

# INFERENCE TO THE BEST LEGAL EXPLANATION\*

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## 1 Introduction

How do legal decision-makers reason about facts in law? A popular response appeals to probability theory, more specifically, to Bayesian theory. On the Bayesian approach, fact-finders' inferential task consists in updating the probability of the hypothesis entailing guilt in light of the evidence at trial in the way dictated by Bayes theorem. If, by the end of the trial, this probability is sufficiently high to meet the reasonable doubt standard, the verdict "guilty" is appropriate (Tillers and Green 1988). Bayesianism provides an elegant framework for analyzing evidentiary reasoning in law. Nonetheless, in the last decades, the Bayesian theory of legal proof has been subjected to severe criticism, which has shed serious doubts upon the possibility of explaining legal reasoning about evidence in Bayesian terms.<sup>1</sup> In this paper, I would explore the feasibility of an approach to legal evidence and proof alternative to the probabilistic one, to wit, an explanationist approach. According to this approach, many instances of factual reasoning in law are best understood as 'inferences to the best explanation,' i.e., a pattern of reasoning whereby explanatory hypotheses are formed and evaluated. More specifically, I shall argue for a coherentist approach to inference to the best explanation for law according to which factual inference in law involves first the generation of a number of plausible alternative explanations of the events being litigated at trial and then the selection, among them, of the one that is best on a test of explanatory coherence.

The defense of an explanationist model of legal proof will proceed as follows. I start by giving a brief description of inference to the best explanation. I then proceed to articulate a model of inference to the best explanation for law. I shall restrict my analysis to criminal trials, even though the model is also potentially applicable to civil trials. Next, I illustrate this model by means of a well-known case, the O.J. Simpson case. I will then consider a major objection that may be raised against a model of inference to the best explanation for law, namely, the so-called 'problem of underconsideration.' I conclude by examining this problem in detail and suggesting some ways in which it may be overcome.

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<sup>1</sup> See Amaya (2007), for a summary of these criticisms.

## 2 Inference to the Best Explanation: Unfolding the Model

Talk about inference to the best explanation has been very popular in the last decades in philosophy of science and A.I. (Harman 1965; Thagard 1978; Lycan 1988; Ben-Menahem 1990; Day and Kincaid 1994; Josephson and Josephson 1994; Psillos 1999; Flach and Kakas 2000; Lipton 2004; Aliseda 2006). Contemporary discussions about inference to the best explanation take Peirce's writings on abduction as their starting point. Peirce's views on abduction changed significantly in the course of his writings, and they have been subjected to a number of different and often conflicting interpretations (Frankfurt 1958; Anderson 1986; Kapitan 1992, 1997; Hintikka 1998). In his earlier work, Peirce distinguished between deductive reasoning, inductive reasoning, and a kind of reasoning that he called 'hypothesis.' He defined hypothesis as follows: "Hypothesis is where we find some very curious circumstance which would be explained by the supposition that it was the case of a certain general rule and thereupon adopt that supposition." (1960, 624). Later, Peirce called hypothesis 'abduction.' In this new classification abduction "furnishes the reasoner with the problematic theory which induction verifies." (1960, 776). That is, Peirce characterized abduction as the coming up with a hypothesis, which is then tested by induction. In this new schema, abduction is a form of hypotheses-generation, rather than a pattern of reasoning that gives us reasons for accepting a hypothesis.

The ambiguities concerning the concept of abduction as characterized by Peirce carry over the current research on abduction. We may distinguish, following Niiniluoto, between two different conceptions of abduction, a weak conception and a strong one (1999). According to the 'weak' conception, abduction is the process by which explanatory hypotheses are generated. In this view, abduction gives reasons for pursuing a hypothesis, as opposed to reasons for accepting a hypothesis. On this view, abduction operates in the context of discovery, rather than in the context of justification. In contrast, according to the 'strong' conception of abduction, abduction is not only a method of discovery, but also a method of evaluation. In this view, abduction is best characterized as 'inference to the best explanation' (IBE, hereinafter), that is, as a pattern of reasoning whereby explanatory hypotheses are both formed and justified. Lycan (1988, 129; 2002, 413) defines IBE as follows:

$F_1 \dots F_n$  are facts in need of explanation.  
Hypothesis H explains  $F_1 \dots F_n$ .  
No available competing hypothesis explains  $F_i$  as well as H does.  
Therefore, probably H is true.

That is, an inference to the best explanation proceeds from a set of data to a hypothesis that explains the data better than any available competing hypothesis would. As described above, this pattern of reasoning looks indeed familiar. Many inferences in a vast array of

contexts are naturally described in terms of inference to the best explanation.<sup>2</sup> For example, Darwin inferred the hypothesis of natural selection because, although it was not entailed by his biological evidence, natural selection would provide the best explanation of that evidence (Lipton 2000, 184). A doctor infers that a patient has measles because it best explains the patient's symptoms (Magnani 2001). Natural language understanding (Hobbs, Stickel, Appelt, and Martin 1993) and fault diagnosis (Peng and Reggia 1990) have also been characterized as IBE. In law, we may recognize many instances of reasoning about evidence as cases of IBE as well. A prosecutor infers that one of the suspects committed the crime because this hypothesis best explains the fingerprints, bloodstains, and other forensic evidence. When we infer –claims Harman- that a witness is telling the truth, our confidence in the testimony is based on our conclusion about the most plausible explanation for that testimony (1965, 89). A juror infers a plausible narrative about how a crime was committed because it best explains the evidence at trial (Josephson 2002, 290-291). Inference to the best explanation is ubiquitous in the context of reasoning about evidence in law (see Thagard 1989, 2003, 2006; Josephson 2002; Walton 2002; Abimbola 2002; Allen and Pardo, forthcoming). I turn now to the issue of how a model of IBE for law may be developed.

### **3 Inference to the Best Explanation in Law: a Coherentist Interpretation**

A good starting point for developing a model of IBE for law is Lipton's model of IBE, which is, to date, the most elaborated account of how explanatory inference works in scientific contexts (Lipton 2004). It is a basic tenet of Lipton's model that IBE includes a two-filter procedure: one that generates plausible candidates, and a second one that selects among them. This two-stage procedure seems initially a plausible description of the way in which legal decision-makers reason about evidence. They first generate a number of plausible explanations of the facts under dispute, and then select among them, the one that best explains the evidence at trial. Under this view, factual inference in law works by exclusion, i.e., from a handful of plausible alternatives legal decision-makers eliminate all but one as the best explanation of the disputed facts. That is, it follows from an explanationist account of legal inference that factual inference in law is first and foremost an eliminative kind of inference. An explanatory view of reasoning about evidence in law also brings to light the extent to which factual inference in law is of a defeasible kind: for there is, of course, always the possibility that a better explanation be discovered which defeats the hypothesis that has been chosen as best.

