

# Forensic evidence and the story-model of jurors' decision-making

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## Abstract

The primary goal of this paper is to present the main tenets of Pennington and Hastie's (1986, 1988, 1992, 1993) "story-model" of jurors' decision-making, and to draw a few criticisms thereof, in the light of an analysis of evidential reasoning. A particular focus will be put on how forensic evidence might be processed by jurors in their reasoning and decision-making process. Empirical questions will be raised, for which an experimental program will be sketched.

**Keywords:** Philosophy; Psychology; Reasoning; Decision-Making

## Introduction

The story-model advocated by Pennington and Hastie (1986, 1988, 1992, 1993) is now among the most widely accepted views of jurors' decision-making. In a nutshell, it states that jurors in criminal trials make sense of the evidence presented to them through the construction of a mental representation of the events, rather than through the estimation and combination of probabilities. Moreover, such "story", which consists in a causal explanatory scenario of the crime, drives their choice of a verdict. One implication of this model is that, the more narratively the evidence is presented to them at trial, the more confident they will be in reaching their verdict.

The main goal of this paper is to propose a critical clarification of some aspects of the story-model, in the light of an analysis of evidential reasoning. Drawing from categories proposed by Schum (2004), and in the line of Lagnado's work on legal reasoning (e.g. Lagnado & Harvey 2008, Lagnado 2011, Lagnado *et al.* 2013, Lagnado & Gerstenberg 2016, Connor Desai & Lagnado 2016), a particular focus will be put on how forensic evidence might be processed by jurors according to the story-model. This will finally open up experimental questions, which are the object of an experimental program in progress.

## Jurors' reasoning: preliminary remarks

How do jurors in criminal trials make sense of the evidence presented to them? And how do they reach a decision? Before presenting what the story-model has to tell us on

those issues, let us first highlight a few important points about the jurors' task in criminal trials.

## Specificities of the jurors' task

Contrary to what is the case in everyday reasoning and decision-making, the jurors' task is to make sense of evidence that has already been gathered and selected by others. Jurors are not in charge of the inquiry, and they are explicitly instructed to ignore any evidence they might have heard of, if this hasn't been considered admissible by the court. Based on the available, admissible evidence, they must make a decision, which can be, *prima facie*, decomposed into two steps: *a.* form a belief regarding what happened; *b.* reach a verdict based on this belief, and on the specific instructions regarding verdict categories and standards of proof.

## Types of judicial evidence

Evidence presented at trial, either by the prosecution or the defense, can be of different sorts. Although there are finer-grained subdivisions, the main two types are testimonial, and physical (tangible) evidence.

Testimonial evidence refers to the pieces of evidence reported by witnesses. It is typically obtained through the mediation of someone else's words.

Physical (tangible) evidence refers to the pieces of evidence consisting of material traces to which the jury may have a direct perceptual access: bleeding knife, video recording, photographs, etc.

The case of forensic evidence is intriguing, since it has to be physical in its origin (DNA traces, fingerprints, tire marks, etc.), but the piece of evidence presented in trial rather consists in an expert witness' report, which is the result of a sophisticated interpretation of the original material traces. Although forensic evidence is generally considered as physical evidence, the mediation of the expert's interpretation raises specific questions concerning its credibility and probative value.

## Credibility, relevance, and inferential force of evidence

Part of the jurors' task is to evaluate the probative value of the evidence presented to them. As proposed by Schum (2004), the probative value of a piece of evidence can be decomposed into its credibility, relevance, and inferential force. Let us briefly present Schum's categories.

**Distinction between evidence and events** Schum distinguishes between  $E^*$ , an item of evidence, which can be a material trace, a scene, a report made by someone (strictly speaking, it is rather a subject's perceptual experience thereof), and  $E$ , which is the fact or event to which  $E^*$  attests. If  $E^*$  is a witness' report that the accused had an argument with the victim the day before the victim's death,  $E$  is the fact that they had this argument.

