Floris J. Bex

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Arguments, Stories and Criminal Evidence

A Formal Hybrid Theory

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A Formal Hybrid Theory

by

Floris J. Bex

University of Dundee, UK

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Preface

This book is based on my 2009 Doctoral dissertation "Evidence for a Good Story – A Hybrid Theory of Arguments, Stories and Criminal Evidence". This dissertation was written while working on the project *Making Sense of Evidence*, in which a theoretically sound sense-making and visualization tool for Dutch police analysts has been developed. During the project I worked at the Centre for Law and ICT at the University of Groningen. I am grateful to my supervisors Henry Prakken, Bart Verheij and Peter van Koppen. I owe much to the knowledge and advice they have shared with me over the years. I also thank John-Jules Meyer, Arend Soeteman and William Twining for taking the time to read, assess and comment on my dissertation. Furthermore, I thank Susan van den Braak, Gerard Vreeswijk and Herre van Oostendorp, who worked on the project at the University of Utrecht and who have provided important feedback by implementing and testing the sense-making system AVERS.

I thank everyone who, over the years, has shown an interest in and commented on my work. The argumentation, evidence and the AI and Law communities I thank for the interesting and fruitful conferences and discussions. In particular, I would like to mention Katie Atkinson, Trevor Bench-Capon, Tom van Engers, Tom Gordon, Jeroen Keppens, Chris Reed, Burkhard Schafer and Douglas Walton.

Dundee, UK
July 2010

Floris J. Bex

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Contents

1 Introduction 1
1.1 Rational Theories of the Process of Proof 1
1.2 Making Sense of Evidence 4
1.3 Reasoning with Evidence in Artificial Intelligence and Law 5
1.4 Research Goals 7
1.5 Book Outline 9

2 Reasoning with Criminal Evidence 11
2.1 Facts, Evidence and General Knowledge 11
2.1.1 Facta Probanda and Facta Explananda 12
2.1.2 Evidence 13
2.1.3 General Knowledge and Generalizations 17
2.2 The Process of Proof: Discovery, Pursuit and Justification 20
2.2.1 Investigation, Trial and the Process of Proof 23
2.3 Reasoning in the Process of Proof 24
2.3.1 Abductive Reasoning and Inference to the Best Explanation 25
2.3.2 Causal Reasoning with Evidence 27
2.3.3 Reasoning About Motives and Actions 29

3 Two Approaches to Reasoning with Evidence: Arguments and Stories 33
3.1 Evidential Arguments 34
3.1.1 The Structure of Evidential Arguments 36
3.1.2 The Dialectical Nature of Argumentation: Attack and Defeat 41
3.1.3 Generalizations and General Knowledge in Evidential Reasoning 46
3.1.4 Summary and Evaluation 53
3.2 Stories 57
3.2.1 The Causal Structure of Stories 59
3.2.2 Episodic Structures and Story Schemes 63
3.2.3 Explaining the Evidence 69
3.2.4 Choosing the Best Explanatory Story for the Evidence . . . 73
3.2.5 Summary and Evaluation 77

4 A Hybrid Theory of Stories and Arguments 83
4.1 Combining Stories and Arguments 85
4.2 Evidential Support, Contradiction and Gaps 87
4.3 Story Coherence in the Hybrid Approach 89
4.3.1 The Plausibility and Consistency of a Story 90
4.3.2 The Completeness of a Story 92
4.4 Assessing and Comparing Stories 93
4.4.1 Comparing Stories 95
4.4.2 A Game for Inquiry Dialogue 98
4.5 Evaluation 100

