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Coherence and Credibility in the Story-Model of Jurors' Decision-Making: Does Mental Simulation Really Drive the Evaluation of the Evidence?

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Abstract. According to the “story-model” of jurors’ decision-making, as advocated by Pennington and Hastie’s (1986, 1988, 1992, 1993), jurors in criminal trials make sense of the evidence through the construction of a mental representation of the events, rather than through the estimation and combination of probabilities. This ‘story’ consists in a causal explanatory scenario of the crime, and is supposed to drive the jurors’ choice of a verdict. As suggested by Heller (2006), the story-model can be described as a legal application of the simulation heuristic (Kahneman and Tversky 1982), according to which people determine the likelihood of an event based on how easy it is to picture the event mentally: the easier to mentally simulate the prosecution scenario, the higher the conviction rate. 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. While acknowledging that some fundamental reasons for adopting this model are well-grounded, and make it a plausible account of jurors’ reasoning, we raise some issues concerning its core theses. In particular, we show that the claim that the evaluation of the credibility of the evidence is mediated by story construction, and determined by the coherence of the story, is not tenable as such, and needs to be complemented by a more probabilistically centered approach.

Keywords: Evidential reasoning, Jurors’ decision-making, Mental simulation

1 Introduction

Jurors in Common Law criminal trials are requested to bring a verdict based on the analysis of the evidence presented in court. This requires first forming a belief about what happened — jurors are ‘fact-finders’ —, and then bring a verdict based on the conclusion of that first step (both on the facts they have found, and on whether those have been established ‘beyond a reasonable doubt’¹). How do they achieve such a complex task? And, how should they? In many regards, the jurors’ task can be taken as

¹ As a matter of fact, since the turn of the 21st century, the Crown Court has given up the phrase “beyond a reasonable doubt” in its guidance to trial judges in directing the jury, in favor of a

paradigmatic of evidential reasoning and decision-making under uncertainty, especially where the stakes of the decision are high: jurors face a heterogeneous, incomplete, and partially contradictory set of evidence, upon which they must make highly consequential decisions, without reaching complete certainty about what actually happened.

Evidential reasoning, conceived of as a cognitive activity aimed at drawing inferences from a set of evidence to reach a conclusion about an uncertain issue, can be analyzed along various dimensions. Confirmation theories in the philosophy of science (Hajek and Joyce 2008, Hartmann and Sprenger 2010, Crupi 2016) tend to focus on the relation between a piece of evidence or a datum, and the hypothesis on which it has confirmatory bearing. However, considering the role of evidence in the criminal context draws attention on other, crucial aspects of evidential reasoning (which also have relevance outside the judicial context), and particularly the issue of the credibility of evidence, and the strikingly complex hierarchical relationships among a network of evidential items which may, or may not, cohere (Schum 1994). How do agents navigate such a tangled web of information? And, how should they?

In the psychology of reasoning, there exist (at least) two types of approaches to jurors' decision-making: scenario-based (in particular Pennington and Hastie's 1986, 1988, 1992, 1993), and probability-based (drawing on Schum's 1994 study of evidential reasoning) approaches.² Those differ from both a normative, and a descriptive perspective. Whereas probability-based approaches argue that jurors (should) reach a decision by estimating and combining probabilities, scenario-based approaches claim that jurors need to envision a causal scenario of what happened to make their decision. As such, scenario-based views can be considered as a legal application of the simulation heuristics (Kahneman and Tversky 1982), according to which people determine the likelihood of an event based on how easy it is to picture the event mentally (see Heller 2006): the easier to mentally simulate the prosecution scenario, the higher the conviction rate.

