A System for Expressing Belief About Facts in Civil Trials

João Marques Martins
University of Lisbon – Law School

Abstract Over the last decades, computer science, cognitive sciences and some branches of philosophy have given a great deal of attention to human reasoning. It is fair to say that in some of these research fields at least two different, though maybe not irreconcilable, currents of thought are well-defined: *bayesianism* and *coherentism*. Not surprisingly for those who are acquaint with judicial reasoning about the facts, researchers on those fields found in the court of law a quite rich environment either to test or demonstrate their theories.

There is a good reason to regard this intromission as providential, desirable or at least worthy of attention. Constructing, justifying and expressing inferences of fact in the probative context both of civil and criminal trials represent a challenge to the judicial actors. Whereas some Bayesianism and coherentism inspired tools are considered suitable to assist the trier of fact in performing those tasks, the pertinence of these approaches under a jurist perspective is self-evident.

They face however some well-known difficulties. To the intervention of Bayes' theorem has been opposed, for instance, the inadequacy of jurists' academic background and the frequent lack of probabilistic data to feed the relevant algorithms. Concerning coherence, the critical problem lies in its vagueness, which should be considered a grave adversity as soon as we acknowledge that a judicial procedure is deemed to be a dialectic event where the clearness and accuracy of arguments play an important, if not essential, role. Some authors have, notwithstanding, tried to demonstrate that some of these problems (and others not referred above) can be overcome.

At the present time, an old and fundamental question persists: are these techniques useful tools that should assist the trier of fact in constructing, justifying and expressing his reasoning?

This paper is certainly inspired by this question, albeit not being its aim to answer it. In the following lines it will be suggested that at least some of the goals addressed by the aforementioned Bayesian and coherentist approaches are achievable by means of a simple judicial communication / argumentation system. A draft of such a system will be put forward. It consists of seven static and seven dynamic intertwined rules. Their content is in part determined by the principle according to which belief is updated given new evidence and in part influenced by civil procedure law.

Subsequently, an empirical illustration of the system´s applicability is presented using data from a real case.

In a nutshell: this paper suggests that as an alternative to a purely epistemic method of treating evidence in court is conceivable a system of communication rules, i.e., a heuristic device for internal and external clarification of the decision's grounds that, once accepted by the parties, paves the way to a fertile and productive debate on evidence and facts.

Keywords Argumentation theory; Evidence; Inductive reasoning; Expressing belief; Bayes' theorem; Coherence.

1. Some well-known difficulties of the Bayesian and coherentist approaches

I – Bayes' theorem plays a vital, though not undisputed, role in modern confirmation theory in the fields of epistemology and philosophy of science. Additionally, over the last three or four decades its applicability to the weighting of evidence in judicial context has been seriously cogitated. It is not difficult to understand why. In modern legal systems, decisions concerning the facts submitted to

trial are only considered legitimated when supported by evidence. Therefore, describing and explaining belief updating about facts given new evidence have become daily activities for the judge.

However, even if Bayes' theorem or, more accurately, Bayesian Networks prove to be an adequate tool to map, replicate or assist human reasoning, the generalization of a pure mathematical and probabilistic approach to fact-finding and/or to weighting of evidence within the judicial context still faces some well-known problems, namely: ***(a)*** technical complexity; ***(b)*** unavailability of relevant data.

(a) In general, judges and lawyers' academic background is insufficiently achieved in theory of probability to prepare them for what Bayes' realm has to offer. One may try to overcome this obstacle by noticing the availability of software capable of doing the mathematical calculus the use of Bayesian Networks involves. Yet, more often than not the inextricable problem lies in understanding the system of interpretation that we bring to bear on the facts in order to convert them in data suitable to apply Bayes' theorem. Indeed, this preliminary step requires a rather complicated procedure through which a fraction of the world is put into a formula and then another fraction of the world is extracted from that formula: the task description will certainly induce a sense of fear rather than of persuasion in a conventional jurist.