While attractive, this picture of factual inference in law is, to be sure, far too sketchy. A model of inference to the best explanation in law needs to rest on a detailed account of the different stages in which factual inference proceeds. The suggestion that I would like to put forward is that we may provide such an account by placing a model of

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<sup>2</sup> In some of these contexts the *explanandum* is a generic event (like in science) while in others it is a unique event (like in law or medical diagnosis), yet the structure of explanatory inference remains the same across contexts.

inference to the best explanation within a coherence theory of legal justification. In a nutshell, my claim is that IBE in law is best understood as an ‘inference to the most coherent theory of the case.’ That is, the claim is that the ‘best’ of the ‘inference to the best explanation’ slogan is the best on a test of coherence (see, in the context of philosophy of science, Harman 1980, 1986; Thagard 1989, 1992, 2000; Lycan 2002; Psillos 2002).<sup>3</sup> Such a theory of the case is -on a coherence theory of justification- the one that enjoys a higher degree of justification. Thus, the coherence-enhancing role of IBE is ultimately its justification-conferring element (Psillos 2002, 616-620). From this point of view, IBE in law is a process of coherence-maximization, which consists of two stages, the generation of a number of candidate theories of the case and the selection, among them, of the one that coheres best. There is, I would suggest, an intermediate stage that is extraordinarily important, to wit, a context of pursuit, in which working hypotheses are subjected to preliminary assessment and developed in further detail (Sintonen and Kikeri 2004, 214-218). Let us now see, from a coherentist perspective, how the structure of inference to the best explanation in law may be described.

### *3.1 Discovering Explanations*

How do legal decision-makers come up with a pool of plausible alternatives? How are hypotheses generated in the forensic context? The mechanisms whereby new hypotheses emerge in the course of legal decision-making are poorly understood. This is hardly surprising, given the relative neglect, until very recently, of discovery-related issues in the legal literature (Schum 2001, 450-505; 2002; Anderson, Twining, and Schum 2005). I do not intend here (neither can I) give a full account of the process of discovery in the forensic context. I shall focus exclusively on the role that coherence plays in this process.

Coherence enters into the process of generation in different ways. First, coherence enters implicitly in the process of generation via background knowledge (Lipton 2004, 150-151). The judgment of plausibility upon which the generation of a restricted number of candidates hinges on depends heavily on background knowledge. Our background beliefs -we take it- indicate which hypotheses one ought to seriously consider. Thus, coherence with background beliefs helps narrow down the range of plausible candidates to a manageable size. Explanations of the facts under dispute which fail to cohere with background beliefs, e.g., beliefs about how crimes are usually committed, beliefs about human motivations, causal principles, etc., are not merely discarded, but rather are never considered.

Of course, this tendency to generate hypotheses that cohere with our background beliefs is quite risky. The role that coherence plays -via background knowledge- in the generation stage is a double-edged sword. On the one hand, it focuses inquiry, by avoiding waste of time and effort in formulating and discarding crazy hypotheses that nobody would seriously consider. To state the obvious, no serious lawyer would say that the crime was committed by an unnatural force because we most firmly believe that

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<sup>3</sup> A thorough explanation of what such a test of coherence involves is given in section II.3.

crimes are ‘usually’ committed by humans –as one of the Grimm Brothers said.<sup>4</sup> Besides, if we take it (and with good reason, I believe) that most of our beliefs are approximately true or, at the very least, justified, then it is but reasonable that we should disfavor hypotheses that would lead us to reject much of the background. But, on the other hand, the role that coherence with background knowledge plays in the process of generation has also a negative side. Favoring hypotheses that cohere with our background of empirical beliefs might prevent us from considering hypotheses which, rare as they might be, are best supported by the evidence we have in the particular case. Here, we face the recalcitrant problem of conservatism which seems to undermine coherence methods.

Second, coherence also enters into the process of generation through a number of marshalling mechanisms. As Schum and Tillers have argued, the success that we enjoy in generating important new hypotheses and discovering new evidence depends to a great extent upon how well we have marshaled or organized the evidence we have (Schum and Tillers 1991; Schum 1999). Successful inquiry is first and foremost an exercise of interrogation (Sintonen and Kikeri 2004, 227-233). Marshalling methods stimulate asking the right questions without which we stand little chance of generating fruitful possibilities. Some important marshalling strategies such as ‘scenarios,’ ‘schemata,’ and ‘theories of the case’ are coherence-oriented. Thus, coherence pushes us towards productive investigative paths by contributing to the effective marshalling of the ideas and evidence that we have.

Third, the generation of new elements is sometimes driven by an effort after coherence. The search for coherence motivates the formulation of questions which importantly aid the aim of inquiry. Asking what evidence would cohere with a particular hypothesis, or what hypothesis could make sense of some evidence we have is an effective way of identifying relevant evidence as well as coming up with innovative hypotheses. It is important to notice here that formulating promising hypotheses and discovering relevant evidence goes hand-to-hand in the process of inquiry. On the one hand, by supposing that one factual hypothesis is true, we can work out what further evidence might be relevant. On the other hand, we may come up with a new hypothesis by supposing what would, if true, explain a particular piece of evidence we have. There is thus a feedback between hypothesis formation and evidence acquisition in actual legal inquiry, and coherence seems to significantly contribute to this feedback.

Last, *incoherence* is also a driving force in inquiry (Thagard 2000, 67). Emotional reactions, such as surprise or anxiety, that signal incoherence may trigger hypothesis formation. That is, sometimes the generation of new elements is prompted by failure to achieve an interpretation that adequately satisfies the coherence standards. In the context of law, one may say that the anxiety produced by the fact that a guilt-hypothesis fails to make full sense of the available evidence may motivate the search for an alternative hypothesis (which might, in turn, suggest the relevance of additional evidence) that is compatible with a story of innocence. And incongruity of the best solution available to a problem of proof in law with one’s firm convictions about the main values which

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<sup>4</sup> In the film *The Grimm Brothers*.

adjudication is meant to protect may be accompanied by a lively sense of non-conformity, which might trigger the search for an alternative explanation (and for evidence which might support the new explanatory hypothesis).