One important aspect of the juror's situation is that her reasoning is backward-looking: most of the time, it concerns a particular event (a crime), the exact causal story of which has to be clarified. This is one reason why jurors' reasoning seems particularly well suited to an explanation-based approach. And indeed, among the scenario-based approaches, one of the first, and still most influential proposals, is Pennington and Hastie's (1986, 1988, 1992, 1993) so-called *story-model* of jurors' decision-making, which takes the construction of a coherent, causal explanation, as central. According to it, jurors in criminal trials make sense of the evidence through the construction of a mental representation of the events, rather than through the combination of probabilities. This 'story' consists in a causal explanatory scenario of the crime, and it is supposed to drive the jurors' choice of a verdict.

mention that "the prosecution must make the jury *sure* that [the defendant] is guilty" to prove guilt, and that "nothing less will do". (Judicial College, *The Crown Court Compendium – Part I: Jury and Trial Management and Summing Up* (February 2017), 5-8 (on line at www.judiciary.gov.uk/publications/crown-court-bench-book-directing-the-jury-2/).

² One should also mention argumentative theories of jurors' reasoning; see *e.g.* (Bex 2011) for a "hybrid theory" integrating arguments and stories.

The story-model is now among the most widely accepted views of jurors' decision-making. It has a strong intuitive appeal: whether, and how easily, one is able to understand what happened by mentally representing the causal sequence of events that led to the death of the victim, seems to be an important component of the very notion of 'reasonable doubt'. In other words, it seems intuitively right that, even in the presence of some strong piece of incriminating evidence, one would feel reluctant to convict someone without being able to construct a coherent and plausible scenario of how then defendant could have committed the alleged crime. Moreover, the model seems to capture important aspects of judicial practice — one of the tasks of the prosecution consists in "story-telling", namely proposing a version of the facts, rather than only exhibiting evidence. This suggests that there should be some normative justification of this, which could be thought of along the lines of theories of inference to the best explanation (Lipton 1991).

This paper is intended to propose a critical clarification of the main tenets of the story-model. Close scrutiny of the story-model reveals important conceptual, as well as empirical, issues, which we shall highlight. In particular, core notions, such as 'coherence', as well as the overall mechanism of story construction, still needs to be clarified. The main claim this paper advocates is that such an approach needs to be complemented by a theory of evidential reasoning that seriously takes into account how evidence is, and should be, analyzed, evaluated, and integrated within one's mental model. In other words, we aim at overcoming the opposition between coherence, and probability-based approaches, which is mostly grounded on caricatural pictures of each. Although probability-based approaches are mainly normative, and the most reasonable reading of the story-model is descriptive, we aim to show that the story-model suffers conceptual and empirical problems that jeopardize it as a descriptive account, and that complementing it with an account of evidential reasoning which is compatible with (normative) probabilistic models makes it more plausible as a descriptive account — and opens up the perspective of a tractable normative program. We thereby hope to contribute to a more general reflection on the articulation between considerations of coherence, which are characteristics of scenario, and explanation-based approaches, and attention to the credibility, relevance, and probative strength of evidence. This paper will mostly be critical in its argumentation, but should be taken as the 'negative' part of a constructive project involving an experimental program, which we sketch at the end of the paper.

2 Pennington and Hastie's 'story-model': core theses and experimental evidence

The following presentation of the story-model is based on a series of theoretical and experimental papers by Nancy Pennington and Reid Hastie (1986, 1988, 1992, 1993). We first present what we take as the two core theses of the model, conceived of as a psychological theory of jurors' decision-making (2.1). We then briefly report some key experimental evidence backing those two claims (2.2), after which, we introduce some additional notions intended at giving some flesh to the main two claims — but whose empirical meaning is less clearly explicated (2.3). Some experimental results aiming at

clarifying such meaning are then reported (2.4); those results are taken as a support for a third, most controversial, thesis, which we finally expose (2.5).

2.1 Core theses

Pennington and Hastie's story model essentially consists of two fundamental claims. Those respectively correspond to the main two steps of the juror's task, namely *i.* making sense of the evidence so as to form a belief regarding what happened, and *ii.* bringing a verdict supposedly based on that belief, and meeting the appropriate standard of proof.

Thesis #1. Evidence processing as story construction. The main, fundamental claim by Pennington and Hastie's is that jurors process trial evidence by constructing a causal, mental model of what happened — they mentally simulate the chain of events that led to, say, the death of the victim. Such construction is not additional to, or a consequence of, evidence interpretation; rather, it is how jurors make sense of the evidence. “During the course of the trial, jurors are engaged in an active, constructive comprehension process in which they make sense of trial information by attempting to organize it into a coherent mental representation (1992, 190).” This results in a “mental representation of the evidence that constitutes an interpretation of what the evidence is about” (1988, 521).