It is however fair to underline that some of these and correlated problems have been addressed and, perhaps, mitigated by some authors: see e.g. FENTON/NEIL (2013: 407 ff.).

(b) Probably the most conspicuous obstacle to a generalization of a Bayesian weighting of evidence is the lack of data [e.g. p(*h*), p(*e*/*h*) e p(*e*)], when there is no quantified information available. Some flexibility shall be accepted regarding p(*h*). The judge should be able to establish it based only on subjective considerations. Furthermore, in a certain defensible perspective, the legal system determines p(*h*), prescribing the principle of impartiality or, probabilistically speaking, the principle of indifference. However, by granting this flexibility we are not solving that much: p(*e/h*) and p(*e*) still need to be found. In what concerns p(*e*) the problem may be mitigated given that p(*e*) = p(*h*) x p(*e/h*) + p(~*h*) x p(e/~*h*) and that p(~*h*) = 1-p(*h*). That is all, but to be accurate it is not enough. If information is lacking, we are supposed to guess p(*e/h*) and p(*e/~h*). Even for those who favour a relaxed subjective interpretation of probability it seems hard to understand what kind of control could be imposed in order to, at the end, p(*h/e*) be regarded as a belief supported by evidence and not simply as a belief supported by a belief in evidence. The foundational problem is quite manifest and challenging.

This obstacle is surely at the basis of a common feature of the literature [e.g.: SCHUM (1999:578ff.); FENTON/NEIL (2013: 407ff.); CHARLOTTE et al (2014: 278ff.)] that takes seriously the Bayesian system and goes behind toy examples: normally it takes under consideration criminal cases. In this context, the presence of DNA tests, fingerprints or any other scientific evidence, which are quantified or already translated to the language of probabilities, grants a credible source of information to feed Bayes's theorem. This kind of evidence is nevertheless very uncommon in a civil trial.

Again, it shall be stressed that the relevant literature has done quite a pertinent and to some extent well--succeeded effort to diminish the deepness of the problems referred above. See e.g.: HILL (2013); BEX (2015); KEPPENS (2016); VERHEIJ (2017).

II – Developments on the notion of coherence and its epistemological applicability, namely regarding the selection of the best theory within the context of Inference to the Best

Explanation (IBE), are due to Paul THAGARD, among others. At the beginning of his research he worked with a list of atomic virtues that may be detected in scientific explanations. They would provide the quantitative and qualitative criteria that subsequently allow the comparison between those explanations by means of judging which one revealed the best or more balanced set of virtues. Later on, THAGARD (1989) introduced the idea of Explanatory Coherence, which came to be a comprehensive notion capable of encapsulating and simultaneously establishing relations between different features (i.e. virtues) of a scientific theory. This could be regarded as a useful tool to work, for instance, with IBE, for the best hypothesis shall be the one that presents higher Explanatory Coherence. THAGARD's reflections called the attention of lawyers because he tried to apply his method to the problem of fact-finding and evidence weighting in trials, giving examples of how it could be done in real cases [see THAGARD (2004: 237-9) and (2005: 305-306)]. Similarly to the Bayesian Networks approach, Explanatory Coherence may result in an algorithm, a computational model.

The appeal of coherence did not reach only those who have in mind a computational project for mapping or even decrypting human reasoning. Actually, some jurists have invested quite a relevant effort on converting coherence in an argumentative tool suitable to epistemically justify judge's decisions. It is with this purpose that AMAYA puts forward the idea of optimal coherence. The notion may be described as follows: judge's belief concerning the facts shall be considered justified whenever optimal coherence is reached, i.e., every time the belief can be regarded as that a responsive judge would acquire in result of maximizing coherence, in the same circumstances [AMAYA (2013): 4]. In what concerns the notion of coherence AMAYA inherits some of THAGARD's ideas and simultaneously brings in a few innovations, introducing amendments regarding the legal framework [AMAYA (2013: 5-14)]. In relation to the responsive decision--maker, AMAYA (2013: 25-6) specifies the characteristics he should present and tries to, though abstractly, describe him in an accurate way.