**The probative value of evidence**  $E^*$  (the report) is evidence (has probative value) for the hypothesis  $H$  that the accused has murdered the victim (*i.e.* it provides reasons to hold  $H$  true, or at least likely) on several conditions. First,  $E^*$  has to be *credible*: the inference from  $E^*$  to  $E$  has to be secure. The credibility of  $E^*$  depends on several criteria, among which the trustworthiness of the witness (her cognitive abilities and sincerity). In the case of tangible evidence, credibility depends, among other things, on authenticity. Once  $E$  can be taken for granted based on  $E^*$ , the second branch of the evidential value of evidence consists in the *relevance* of  $E$  to  $H$ : if  $E$  is the case, does it make  $H$  more or less likely? Finally, one must evaluate the inferential force of the evidence: How much does the truth of  $E$  increase the likelihood of  $H$ ?

**The case of scientific evidence** Issues of credibility, relevance, and inferential force arise in a specific way in the case of scientific (forensic) evidence. Consider a forensic report about DNA found at a crime scene. Many aspects of its credibility concern the material nature of the evidence: Has the DNA sample collection been correctly performed? How was the chain of custody from crime scene to lab? Other aspects have to do with the quality of the biological analysis that was performed. But whether the margin of error, and the specificity of the methodology employed that may allow for errors of a certain kind while controlling for others, belong to the credibility side, or to the inferential force (what can be inferred from the result of the analysis) is a tricky question. In principle, expert witnesses are expected to deliver the result of their analysis without drawing any conclusion beyond. However, they cannot provide too many scientific details about their methodology. The extent to which they take responsibility of categorically asserting some conclusion (which is at most highly probable) somehow sets the boundary between what pertains to the credibility side and what pertains to the inferential force side. For example, whether they state that there is a match between a DNA sample collected on the crime scene and the accused's DNA, or that the DNA found on the crime scene is the accused's DNA, for instance, makes a huge difference from this point of view. The debates on whether forensic

experts should use statistics in their reports to the jury are closely linked to this issue. However, they are beyond the scope of this paper.

What is of direct interest to us here, is that the requirement that experts should not draw any inferences about the crime itself, but only present their scientific conclusions makes scientific evidence much less narrative than testimonial evidence (provided by lay witnesses): some additional effort (often provided by the prosecution or the defense) needs to be done to make a piece of scientific, probabilistic evidence part of an explanatory scenario.

## The narrative aspect of testimonial evidence

As emphasized by Heller (2006), testimonial evidence, on the other hand, is intrinsically narrative. Being reported in first person by lay witnesses, it is often more vivid and concrete, while scientific evidence is abstract in nature. Testimonial evidence, moreover, can be direct evidence, while scientific evidence has to be circumstantial.

Because it is intrinsically narrative, testimonial evidence is much more readily accommodated within a story. From the perspective of the story-model, it is thus to be expected that testimonial evidence should weigh (relatively) more in jurors' decision than forensic evidence.<sup>1</sup> Even more, as we will see, the relative credibility and inferential force of either should not matter much in decision-making.

Since testimonial, direct evidence, such as confessions or eyewitness identification, is notoriously unreliable, this is a problem from a normative point of view. But is this really empirically true? How do jurors actually process information from scientific expertise? After presenting the main tenets of the story-model, we will address these questions as a way to highlight the limits of this model.

## Pennington and Hastie's story model: core theses and empirical evidence

The following presentation of the story-model is based on Pennington and Hastie's papers (1986, 1988, 1992, 1993).

### Core theses

**Story construction** The main, fundamental claim of Pennington and Hastie's is that jurors spontaneously impose a story-structure on the evidence. This is often prompted by the prosecution or the defense addresses, whose job is to organize evidence so as to make it fit an inculpatory/exonerating scenario. However, Pennington and Hastie's claim goes further: the very process of making sense of information consists in the construction of a causal, explanatory, mental model of the events. A story is thus a "mental representation of the evidence that constitutes an interpretation of what the evidence is about, incorporating

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<sup>1</sup> Heller (2006) refers to the story-model to provide an explanation of the so-called "Wells effect" (see Wells 1992) — namely that jurors are more likely to convict based on testimonial, narrative evidence, than on scientific, statistical evidence, even if it is probabilistically more incriminating.

inferred events and causal connections between events in addition to relevant evidentiary events.” (1988, 521)

Stories are composed of sub-stories called “episodes”, which are made of causal links between physical and mental events (typically goals, intentions, and beliefs).