Such mental representations, called ‘stories’, involve chains of physical, as well as psychological events (crime stories typically involve goals, intents and motives). Stories themselves are composed of sub-stories called ‘episodes’, which are made of causal links between physical and mental events. It is important to insist that stories, as mental representations, are made of *events*, rather than of the *evidence* that is supposed to attest to such events.

Story construction can typically be prompted or facilitated by the prosecution address, which most often consists in organizing evidence so as to make it fit a particular causal sequence of events that led to the alleged crime. But Pennington and Hastie's claim goes further: they claim that jurors *spontaneously* impose a story-structure on the evidence. Evidence processing is not dissociable from mentally simulating what happened.

Since evidence presented at trials is seldom exhaustive — it hardly provides all the elements that are needed to tell a complete story, Pennington and Hastie insist that stories “incorporat[e] inferred events and causal connections between events in addition to relevant evidentiary events.” (1988, 521). And in fact, this will be a crucial aspect of their interpretation of experimental data as supporting their model, as exposed below.

Thesis #2. Verdict categories and verdict choice. The second, main claim by Pennington and Hastie's is that story construction determines verdict choice, by allowing jurors to process the evidence “such that evidence can be meaningfully evaluated against multiple verdict judgment dimensions” (1992, 192). 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.

In summary, during trials, jurors interpret evidence by constructing a mental representation of the events, and then compare the causal structure of that representation with the typical structure of verdicts, so as to come to a decision.

2.2 Empirical evidence backing claims #1 and 2 — Interview studies

Pennington and Hastie’s (1986) original experimental procedure consisted in interview studies based on a verbal protocol. Having been presented with some trial materials, mock jurors were asked to talk aloud while making their decision, and to respond to questions about the evidence and about the instructions they got from the judges. The goal of such experiment 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, 203).

The analysis of the verbal data so obtained revealed that 85% of the events described by the subjects were causally linked (*e.g.* “Johnson was angry so he decided to kill him”), which Pennington and Hastie took as “strong evidence that subjects were telling stories and not constructing arguments” (1993, 205). They thus concluded that mental representations of the evidence “showed story structure and not other plausible structures” (*ibid.*).

Another important result from those original studies was that “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.” (1993, 206). As mentioned above, one aspect of the story-model is that stories need to be richer representations than what is warranted by the evidence. According to Pennington and Hastie, this result “argues strongly against the image of the juror as a “tape recorder” with a list of trial evidence in memory.” (*ibid.*)

In support of the second main thesis presented above, experimental data reveal that people construct different stories from the same evidence, and that “story structures differed systematically for jurors choosing different verdicts.” (1993, 206) Lastly, such link between story structure and verdict is interpreted as a causal relation between the former and the latter. To rule out the hypothesis that story construction may be a post hoc rationalization for the choice of a verdict (rather than a determinant thereof), Pennington and Hastie (1988) gathered evidence that “mental representations that resemble stories are constructed *spontaneously* in the course of the juror’s performance, that is, without the prompt of an experimenter’s requests to discuss the evidence or the decision” (1988, 523).

2.3 Story acceptance and verdict choice

Two steps are described in the model just presented. The first one consists in the construction of a story. The second one is the choice of a verdict. However, several stories can be constructed on the basis of the same evidence; but, at the end of the day, the

juror must select one of them, as it is supposed to provide the ultimate ground for verdict choice. Let us see in more details what Pennington and Hastie tell us about the criteria governing those two decisional steps.

Story acceptance: certainty principles and levels of confidence. Evidence does not uniquely determine a story. And in fact, one common strategy for defense lawyers is to propose an alternative, exonerating scenario — although they do not have to do so, and are allowed just to raise issues about the prosecution’s scenario without constructing an alternative one³. Besides, different jurors may come up with different stories, and the very same juror can herself imagine different scenarios. One story, however, has to ‘win’. Who the ‘winner’ will be depends on how well it satisfies a set of criteria, called ‘certainty principles’ (1992, 190). Those principles both determine which story is the most acceptable, and how much confidence the juror will place in it, once it is accepted⁴. As we will see, such relative confidence also has a bearing on verdict choice.

