes, they can be used to establish the legal coherence of a case analysis.

## REFERENCES

- [1] Alexy, R., and Peczenik, A. 1990. The Concept of Coherence and Its Significance for Discursive Rationality. *Ratio Juris* 3: 1, 130-147.
- [2] Anderson, T.J., Schum, D.A., and Twining, W.L. 2005. *Analysis of Evidence*, 2nd edition. Cambridge University Press, Cambridge.
- [3] Ashley, K.D. 1990. *Modeling Legal Argument*. MIT Press, Cambridge, MA.
- [4] Bench-Capon, T. and Sartor, G. 2001. A Quantitative Approach to Theory Coherence. In B. Verheij, A.R. Lodder, R.P. Loui, A. Muntjewerff (Eds.), *JURIX 2001: The 14th annual conference*, 53–62. IOS Press, Amsterdam.
- [5] Bex, F.J. 2011. *Arguments, Stories and Criminal Evidence: A Formal Hybrid Theory*. Springer, Dordrecht.
- [6] F.J. Bex, T. Bench-Capon & B. Verheij. 2011. What Makes a Story Plausible? The Need for Precedents. *Legal Knowledge and Information Systems. JURIX 2011: The Twenty Fourth Annual Conference. Frontiers in Artificial Intelligence and Applications* 235.
- [7] Bex, F.J., van Koppen, P.J., Prakken, H., and Verheij, B. 2010. A Hybrid Formal Theory of Arguments, Stories and Criminal Evidence. *Artificial Intelligence and Law* 18:2, 123–152.
- [8] Bex, F.J., Prakken, H., Reed, C., and Walton, D.N. 2003. Towards a formal account of reasoning about evidence: argumentation schemes and generalisations. *Artificial Intelligence and Law* 11, 125–165.
- [9] Bex, F.J. and Verheij, B. 2011. Solving a Murder Case by Asking Critical Questions: An Approach to Fact-Finding in Terms of Argumentation and Story Schemes. *Argumentation*, to appear.
- [10] Bex, F.J., and Verheij, B. (2011). Legal Shifts in the Process of Proof. *The 13th International Conference on Artificial Intelligence and Law (ICAIL 2011). Proceedings of the Conference*, 11-20. New York (New York): ACM.
- [11] Bex, F.J. and Walton, D. 2011. Burdens and Standards of Proof for Inference to the Best Explanation: Three Case Studies. *Law, Probability and Risk*, to appear.
- [12] Console, L., and Dupré, D.T. 1994. Abductive reasoning with abstraction axioms. *Lecture Notes In Computer Science* 810, 98–112.
- [13] Console, L. and Torasso, P. 1991. A spectrum of logical definitions of model-based diagnosis. *Computational Intelligence* 7: 133–141.
- [14] Dung, P.M. 1995. On the acceptability of arguments and its fundamental role in nonmonotonic reasoning, logic programming, and n-person games. *Artificial Intelligence* 77, 321–357.
- [15] Gordon, T.F. 1987. Some Problems with Prolog as a Knowledge Representation Language for Legal Expert Systems. In C. Arnold (Ed.), *Yearbook of Law, Computers and Technology*, 52–67. Leicester Polytechnic Press, Leicester.
- [16] Hage, J.C. 1997. *Reasoning with Rules. An Essay on Legal Reasoning and Its Underlying Logic*. Kluwer, Dordrecht.
- [17] Hage, J.C. 2001. Formalising Legal Coherence. *Proceedings of the 8th International Conference on Artificial Intelligence and Law*, 22–31. ACM, New York.

- [18] Hage, J.c. 2004. Law and Coherence. *Ratio Juris* 17: 1, 87-105.
- [19] Israël, H. 2006. *Moord in Wamel (Murder in Wamel)*. Boom Juridische Uitgevers, The Hague.
- [20] Keppens J. and Schäfer B. 2006. Knowledge based crime scenario modelling. *Expert Systems and Applications* 30, 203-222.
- [21] McCarty, L.T. 1997. Some Arguments About Legal Arguments. *The 6th International Conference on Artificial Intelligence and Law*, 215–224. ACM, New York.
- [22] Pennington, N., and Hastie, R. 1993. Reasoning in explanation-based decision making. *Cognition* 49:1–2, 123–163.
- [23] Pollock, J. L. 1995. *Cognitive Carpentry: A Blueprint for How to Build a Person*. MIT Press, Cambridge.
- [24] Poole, D. 1998. Learning, Bayesian probability, graphical models, and abduction. In *Abduction and Induction: essays on their relation and integration*, eds., P. Flach and A. Kakas, Kluwer.
- [25] Prakken, H. 2010. An abstract framework for argumentation with structured arguments. *Argument and Computation* 1, 93–124.
- [26] Prakken, H. and Sartor, G. 1996. A Dialectical Model of Assessing Conflicting Arguments in Legal Reasoning. *Artificial Intelligence and Law* 4: 331–368.
- [27] Rawls, J. 1951. Outline of a Decision Procedure for Ethics. *Philosophical Review* 60:2, 177–197.
- [28] Schank, R.C. 1986. *Explanations Patterns: Understanding Mechanically and Creatively*. Lawrence Erlbaum, New Jersey.
- [29] Searle, J.R. 1969. *Speech Acts: An Essay in the Philosophy of Language*. Cambridge University Press.
- [30] Thagard, P. 2004. Causal Inference in Legal Decision Making: Explanatory Coherence vs. Bayesian Networks. *Applied Artificial Intelligence* 18:3, 231–249.
- [31] Verheij, B. 2005. *Virtual Arguments. On the Design of Argument Assistants for Lawyers and Other Arguers*. T.M.C. Asser Press, The Hague.
- [32] Walker, V.R. 2007. A Default-Logic Paradigm for Legal Fact-Finding, *Jurimetrics* 47:193-243.
- [33] Wagenaar, W.A., Koppen, P.J. van, and Crombag, H.F.M. 1993. *Anchored Narratives: The Psychology of Criminal Evidence*. St. Martin's Press, New York.
- [34] Walton, D.N., Reed, C.A. and Macagno, F. 2008. *Argumentation Schemes*. Cambridge University Press, Cambridge.
- [35] Walton, D.N., 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(2):1–47.