5 A Formal Logical Hybrid Theory of Argumentation and Explanation 101
5.1 A Defeasible Logic 102
5.2 A Formal Theory for Argumentation 109
5.2.1 A Defeasible Logic for Evidential Arguments 109
5.2.2 Evidential Arguments 113
5.2.3 Attacking Arguments 116
5.2.4 Defeat and the Status of Arguments 118
5.3 A Formal Theory for Explanatory Stories 120
5.3.1 A Causal Theory for Explanations 120
5.3.2 Causal Stories 121
5.3.3 Stories as Explanations 123
5.3.4 Story Schemes 128
5.4 A Hybrid Theory of Argumentation and Explanation 132
5.4.1 Supporting and Contradicting Stories 133
5.4.2 The Coherence of Stories: Plausibility and Implausibility . 136
5.4.3 The Coherence of Stories: Story Schemes and Completeness 138
5.4.4 Assessing and Comparing Stories 140
5.5 Dialogues About Proof 141
5.5.1 Framework for a Formal Dialogue Game 142
5.5.2 Players, Language and Moves 143
5.5.3 The Hybrid Theory in a Dialogue 145
5.5.4 Commitments 146
5.5.5 Comparing Explanations 147
5.5.6 Current Winner and Turntaking 149
5.5.7 The Protocol 151
5.6 An Example of the Dialogue Game 154
5.7 Evaluation 160

6 Case Study: Murder in Anjum 163
6.1 The Murder of Leo de Jager 164
6.1.1 Before the 24th: The Cannabis-Growing Operation and Bank Fraud 166
6.1.2 The Evidence in the Investigation into Leo's Death 167

6.2 An Analysis of the Case: Constructing Stories and Arguments . . . 176
6.3 Cause of Death, Murder Weapon and Leo's State . . . 178
6.3.1 The Murder Weapon . . . 179
6.3.2 The Location Where Leo Died . . . 186
6.3.3 Leo's Drugged State . . . 188
6.3.4 Summary . . . 189
6.3.5 Initial Evaluation . . . 190
6.4 The Judiciary's View: Marjan Drugged and Killed Leo . . . 193
6.4.1 Marjan's Motives for Drugging Leo . . . 195
6.4.2 Marjan's Motives for Leo's Death . . . 200
6.4.3 Leo's Death and the Events Afterwards . . . 205
6.4.4 Summary of the Improved Judiciary's Story . . . 213
6.5 Alternatives to the Judiciary's Story . . . 215
6.5.1 Leo Took the Temazepam Himself . . . 215
6.5.2 Beekman As the Killer . . . 219
6.6 Comparing the Alternatives . . . 224
6.7 Evaluation . . . 225

7 Related Research on Reasoning with Criminal Evidence . . . 229
7.1 Reasoning with Stories . . . 230
7.1.1 Bennett and Feldman and Pennington and Hastie . . . 230
7.1.2 The Anchored Narratives Theory . . . 234
7.1.3 Evaluation . . . 238
7.2 Wigmore and the New Evidence Theorists . . . 240
7.2.1 Wigmore and the Science of Judicial Proof . . . 240
7.2.2 Modified Wigmorean Analysis . . . 244
7.2.3 Evaluation . . . 248
7.3 Theoretical Models of Inference to the Best Explanation . . . 250
7.3.1 Thagard's Explanatory Coherence . . . 250
7.3.2 Josephson's Logical Model of Abduction . . . 251
7.3.3 Evaluation . . . 252
7.4 Keppens and Colleagues' Decision Support System for Police Investigation . . . 254
7.4.1 Evaluation . . . 255
7.5 Probabilistic Reasoning and Bayesian Belief Networks . . . 256
7.5.1 Kadane and Schum's Analysis of the Sacco and Vanzetti Case . . . 257
7.5.2 Bayesian Belief Networks and Sensitivity Analysis . . . 259
7.5.3 Evaluation of Bayesian Approaches . . . 262

8 Conclusions . . . 265
8.1 Summary . . . 265

8.2 Results 269
8.2.1 Reasoning with Criminal Evidence 269
8.2.2 Formal Theories of Defeasible Reasoning 272
8.3 Suggested Topics for Further Research 274

References 277

Name Index 285

Subject Index 289

Chapter 1
Introduction

The subject of this book is reasoning with evidence to establish the facts in criminal cases. In a legal context, the study of evidence is often equated with the study of the *law of evidence*, for example, the legal rules of evidence that govern which types of evidence are legally valid or admissible.[1] However, a large part of the study of evidence, and particularly reasoning with evidence, constitutes the study of the *rational process of proof*. This process involves reasoning with observed evidence and commonsense knowledge of the world around us in order to establish whether something is or was the case, that is, to establish the facts of the case. The rational process of proof and the reasoning employed in this process is the central theme of this book.