Shall (optimal) coherence be regarded as a (or the) virtue of a good (right) decision about the facts? The efforts of those who would presumably answer affirmatively to this question were not capable of avoiding the sense that only a small, far from decisive, progress has been accomplished. Indeed, old problems regarding coherence conceptual vagueness seem not to be solved, despite significant improvements achieved in this respect. Therefore, at stake is not so much the quality of the accomplished outcome, but the overrating of coherence, namely when we are invited to take it as the axiom of epistemic justification in legal context.

III – It could be debated whether recent and future developments on Bayes' theorem and coherence had (or will) convincingly overcome some of the difficulties put forward in the precedent paragraphs (as well as others not referred). Yet, it is not the aim of this paper to decide whether a Bayes' theorem or coherence based analysis of evidence is both sufficient and generalizable. The goal is instead to suggest that an argumentation--communication set of rules, that avoids some of the problems affecting Bayesian and coherentist approaches, can perhaps be seen as a suitable tool to explicate the underlying epistemic support of decisions of fact in the context of civil trials.

2. A system for expressing belief about facts in civil trials

I – THAGARD [(2004): 242-3] held that his model describes (or captures) the inferences carried out by the judge better than the Bayesian Networks. According to

one of his main arguments, psychological research shows that degrees of belief do not conform to probabilistic calculus, rather it seems more plausible that human beings put their degrees of beliefs into qualitative states, i.e., strong or weak belief, strong or slight doubt. If this is a good argument, if this psychological theory is coherent, then it is a quite severe straw in a Bayesian approach to human reasoning.

However, one may feel legitimated to ask whether such assertiveness is supported by a sound epistemic ground. Perhaps we are dealing with the limits of human understanding as regards to our method of reasoning: we are only trying to find the best way forward, and not making a safe journey guided by a well-defined map. Some of us will ascertain inclination to weight evidence in a probabilistic manner, chiefly when quantified evidence is involved; others feel closer to a more coherentist or holistic approach. But few would be willing to assure their fidelity to one or another method in all circumstances. This hesitation may indicate that the final theory will reveal a complex cluster of intertwined rationalities, each of them gaining preponderance in different moments of the path towards the formation of an epistemically grounded belief: this very outcome seems to be implicit in the theories put forward, for instance, by BEX [2015] or VERHEIJ [2017].

II – Alongside (or beneath) the ambitious projects that intend to model or replicate human reasoning it is possible to create an operative and, at least under a jurist perspective, simpler system that can be considered and work as a communication tool. The project is then to create a set of elementary rules of argumentation that assist the trier of fact in handling the herculean task of explicating and justifying his decision. Judges complain of not being able to clearly express the grounds of their belief: it is often heard that the trier of fact is guided by some sort of intuition. This kind of solipsism or hermeticism is, however, in contradiction with the essence of judicial procedure.

This paper addresses this specific problem. The goal that is now being pursued consists no longer (or not mainly) in structuring and ruling the formation of an epistemically grounded belief, but instead (or mostly) in finding a way to bring clearness to the dialectic dispute at court, which means to set some fundamental rules of discourse and consequently enable debate.

The system to be proposed rests upon the three following cornerstones: *(i)* In general, epistemic justification of a decision about the facts in judicial context, especially when inductive inferences play a role, is obtained if and only if, during the construction of a belief, the rules of a validation system implicitly accepted by the parties involved are observed; *(ii)* The only indisputable rule to be found in the various possible configurations of such a system is the one that prescribes to evidence the role of confirming or refuting the versions of fact submitted to trial; *(iii)* Whereas the communication system to be presented is conceived to operate in the context of civil trials, it will reflect the idiosyncrasy of the civil procedural law, and therefore some structuring concepts as the burden of allegation and the burden of proof will play a role.

The first two principles determine the system's epistemic grounds; the third one defines its structure.