**Evidence evaluation is mediated through story construction** Another fundamental claim is that organization, interpretation, and processing of evidence is *mediated* through story construction. In constructing a story, jurors choose what evidence to believe, and they may complement it with inferences based on their background knowledge. Hence, they don’t use all the evidence available to them, and they may complement it with further inferences (which are particularly important to fill in the psychological events such as goals, intentions, and beliefs).

Pennington and Hastie insist on the “distinction between the evidence presented at trial and [their] concept of verdict stories. The evidence is a series of assertions by witnesses that certain events occurred. The juror chooses to believe only some of these assertions and will make inferences that other events occurred, events that are never stated explicitly in the evidence, as well as inferences concerning causal connections between events. This activity on the part of the juror results in a mental structuring of the evidence that is the ‘juror’s story.’ (Pennington and Hastie, 1988, 524)

According to the model, the evaluation of evidence credibility, relevance, and force, is thus dependent on the story the subject constructs. This is a problematic claim, to which we will turn later.

**Verdict categories and verdict choice** The third, main claim is that the story determines the choice of a verdict. Story construction allows them to “meaningfully evaluate evidence against multiple verdict judgment dimensions”. This is done through a matching of the structure of the story with the criteria of the verdict, as enunciated by the judge. Quite notably indeed, legal verdict categories correspond to human action sequences, like stories: they explicitly refer to mental states such as intentions and goals. For example, for the qualification of “first degree murder”, there must be intent to kill, whereas there is no intent in a manslaughter.

### **Empirical evidence backing the model**

**Interview studies** Pennington and Hastie (1986) original procedure consists in interview studies based on a verbal protocol. Their goal was to “elicit data that would provide a snapshot of the juror’s mental representations of evidence and of verdict categories at one point in time” (1993). Subjects (mock jurors) were asked to talk loud while making a decision, and respond to questions about the evidence and about the judges’ instructions to the jurors.

Analysis of the verbal data concluded that the mental representations of the evidence “showed story structure and not other plausible structures” (85% of the events described in their protocols were causally linked). This was taken as

strong evidence that subjects were telling stories and not constructing arguments.

Moreover, “only 55% of the protocol references were to events that were actually included in testimony. The remaining 45% were references to inferred events — actions, mental states, and goals that “filled in” the stories in episode configurations.” “This argues strongly against the image of the juror as a “tape recorder” with a list of trial evidence in memory.”

Evidence also shows that people construct different stories from the same evidence, and that “story structures differed systematically for jurors choosing different verdicts.” This shows that the story structure influences the choice of the verdict, and not the other way around.

In 1988, they run another study to show that “stories were constructed spontaneously in the course of the juror’s performance.” This runs out the hypothesis that the story might be of a post hoc rationalization of the verdict choice.

### **Story acceptance and verdict choice**

Two steps are described in the model. The first one consists in the construction, and the acceptance of a story. The second one is the choice of a verdict. Let us see in more details what the criteria are for those two decisional steps.

#### **Story acceptance: levels of confidence and acceptability principles**

As mentioned earlier, several stories can be constructed on the basis of the same evidence (in particular, different stories might be suggested by the prosecution and the defense). Different jurors may construct different stories, and one juror may herself construct various stories. But at the end of the day, the juror is expected to make a choice and accept one story. However, acceptance of a story isn’t an all-or-nothing matter: one can accept a story with varying levels of confidence.

Both which story one chooses, and how confident one is, depend on how “good” the story is. The “goodness” of a story is assessed according to criteria called “acceptability principles”.