Thus, coherence plays an important role in the process of generation. By the end of this process, fact-finders should have constructed from an original 'base' of coherence,<sup>5</sup> which includes the evidence at trial and the competing explanatory hypothesis, a 'contrast set,'<sup>6</sup> that is, a set of plausible alternative theories of the case to be further considered.

### *3.2 The Context of Pursuit*

In a second stage, initially plausible alternatives are developed and refined into full-blown theories of the case. How may the alternative theories of the case be rendered as coherent as they can be? There are three-main coherence-making strategies whereby legal fact-finders may enhance the coherence of the alternatives: subtractive, additive, and reinterpetative.<sup>7</sup> The 'subtractive strategy' constructs coherence by subtracting one (or more) elements from an incoherent set. For instance, a fact-finder may eliminate the belief that a piece of circumstantial evidence is reliable on the grounds that it detracts from the coherence of a hypothesis that is well-supported by the independent and credible testimony of several witnesses. The 'additive strategy' consists in adding one (or more) elements to a set in order to render it coherent (or in order to increase its degree of coherence) (Klein and Warfield 1994, 129-130). For example, suppose that a legal fact-finder believes that the evidence at trial strongly supports the guilt-hypothesis. However, suppose that she also believes a witness claiming that she saw the accused miles away from the scene of the crime. Upon further investigation it is discovered that, as it turns out, the witness is visually impaired. The legal fact-finder may increase the coherence of the theory of the case entailing the guilt of the defendant by adding the belief that, given the deficient sight of the witness, he could not have been able to identify, as he claims to, the defendant. Last, the 'reinterpetative strategy' amounts to removing the incoherencies in one's theory of the case by revising the interpretation of one (or more) of its elements.<sup>8</sup> For instance, incriminating evidence found in the house of the accused can be reinterpetated, in light of evidence of irregular police conduct, as decreasing rather than enhancing the coherence of the theory of the case entailing guilt. Reinterpetation may be viewed as a composition of subtraction (of the rejected interpretation) and addition (of the accepted interpretation). In the course of deliberation, legal decision-makers may (and indeed should) maximize the coherence of the alternatives under consideration by manipulating them in the ways indicated above.

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<sup>5</sup> The term is Raz's (1992).

<sup>6</sup> The term is borrowed from Josephson (2002).

<sup>7</sup> This taxonomy of coherence-making strategies is broadly inspired by the kinds of belief change operations distinguished in the belief revision literature (see Gärdenfors 1988; see Amaya 2007, for the legal applications of belief revision formalisms).

<sup>8</sup> I borrow the term 'reinterpetation' from Conte (1999, 88).

Again, there are some ‘dangers’ involved in employing these coherence-making mechanisms. While it seems necessary, in order to ensure a fair evaluation of the different alternatives, that each of the alternatives be shown as coherent as it can be, there is always the possibility that the process whereby the coherence of each of these alternatives is maximized is performed in such a way as to ensure that one of the alternative theories of the case ends up being later selected. That is, there is always the risk that one uses these mechanisms for inflating the degree of coherence of one’s preferred alternative and deflating the degree of coherence of the competing alternatives. In fact, this is what happens, according to Simon, in the course of legal decision-making (Simon 2004). One might then make it the case that while rendering each of the alternative explanatory hypothesis the most coherent it can be, one’s preferred alternative is shown to be more coherent than it actually is and competing alternatives are rendered in fact less coherent than they could have been shown to be. This, of course, would result then in a biased, rather than a fair, evaluation of the alternatives. We might be so wired – as Simon and collaborators’ psychological research shows- that such manipulations of the decision alternatives are an essential part of what is involved, as a matter of fact, in effective decision-making. But while to some extent these manipulations might be indispensable for reaching a decision at all, it still seems possible –and indeed, desirable- to keep these psychological tendencies from running riot. Complementing –in the way that I shall suggest later- a theory of coherence-based reasoning with a theory of epistemic responsibility might be a way of exploiting the drive towards coherence which –as empirical studies show- guides our decision-processes, while avoiding the dangers inherent in coherence-based reasoning.

### *3.3 Selecting the Best Explanation*

Faced with a number of plausible explanations, IBE has us select the candidate that is best. The ‘best’ explanation, I have argued, is the most coherent explanation. To be sure, coherence is hardly a transparent notion. In fact, one of the main objections against coherence theories is that they fail to give a precise account of the nature of coherence. Thus, it might be argued, identifying the ‘best’ with the ‘most coherent’ does not seem to clarify what are the standards of evaluation against which we may determine which, among a number of alternative explanations, is best. However, the prospects of elaborating a reasonably clear notion of the kind of coherence that is relevant to factual reasoning in law are not as bleak as they might appear. Thagard has developed a conception of coherence as constraint satisfaction on the basis of which, I would argue, we may work out a precise enough notion of coherence for evidential reasoning in law, which I shall refer to as ‘factual coherence.’<sup>9</sup>

According to Thagard, coherence is a matter of satisfying a number of positive and negative constraints. To achieve coherence, he says, we divide up a set of elements into two disjoint subsets A –which contains accepted elements- and R –which contains rejected elements- by taking into account the coherence and incoherence relations that

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<sup>9</sup> Other prominent conceptual analyses of coherence include BonJour (1985) and Lehrer (1990).

hold between pairs of elements of the given set. For example, if a hypothesis  $h_1$  explains a piece of evidence  $e_1$ , then we want to ensure that if  $h_1$  is accepted, so is  $e_1$ . And if  $h_1$  contradicts  $h_2$ , then we want to make sure that if  $h_1$  is accepted, then  $h_2$  is rejected. According to the theory of coherence as constraint satisfaction, coherence results from dividing a set of elements into A and R in a way that best satisfies the positive (coherence relations) and negative (incoherence relations) constraints (Thagard and Verbegeurt 1998; Thagard 2000, 15-40).

It is a virtue of this approach that it is applicable to a wide variety of problems. In order to apply the general approach of coherence as constraint satisfaction to a particular problem, says Thagard, we need to specify the elements and the constraints that are relevant in a particular domain as well as the kinds of coherence involved. He distinguishes six kinds of coherence: explanatory, analogical, deductive, perceptual, conceptual, and deliberative. For instance, in Thagard's view, we may view epistemic justification as a coherence problem the solution of which requires the integrated assessment of explanatory, analogical, deductive, perceptual, and conceptual coherence. Thagard has proposed a set of principles for all these kinds of coherence, which specify the relevant elements and constraints.