Let us now see what certainty principles consist in.

Coverage and Coherence. The first two principles enunciated by Pennington and Hastie are *coverage* and *coherence*. ‘Coverage’ corresponds to how much the story covers the available evidence. ‘Coherence’, on the other hand, is defined in terms of three components: *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 (“the extent to which the story has all of its parts”, 1992, 191). Coverage and coherence together determine both the acceptability of a story, and the confidence one places in it, once accepted.

Uniqueness. To these first two criteria, Pennington and Hastie add a third one, namely *uniqueness*: one unique, good, story is better than two rival ones. This principle, which does not bear on the intrinsic characteristics of a story but rather on the context in which it is constructed, cannot be used as a measure of its acceptability. However, when there are more than one theory that is judged acceptable, “great uncertainty will result” (1992, 191), which should impact verdict choice. The interpretation of this principle is

³ There are different views as to what might be the best strategy. McKenzie’s research (as reported by Heller, 2006, 263) into the relationship between prosecution and defense cases suggests that a defense case reduces confidence in the prosecution’s case only if it exceeds its “minimum acceptable strength”, a threshold that is determined by the strength of the prosecution’s case. And he finds that a defense case can backfire if it fails to exceed its minimum acceptable strength. Heller reinterprets McKenzie’s results in the framework of the story-model, through the notion of ‘ease of imagination’.

⁴ Pennington and Hastie are not very specific about their notion of acceptance, and how it relates with levels of confidence. It seems that they consider acceptance as an all-or-nothing matter — that at some point one accepts one story and rejects the others, based on a comparison of their relative satisfaction of the various certainty principles —, but that, once accepted, it can be held with different levels of confidence.

not entirely clear, and this raises several philosophical, as well as empirical issues that deserve close attention, but are beyond the scope of this paper.⁵

Verdict choice: goodness of fit, and the standard of proof. How does the acceptance of a given story determine the choice of a verdict? As mentioned above, verdict categories (first degree murder, manslaughter, etc.) typically correspond to human causal actions sequences, like stories. The second step of the juror’s task is therefore to assess whether, and how much, the structure of the story she has accepted matches the structure of one of the verdict categories presented by the judge (see figure 1).

[INSERT FIGURE 1 HERE]

Goodness of fit. One first thing is to determine the “best-match verdict” (1992, 192), namely the verdict category whose structure is the closest to the one of the accepted story. But then one also needs to assess how nicely the two match together. This is measured through the fourth ‘certainty principle’ introduced by Pennington and Hastie (1992, 1993), namely ‘goodness of fit’. This latter principle is supposed to govern — together with the other three — “the confidence or level of certainty with which a particular decision will be made” (1993, 193). How it does so is not entirely clear, though, as we will now briefly see.

The question of the 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’.⁶ There are important debates as to what the right interpretation of the standard is, but no consensual definition has been reached in legal theory or practice.⁷ By contrast with interpretations of the standard in terms of a probabilistic threshold, Pennington and Hastie describe it in terms 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. We are basing this hypothesis on the assumption that jurors either (A) construct a single ‘best’ story, rejecting other directions as they go along or (B) construct multiple stories and pick the ‘best.’ In either case, we allow for the possibility that the best story is not good enough or does not have a good fit to any verdict option. Then a default verdict has to be available” (1993, 201).

Pennington and Hastie here seem to suggest that both the level of confidence one places in the story, and the goodness of fit of that story with the verdict category matter to determine whether the corresponding charge has been established beyond a reasonable doubt. Although this may seem intuitively right, several issues arise about this

⁵ This is the object of our experimental work in progress with Katya Tentori and Saoirse Connor Desai.

⁶ But see footnote 1.

