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Kevin M. Clermont
Cornell Law School, kmc12@cornell.edu

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The silliness of magical realism

Kevin M Clermont
Ziff Professor of Law, Cornell University, Ithaca, USA

Abstract

Relative plausibility, even after countless explanatory articles, remains an underdeveloped model bereft of underlying theory. Multivalent logic, a fully developed and accepted system of logic, comes to the same endpoint as relative plausibility. Multivalent logic would thus provide the missing theory, while it would resolve all the old problems of using traditional probability theory to explain the standards of proof as well as the new problems raised by the relative plausibility model. For example, multivalent logic resolves the infamous 'conjunction paradox' that traditional probability creates for itself, and which relative plausibility tries to sweep under the rug.

Yet Professors Allen and Pardo dismiss multivalent logic as magical realism when applied to legal factfinding. They reject this ring buoy because they misunderstand nonclassical logic, as this response explains.

Keywords

civil procedure, evidence, logic, standards of proof

The ancient Chinese believed that a celestial animal would try to devour the sun during a solar eclipse. Accordingly, during an eclipse, they would make all sorts of noise by beating drums and chanting to scare off the devourer.[1] If the ancient Greeks had sailed over to explain that the moon was travelling between the earth and sun, the Chinese would have angrily accused the foreigners of magical realism[2] and continued in their ways. After all, the Chinese approach worked, as the sun would remarkably reappear every time.

Professors Allen and Pardo characterise my approach to understanding the standards of proof as magical realism. But they have misunderstood what my theory maintains and how the underlying mathematical logic gives it support.

1. See Ancient Civilizations Created Myths to Explain Solar Eclipses (2017), available at: www. gaia.com/lp/content/these-ancient-civilizations-had-strange-beliefs-about-the-solar-eclipse/ (accessed 5 November 2018). Today's Mandarin words for eclipses derive from the root 'shi', which means 'to eat'. See Metcalfe (2017).
2. See Allen and Pardo (2019: 50) (defining this literary movement as centrally contending that 'the combination of realism with mystical elements may heighten readers' appreciation of their own sense of reality').

Corresponding author:
Kevin M Clermont, Ziff Professor of Law, Cornell University, Ithaca, NY 14853, USA.
E-mail: kmc12@cornell.edu

Their misunderstandings require clarification, but are so basic as to make a detailed response unproductive. To defend my theory, even briefly, I need to explain it in comparison to their theirs. Then I shall treat their major misunderstandings. Thus, in the limited space allotted, I shall be more affirmative in restating my position than negative in rebuttal.

My theory

Multivalent-belief model

Multivalent beliefs. We in trial law would love to know if a fact happened or did not happen, but the factual dispute's reaching trial means we cannot know for sure what really happened. Facts, as they appear in a world of uncertainty upon imperfect evidence, cannot be captured by the bivalent measures of classical logic that assume facts to be either completely true or completely false. Likewise, the hypothetical probability of the facts being revealed as completely true rather than completely false is a measure of little usefulness to legal actors. The law should not ask the factfinder to place a bet while largely in the dark, but should instead ask the factfinder what it believes to be the facts based on the information available.

Legal decisionmakers need a way to represent their state of knowledge as to the facts, the best evidence-based estimate of truth in a world where uncertainties will persist. The required tool is multivalent logic, which can represent the belief in a disputed fact, ranging in degree from 0 to 1. While the factfinder forms some degree of belief that the fact is true, it will also form some degree of belief that the fact is false, but it will leave some of its belief uncommitted. The committed belief and disbelief will not add to one if there is uncommitted belief.

A belief or disbelief is neither firm knowledge nor personal feeling. It is instead the factfinder's attempt to express its degree of sureness about the state of the real world as represented by the evidence put before it. Nor is a belief or disbelief a probability of truth or falsity. Traditional probability of truth, p, provides the bivalent odds of the fact being revealed as certainly true. The odds of the fact being revealed as certainly false is $1 - p$. Traditional probabilities have many roles to play properly in legal proof. But measuring sureness in factfinding is not one of those proper roles. Deciding how to proceed in a world of persisting uncertainty differs logically from predicting how uncertainty would resolve itself into certainty.