The first two criteria are *coverage* and *coherence*. Coverage corresponds to how much the story covers the available evidence. Despite being at the core of some influential accounts of reasoning and decision-making (e.g. Simon and Holyoak 2002; Thagard 2000), coherence has no precise and consensual definition. Pennington and Hastie define it as composed of *a.* consistency (how little contradiction there is among the elements of the story), *b.* plausibility (how much it matches background knowledge and common assumptions about how the world goes, how people act in general, etc.), *c.* completeness (how little is needed to fill in the story with additional inferred events). To these first two criteria, Pennington and Hastie add a third one, namely *uniqueness*: one unique, good, story is better than two rival ones (however good they might be).

### Verdict choice: goodness of fit

Once she has accepted a story, the juror has to assess whether, and how much, the structure of this story matches one of the verdict categories presented by the judge.

So, to sum up, the choice of a verdict is driven by how much the story that satisfies best the acceptability criteria itself matches the verdict criteria.

### Standard of proof

As is well known, jurors in criminal trials are instructed to bring a verdict of guilty when guilt has been proven beyond a reasonable doubt. Rather than a probabilistic threshold, the standard is understood here as a measure of goodness of fit: “If the best fit is above a threshold requirement, then the verdict category that matches the story is selected. If not all of the verdict attributes for a given verdict category are satisfied ‘beyond a reasonable doubt’ by the events in the accepted story, then the juror should presume innocence and return a default verdict of not guilty.” (Pennington and Hastie, 1993)

This raises several problems. One is whether this understanding of the BARD standard is normative or descriptive. If normative, what should the measure of fit look like? This clearly gives no operational definition of reasonable doubt.<sup>2</sup> Indeed, the model as such provides no clear criteria for either the required level of confidence in the story or for the goodness of fit with a verdict category.

### Story coherence and evidential value

What does the story-model tell us about the link between judicial evidence and verdict choice? As we have just seen, it is the “goodness” of a story (how much it satisfies the acceptability criteria), which makes it a good support for a given verdict. Indeed, it is the intrinsic characteristics of the story itself, not the evidential basis on which it is constructed, which bears evidential force for a given verdict: it is the story that provides reasons to choose it.

To be sure, the decision-making process isn’t disconnected from the trial evidence, as story construction is made on the basis thereof. But the link between the various virtues of a story (its coherence, coverage, etc.) and the evidential basis needs to be clarified.

### Stories are about events, not about evidence

The first thing to note is that the characteristics of a story (coherence, completeness, coverage), which contribute to its evidential strength in support of the verdict, are not characteristics of the evidential set on the basis of which it is constructed, but rather of the structure of the story itself, as mentally elaborated and represented. Coherence is coherence *of the story* (how well it fits together, and with the jurors’ background knowledge, etc.), not of the

evidential set (how little contradiction there might be between items).

### Experimental manipulation of ease of construction: presentation order

In order to manipulate coherence and completeness of the stories constructed by the jurors (as a way to test their influence on verdict choice), Pennington and Hastie have developed an experimental protocol. They influence the process of story construction (both which story will ‘win’, and how strongly it will be accepted), by manipulating what they call “ease of construction” of a particular story, which itself is made by varying the presentation order of the evidence (but not its content)<sup>3</sup>.

According to them, this has an impact on the coherence and/or completeness of the story<sup>4</sup>. Hence this impacts the confidence one has in the story, hence the verdict choice.

The protocol consists in presenting evidence regarding a trial, in two basic conditions: story order *vs* no story order, and testing the consequences on the verdict choice.<sup>5</sup>

The assumption is that stories are easier to construct when evidence order in a temporal and causal sequence that matches the original events (what they call “story order”). What counts as “no story order” is not entirely clear though: in their 1988 paper, it corresponds to the witness order, but, in 1992, the witness order is actually the story order, and the no story order corresponds to the issue order. Such difference might be explainable in terms of the content of the reports themselves; but this calls for clarification. And, empirically, what may count as story order is an empirical question that needs further inquiry.