⁷ See e.g. Laudan 2008, 32-37, Roberts and Zuckermann 2010, 253-258.

view. Firstly, no precise indication is given about how the different measures (confidence, match between events and ‘verdict attributes’) can be operationalised, nor about how they trade off with each other. Second, and more importantly, it is not clear whether this view is supposed to be normative or descriptive. If descriptive, what empirical evidence could there be in its support? It is hard to see how the several aspects of this complex construct might be tested. Similarly, if the view is normative, then we need more precise measures of fit to turn this into an operational definition of reasonable doubt.⁸ As such, the model provides no clear criteria for either the required level of confidence in the story or for the goodness of fit with a verdict category. We will leave these issues aside, as they are beyond the scope of the present criticism.

To those issues, however, additional problems arise with regard to the empirical meaning and testability of what can be taken as the most important certainty principle, namely coherence. Let us now focus on this.

2.4 Experimental manipulation of ‘ease of construction’: presentation order

No clear and operational definition is given of the various certainty principles, and nothing clear is said about how they interact in the juror’s belief formation and decision-making processes. In particular, ‘coherence’ is far from having a clear and consensual definition, although it is central to the model. However, experiments by Pennington and Hastie (1988, 1992) suggest a way to indirectly test the impact of story coherence on confidence and verdict choice, through a manipulation of the ‘ease of construction’ of stories. The basic idea is that, the easier to construct, the more complete and therefore coherent the story will be, which should result in a higher confidence in the story, and hence in the verdict choice.

Pennington and Hastie’s experimental protocol consist in influencing story construction (both which story will ‘win’, and how strongly it will be accepted), by varying the presentation order of the evidence — but not its content⁹ —, and in testing the effects of such manipulation on the verdict choice and confidence. It is important to note that 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.

There are obviously several non-trivial assumptions here, which we will not scrutinize in this paper. One core assumption though is that stories are easier to construct when evidence is ordered 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 witness order (the order in which witness come to the bar to give testimony), but, in 1992, the witness order actually corresponds to the ‘story order’, and the ‘no story order’ corresponds to the presentation of the evidence issue by issue. 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.

⁸ See Laudan 2007 for a criticism of Inference of the Best Explanation as a candidate to understand the BARD (‘Beyond a Reasonable Doubt’) standard.

⁹ That manipulating presentation order without modifying the content is possible is no trivial assumption, though.

In their 1988 experiments, Pennington and Hastie 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: “Thus, story coherence, as determined by presentation order of evidence, affects verdict decisions in a dramatic way” (1993, 211). *b.* They express more confidence in those decisions when the evidence is presented in the story order: “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 (although ‘story order’ is implemented differently, see above). 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 that credibility information about a source of testimony has more impact in the ‘story order condition’. From this second study, Pennington and Hastie draw a conclusion, which essentially corresponds to what can be considered as their third, core thesis, namely that “ease of story construction mediates perceptions of evidence strength, judgments of confidence, and the impact of information about witness credibility.” (1992, 202)

2.5 Core thesis #3 Story coherence and evidential value

Although we are left in the obscurity about the very meaning of this ‘mediation’, it is at the core of what can be taken as the third core thesis by Pennington and Hastie, which is by far the most controversial and problematic one, namely that *evidence organization, interpretation, and processing is mediated through story construction*. What does that mean?

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) Hence, although evidence presented at trial provides the main ground for story construction, it does not constrain it in any strong way: jurors may select the evidence items they judge relevant for their story, and complement them with the representation of events inferred from their background knowledge. Such additional inferences are particularly important to fill in psychological events such as goals, intentions, and beliefs.

Based on the experimental results presented above, Pennington and Hastie sketch what could be taken as their own theory of evidential reasoning, by claiming that the very evaluation of the evidence — evaluation of its credibility, relevance, and probative force, which is central to any theory of evidential reasoning — is dependent upon story construction. “The basic claim of the story model is that story construction enables critical interpretive processing and organization of the evidence.” (1993, 203)

As explained above, evidence assessment must finally be dependent upon the coherence of the story, and on how well a given piece of evidence fits that story. Coherence,

and explanatory power, are the main virtues a story must have to be acceptable. And it is the story itself which determines whether a piece of evidence should be taken into account, or not, as 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)

Hence, evidential strength does not so much depend on the evidence presented at trial, than on the virtues of the story itself: 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). And in turn, it is the structure and characteristics of the story itself, which drive 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.