The idea of multivalent degrees of belief received formalisation and elaboration in Glenn Shafer's imposing work on 'belief functions' (Shafer, 1976). It is highly mathematical, but its imagery nevertheless nicely captures the application of standards of proof. Indeed, the imagery represents both how factfinding *should* proceed but also fairly well how factfinders *do* act.

Under belief function theory, any case starts with the whole range of belief standing as uncommitted. The factfinder starts at zero belief and zero disbelief. After it processes the evidence, its belief in a fact called a can range anywhere between 0 and 1. Likewise, belief in *not-a*, which is disbelief of a or equivalently an active belief in a's contradiction, ends between 0 and 1. On the basis of incomplete, inconclusive, ambiguous, or dissonant evidence, some of the factfinder's belief should remain indeterminate.

The probative force of the parties' presentations, as well as avoidable evidential defects, will affect the degree of belief in a and in *not-a*. As the plaintiff introduces proof, some of the factfinder's uncommitted belief should start to convert into a degree of belief in a's existence, and almost inevitably the plaintiff's proof will also have the inadvertent effect of generating an active belief in at least the slightest possibility of its nonexistence. If the defendant introduces proof to reduce the belief in a, whether in the form of negation or as part of an alternative and inconsistent account, the degree of active belief in a's nonexistence would presumably grow. Or the very clash of beliefs could diminish the degrees of belief in both a and *not-a*.

When we say after evidence processing that $Bel(a) = 0.40$, we are not saying that $Bel(not\text{-}a) = 0.60$. We are saying only that the proof is such that to a degree of 0.60, which could represent uncommitted belief in part or in whole, a has not been proven to be true. In Figure 1, the belief in a's falsity equals 0.20. It is smaller than $1 - Bel(a)$, a measure that expresses the maximal possibility of *not-a*.

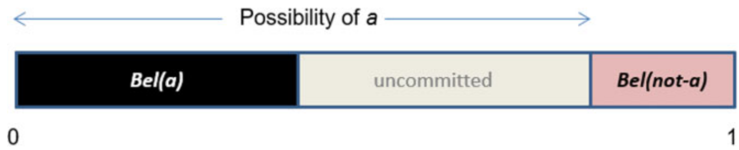

Figure 1. Belief function representation, after proof on fact *a*.

Standard of proof. In evaluating the evidence, the factfinder must apply the standard of proof. A civil case's preponderance standard, for an example under belief function theory, asks whether the factfinder believes the fact is true more than the factfinder believes that the fact is false. That is, the factfinder does and should ask the natural question that the law seems to pose by 'more likely than not': do you believe the burdened party's allegation more than you disbelieve it?

More specifically, this believed-more-than-disbelieved standard calls for constructing separate beliefs for *a* and *not-a* while leaving some belief uncommitted, and then comparing the beliefs in *a*'s truth and falsity while ignoring the uncommitted belief. A preponderance of the evidence then means that $Bel(a) > Bel(not\text{-}a)$, not that $Bel(a) > 0.50$. To continue my example, the factfinder should find *a* even if $Bel(a) = 0.40$, when $Bel(not\text{-}a)$ appears as 0.20 and the uncommitted belief equals 0.40.

Bear in mind that one need not quantify beliefs in order to work with them, and indeed usually one should not, given humans' limited ability to evaluate likelihood. Even if one desired to quantify a particular proposition, one should express the belief in words drawn from a coarsely gradated scale of likelihood, rather than speaking in misrepresentative terms of decimals.

Conjunction paradox. The multivalent-belief approach resolves the many logical puzzles posed by trying to fit the standards of proof into traditional probability theory. Take the conjunction paradox. Explaining its resolution is easier if I switch from belief functions to the compatible imagery of fuzzy logic, a multivalent system that derives from the brilliant pioneering work of Lotfi Zadeh (Zadeh, 1965). Fuzzy logic measures an instance's degree of membership in some fuzzy set. The degree may take any value throughout the interval [0,1], rather than just the value of 0 or 1 as in classical logic. Now, think of the set of facts fully believed to be true, where membership measures the degree of believed truth of a statement of fact. The statement can be believed as true and as false to varying degrees, so we can call each degree a fuzzy belief.

Fuzzy beliefs differ from belief functions in their treatment of uncertainty. Belief functions treat all uncertainty front and centre in terms of uncommitted belief, while fuzzy set theory moves any second-order uncertainty, that is, uncertainty about the estimate of degree of membership, into the additional dimension of a so-called ultra-fuzzy set.