1.1 Rational Theories of the Process of Proof

The distinction between the study of evidence law and the study of the process of proof was made in the beginning of the twentieth century by Wigmore, as follows: "The study of the principles of evidence [...] falls into two distinct parts. One is Proof in the general sense – the part concerned with the ratiocinative process of contentious persuasion – [...]. The other part is Admissibility– the procedural rules devised by the law" (Wigmore, 1931, p. 3). In the process of proof, the reasoning takes the form not of legal reasoning, but rather of commonsense reasoning: viz. "the counsel sets himself the task [...] of persuading the jury that they should or should not believe the fact [...]. To do this, he must reason naturally, as all men reason [...]" (Wigmore, 1931, § 1–2). Wigmore argued for the development of a "science of judicial proof". This science of proof should formulate rational principles for reasoning with evidence and proof independent of the rules of law. He himself set out to develop such a rational theory which could be used for structuring and analysing arguments based on a mass of evidence.

[1] Examples of rules about the legal validity or admissibility of evidence can be found in the Dutch Code of Criminal Procedure (DCCP) and the American Federal Rules of Evidence (FRE), respectively.

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Twining also distinguishes between legal and rational, commonsense features of the study of evidence in his discussion of the Rationalist Tradition of Evidence Scholarship.[2] The fundamental principle of the Rationalist Tradition, which according to Twining has served as the basis for most of the Anglo-American research on judicial evidence of the last 250 years, is that the main objective of procedural law is to correctly apply the law to facts which are considered to be proven and that these facts should be proven by rational means. The assumptions that underlie the Tradition can be expressed in two models: a rationalist model of adjudication and a model containing assumptions for a rationalist theory of proof. This second model assumes that knowledge about particular past states and events in the world is possible and that it is necessary to rationally reason with the evidence in order to establish whether or not our belief in the truth of such events is justified.

It is this rational and commonsense "pursuit of truth" that is the main interest of this book and the assumptions contained in the rationalist model of proof are also at the basis of the current work. More specifically, the current view on rationality can be characterized as *bounded procedural rationality* (Rescher, 1977; Simon, 1982): a belief or decision is rational if it is in agreement with the knowledge that has actually been considered (or should have been considered) in a proper procedure. This rationality is bounded because humans are limited by cognitive and practical constrains in their consideration of knowledge; it is procedural because the rationality of a belief depends on the quality of the process that has been used to obtain the belief. Note that the rational process of proof is by no means exclusive to a legal setting. In science but also in our everyday lives we continually use and reason with evidence in order to infer conclusions; Schum speaks of "the context in which evidence arises", for example scientific, medical or legal evidence (Schum, 1994, p. 1).

After Wigmore, the interest in a rational theory of proof decreased. Most legal theorists continued their research which focused more on the model of adjudication rather than on factual inference. However, in the past 30 years, a movement that has become known as the "New Evidence Scholarship"[3] has become an important force in research on evidence. New Evidence Scholarship, which is firmly based on the Rationalist Tradition, includes researchers who have the same interests, namely factual evidence and reasoning with this evidence in a legal context. Subjects are, among others, the logic of inferences about facts and how to use formal probabilistic methods in evaluating evidence. New Evidence Theorists such as Anderson, Schum, Tillersand Twining explicitly build on Wigmore's ideas in their development of *Modified Wigmorean Analysis*.[4] Central in this analysis is the reasoning from the

[2]Most of Twining's work on evidence includes a section on the Rationalist Tradition. For an overview see (Anderson et al., 2005, pp. 78–86) and for a more extensive account see Twining (1994, Chapter 3) and (2006, Chapter 3).