3 A theory of evidential reasoning? 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, 203). It therefore presents itself as a theory of evidential reasoning, explaining how people deal with complex evidence, when having to make a decision based thereupon. But, as emphasized above, 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.

3.1 Conceptual issues

No one would deny that verdict choice, insofar as it is supposed to depend on the conclusions of the fact-finding process, should be grounded on the evidence presented at trial. How does the story-model accommodate this rather uncontroversial (normative) assumption? What does it tell us about the link between judicial evidence and verdict choice?

As we have just seen, it is the intrinsic virtues of the story itself (how much it satisfies the acceptability principles), rather than of the evidential set, which provide strength to the confidence placed in it, and hence in the subsequent verdict. In other words, the story, rather than the evidential set on which it is supposed to be constructed, bears evidential force for a given verdict: it is the story that provides reasons to choose it. But, as we have seen, the story is not uniquely determined by the evidential set: quite the opposite, what evidence will actually be taken into account by the juror depends on how well it fits within the story.

Pennington and Hastie would surely not maintain that the decision-making process is disconnected from the trial evidence: after all, story construction is supposed to be prompted by evidence. However, it is far from clear what the functional relationship is, between the story supposedly constructed on the basis of a set of evidential items, and such items whose relevance, credibility, and probative force is assessed through story construction.

Evidence and events. As mentioned above, Pennington and Hastie take as crucial the “distinction between the evidence presented at trial and [their] concept of verdict stories” (1988, 524). Indeed, their view is that only some pieces of evidence feature in the stories, which are complemented by further inferences. To make our point clear in the following, it might be useful to introduce a distinction proposed by Schum (1994), between a piece of evidence E^* — most often a report, either by a lay or by an expert witness, but E^* can also refer to any physical evidence presented at trial —, and the fact or event E that E^* attests to. Where E^* is the victim’s neighbor’s testimony that she saw the defendant in the staircase five minutes before the hour of the alleged crime, E is the fact that the defendant was actually in the staircase at that moment¹⁰.

In Schum’s terms, what Pennington and Hastie’s stories represent is E , not E^* . The objects of jurors’ mental simulation are the events E_n themselves, without consideration of the evidential items E_n^* , which do not feature as such in the model. Of course, they may be part of the model insofar as, taken as events themselves, they are causally connected to the main events. Consider for example a case where experts report that some DNA sample was found on the crime scene that matches the defendant’s DNA: this reported fact might feature as an effect of the defendant’s actions as represented in the story. Similarly, the fact that the witness saw the defendant in the staircase might feature as an event related to the actual presence of the defendant. But the experts’ and witness’ reports in court, as evidence for those facts, are not part of the crime story. To be sure, a juror’s mental representation may be rich and encompassing enough to feature aspects of the trial as part of the crime story: after all, the experts’ as well as the witness’ testimonies are themselves events that are causally related to the events featuring the crime. However, where a juror’s story includes such events, it does not involve any reasoning process on the evidence as such — on its credibility, relevance, taken independently from the story in which it may, or may not, feature.

In brief, presented with a series of evidential items E_1^* , E_2^* , ... E_n^* , jurors either represent E_1 , E_2 , ... E_n , or not, but nothing is said in the model about their entertaining E_1^* , E_2^* , ... E_n^* as such — about considering whether, and how much, they are credible and relevant. If they feature in the mental simulation, it is not as evidence items, but rather as events themselves. Of course, their explanatory power is part of the construction of a good causal model — and in fact, as we will mention later, it is likely that jurors do construct such complex causal models including evidence items. But, as such, the story-model leaves us in the dark as to how the evidence items are selected in the first place — or how the story is constructed in the first place.