The justification of factual conclusions in law may also be viewed –I would argue– as a coherence problem.<sup>10</sup> 'Factual coherence' requires the interaction of the same kinds of coherence which, according to Thagard, are relevant to epistemic justification with one major addition, that is, deliberative coherence. Deliberative coherence needs to be added because reasoning about facts in law, unlike other kinds of evidential reasoning, is ultimately a piece of a practical deliberation about whether one should acquit or convict. For the purposes of this paper, it may suffice to focus on what is, arguably, the most important contributor to factual coherence, to wit, explanatory coherence. In explanatory coherence, elements are evidence and hypotheses. According to Thagard's principles of explanatory coherence, positive constraints arise from relations of explanation and analogy and negative constraints result from contradiction and competition (see Thagard 1989, 1992, 2000). Some modifications need to be introduced in order to make Thagard's theory of explanatory coherence suitable to the legal realm. Specifically, it is necessary to add further principles so as to account for the fact that the explanatory evaluation of hypotheses at trial takes place within an institutional context. This context gives rise to additional constraints, more importantly, the presumption of innocence and the standard of reasonable doubt. The presumption of innocence may be treated as a constraint that requires that hypotheses compatible with innocence be given a priority in being accepted. In other words, not all hypotheses about the events at trial may be treated equally in determinations of coherence, but hypotheses compatible with innocence should be assigned an initial degree of acceptability. The reasonable doubt standard imposes a further constraint on the acceptance of a guilt hypothesis: this may be accepted only if its degree of justification is sufficiently high to meet the standard. From an explanationist perspective, there are two conditions that a guilt explanation should

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<sup>10</sup> The justification of normative, rather than factual, conclusions in law may also be viewed as a coherence problem (see Amaya 2006, for a discussion of the literature).



meet for belief in such an explanation to be beyond a reasonable doubt: it has to be highly coherent with both background beliefs and the evidence at trial and it has to be much more coherent than competing explanations that are compatible with innocence. Together these two constraints ensure that the guilt explanation will be accepted only if coherence overwhelmingly requires it.

The principles of factual coherence, which result from adding the institutional constraints (in italics) to Thagard's principles of explanatory coherence, may be stated as follows:

Principle E1: Symmetry. Explanatory coherence is a symmetrical relation, unlike, say, conditional probability.

Principle E2: Explanation. (1) A hypothesis coheres with what it explains which can either be the evidence or another hypothesis; (2) hypotheses that together explain some other proposition cohere with each other; and (3) the more hypotheses it takes to explain something, the lower the degree of coherence.

Principle E3: Analogy. Similar hypotheses that explain similar pieces of evidence cohere.

Principle E4: Priority. (a) Propositions that describe the results of observation have a degree of acceptability on their own; (b) *hypotheses that are compatible with innocence have a degree of acceptability on their own.*

Principle E5: Contradiction. Contradictory propositions are incoherent with each other.

Principle E6: Competition. If *P* and *Q* both explain a proposition and if *P* and *Q* are not explanatorily connected, the *P* and *Q* are incoherent with each other.

Principle E7: Acceptance. (a) The acceptability of a proposition in a system of propositions depends on its coherence with them; (b) *the guilt hypothesis may be accepted only if it is justified to a degree sufficient to satisfy the reasonable doubt standard.*

Principle 1, symmetry, establishes that explanatory coherence is a symmetric relation. For example, if the guilt-hypothesis coheres with the DNA evidence, then the DNA evidence and the guilt-hypothesis also cohere. As principle 2 (a) says, a hypothesis coheres with what it explains. For instance, the hypothesis that the perpetrator of the crime was not an outsider (to take a well-known example by Conan Doyle) coheres with the evidence that the dog did not bark. This principle also allows the possibility of hypotheses explaining each other, as when the hypothesis that a family member was the murderer is explained by the motive that he was to inherit from the victim. Principle 2 (b) says that hypotheses that together explain some other proposition cohere with each other. For example, the hypothesis that the maid's testimony (saying that no outsider was seen around the house the night of the crime) is true and the hypothesis that the perpetrator of the crime was from within the family, together explain the evidence that the dog did not bark, and thus

cohere with each other. The last part of principle 2 says that the more hypotheses it takes to explain something, the lower the degree of coherence. Simplicity is in law, as much as everywhere else, a cognitive virtue. Principle 3 states that similar hypotheses that explain similar pieces of evidence cohere. For example, the hypothesis that a family member was the murderer coheres with well-known stories of domestic violence that explained similarly motivated crimes. The first part of principle 4 says that propositions that describe the results of observations have a degree of acceptability on their own, that is, that they have a priority in being accepted. In law, all the evidence at trial will enjoy this kind of priority. The second part encodes the principle of innocence by requiring that hypotheses that are compatible with innocence be also assigned an initial weight. Contradictory propositions, states principle 5, are incoherent with each other. For example, the hypothesis that the maid's testimony is trustworthy is incoherent with the hypothesis that she was lying, insofar as both hypotheses contradict each other. Incoherence relations might also be established between two hypotheses if they are in competition –as principle 6 says. Two hypotheses compete with each other if they both explain a proposition but are not explanatorily connected. For instance, the hypothesis that the victim was killed and the hypothesis that she committed suicide both explain the evidence of the body, but since neither one explains the other nor do they together explain any evidence, they compete with each other, and they are thus incoherent with each other. Last, the first part of principle 7 says that the acceptability of any proposition depends on its coherence with the rest of elements to which it belongs. So, according to this principle, the guilt hypothesis and the innocence hypothesis are to be accepted if they best cohere with the hypotheses put forward at trial and the evidence available. In law, however, the evaluation of the explanatory coherence of the alternatives is subjected to institutional constraints, such as the standard of proof, which is encoded in the second part of principle 7.