[3]The term was coined by Richard Lempert (1986)

[4]This term was to my knowledge first used by Twining (2007). The research on Modified Wigmorean Analysis encompasses a large amount of interesting material on a multitude of different subjects. The "locus classicus" would be Wigmore's (1931) work. Important new work in

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evidence to the propositions that have to be proven and the use of detailed graphs to logically structure and analyse this reasoning from evidence to conclusions. The authors argue that this type of analysis can be useful in both the investigative and the decision-making phase, as subjecting the evidence and reasoning in a case to a thorough Wigmorean analysis allows one to identify sources of doubt. Thus possible miscarriages of justice – an example is the famous Sacco and Vanzetti case – as well as mistakes in criminal investigation – Anderson and colleagues mention that the mistakes made by the intelligence services surrounding the 9/11 events – can perhaps be prevented.

In contrast to the New Evidence Theorists in the Anglo-American law community, the Dutch legal community does not have a long and broad tradition of research into the rational and non-legal aspects of proof.[5] However, in the past decades, interest in the psychological background of reasoning with evidence has grown. This growing interest is partly prompted by a number of (perceived or possible) miscarriages of justice which have not been caused by wrongly interpreting or applying the law, but rather by mistakes of a psychological nature. For example, in some cases the police investigation suffered because of the well-known effect of confirmation bias: a tendency to search for and interpret evidence in a way that conforms to one's prior beliefs (e.g. a suspect's guilt), while dismissing evidence that might point to other hypotheses (e.g. the suspect's innocence).

In 1993, the legal psychologists Crombag, van Koppen and Wagenaar published an influential book entitled *Dubieuze Zaken – de psychologie van strafrechtelijk bewijs* (Dubious Cases – the psychology of criminal evidence). In this book, they discuss by means of example cases a number of possible mistakes people make when reasoning with evidence and proof.[6] They also provide a rational and normative theory of reasoning with criminal evidence. This theory takes as its basis earlier empirical research and theories by Bennett and Feldman (1981) and Pennington and Hastie (1986, 1992, 1993b), where it is claimed that investigators and jurors use stories about "what happened" in a case to organize and analyse the available evidence. In order to sidestep the problem of believing a "good story" above a "true story", Crombag, van Koppen and Wagenaar's Anchored Narratives Theory postulates that stories should be anchored in commonsense knowledge of the world around us.

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this school of thought is the *Analysis of Evidence*, authored by Anderson, Twining and Schum (2005). This book, which I have used extensively in the development of my own ideas, contains information on a wide variety of subjects regarding reasoning with evidence and proof. Other seminal work in the tradition of the New Evidence Theory is contained in *Rethinking Evidence* (Twining, 2006). Finally, Peter Tiller's website (Tillers, 2006) can also be used as an invaluable source on (the law of) evidence in the tradition of the New Evidence Theory.

[5] Nijboer (2000, p. 28), however, argues that investigation and proof in criminal cases can be characterized as "special forms of empirical investigation and proof" and that Dutch jurists largely agree with a rationalist notion of knowledge.

[6] An English adaptation was publishedas (Wagenaaretal.,1993). Other work which stands in the same tradition is Wagenaar and Crombag (2005) and De Poot et al. (2004), in which the Anchored Narratives Theory is applied to police investigation.

1.2 Making Sense of Evidence

The above-mentioned theories on reasoning with evidence and proof almost all have a descriptive as well as a normative side: on the one hand, the theories try to model the patterns of reasoning that are employed in the process of proof and on the other hand, the theories try to indicate the shortcomings of people and mistakes that are made when reasoning with masses of evidence and propose ways in which these mistakes can be avoided. In a way, theories for reasoning with evidence specify how we can and should *make sense of evidence*. In other words, given a mass of evidence how can we best structure and represent the evidence?

In any (larger) case it is highly important that the lines of reasoning and the evidence, hypotheses and background knowledge used in the reasoning are made explicit. In this way, sources of doubt in the reasoning can be identified and reasoned about. Furthermore, explicitly identifying and structuring all hypotheses lessens the danger of so-called *tunnel vision*, where the most likely scenario is taken as the leading hypothesis and alternatives are insufficiently considered.