Before going any further, it is convenient to clarify two aspects: *(i)* Numbers will be convened to play a part. Why is that? Indeed, a belief is a dynamic and gradual entity whose intensity oscillates with evidence. Therefore, if we are looking for tools to communicate this kind of variations, numbers arise as obvious candidates. However, it should be made clear that their intervention is only but sufficient and not also necessary;

colours would be also a suitable choice. *(ii)* The arithmetic involved is to be regarded as a *way of saying* and not as a *way of doing*.

III – This said, I postulate:

A - Static Rules:

(i) The degree of epistemic support (*Des*) of a certain representation of fact (i.e. hypothesis) is expressed by numbers (limited to a decimal place) between 0--100;

(ii) It can be established a *Des* under which a *non liquet* situation obtains; I shall postulate 75 (in accordance with the Civil Law tradition);

(iii) At least two representations of fact must always be in dispute and shall be denoted by *h*, *~h* (or h_1, h_2);

(iv) To each party shall be assigned only one hypothesis: *h* or h_1 denotes the version of the facts brought by the party that bears the burden of proof, normally the plaintiff; *~h* denotes the set of all possible hypotheses but *h*, and shall be used whenever the party, normally the defendant, challenges *h* only by means of denying its veracity; h_2 denotes a version of the facts (presented by the defendant) different and incompatible from/with h_1;

(v) A *Des* shall be assigned to each hypothesis;

(vi) The sum of all *Des* shall be equivalent to 100;

(vii) It must be assigned an initial *Des*, i.e., independent from evidence, to each hypothesis submitted by the parties. The initial *Des* of each hypothesis is 50. Where allowed by procedural rules, suitable arguments may be presented in order to assign to a given hypothesis an initial *Des* superior or inferior to 50.

B – Dynamic Rules:

(i) Each piece of evidence shall be to each hypothesis in a relation of confirmation or refutation;

(ii) A degree of confirmation or refutation reinforcement (to be respectively denoted by *Dcr* or *Drr*) shall be assigned to each piece of evidence relative to each hypothesis in dispute;

(iii) *Dcr* and *Drr* should be expressed in numbers (units) between 0-100 and -100-0, as the case may be confirmation or refutation;

(iv) Each *Dcr* and *Drr* implies an arithmetic variation of the *Des* associated to each hypothesis;

(v) This mechanism should not breach the above-mentioned rule A-(vi); therefore, the confirmation or refutation of one hypothesis by evidence must be symmetrically reflected on the refutation or confirmation of the other hypothesis;

(vi) The *Dcr* and the *Drr* (as well as their quantification) provided by a given piece of evidence regarding a certain hypothesis must always be substantiated, appealing in particular to the so-called rules of experience, generalizations, *id quod plerumque accidit* or *res ipsa loquitur*. The judge is only exempted from this duty of justification whenever the confirmation or refutation effect is caused by the symmetric adjustments prescribed by rule B-(v) in order to observe rule A--(vi);

(vii) The *Dcr* and the *Drr* induced by a piece of evidence epistemically equivalent to another one already considered should be 0 (e.g.: two concordant opinions brought by the same expert are not to be valued twice).

IV – The structure and content of this system do not allow the inference according to which judge's belief about the veracity of a given hypothesis is quantifiable, nor that the decision on the facts should be seen as a result of, in this case, rudimentary arithmetic operations. This system should be rather seen as a heuristic device for internal and external clarification of the decision's grounds, i.e., an argumentation tool for evidence in judicial context.

I believe it is fair to acknowledge the following virtues to the proposed system: *(i)* It is simple and operative; *(ii)* It precisely captures and marks off the field, actually wide, of potential disagreement between those who take part in a civil trial (essentially the plaintiff, the defendant and the judge): it is bounded by the decision of granting (and quantifying) a degree of confirmation/refutation reinforcement to a piece of evidence relative to a certain hypothesis*; (iii)* It compels the trier of fact to order and test his reasoning, i.e., to put under a critical perspective the grounds of his decision.