Thus, under the proposed coherentist framework, the coherence of a particular factual hypothesis in law is computed through the satisfaction of a number of constraints as established by the foregoing principles. IBE in law has us select the explanation of the facts disputed at trial that best satisfies these coherence constraints. An important advantage of using a modified version of Thagard's theory of explanatory coherence to determine which, among a set of alternative theories of the case, is best is that it allows us to compute coherence in a precise way. Thagard's theory of explanatory coherence has been implemented in a computational model, ECHO, which shows how coherence can be calculated. In ECHO, hypotheses and evidence are represented by units that are linked through excitatory and inhibitory links. When two propositions cohere, there is an excitatory link between the two units representing them. When two propositions are incoherent with each other, there is an inhibitory link between them. Activation is spread among the units until they reach a stable state in which some units have positive activation, representing the acceptance of the propositions they represent, and some units have negative activation, representing the rejection of the propositions they represent. Thus, ECHO offers a respectable way for evaluating the coherence of the alternative hypotheses about the events at trial.

Let me recapitulate. On the coherentist interpretation of IBE proposed, legal

decision-makers settled on which explanation to infer by a process of coherence maximization that has the following stages:

1. The *specification of a base of coherence*, that is, the set of hypotheses and evidence over which the coherence calculation proceeds.
2. The *construction of a contrast set*, which contains a number of alternative theories of the case.
3. The *pursuit* of the alternative theories of the case by means of a number of coherence-making mechanisms, which results in a revised contrast set.
4. The *evaluation* of the coherence of the alternative theories of the case.
5. The *selection* as justified the theory of the case that best satisfies the criteria of factual coherence.

Some commentary is required. First, this account of factual inference does not assume that the base of coherence remains fixed during the process of coherence-maximization. Rather, the base of coherence is transitory and may be modified in the course of legal decision-making. The pursuit of the alternative theories of the case leads to modifying the base of coherence in several ways, by adding new elements, eliminating some of the elements, or changing their interpretation. This squares well with the dynamics of legal inquiry, for typically evidence and hypotheses become available sequentially in the course of the trial.

Secondly, the theories of the case are treated as a crucial component of coherence-based reasoning in law. In this model, coherence is not computed at once among all the evidence and hypotheses, but is constructed incrementally, by focusing on subsets of elements (i.e., the theories of the case) at a time. On this view, fact-finders work with a ‘traveling focus of attention’ (Hoadley, Ranney, and Schank 1994), concentrating on some alternatives and then on others. This local approach to coherence-building seems psychologically more realistic than global approaches, for limitations of memory and attention make it unlikely that we are able to consider at once all the coherence relations that hold among the whole set of elements.<sup>11</sup>

Last, the different stages of coherence-based inference are distinguished here for the sake of clarity, but in real instances of reasoning, fact-finders would move back and forth between stages. If they are not satisfied with any of alternatives being evaluated, they may strive to find out additional evidence or they may seek out alternative hypotheses in the course of deliberation. New evidence may also prompt the reconsideration of a hypothesis that was discarded before in the process of coherence-construction. Thus, the proposed account of factual reasoning brings to light the extent to which discovery and justification go hand-to-hand in the course of legal decision-making. Let us now illustrate this explanationist approach to evidential reasoning in law by means of an example.

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<sup>11</sup> In the context of legal decision-making, Simon’s empirical research has shown that judges’ attention oscillates between the decision alternatives during the process of decision-making over which coherence is constructed (see Simon 1998, 80-81).

#### 4 An Example: the O.J. Simpson Case

In this section I shall exemplify the explanationist account of legal reasoning about evidence articulated above to one well-known case, the *People of the State of California v. Orenthal James Simpson*. This case has generated an enormous amount of literature and discussion not only among legal scholars but also in the media and public at large. There are several reasons why this trial has been perceived by many to be ‘the trial of the century.’ It is an interesting drama of love and rage, whose main character was the famous football player O.J. Simpson. It raises issues about race and the criminal justice system, about police misconduct, about domestic violence, about social perceptions of black men-white women intimate relationships, about the reliability of DNA evidence, and about the impact of class in justice. It also raised questions about the competence of the juries, as the jury reached a verdict which a large part of the population thought wrong. Here, I shall not attempt to give a psychological explanation of the jurors’ reasoning in this case. Rather, my purpose is to illustrate how deliberating about the facts of this case involves the generation and pursuit of alternative theories of the case and the selection among them of the theory that is best on a test of explanatory coherence. But before I proceed to explain how the proposed model of inference to the best explanation would work in a concrete case, let me give a brief overview of the facts of the O.J. Simpson trial.

O.J. Simpson was tried for the murder of his ex-wife, Nicole Brown Simpson, and her friend Ron Goldman. The prosecution relied mainly on three kinds of proof. First, there was proof of Simpson’s motive, appearance, mood, and behavior. O.J. Simpson and Nicole Brown Simpson had a difficult relationship, with episodes of domestic violence both during and after their marriage. The day of the murders O.J. Simpson was in a rage because of a series of incidents with his ex-wife and his then current girlfriend. He had dinner with a friend, Kato Kaelin; O.J. and Kato parted company at 9:30 p.m.; and O.J. took a plain by midnight to Chicago. The murders occurred between 10:15 p.m. and 10:30 p.m. When the police arrested him, he had a fresh cut on his hand, which Kato had not seen when they went for dinner. Second, there were physical proofs. In Simpson’s back yard the police found a bloody glove that was of a pair with one found at the crime scene. They also found a bloody sock in Simpson’s bedroom as well as blood drops in the hallway of Simpson’s house and in his car. Thirdly, there was DNA evidence. The DNA test revealed that the blood discovered inside O.J.’s car matched that of O.J., Nicole, and Ron. The blood on the sock produced a DNA match for Nicole. The blood drops on the hallway at Simpson’s house as well as drops of blood found at the crime scene matched O.J.’s blood.

The defense developed several lines of argument. First, based on Nicole’s known use of drugs, they contended that Nicole and Ron were killed by drug dealers. Secondly, the defense attacked the interpretation of the circumstantial evidence. The defense argued that the evidence incriminating O.J. was planted by the L.A. police department officers determined to frame Simpson for the crime. They found evidence that Furhman, the detective who had claimed to discover the glove in Simpson’s back yard, was a racist

who had said that police planted evidence against black suspects. Moreover, the glove which O.J. supposedly used to commit the murders did not fit when he tried to put it on in court. The defense identified irregularities in the police investigation and the forensic specialists. Detective Vannater had carried a sample of O.J. Simpson's blood for hours and some of that blood turned up missing; O.J. Simpson's blood was discovered at the crime scene only in July, weeks after the murder, what is more, some of the O.J.'s blood that was allegedly found on the crime scene was absent from a police photo taken in June; this blood as well as the blood on the sock showed traces of EDTA, a preservative used in collection vials. Furhman and Vannater, argued the defense, had ample opportunity to plant the evidence that implicated Simpson and were racially motivated to do so.