As mentioned earlier, Pennington and Hastie are quite aware of this distinction, since they insist that their theory is that jurors’ reasoning primarily concerns the events — what the evidence is about: “On the basis of this research, we assume that when evidence is presented, the subject constructs a verbatim representation of the surface structure of the evidence (in the present experiment the evidence was presented as a written text), a semantic representation of the evidence in the form of a propositional textbase, and a situation model that represents an interpretation of what the evidence is about (in

¹⁰ To be more precise, we should add in an intermediary fact, namely she saw the defendant in the staircase, from which we might infer that he was actually there. As Schum argues, such chains of inferences can be indefinitely decomposed. See his chapter 3 about the components of the credibility of a testimonial report.

our terms, this is the juror's story that we hypothesize is a determinant of the juror's decision)." (1988, 524)

So stated, 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 a 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.

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 clarity on how the whole process of story construction works, and on what such models consist in, raises further issues.

Circularity. As a symptom of such issues, let us start by mentioning that Pennington and Hastie are sometimes unclear about whether the story is an explanation of the facts, or of the evidence: "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*).

This might well be due to the fact that stories have a double mediating function: governing evidence evaluation, and being a mediation between such evidence and the choice of a verdict. Why, and how, may jurors "choose to believe some assertions rather than others"? There seems to be some circularity in the process as described by Pennington and Hastie: where does the explanatory structure come from in the first place, 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? So, if story construction drives evidence processing, what drives story construction, and the choice of a particular one among the various that may be constructed to make sense of the evidence? In other words, if jurors' mental representation is on E, how do they initially infer E from E* (if the credibility of different E_s* depends on which E_s feature in their story)?

The 'certainty principles' are not well defined enough to figure out precise answer to those questions. True, the 'coverage' principle concerns the relation between evidence and story, but it lacks any operational definition, and it is not clear how it may trade off with other principles. In brief, the functional relationship between evidence and events is unclear, and that threatens the explanatory, and predictive power of the model.

Credibility and coherence are not independent. Let us now come to what we see as the major limitation of the model. As stated above, the central claim by Pennington and Hastie, which can be taken as the core principle of their theory of evidential reasoning, is that the credibility of a piece of evidence is evaluated through story construction, and

that the more coherent the story, the more sensitive jurors are to the credibility of a piece of testimony.

It is worth insisting that coherence is coherence of the story itself, as mentally elaborated and represented (how well it fits together, and with the jurors' background knowledge). It is not coherence of the evidential set (how little contradiction there might be between the evidentiary items presented at trial). However, the way the evidential set is presented, as we have seen, may impact the coherence of the story through facilitating — or preventing — story construction. The fact that Pennington and Hastie's own definition of coherence is not entirely explicit might not be such a big problem, since it can be supplemented by other approaches to explanatory coherence, such as Thagard (2000), Simon and Holyoak (2002). And in fact, Byrne (1994) has attempted to show the convergence of Thagard's views on explanatory coherence, and Pennington and Hastie's model.

However, there is some further worry with the claim that the evaluation of the credibility of a piece of evidence (as well as its relevance, and strength) depends on story coherence. On any precise account of model coherence, coherence of the evidential set has a role to play. But the credibility of a piece of evidence cannot be taken as independent from its coherence with other pieces of evidence, which themselves attest to other events. 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 formalize 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). An evidential set is not a collection of items that can be considered separately, but rather a complex, hierarchical network, with subtle and multidimensional internal dynamics. Works by formal epistemologists provide precise, quantitative models of how coherence and credibility may interact in the evaluation of multiple testimonies (Bovens and Hartmann 2003).

This is not to deny that constructing causal models of the crime is the right strategy to deal with such a complex evidential network, but that the causal model cannot ignore the internal dynamics of the evidential set itself. It is not clear what the coherence of a piece of evidence within a story means, independent from other considerations. Consider a set of evidential items. Where there is contradiction between some of them, this may lower the credibility of each of them. How do jurors deal with contradictory items? What makes them choose one, rather than the other?

In other words, evaluating a piece of evidence (say, a testimonial report) as not credible is non dissociable from telling a story about how it was produced (by suggesting that the witness was interested in such or such outcome of the trial, or that she has some memory problems, etc.). A more complete theory of story construction should take account of this. But Pennington and Hastie rather seem to consider that jurors simply dismiss pieces of evidence that do not fit their story, without providing any causal explanation for their existence.