The system's disadvantages should not be disguised. One that appears to be quite conspicuous is the lack of a global, holistic, weighting; the system seems to be exclusively based – it may be held – on an atomistic approach to evidence. However, what has been proposed is not in any way unable to coexist with a more general valuation of the adduced evidence. And as far as this sort of global assessment does not impair the principle according to which decisions made by public authorities must be intelligible for its recipients, there should be no problem in adopting it as a complement.

3. Applying the system to a real case[1]

I – The framing of the facts is, briefly, the following: *(i)* *β* was staying at a guesthouse; *(ii)* in a particular morning, about 9 a.m., in her way down, *β* jammed her leg in the iron bars protecting the stairs and supporting the handrail, when using the guest house's outdoor stairs; *(iii)* by jamming her leg in the bars, she scratched her shin, in the tibia area, giving rise to an injury and consequent bleeding; *(iv)* at the moment of the accident, *β* was standing behind her husband who was also going downstairs.

In court, it was debated whether the owner of the guest house should be ordered to compensate *β* for all damages incurred. In this scope, the possibility of contractual or tort liability was also discussed. In relation to the latter, the argument was that the stairs at issue were not complying with some safety standards: its steps were not equipped with anti-skid protection.

Apart from this qualification perspective, as it is not significant for our purpose, we must note that the following issue was evoked for the centre of the debate on the facts: had *β* slipped, and then, as a result, jammed her leg in the bars; or was *β* distracted when walking, losing her balance, and then, as a result, jammed her leg in the bars? This question is surely pertinent, because if the second hypothesis is true, the hypothetical preventing effect of the presence of anti-skid protections in the staircase would have to be rejected, resulting in the ruling out of wrongfulness and, consequently, of liability. *β* defended the first version; the owner of the guest house advocated for the second version.

II – The published decision includes the following facts/evidences, relevant for the decision regarding the question above:

(i) The stairs were made of marble and, as per the statement of *β*'s brother-in-law, also a guest at that same site, its surface was "very smooth";

(ii) Its steps were lacking anti-skid protection;

(iii) None of the witnesses heard during trial said that there was condensation in the stairs at the moment of the accident;

(iv) As a witness, *β*'s husband stated that: "*(…) I was coming downstairs, ahead of my wife, when she suddenly grabbed me; she didn't fell on the stairs; when I looked back, she had her leg jammed in the bars; she was behind me; I don't know how she got her leg jammed in the bars (…)*". He further added that *β* had told him she had slipped;

[1] Decided by the Court of Appeal of Guimarães - Portugal (12.01.2012 | Procedure n.º: 349/10.4TBAMR. G1) (www.dgsi.pt).

(iv) A few days later, two of the witnesses stated that they had heard *β* telling the guest house owner in conversation that she had lost her balance when combing her husband's hair, hitting the bars with her leg.

III – All facts described, plus the epistemic claim determined by the legal solution to this case, undeniably require the use of an abductive reasoning: note that the goal here is to determine which of the two potential and mutually excluding causes of an event has occurred.

This said, available data will be analysed using, for such purpose, the previously suggested communicational system (which is herein deemed as known).

The explanatory hypothesis presented by *β* will be designated as h_1 and the explanatory hypothesis presented by the defendant will be designated as h_2. Initial *Des* for each hypothesis is 50.

Thus, let us proceed to the analysis of the available evidence:

(i) The fact that the stairs are made of marble favours *β*'s thesis. Indeed, experience tells us that, in general, decorative marble is polished, turning into a smooth rock, therefore creating no significant friction when mobile surfaces, namely, shoe soles, come in contact with it. Anyhow, marble is not ice: most people walking in marble do not slip. But, it is acceptable that marble enables accidents like the one described by *β*, due to its physical characteristics.

We can further add to these considerations that *β*'s brother-in-law has testified that the stairs were too smooth, reinforcing the assumption arising from the experience, therefore invalidating the hypothesis that the marble at issue might not be polished.[2]

Lastly, we must note that the fact that stairs are made of marble does not invalidate h_2.

Based on these considerations, a *Dcr* of 30 shall be assigned to this evidence, regarding h_1, wherefore the *Des* are reviewed as follows: $h_1 = 80$; $h_2 = 20$.