How should a fact-finder reason about the evidence in this case? The *first* stage is to specify the evidentiary problem. On the coherentist approach proposed, this involves specifying *the base of coherence*, that is, the set of hypotheses and evidence over which the coherence calculation is performed, as shown in figure 1.

Figure 1

#### Hypotheses

- H1 O.J. Simpson was framed
- H2 O.J. Simpson killed Nicole
- H3 Nicole was killed by drug dealers
- H4 O.J. Simpson is innocent
- H5 Furhrman is a racist
- H6 O.J. Simpson was abusive of his wife
- H7 O.J. Simpson was in an emotional turmoil the night of the crime

#### Evidence

- E1 O.J.'s blood on crime scene
- E2 O.J.'s blood in his hallway and car
- E3 Bloody sock in O.J.'s bedroom
- E4 Bloody glove in O.J.'s back yard
- E5 EDTA on the traces of Nicole's blood on the sock
- E6 EDTA on the traces of O.J.'s blood on the crime scene
- E7 Glove did not fit O.J.'s hands
- E8 Some of O.J.'s blood at the crime scene was absent in pictures taken in June
- E9 Some of O.J.'s Simpson's blood was unaccounted for

At the *second* stage, the trier of fact tries to specify the *contrast set*, that is, the set of theories of the case (which I will label C in figure 2). This involves determining the coherence and incoherence relations that hold among the different elements, i.e., hypotheses and evidence. In order to do so, the fact-finder needs to consider which evidence is explained by which hypothesis, which hypotheses are explanatorily related,

whether there are any significant analogies at work, whether the different hypotheses compete with each other, and whether there are any propositions describing either evidence or hypotheses that are contradictory. For example, the hypothesis that O.J. Simpson was framed coheres with the evidence the there was EDTA on the bloody sock, as this hypothesis explains the evidence of the traces of EDTA. Or, for another example, the hypothesis that Nicole and Ron were killed by drug dealers is incoherent with the hypothesis that they were killed by O.J. Simpson, since they compete with each other. By the end of this process, the fact-finder would have constructed a number of theories of the case, each of which contains several hypotheses and evidence that cohere with each other. Three main theories may be advanced in this case: (i) The O.J.Simpson-did-it theory; (ii) The frame theory; (iii) The drug dealers theory. Letting G stand for the first theory, F for the frame theory, and D for the drug dealers theory, the theories are coherent subsets of propositions describing evidence and hypotheses as shown in figure 2.

Figure 2

explain (H2, E1)	compete (H1, H2)
explain (H2, E2)	compete (H2, H3)
explain (H2, E3)	compete (H1, H3)
explain (H2, E4)	
explain (H2, H6)	
explain (H2, H7)	C = {G, F, D}
explain (H1, H5)	
explain (H1, E5)	G = {H2, H6, H7, E1, E2, E3, E4}
explain (H1, E6)	F = {H1, H5, E5, E6, E7, E8, E9}
explain (H1, E7)	D = {H3, H4}
explain (H1, E8)	
explain (H1, E9)	
explain (H3, H8)	

It is important to notice that even though these three theories of the case were put forward by the parties, the triers of fact are not limited to consider those, but they may (and indeed should, as I would argue below) seek out alternative explanations of the facts being litigated in the course of deliberation.

At the *third* stage the fact finder revises and refines the different theories of the case being considered so as to make them the best –i.e., the most coherent- that they can be. As argued, there are three main strategies whereby coherence may be enhanced: additive, subtractive, and reinterpetative. For example, the fact that the glove was found in O.J. Simpson’s backyard may be reinterpreted, in light of evidence of police misconduct, as evidence that lends support to the hypothesis that O.J. was framed, rather than as evidence of guilt. As a result of this reinterpetation, the degree of coherence of the frame theory is augmented. Or adding the belief that Furhman lied in court (which I label H8 in the figure below) makes the frame hypothesis more coherent. The point of this exercise is to give a fair chance to each of the competing theories of the case by

seriously considering the possibility that each of them might obtain. By the end of the third stage, the coherence of each of the theories of the case is maximized. Figure 3 shows one of the theories of the case –the frame theory- which results from revising it with a view to enhancing its degree of coherence.

Figure 3

$F' = \{H1, H5, E5, E6, E7, E8, E9, E4, H8\}$

At the *fourth* stage, the fact finder assesses the coherence of the different theories of the case by examining the extent to which they satisfy the coherence constraints. He will ask whether the guilt theory explains most of the evidence at trial or whether, to the contrary, the frame theory does a better job at explaining the evidence. He will consider which of the theories being considered is simpler and which fits better with background knowledge about analogous cases. He shall watch out for sources of incoherence and identify inconsistencies in the theories which persist even after each of the theories of the case has been refined. In the explanatory evaluation of these theories of the case it is crucial that he give a priority both to the evidence at trial as well as to the theories of the case that are compatible with innocence. A preference ought to be assigned to these theories in the coherence calculation for the presumption of innocence to be duly respected. The aim of this stage is to arrive at a ranking of the theories of the case in terms of their degree of coherence. In this case, the drug dealer theory clearly ranks far below the O.J. Simpson-did-it theory and the frame theory, both of which enjoy a high degree of coherence. As shown in figure 2, while the O.J. Simpson did-it and the frame theory explain a substantial part of the evidence available (E1-E4, and E5-E9, respectively), the drug dealer theory lacks evidential support.

Finally, at the *fifth* stage, the most coherent theory of the case is selected, provided that its degree of justification (on this account, its degree of coherence) is high enough to satisfy the reasonable doubt standard. Which candidate, among the remaining theories of the case, ought to be selected? Thagard has simulated the reasoning in the O.J. Simpson case in ECHO and the program found O.J. Simpson guilty (2003). Although Thagard's simulation of the O.J. Simpson case took into account a large part of the evidence and hypotheses presented at trial, legal institutional constraints, such as the presumption of innocence and the standards of proof, were not given, I would argue, due consideration. The presumption of innocence was not implemented in Thagard's computer simulation and reasonable doubt was implemented by allowing the guilt hypothesis to be rejected if the inhibition of the unit representing it is over .065, which is stronger than the default .05 excitation value for data, but still not demanding enough to capture the standard of reasonable doubt.