Fuzzy imagery will allow us to speak of likelihood that a fact is true and a complementary likelihood that it is false. To do so, we normalise the beliefs $Bel(a)$ and $Bel(not\text{-}a)$ by scaling them up proportionately so that together they equal 1, thereby moving the uncommitted belief back into another dimension. The degrees of beliefs then appear as normalised fuzzy beliefs. Normalising $Bel(a) = 0.40$ and $Bel(not\text{-}a) = 0.20$ would yield a fuzzy belief in *a* equal to 0.67, and in *not-a* equal to 0.33.

Now, we can resort to the well-established logical operators of fuzzy logic. Its conjunction operator, a more general replacement for the product rule, is the so-called MIN rule for combining fuzzy beliefs in proposition *a* and proposition *b*:

$$FuzzyBel(a\ AND\ b) \ = \ minimum\Big(FuzzyBel(a),\ FuzzyBel(b)\Big)$$

If after proof $FuzzyBel(a)$ is 0.67 and $FuzzyBel(b)$ is 0.60, then by fuzzy logic their conjunction is 0.60.

The MIN rule can be derived by formal proof (Clermont, 2017: 32, 51 n.32, 67–68). But it can also be intuited. If one believes *a* and one believes *b*, then one believes *a* and *b* together, although of course not more than one believes *a* or *b* separately.

Legal proof tells a story consisting of elements, which can be strung element-by-element as links in a chain whose strength is the strength of its weakest link. By contrast, the product rule would start producing obvious nonsense for law cases as the number of elements starts increasing. The mathematical fact is that the MIN operator applies in multivalent systems like belief functions and fuzzy logic, while the product rule can apply where its assumption of bivalence holds.

In sum, figuring odds is fundamentally different from conjoining beliefs. Even though the mathematics of traditional probability seem to suggest for a legal claim that each element's being more likely than not is no guarantee that the elements' conjunction will be more likely than not, those mathematics are not applicable to combining beliefs. The highly developed and widely accepted mathematics for combining beliefs instead instruct that the conjunction has a degree of belief equal to the weakest of the conjoined beliefs. The paradox vaporises: if each element is more likely than not, then the elements' conjunction must be more likely than not.

Convergence with relative plausibility theory

Relative plausibility. A popular alternative model is inference to the best explanation ('IBE'). This method is built on abductive reasoning, a creative process of fallible and defeasible insight. Abduction involves analysis of causal conjectures. It uses data to generate hypotheses that are possibly true and that need to be inductively and deductively tested and then refined. Abduction came to be formalised as a problem-solving method in IBE. As such, it involves generating and testing hypotheses, before eventually settling on the best one as the explanation of the evidence.

Medical diagnosis employs IBE, successively eliminating plausible causes of a medical condition to reveal the best explanation and so guide future treatment. But quite simply, diagnosis does not involve applying a standard of proof, such as more likely than not. Medical diagnosis is a very different task from legal factfinding.

Applying IBE to law would therefore be a stretch. Still, some have tried to twist IBE to the legal task, using its verbiage but renaming their creation as relative plausibility theory ('RP'). They posit that the factfinder constructs (i) the overall story (or explanation, in the latest preferred terminology) that the plaintiff is spinning and (ii) another story (including alternative versions) that the defendant is or could be spinning. The factfinder then compares the two stories and gives victory to the plaintiff if the plaintiff's version is more plausible than the defendant's.

No doubt, RP has some advantages, which explains why it is pushed. It does echo the way lawyers talk about their cases. It embraces the use of humans' strong capacity for relative judgement rather that absolute judgement. It strikes the tone of psychology's story model, while using the words of IBE.

Yet, RP has no theoretical underpinning, so nothing explains why RP's path is the right path to follow. Despite Allen and Pardo's claim to the contrary, abduction does not justify RP, as abduction is a way for the investigator creatively to imagine possible explanations for later testing, and not a way to reason to a conclusion. Verbiage aside, RP is not a version of the wide-ranging IBE, so its bow to IBE adds no support. Instead, RP primarily looks to the parties in an adversary system to select the story candidates. It does not consider all possible explanations or even demand a decent pool of explanations, but by the theorists' fiat it limits consideration to two contesting explanations, each party's position on the allegations and evidence. This fiat makes life simpler, but does not justify the narrow focus other than by viewing adversariness as implying a law of the jungle: 'You put up your best story, and you, defendant, do the same. We'll pick the better one.'