(ii) The absence of anti-skid strips does not reduce friction, it just does not increase it. Also, the epistemic strength of the above described reasoning remains unchanged due to the absence of anti-skid strips. Marble stairs are not more dangerous because they lack anti-skid strips. Consequently, this evidence does not confirm nor refute any of the hypotheses being tested.

(iii) Assuming the credibility of those who have testified, stairs were not damp. This element, as the previous, does not favour any of the theses. Note that the dangerousness of the stairs does not increase nor decrease in relation to the determination made in *(i)*. Consequently, in the same way that it would not be epistemically correct to value the evidence described in *(ii)* in favour of *β*, it would not be correct to do it now in favour of the defendant.[3]

(iv) *β*'s husband testimony is, presumably, irrelevant. He is not aware if his wife has lost her balance or if she has slipped, which is in accordance with the fact that he was moving in front of her, i.e. with her on his back. Actually, it would be odd if he was able to describe the event: according to common experience, no one is able to see behind their back.

[2] Assessing witness credibility does not seem viable in this exercise. However, it is hereby added that, in theory, for this consideration, the witness bond in relation to *β* would have to be negatively (though not decisively) accounted for.

[3] An example would be useful, in case the irrelevance of the evidence described in *(ii)* and *(iii)* is not clear. Let us say *α* is walking in open land when it starts raining. What is the probability of *α* becoming wet? Assuming he may take shelter in a hut at a distance of 300m., we would say the probability is ≈0,8. And what is the probability of *α* becoming wet, given he was not carrying an umbrella? ≈ 0,8. I.e., the evidence for the non-occurrence of certain facts is irrelevant to the creation of a belief epistemically based on an event that has taken place. However, it shall not be forgotten that the Law is sometimes interested in knowing if the positive counterfactual would or would have not decreased (and to which extent) the probability of said event taking place.

Apparently, β has subsequently told her husband how the accident took place, having said that she has slipped. Must that be taken into account? The question may be raised in these terms: how to value a testimony whose content is "*p* has taken place" if it is not expectable that, if *p* had not taken place or *q* had taken place instead, testimony content would be "*p* did not take place" or "*q*, instead of *p*, has taken place"? I believe that, in principle, it cannot be valued. It is not hereby suggested that, in general, the statement of the spouse of any of the parties lacks epistemic value; it will all depend on the circumstances. However, when the described event, like this conversation between β and her husband, is simple and brief (therefore complicating incoherence detection), and from the reverse of the actual testimony would almost necessarily result that the plaintiff is not entitled to damages, as it would happen with β, then there are insufficient grounds to say it has epistemic value.

(v) Lastly, there is also the testimony of two witnesses who have heard β talking to the guest house owner, saying that she had lost her balance while she was combing her husband's hair. Valuing this testimony would depend on witness credibility, as well as on the answer to the following question: for which reason and under what circumstances did they hear the conversation between β and the owner? Naturally, this cannot be assessed herein. Anyhow, if said credibility is high and if the clarification regarding the context within which the knowledge was obtained is plausible, we must grant significance to this evidence. Note that we are talking about two witnesses and not just one, with this evidence being further reinforced, if they are independent (e.g. are not acquainted with each other).

Moreover: it is expected that a conversation between β and the owner would take place, because the latter would have wanted to know how the event had taken place; if β has not slipped and has lost her balance instead, it would be reasonable that, back then, free from proceeding partiality constraints, she has spontaneously revealed to the owner a version that hinders her present claim.

This said, I believe this evidence implies a *Dcr* of 40 regarding h_2, wherefore the *Des* are reviewed as follows: $h_1 = 40$ $h_2 = 60$.

Thus, and according to the available evidence, the best explanation seems to be h_2. This is not surprising at all as the only evidence β produced in favour of her thesis was the reference to the physical characteristics of the stairs. As none of the hypotheses reached a *Des* equivalent or superior to 75, the decision content would be depending on the direction determined by the rules regarding burden of proof.