Pennington and Hastie (1988) found that, when evidence is presented in story order, *a.* subjects make more decisions in the direction of the preponderance of the evidence (they are likeliest to convict when presentation order facilitates the construction of a prosecution story, and vice-versa), and the conviction rate is greater when more coherence: “Thus, story coherence, as determined by presentation order of evidence, affects verdict decisions in a dramatic way”. *b.* They express more confidence in those decisions when more coherence: “the coherence of the explanation the decision maker is able to construct influences the confidence associated with the decision.” (1988, 521)

In another study (1992), they replicate this effect. Subjects are presented with three consistent witnesses’ reports, and a fourth one which is inconsistent with the first three. The three consistent witnesses are presented as credible. The fourth one’s credibility varies. Results show

<sup>3</sup> That manipulating presentation order without modifying the content is possible is no trivial assumption, though.

<sup>4</sup> Completeness is sometimes taken as one component of coherence, and sometimes treated as a different criterion.

<sup>5</sup> The effect here is not supposed to be an order effect (according to which depending on whether it was presented first or last a piece of evidence will not have the same weight. One important aspect of Pennington and Hastie’s model is that evidence evaluation is a holistic, rather than sequential, process.

<sup>2</sup> See Laudan (2007) for a criticism of Inference to the Best Explanation as a candidate to understand BARD.

that credibility information about a source of testimony has more impact in the story order condition. As a conclusion, “ease of story construction mediates perceptions of evidence strength, judgments of confidence, and the impact of information about witness credibility.” (1992, 202)

### **Evidence credibility, coherence, and inferential force evaluation**

Pennington and Hastie make a strong claim regarding the evaluation of the credibility of evidence: its importance is *mediated by story construction*, and *determined by the coherence of the story*.

This claim seems to be extendable to evidential strength, although they don’t test it: “The perceived strength of the evidence for or against a particular verdict decision is a function of the completeness of the story constructed by the juror”. (1992, 196).

Hence, it is really the structure and characteristics of the story itself which drives evidence evaluation, and not the other way around: “Story coherence as determined by the presentation order of evidence affects perceptions of evidence strength, verdict decisions, and confidence in decisions.” (1988, 529) This is a highly controversial claim, both from a normative, and from a descriptive point of view.

### **Limits of the model**

One of the declared goals of the model is to provide “a psychological account of the assignment of relevance to presented and inferred information” (Pennington and Hastie, 1993). However, as just emphasized, it consists in making evidence evaluation conditional on story construction. This claim calls for a thorough examination, both from a normative, and from an empirical point of view.

### **No account of evidential reasoning**

The story-model, as such, does not provide us with an account of evidential reasoning, understood as an activity aimed at administrative, and evaluating proof.

**No clear distinction between evidence and events** Jurors construct stories *about events*. In Schum’s notation, they either mentally represent *E*, or not. But they do not reason about *E\** as a piece of evidence: how credible it is, how good a reason it provides to assume that *E* actually happened. At least, this evidential reasoning is not accounted for by the model.

From this perspective, the story-model appears as very different from accounts on evidential reasoning that take as a central task evaluation of credibility and probative force of evidence (such as the Bayesian approach, and more generally any probabilistic approach). Indeed, as we have just seen, according to the story-model, what counts as reason to accept a story, and choose a verdict, is only indirectly related to credibility and strength of evidence. Rather, it is the story which is the bearer of the evidential strength, in support of a verdict.

**Why is it a problem?** As such, this might not be taken as a strong objection to the model: quite the contrary, one of the findings put forward by the advocates of the story-model is that, contrary to what probabilistic approaches claim, the evaluation of evidence credibility and strength is *mediated* through story construction.

However, the lack of light shed on evidential reasoning is a problem because *a.* coherence and other acceptability criteria are not sufficiently well defined: the very process of story construction isn’t clear enough to understand why, and how, jurors “choose to believe some assertions rather than others”: “The perceived importance of a piece of evidence is determined by its place in the explanatory structure imposed by the decision maker during the evidence evaluation stage of the decision process.” (1988, 527) This sounds like a circular process: where does the explanatory structure come from, if not from the consideration of the evidence, and the evaluation of its importance? What drives the choice of a given piece of evidence? How is evidence chosen for the construction of a story, if it is the story which drives evidence evaluation? *b.* they are not even totally clear about the fact that stories as explanations are explanations of facts and not of evidence. See, for example, the ambiguity: “decision makers begin the decision process by constructing a causal model to explain the available facts” (1988, 521), but “the decision maker constructs a causal explanation of the evidence” (*ibid*)