The lack of theory permeates RP. First, by another fiat, this time in defiance of the law, it repeals the requirement of a standard of proof, at least in any traditional sense. No longer must the case be, say, more likely than not. The plaintiff's story need only be the better of two. RP further ignores the law stated in judicial instructions. It does not contemplate going element-by-element. It tells the factfinder to construct holistic stories and compare them. Second, a final fiat dictates that factfinders should simply ignore probabilities. RP thus does nothing about the paradoxes or puzzles of traditional probability, but accepts them as facts of life and then sweeps them under the rug. As I shall explain below regarding the conjunction paradox, if the factfinder just compares stories, any oddity concerning the necessary likelihood of the elements disappears, but only from view.

Moreover, even after countless articles, it is an underexplained model. It gives little guidance as to how the choose which story is better. RP instead depends on the unfortunate word ‘plausible’. Is plausibility all that the law should ask for? Even accepting ‘more plausible’ as the test, how does it work when, say, the plaintiff’s story is strong on all but one element? Resorting to probabilities just for illustration, imagine the plaintiff’s story is 51%, 51%, 51%, and 40% on four elements, and the defendant’s story is 49%, 49%, 49%, and 60%. When the factfinder goes to compare the whole stories, which is more plausible?

Convergence. Ironically, a theory to support RP does exist. It lies in the multivalent-belief model. Unknowingly, RP ends up as an overly specific statement of multivalent-belief theory. I can demonstrate the near equivalence either by showing how the multivalent-belief model can produce the more dialectical RP model or by showing how RP can generalise into the multivalent-belief model.

First, consider how the multivalent-belief model works, using a civil case as the example. If the factfinder goes element-by-element, a plaintiff’s success means that each element in the claim is more likely than not, in the sense that the fuzzy belief in the element exceeds the fuzzy disbelief. By the MIN rule, the conjunction of elements is also more likely than not. The mathematics of beliefs, by the so-called MAX rule, instruct that a disjunction has a degree of belief equal to the strongest of the disjoined beliefs. Thus, the likelihood of any contesting story being true is the likelihood of the strongest disbelief of any one element. But we already know that each and every element is more likely than not. Thus, the plaintiff’s conjoined story is more likely than the defendant’s disjunction of all contesting stories. And if that is so, it is more likely than the defendant’s best story. Therefore, if the plaintiff prevails under the multivalent-belief model, it prevails under RP.

Second, going the other way is a little tougher, because RP is bereft of theory. Assume that the best story constructible for the plaintiff is ‘better’ than the best story constructible for the defendant. The most sensible meaning of ‘better’, I posit, is that the degree of belief in the conjoined elements of the plaintiff’s best story exceeds the degree of belief in the disjoined denials. By the MIN and MAX rules, this means that the weakest element of the plaintiff’s story is more likely than the strongest element of any contesting story. If that is so, then every element of the plaintiff’s story is more likely than the corresponding element of any contesting story. Therefore, if the plaintiff prevails under RP, it prevails under the multivalent-belief model.

In sum, asking whether the degree of belief in each element of the plaintiff’s claim exceeds the corresponding degree of disbelief is equivalent in effect to comparing the plaintiff’s and the defendant’s best stories. The latter approach is cheered by RP theorists because of its practical advantages, such as conforming to how adversarial lawyers talk about their cases. But the convergence of my and their methods means that the multivalent-belief model can likewise claim all those practical advantages, as it too can speak in terms of comparing best stories. Meanwhile, only the multivalent-belief model has a firm theoretical foundation.

Allen and Pardo’s two major mistakes

Their approach and mine reach the same endpoint. I provide them an actual theory to justify the route taken. Yet I do not meet gratitude.

It seems ill-advised to attack a theory that ends up in the same place. Certainly, for them, the common destination takes off the table any criticism of my approach as failing to meet the normative goals of the standards of proof. Allen and Pardo do not, in fact, so criticise. Instead, they argue that my approach fails as a positive account, not because of how I describe the standards but because my theory cannot generate that description.