Various tools, such as tables, stories or visualisation aids can be used in the sense-making process. For example, Anderson and colleagues (2005) argue that charting the reasoning from evidence to conclusions is necessary in order to expose sources of doubt in the reasoning. Wagenaar and colleagues (1993) and Pardo and Allen (2007) argue that stories are a natural tool humans should use when talking about a mass of evidence and Heuer's (1999) procedure for analysing hypotheses contains a step in which the various alternatives are ordered in a matrix. A relatively new development concerning sense-making and (criminal) evidence is the emergence of computer-based support tools for investigators and decision makers. Such a support tool is a computer program that allows for the electronic management of evidence and scenarios in a case.[7] Through a combination of spreadsheets and (timeline) visualization functions, these tools allow the user to give an overview of the evidence and scenarios in a case and link the evidence to specific persons or places.

Making sense of evidence using the various tools is important in all stages of the process of proof. In the investigative phase, the amount of evidence and hypotheses can quickly grow and various representations of the hypotheses and evidence serve as reminders and facilitate the communication between the investigators. Thus, in the investigative phase the sense-making tools are used for the general purpose of keeping track of all the incoming information and the reasoning associated with this information. In the decision-making phase, sense-making is oriented towards a specific goal. For example, Anderson and colleagues argue lawyers can use visualisation techniques to identify weaknesses in their own arguments and in arguments from the opposing party. In an adversarial system, this allows a party to strengthen his own case by anticipating counterarguments and weaken the opponent's case by

[7]Examples are CaseMap (http://www.casesoft.com/casemap/casemap.asp; accessed on 26 July 2010) and Analyst's Notebook (http://www.i2.co.uk/Products/Analysts_Notebook/default.asp; accessed on 26 July 2010).

attacking them at their weakest point. Nijboer and Sennef (1999) argue that the justification for a decision that judges give in the Dutch inquisitorial system should not only be aimed at allowing higher authorities to check and control the decision on its legal merits but also make the decision about the facts of the case and its justification understandable to the general public.[8]

1.3 Reasoning with Evidence in Artificial Intelligence and Law

Whilst the general view on rational reasoning with evidence as described above stems mainly from legal theory and legal psychology, the basis of this book is firmly in the field of *Artificial Intelligence and Law*. Artificial Intelligence (AI) is a multidisciplinary field which combines insights from diverse disciplines such as cognitive psychology, computer science and philosophy. Because of this multidisciplinary background, logical models of knowledge and reasoning in AI are constructed with differing aims in mind. For example, a model of reasoning may be intended as a cognitive model that describes actual human reasoning, as a computational model that forms the basis of programs for automated reasoning or as a theoretical model that conceptually analyzes knowledge and reasoning.[9] For a computational model the advantage of a logical model is that such a model can be more readily understood by a computer than models expressed in, for example, natural language.[10] In descriptive cognitive or theoretical models, a formal logic adds a level of detail and specificity that can take away ambiguities and thus allow for the detection of omissions, errors and inconsistencies.

In the field of AI and Law, insights from general AI are applied to topics which are typically studied in law and legal theory; the reasoning that is formally modelled in AI and Law hence concerns legal reasoning. For example, Loui and Norman (1995), Prakken and Sartor (1996) and Verheij, Hage and van den Herik (1998) model legal rules in a formal logic and Ashley (1991) provides formal models of legal cases. Most of the formal research in AI and Law focuses on reasoning with legal rules and cases. However, in the past decade the interest in formal theories of reasoning with evidence and crime scenarios has also emerged. For example, Verheij (2000) compares the Anchored Narratives Theory to formal logics for argumentation and Bex, Prakken, Reed and Walton (2003) have modelled Wigmore charts using a formal argumentation logic. Keppens and colleagues (e.g. Keppens and Schafer, 2006) provide a logical model-based approach to reasoning with crime scenarios. There are also formal approaches to modelling reasoning with evidence which do not use a symbolic logic but rather a quantitative approach. Thagard (2004,

[8]The increased public nature of decisions in the Netherlands (cf. van Lent, 2008) forces judges to explain their decisions more thourougly and intelligibly.