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

3.2 Empirical adequacy and completeness of the model

One could argue that the issues raised above are problematic if one wants to provide a normative model of jurors' decision-making, but that this does not jeopardize the model as a descriptive one. After all, it is possible to argue that jurors spontaneously and rather idiosyncratically generate some representation of a series of events on the basis of an a-rational consideration of the evidential set, together with the prosecution's address, and then re-consider each piece of evidence in the light of this spontaneous representation. That this is not epistemologically desirable is another issue.

However, at least two kinds of issues arise as to the empirical adequacy of the model. The first one is that it is not even clear what empirical evidence there could be in favor of such an underdetermined model. Indeed, as soon as one tries to design some experimental protocol aiming at testing whether subjects are indeed more sensitive to evidence credibility or to story-order, for instance, one realizes that it is practically impossible to manipulate one without impacting the other.

Second, even empirically, the model needs to be complemented. It is not only normatively true that jurors *should* reason about witnesses' credibility before accepting their report (that it is not only the way they fit in a coherent story — whose origin is not clear — that drives their acceptability). There is empirical evidence that this is what they do: as shown by Connor Desai *et al.* (2016), people do draw inferences about credibility of witnesses, and their motivations. They construct a causal 'story of the trial', in complement to the 'story of the crime', and the two interact in complex ways.

Moreover, there is now robust evidence that agents correctly deal with the dynamics of coherence and credibility, at least qualitatively (Harris and Hahn 2009, Lagnado 2011, Lagnado & Harvey 2008). The story-model still needs to be complemented to accommodate that. Such considerations are not aimed at dismissing the story-model altogether. Rather, we claim that it is perfectly compatible with probability-based approaches, which are too often caricatured as describing human agents as super calculators. Without claiming that jurors should (and could) compute complex Bayesian calculations, the use of qualitative Bayes nets (Lagnado *et al.* 2013) seems to be a promising path to represent how aspects of evidence credibility are taken into account into the computation of causal models.

The story-model thus needs to be complemented by an account of evidential reasoning. Story construction as such cannot provide a complete account. One needs to account for how subjects analyze different items of evidence (witness testimonies, expert reports, etc.), and how this affects story construction and evaluation.

3.2 Accounting for the variety of types of evidence — How do jurors process forensic evidence?

As is well-known, judicial evidence can be of various sorts, from expert reports to lay witness testimony, and physical objects, recordings, written documents, etc. It would be rather risky, we suspect, to assume that those diverse types of evidence are similarly analyzed by jurors. It is now common knowledge that eyewitness testimony is rather unreliable, and that scientific evidence is to be taken more seriously — though cautiously as well, for other reasons having to do with the communication of scientific results and the use of statistics. However, how do people, in practice, deal with those

different types of evidence? One implication of the story-model is that, the more narratively the evidence is presented at trial, the more confident jurors will be in reaching their verdict. For those reasons, testimonial evidence is likely to have more impact, as it is intrinsically narrative (see Heller 2006).

However, is it really the case that jurors are more influenced by a piece of verbal testimony than by a scientific report? Even though the need for narration is well documented — and rather intuitive, it seems highly dubious that, for instance, 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. One important project would be to test the relative influence of a piece of forensic evidence (by manipulating its strength) in comparison with a story (manipulating its 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?¹¹

4. Conclusion

Although it was first proposed in the early 1980s, the story-model is still the most influential account of jurors’ reasoning and decision-making. We suspect that this is because of its strong intuitive appeal — which is most probably a sign that it accurately captures something of how jurors make sense of complex evidence. Moreover, we fully agree that that Pennington and Hastie’s “explanation-based approach could be viewed as complementary to these other models [information integration and Bayesian models].” (1988, 531) However, we do not see such complementarity as they do: rather than providing “an account of which conditional dependencies between evidence items will be considered in Bayesian calculations”, we claim that the story-model’s main virtue is to draw our attention to the importance of causality in mental simulation, and that explanation-based reasoning should be supplemented with a framework for evidence evaluation, as provided *e.g.* by Bayes nets (Lagnado *et al.* 2013).

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¹¹ This is the object of our experimental project with Saoirse Connor Desai and Katya Tentori.

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