In brief, Allen and Pardo's argument critically rests on two assertions of my theory's shortcomings, both of which are incorrect.[3] First, they say that multivalent logic systems, such as belief functions and fuzzy logic, cannot apply to historical facts such as whether an event occurred or not. Second, they complain that my approach resurrects the conjunction paradox that they supposedly just buried.

Reach of MIN *rule*

Allen and Pardo's article recognises that there are two different ways to handle uncertainty in legal factfinding: traditional probability theory and the nontraditional mathematics of a system like belief functions or fuzzy logic. They insist that I think the two schemes are interchangeable, so that I can change a fact of the world simply by choosing a different probability scheme. Of course not. I am saying that the odds of revealed truth is a different quantity than a factfinder's belief formed while retaining uncommitted belief, so that these 'probabilities' can differ.

We do disagree on where the two mathematics are applicable. I am saying that measured quantities fall mainly into one of two piles: one of bivalent measures for which the product rule suffices (such as frequentist events and betting odds), and another of multivalent measures to which the more general MIN rule applies (such as vague terms). They insist that the multivalent pile includes only vagueness problems. The MIN rule does apply to vagueness, because the product rule obviously does not work there. But the MIN rule applies much more widely. It alone applies to multivalent measures such as belief functions, fuzzy logic, and much else.

Indeed, any variable can be stated in multivalent terms. If the variable is actually binary in that its only values are 0 or 1, then multiplicative operators like the product rule will suffice. But if the variable does not rest on an assumption that middle values are excluded, then the more general MIN rule is necessary.

The MIN rule can handle the uncertain matters submitted to legal factfinding, as long as the factfinder gauges a degree of membership in the fuzzy set of fully believed statements rather than formulating betting odds. Even past facts that look to be either/or and are subject only to random uncertainty appear to the factfinder in a real trial not as true or false, but instead as something falling between completely true and completely false. Such expression is not predicting the probability of absolute truth revealed, but instead is measuring judgement, based on the evidence available, about how sure a fact appears. It represents not a percentage chance, but a degree of belief. In other words, even for a past event, one can express a multivalent belief in truth, just as one can vaguely express tallness.

The pivotal point of my approach entails this realisation that legal factfinders do not announce the odds of an element or story being somehow revealed to be true. Factfinders instead give their degree of belief in the truth based on proof. They might believe a fact to a greater degree than they believe its opposite, although they would not be willing to bet even money on it, assuming the truth were going to be revealed. The reason is that the bettor must somehow commit total belief between yes or no, while the factfinders' allocation between belief and disbelief can leave most of their belief uncommitted. Again, the law is trying to decide how best to proceed in a world of persisting uncertainty rather than trying to predict how uncertainty might resolve itself into certainty.

Resolution of conjunction paradox

Allen and Pardo accept the conjunction paradox as 'a feature of the world' (Allen and Pardo, 2019: 35 n. 221, 39, 52). But they think that RP can avoid the paradox by simply comparing whole stories. Yet, given the product rule as a feature of life, and given the aim of finding for the plaintiff only when conjunctive liability is more likely than disjunctive nonliability, the elements individually must have satisfied a much higher standard of proof for the plaintiff's conjoined story to satisfy the law's standard of proof.

3. They also repeat a number of technical arguments, none of which is correct. See Clermont (2018: 1074 n.43) (previously rebutting the same arguments).

Neglecting to ask for element-by-element likelihoods does not make the paradox disappear. That is just sticking your head in the sand.

By contrast, I contend that if the elements meet the standard of proof, then by the MIN rule their conjunction will satisfy that same standard. The product rule is not a feature of life. It is a feature of calculating traditional probabilities, not of combining beliefs. So, whether the belief-finder psychologically proceeds element-by-element or holistically, the conjunction paradox vaporises.

If RP theorists counter that the conjunction paradox really does not affect their method—that the law can apply their standard to the whole story without requiring stronger proof on the elements—then they must be applying the MIN rule. They just are not aware of doing so.

Conclusion

The relative plausibility model resembles my multivalent-belief model more than Allen and Pardo care to admit. The differences are that my model has an underlying theory, while theirs does not, and that this theory resolves all the incidental problems of relative plausibility.

Author's note

Ziff Professor of Law, Cornell University. This response relies heavily on my recent article, *Staying Faithful to the Standards of Proof*, 104 *Cornell Law Review* (2019). There I make my own 'paradigm shift' away from probabilism, while providing more in the way of supporting authority than appears in this response.

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