[9]These three aims are adapted from Verheij's (1996) discussion of the aims of formally modelling argumentation.

[10]See Prakken (1997, Chapter 1) for a brief discussion of the role of logic in AI.

2005) models stories and evidence in connectionist "coherence networks" and statistically inspired Bayesian Network theories of reasoning with Wigmore charts have, for example, been studied by Kadane and Schum (1996), Levitt and Laskey (2000) and Hepler and colleagues (2007).

Within AI and Law, formal models of legal reasoning or reasoning with evidence might serve any of the above-mentioned aims of logical models in AI. For example, Prakken (1997) notes that a concern of AI and Law research is to provide formal rational theories that act as foundations for computer programs. An example is Thagard's theory of explanatory coherence, which has been implemented as a system for automated reasoning called ECHO (Thagard, 1989). Hage (1996) argues for a theoretical logical model of legal reasoning when he says that logic can be an intermediary between on the one had a jurisprudential account of legal reasoning and on the other hand a computational account of legal reasoning. Such a logic abstracts from the characteristics of a specific legal system and also does not aim to give a model that is necessarily computationally feasible. Verheij's (2000) interpretation of the Anchored Narratives Theory and Bex and colleagues' (2003) treatment of Wigmore charts fall in this category.

In addition to computer systems that reason automatically, such as classic knowledge-based expert systems, the interest in *sense-making systems* has recently also grown in AI (and Law). Sense-making systems do not contain a knowledge base and do not reason automatically, but instead help the user make sense out of a certain problem by allowing the user to logically structure his knowledge. One development in this respect is the emergence of argument visualization tools.[11] Based on ideas from critical thinking and argumentation theory these tools allow the user to structure and visualize the reasoning employed in a case according to some specific underlying logical theory of reasoning.[12] This underlying theory serves multiple aims. One aim is to enforce a standard of rationality by requiring that the user's reasoning stays within the logical system. Another use of an underlying theory is that the sense-making tool can perform some computations; for example, showing the user which arguments can be accepted and which should be rejected according to the current assumptions.

A logical theory underlying a sense-making system should essentially find a middle ground between the three aims of logical models (i.e. conceptual, cognitive and computational). In order to provide a standard of rationality, a theoretical model should precisely define the various core concepts that apply to the particular mode of reasoning. Because of the aim of sense-making, however, the model should also fit with cognitive models of reasoning so as to ensure that it employs concepts that

[11] Examples are Araucaria (http://araucaria.computing.dundee.ac.uk; accessed on 26 July 2010) and Rationale (http://rationale.austhink.com; accessed on 26 July 2010). See (Verheij, 2005b; van den Braak, 2010, pp. 35–45) for overviews.

[12] In some tools, like Rationale, the underlying logic is basic and largely implicit (cf. van Gelder, 2007) whereas other tools, like Argumed, essentially allow the user to build arguments using an explicit argumentation logic (cf. Verheij, 1999).

are natural to an everyday user, which cannot be expected to have in-depth knowledge of formal models of reasoning. Finally, the model should have a computational side so that the tool can help the user by performing computations.

1.4 Research Goals

Section 1.1 discusses the idea of rational theories of criminal evidence. In the research on such theories, essentially two trends can be distinguished. The research by the New Evidence Theorists such as Anderson, Schum, Tillers and Twining largely focuses on the use of detailed Wigmorean argument charts to structure and analyse a mass of evidence and to expose sources of doubt in the reasoning.[13] In contrast, Crombag, van Koppen and Wagenaar's Anchored Narratives Theory uses stories to organize and analyse available evidence. The two methods share many ideas and the central concepts of argument and story play an (often implicit) role in both methods. The New Evidence Theorists's Modified Wigmorean Analysis is complemented by outlines, chronologies and stories. For example, the *Analysis of Evidence* (Chapters 6 and 10) and *Rethinking Evidence* (Chapters 10 and 11) discuss several aspects of stories and the use of stories for providing an overview of a case, for identifying gaps in a case and for making a persuasive case in court. Although Crombag, Van Koppen and Wagenaar focus on the story-based perspective in both in their choice of wording and in their research background, several of their central claims have a more argumentative than story-based flavour. Especially the role of generalizations (or anchors), exceptions to these generalizations and of the dynamics of developing and refining an analysis of the evidence in a case are characteristic for the argumentative slant of the approach by Crombag, Van Koppen and Wagenaar.