As argued above, there is an important institutional dimension to the explanatory evaluation of hypotheses at trial. In order to give an account of the highly institutional nature of the evaluation of legal evidence, Thagard's principles of explanatory coherence need to be slightly modified. More specifically, I suggested modifying principles 4 (data

priority) and 7 (acceptance) by adding two institutional constraints: the presumption of innocence and the reasonable doubt standard. A version of ECHO (let us call it L-ECHO) could be then developed in which these institutional constraints were implemented. The presumption of innocence could be implemented in L-ECHO by treating the innocence hypothesis as a weak form of data. A promising way of implementing reasonable doubt could be by manipulating the decay rate, which is a parameter such that the higher it is the more excitation from the data is necessary to activate a hypothesis. To model reasonable doubt, the decay rate could be set higher for the guilt hypothesis so as to capture the skeptical stance that jurors ought to have towards the theory of the case that entails guilt.<sup>12</sup>

My hypothesis is that the outcome of applying the modified principles of explanatory coherence and L-ECHO to the O. J. Simpson case would be different from the one reached by ECHO. In L-ECHO, hypotheses compatible with O.J. Simpson's innocence will be assigned an initial weight in the coherence calculation so that the guilt hypothesis would only be accepted if it is indeed much better than alternative hypotheses. In addition, the unit representing the hypothesis that O.J. Simpson-did-it will have a higher decay rate with the result that it will not get very active unless it is highly coherent with the evidence at trial. Although both the O.J. Simpson-did-it theory and the frame theory are reasonably good explanations of some subset of the evidence at trial, I would suggest that (i) the existence of a coherent theory compatible with innocence (i.e., the frame theory) and (ii) the fact that some subset of the evidence (that is, E5-E9, as shown in figure 2 above) is unexplained by the O.J. Simpson-did-it theory raises reasonable doubts over the guilt of O.J. and would lead L-ECHO to reject the guilt hypothesis as unjustified. The institutional constraints on the maximization of coherence –the importance of which is not fully recognized in Thagard's simulation- played, I would argue, a prevalent role in the case being analyzed. That reasonable doubt considerations were determinant of the decision of the jury (who found O.J. innocent) have, in fact, being argued by some analysts of this case (see Hastie and Pennington 1996; Derhowitz 1996). Computational experiments of this and other legal cases would need to be done to further understanding of how the institutional aspects of the explanatory evaluation of hypotheses in law may be best implemented and which role they play in the process of coherence-maximization that leads to accepting one theory of the case, among a number of plausible theories, as justified.

To review, in the previous sections I have argued that IBE provides a useful description of factual inference in law. More specifically, I have argued for a coherentist interpretation of explanatory inference in law according to which IBE involves the generation and pursuit of a number of alternative explanations of the facts under dispute and the selection, among them, of the one that coheres best. In what follows, I shall consider a main objection that may be directed against an explanationist model of legal

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<sup>12</sup> I thank Paul Thagard for his suggestions and extended discussion about to how the presumption of innocence and reasonable doubt could be implemented.



proof, to wit, the problem of underconsideration.<sup>13</sup>

## 5 The Problem of Underconsideration

The problem of underconsideration (also called ‘the argument from the bad lot’) has been formulated by van Fraassen against IBE as a model of scientific inference. He states the problem as follows:

[IBE] is a rule that only selects the best among the historically given hypotheses. We can watch no contest of the theories we have so painfully struggled to formulate, with those no one has proposed. So our selection may well be the best of a bad lot. To believe is at least to consider more likely to be true, than not. So to believe the best explanation requires more than an evaluation of the given hypothesis. It requires a step beyond the comparative judgment that the hypothesis is better than its actual rivals. While the comparative judgment is indeed a ‘weighing (in the light of) the evidence,’ the extra-step –let us call it the ampliative step- is not. For me to take it that the best of set X be more likely than not, requires a prior belief that the truth is already more likely to be found in X, than not (Van Fraassen 1989, 143).

Thus, van Fraassen sheds doubts about whether we have any reason to believe that the outcome of an application of inference to the best explanation is likely to be true. Unless we know that it is more likely than not that the true explanation is included among those we have discovered, we have no reason to accept the best explanation as (probably) true. For all we know, he says, the best explanation may just be the best of a ‘bad lot.’ The true explanation, that is, may well lie among those explanations that we have so far failed to consider.

The problem of underconsideration poses a real challenge to the project of articulating a model of inference to the best explanation in law. After carefully examining the evidence at trial and comparing the relative coherence of the different alternatives available, the jury decides that the guilt hypothesis is the most coherent one, and thus the best candidate for the basis of their decision. However, had the jurors considered the hypothesis that the police had framed the accused they would have realized the relevance of some evidence –so far unnoticed- and concluded that the innocence hypothesis was, all things considered, explanatorily best. I think that it is plain what the problem of underconsideration, which this example illustrates, is. The set of ‘available’ hypotheses depends on the evidence legal decision-makers have and on their capacities to bring relevant evidence to bear on existing hypotheses or to come up with good hypotheses. Unless we have some reason to think that the set from which legal decision-makers infer to the best is ‘good enough,’ we seem to lack any reason to believe that the best of such a set is likely to be true.

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<sup>13</sup> This problem is, to my mind, the most serious problem that a model of IBE for law has to face. For a discussion of other objections that may be raised against an IBE model for law, see Laudan (2007, forthcoming) and Allen and Pardo (2007, forthcoming).

Now, what are the prospects of meeting this, admittedly serious, objection? In the context of philosophy of science, one popular response appeals to the role that background knowledge plays in theory evaluation. Theory choice operates in a network of background beliefs which is approximately true, and this makes it plausible to believe –contrary to what the argument from the bad lot states- that the correct account of the phenomena does lie within the spectrum of theories that scientists have devised (Lipton 1993; Psillos 1996; Iranzo 2001). In the context of legal –rather than scientific- reasoning a similar response can be articulated. The evaluation of theories of the case does not operate in a ‘conceptual vacuum,’<sup>14</sup> but is rather guided and constrained by background knowledge. This makes it plausible that the true explanation of the facts under dispute lies within the set of theories which legal decision-makers consider in the course of their deliberations.