More significant than the final result of the exercise is the point made by the method applied to execute the exercise and obtain the result: in fact, the argumentative effort to justify the assignment (or not) of a certain *Dcr* or *Drr* to a piece of evidence relative to each hypothesis enables a transparent and intelligible debate between the judge and the parties as well as between the judge and the Court of Appeal or the Supreme Court.

- ***Concluding remarks***

In modern democratic societies and legal systems, the trier of fact is bound to justify and give an account of his (presumptive) reasoning on evidence and facts.

Bayes' theorem and an analytic coherence seem promising candidates to aid judge executing that task. However, jurists' lack of sufficient mathematical knowledge and the common absence of evidence expressed/represented in the language of probabilities may jeopardise the general acceptance of Bayes' theorem in civil trials. Concerning coherence, its vagueness still remains a critical problem. In the meanwhile, theories integrating different kinds of rationalities (e.g.

probabilities, stories and arguments) seem to overcome some of those issues and promise to play a decisive role in the analysis of judicial evidence.

The goal of this paper was not to assess the evolution of the epistemic approach to evidence in judicial context, but instead to suggest that a different perspective of the problem, one that puts at the centre the communicational and the argumentative dimension, is also valid and deserves attention. Indeed, the judicial process is a dialectic event where the parties and, particularly, the judge have to make their reasoning clear enough to allow a fruitful and efficient debate.

Bearing this in mind, it was proposed a set of simple and manageable rules of communication specifically conceived to express judge's reasoning on evidence and facts, as well as the support of the achieved outcome. This set is composed by seven static and seven dynamic rules. The epistemic dimension of the resulting system of communication is permeated by the principle according to which belief is a dynamic and gradual entity whose intensity varies with evidence. The system's structure is to a significant extent determined by crucial notions of civil procedural law such as the burden of allegation and of proof.

The adoption of this system is supposed to bring, at the end, the following outcome: a decision about the facts that is well--founded and comprehensible for the rest of the parties in a lawsuit, as well as for the judges of a Court of Appeal or of a Supreme Court. This is crucial because it will provide the context for a rational and efficient debate.

The application of the proposed system to a real case showed how the aforementioned outcome can be achieved.

References:

- AMAYA, Amalia (2013) – Coherence, Evidence and Legal Proof. *Legal Theory*, 19(1):1-43;
- BEX, Floris (2015) – An Integrated Theory of Causal Stories and Evidential Arguments. *Proceedings of the 15th International Conference on Artificial Intelligence and Law*:13-22;
- CHARLOTTE, S. Vlek | PRAKKEN, Henry | RENOOIJ, Silja | VERHEIJ, Bart (2014) – Building Bayesian networks for legal evidence with narratives: a case study evaluation. *Artificial Intelligence and Law*, 22: 375-421;
- FENTON, Norman | NEIL, Martin (2013) – *Risk Assessment and Decision Analysis with Bayesian Networks*. CRC Press;
- HILL, Brian (2013) – Confidence and Decision. *Games and Economic Behavior*, 82: 675-692;
- KEPPENS, Jeroen (2016) – Explaining Bayesian Belief Revision for Legal Applications. *Legal Knowledge and Information Systems*: 63-72;
- SCHUM, David A. (1999) – Inference Networks and the Evaluation of Evidence: Alternative Analyses. *Proceedings of the Fifteenth Conference on Uncertainty in Artificial Intelligence*: 575-84;
- THAGARD, Paul (1989) – "Explanatory Coherence". *Behavioral and Brain Sciences*, 12 (3): 435-502;
- THAGARD, Paul (2004) – Causal Inference in Legal Decision Making: Explanatory Coherence *vs.* Bayesian Networks. *Applied Artificial Intelligence*, 18: 231-49;
- THAGARD, Paul (2005) – Testimony, Credibility and Explanatory Coherence. *Erkenntnis*, 63: 295-316.
- VERHEIJ, Bart (2017) – Proof with and without Probabilities. *Artificial Intelligence and Law*, 25:127-154.

Lisboa, 10th June 2017