Despite the appearance of arguments and stories in Modified Wigmorean Analysis and the Anchored Narratives Theory, none of these theories fully integrates stories and arguments in one concise rational theory of reasoning with evidence. For example, stories and their rational analysis can and should play a bigger part in the analysis of a mass of evidence; in particular, their precise role in generating hypotheses and finding "gaps" is at present not clarified in Modified Wigmorean Analysis. In the Anchored Narratives Theory, the evidential data has no clear place and the various ways of argumentative reasoning from evidential data to a conclusion are not discussed in detail.

The main goal of this book is to propose a hybrid argumentative story-based theory which combines reasoning with arguments and stories. An informal as well as a formal logical version of the theory will be developed, in an attempt to make the core ideas and concepts accessible to a wide audience consisting of lawyers, legal theorists, psychologists and formally oriented researchers from AI and Law. A general conceptual framework will be constructed, in which both reasoning with

[13] A notable exception here are Pardo and Allen (2007), who advocate using stories to explain the evidence.

stories and arguments will be discussed. In this discussion, insights from various fields of research[14] will be combined with new ideas to form an informal hybrid theory of reasoning with evidence. Aside from the academic pursuit of developing a theoretical account of reasoning with evidence, the hybrid theory is also intended to provide lessons for the investigative and judicial practice by formulating guidelines or heuristics for correct and rational reasoning in various contexts of investigation and decision making. Modelling the hybrid theory in a formal logic forces the precise and detailed definition of the various ideas proposed in the informal theory and compels us to make clear choices as to how the various concepts should be defined.

The need for the development of a logical theory is emphasized since it facilitates the implementation of the theory in a sense-making tool. In *Making Sense of Evidence*,[15] the coordinating research project of this work, a theoretically sound sense-making and visualization tool for Dutch police analysts has been developed. This tool, called AVERS (Argument Visualization for Evidential Reasoning based on Stories, see van den Braak, 2010; van den Braak et al., 2007; Bex et al., 2007b), combines reasoning with arguments and scenarios and is based on the logical theory as developed in this book. As was discussed above, a logical model or theory that serves as the basis for a sense-making system should meet essentially three criteria. First, the theory should be *natural* in that it employs concepts that are natural to an everyday reasoner such as a crime analyst or a judge. Investigators and decision makers cannot be expected to have in-depth knowledge of mathematical or formal models and therefore the theory should be based on reasoning forms used in practice. Second, the theory should be *rationally well-founded*, that is, the theory should provide a clear rational framework which is in agreement with the prevailing (legal and philosophical) theories of rational reasoning about evidence. Furthermore, the theory should ideally encourage a correct and general standard of rational reasoning. Like in all kinds of commonsense reasoning, mistakes can be made in reasoning with criminal evidence; because such mistakes can have a large impact on the life of a person (e.g. conviction of an innocent) or society as a whole (e.g. acquittal of a murderer), they should be avoided. Given the current conception of procedural rationality, the theory should facilitate and promote a proper procedure for performing an inquiry concerning evidence in a criminal case, thus promoting rational reasoning about the evidence. Finally, the theory should be *formally specified* with an eye towards software development, so that it can act as a proper foundation for AVERS. This means that the model of reasoning ideally has a computational side so that it can aid the investigators by, for example, computing which possible scenario is best supported by evidence. However, since only a small amount of automated

[14] In particular legal theory, legal psychology, philosophy, argumentation theory, cognitive modelling and AI.

[15] The project is a collaboration between the Centre for Law and ICT (University of Groningen), the department of Artificial Intelligence (University of Groningen) and the Intelligent Systems Group (Utrecht University). For more information, see: http://www.cs.uu.nl/research/projects/evidence/ (last accessed on July 19, 2010).

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