Appealing to background knowledge may undermine van Fraassen’s argument by showing that, as it turns out, it is plausible that the truth is already more likely than not to be found within the lot of theories available. However, this still does not dissipate the skeptical worries raised by the bad lot argument for even if –contrary to van Fraassen- it is more likely than not that the truth lies within the theories under consideration, it remains possible that, in a particular application of inference to the best explanation, the truth *does* lie outside the spectrum of the theories that have been generated. The argument from underconsideration might therefore be restated as follows: let us assume (for the sake of the argument) that it is plausible that the truth is more likely than not to be found within the lot of theories that we generate, still, one never has reason to believe that the best explanatory hypothesis is likely to be true, for, even if the ‘bad lot’ possibility is not in fact normally realized, we never have, in a particular application of an inference to the best explanation, any reason to believe that the set of hypotheses we consider contains the truth.

So restated, the argument from underconsideration is not an argument against the reliability of inference to the best explanation, but an argument against the rationality of employing it (Okasha 2000). Even if it is conceded that it is more probable than not that the set under consideration contains the truth, this still says nothing about whether we have any reason to believe that this is so. In any particular application of inference to the best explanation, we never know –the argument says- whether the ‘bad lot’ possibility obtains or not. As a result, we never have reason to believe that the best explanation is likely to be true.

Now, what are we to say to the skeptic who claims that fact-finders are never justified in inferring the best theory about the facts under dispute, for it might be just the best of a bad lot? The defense of the claim that legal decision-makers may be justified in accepting a hypothesis on the grounds that it is the best of those that have been considered is two-pronged. In short, I shall claim that once we appreciate first, that inference to the best explanation is a defeasible form of inference, and, second, that standards of responsibility are relevant to attributions of justified belief, we may come to

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<sup>14</sup> The phrase is Ben-Menahem’s (1990, 330).

see how particular applications of inference to the best explanation can yield justified beliefs.

A reply to the objection that inference to the best explanation cannot yield justified beliefs because ‘best’ can only mean ‘best among those that have been generated,’ and this might well be a ‘bad lot,’ starts by examining the kind of warrant which we may reasonably expect inferences to the best explanation to confer to their conclusions. The warrant conferred to the chosen hypothesis is, of course, a defeasible kind of warrant. Thus, it might always be possible that new information –e.g., the discovery of a better explanation- will defeat the justification of the chosen hypothesis. But, inference to the best explanation being defeasible, this is as it should be. Of course, this is not to say that just any lot would do. No warrant –defeasible or otherwise- is conferred upon the hypothesis that is best among those that we just happen to examine. The interesting question is: what is the proper set of explanations that need to be considered for belief in the best of them to be *prima facie* justified?

An answer to this question requires taking a stance regarding the issue of what is the relevant sense of justification at play. There are different senses in which the notion of justification may be understood. Most importantly, one may distinguish between responsibilist and non-responsibilist views of justification (Pryor 2001). While the former asserts that justification is connected with what an agent has done (or failed to do) to ensure that his beliefs are true, the latter takes justification to be a standard of epistemic appraisal that has to be analyzed exclusively in terms of evidential support. The suggestion is that it is the former view of justification, rather than the latter, that is relevant for analyzing the sense in which judgments of best explanation in law can be warranted. That is, if one has done all that one can be expected to do for insuring that one’s claim is not defeated by an alternative explanation in the particular case, there is an important sense in which one’s claim may be said to be justified. More specifically, provided that one has conducted a thorough search for other potential explanations and there is no reason that justifies a further search, then one is justified (in the sense that matters) in accepting as justified the best explanatory hypothesis of the events at trial.

Now, the problem arises as to how we are to spell out the idea of doing one’s best that –I have claimed- is at the core of the notion of justification. The suggestion that I would like to advance is that appealing to the idea of epistemic responsibility can help us here. More specifically, the suggestion is that, for a model of inference to the best explanation for law to provide a workable account of how to arrive at justified beliefs (beliefs which are justified by virtue of their coherence), it should be wedded to a responsibilist view of legal justification. A belief in an explanatory hypothesis about the facts under dispute is not justified merely because it is the best among those that have been considered, but we need to have some reason to believe that the set of hypotheses from which we have inferred to the best is ‘good enough.’ Insofar as we lack any such reason, we fall short of meeting the argument from underconsideration. A set of hypotheses is ‘good enough’ –I contend- if it has been constructed in compliance with the standards of epistemic responsibility. Thus, the claim is that, as long as one’s contrast set (the set of alternative explanations) has been constructed in an epistemically responsible

way, inferring to the best explanation is warranted (as warranted as non-demonstrative inference can be, it goes without saying), and, thus, the argument from the bad lot is undermined.

What is it for a legal decision-maker to behave in an epistemically responsible way? I cannot go here into examining in detail what epistemic responsibility requires in the context of fact-reasoning in law (see Amaya 2007). In short, epistemic responsibility is a matter of complying with some epistemic duties and exercising a number of epistemic virtues in the course of inquiry and deliberation about factual problems in law. Seeking further evidence on uncertain propositions or believing as one's evidence dictates are examples of epistemic duties which legal decision-makers are expected to comply with. Epistemic virtues include virtues such as open-mindedness in collecting and appraising evidence, perseverance in following a line of inquiry, or readiness to change one's views in the face of new conflicting evidence. If one has constructed a contrast set in an epistemically responsible way, then one has done all that can be expected to ensure that the selected explanation is not defeated, and thus belief in such an explanation is justified. General doubts about whether there might be yet a better explanation lying somewhere do not have the potential to defeat justification. And concrete doubts about whether a particular defeater obtains may be easily dispelled, provided that one has constructed a contrast set in an epistemically responsible way. The objection from the bad lot is thus ineffectual against a model of inference to the best explanation that gives to duties and virtues their due in legal justification.

## **6 Conclusion**

In this article, I have argued that most instances of factual reasoning in law are best understood in terms of inference to the best explanation. I have argued for a coherentist interpretation of IBE according to which IBE leads us to accept as justified the conclusion about the facts under dispute that best satisfies the standards of coherence. Such a coherentist interpretation has two main constructive advantages: it allows us to see why conclusions of IBE are justified, and it allows us to spell out in some more detail the structure of IBE. I have considered one major objection that may be addressed against a model of IBE for law, namely, the objection from the bad lot. This objection, I have argued, while important, fails to undermine the proposed model of IBE for law. Wedding explanatory coherentism to a responsibilist conception of legal justification and recognizing the defeasible nature of IBE allows us to put worries about bad lots to rest. IBE, I hope to have shown, is thus a promising alternative to the problematic Bayesian model of legal proof.

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