**Credibility and coherence are not independent** In some places, it is not entirely clear whether “coherence” concerns the story (hence rather its plausibility) or the evidential set. And this ambiguity is symptomatic of the fact that coherence and credibility cannot be taken as independent from each other. In fact, one important lesson from Schum’s structural analysis of evidence, and from the legal scholarship in the line of Wigmore’s (1937), which often uses Bayes nets to formalise inference chains is that whether an agent chooses to believe such or such source, and hence use such or such piece of evidence for the construction of her story, has consequences on the credibility of other pieces of evidence, and hence on the coherence of the whole set (see Lagnado & Harvey 2008, Lagnado 2011).

Hence, the claim that “the Story Model directly addresses the question ‘Where do the weights come from?’” (1988, 527) doesn’t sound totally legitimate: the story-model does not allow for a clear account of selection of evidence and assessment of its credibility.

### **Empirical adequacy and completeness of the model**

One could argue that this is a problem if one wants to provide a normative model of jurors’ decision-making, but that this does not jeopardize the model as a descriptive one. However, even empirically, the model needs to be completed. It is not only normatively true that jurors *should* reason about witnesses’ credibility before accepting their report. There is empirical evidence that this is what they do: as shown by Connor Desai and Lagnado (2016), people do draw inferences about credibility of witnesses, their

motivations, etc. To borrow Lagnado's words, they construct a causal "story of the trial", in complement to the "story of the crime", which modulates subjects' beliefs about what happened in complex ways.

The story-model thus needs to be complemented by an account of evidential reasoning: "As well as constructing plausible stories, fact-finders must evaluate how well the evidence supports these stories and assess the strength, credibility, and reliability of the evidence (Schum, 1994). Although the story model supplies some criteria for story evaluation, it does not attempt to model how different items of evidence (e.g. witness testimony, forensic evidence etc.) relate to different elements in a story, nor does it consider how one captures the credibility or reliability of this evidence." (Lagnado & Gerstenberg, forthcoming)

"What we need is a fine-grained analysis of how fact-finders represent and reason about the strength and reliability of the evidence, and how this affects their story evaluation." (Lagnado & Gerstenberg, forthcoming). In the following, we will briefly sketch an experimental programme aimed at providing such a fine-grained analysis for the specific case of forensic evidence.

### How is forensic evidence processed?

Forensic evidence is a very important part of the evidence in criminal trials. However, for several reasons we have highlighted earlier, it is not clear how it could be integrated in jurors' reasoning as described by the story-model. Even though it is highly credible and should have strong inferential force, the model seems to predict that, if it is not easily accommodate within a story (otherwise facilitated by less credible, and weaker, but more narrative testimonial reports), a piece of forensic evidence should have virtually no weight in decision.

Even though the need for narration is well documented — and rather intuitive, it seems highly dubious that, for instance, a forensic report attesting that there is a 90% chance that the accused was on the crime scene should have the same weight as another report saying that it is merely possible. As dubious is the claim that a strong exculpatory forensic report should have no weight against an otherwise coherent, but weak, set of incriminating lay testimony.

These are empirical questions, which call for experimental testing. Our ongoing project is thus to test the relative influence of a piece of forensic evidence (of which we manipulate the strength), in comparison with a story (of which we manipulate the coherence by varying presentation order following Pennington and Hastie's protocol). Does a coherent story with weak forensic evidence trump a less coherent story with strong evidence? To what extent? How much does the strength of a piece of forensic evidence matter, depending on whether the rest of the evidence is narrative or not? How much does it trump the story when it goes in the other direction?

This project implies to first clarify what story order means, by trying to replicate the presentation order effect. And second, the manipulation consists in varying the

strength and direction of a piece of forensic evidence in the two conditions (story order / no story order).

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