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Machine learning algorithms in forensic science: A response to Morrison et al. (2022)

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ABSTRACT

In Swofford & Champod (2022), we report the results of semi-structured interviews to various criminal justice stakeholders, including laboratory managers, prosecutors, defense attorneys, judges, and other academic scholars, on issues related to interpretation and reporting practices and the use of computational algorithms in forensic science within the American criminal justice system. Morrison et al. (2022) responded to that article claiming the interview protocol used a leading question with a false premise relating to the opaqueness of machine-learning methods. We disagree with the assertions of Morrison et al. (2022) and contend the premise to the question was relevant and appropriate.

Letter to the Editor

We read with interest the recent Letter to the Editor by Morrison et al., "The opacity myth: A response to Swofford & Champod (2022)" [1]. We are encouraged by the authors' enthusiasm and advocacy for greater transparency and scientific fidelity in forensic science applications, and we commend the authors for their work in developing forensic-inference systems that make use of statistical-modelling and machine-learning methods to do so, e.g., Refs. [2,3]. We believe these systems will be critical to providing a stronger foundation for the evaluation of forensic evidence.

In their Letter, Morrison et al. raise concern with how we framed a particular question to participants in our recent work involving semi-structured interviews to various criminal justice stakeholders, including laboratory managers, prosecutors, defense attorneys, judges, and other academic scholars, on issues related to interpretation and reporting practices and the use of computational algorithms in forensic science within the American criminal justice system [4]. In particular, Morrison et al. argue we "use [d] a leading question in the interview protocol that may have led to bias in the interviewees' stated opinions" that promotes what they refer to as "the opacity myth" [1]. The question from Swofford & Champod [4] that was of concern to Morrison et al. [1] is:

> Many modern computational algorithms are based on artificial intelligence and machine learning (AI/ML) methods, which are often "black boxes" even to their developers irrespective of the availability of the source-code. What is your opinion about the use of these algorithms in forensic science for court purposes?

Morrison et al. contend the question leads with a false premise, and that they do understand the methods that they use in their work and claim "forensic evaluation systems that calculate likelihood ratios using relevant data, quantitative measurements, and statistical models/machine learning algorithms are actually paragons of transparency" [1],.[1] Morrison et al. further assert that evidentiary rules do not specify "the explainability of an expert witness's methods or the understandability of those methods for the trier of fact" as a consideration for admissibility in court [1]. Instead, Morrison et al. suggest the court should only be concerned with the validation of such systems, claiming "[w]hat provides the warrant for whether the trier of fact should or should not trust the output of a forensic-inference system is not understanding by the trier of fact of the methods that constitute that system, but validation of that system. What the trier of fact needs to understand are: first, whether the system has been validated under conditions sufficiently representative of those of the case under consideration; and, second, whether the results of that validation indicate that the system works sufficiently well under those conditions" [1].

We welcome Morrison et al.'s opinions on this important issue; however, we disagree with their assertion that the question leads with a false premise. We are concerned that Morrison et al. is overly broad in their response and basing their arguments on a narrow view of the bigger issue by (a) focusing specifically on the algorithms they developed in their own work, (b) ignoring the reality that there are machine learning methods that can be used to develop computational algorithms that are based on non-human interpretable processes for which the inner-workings are in fact opaque (e.g., complex deep learning methods), and (c) disregarding potential legal implications beyond explicit evidentiary rules related to the use of non-human interpretable methods in the American criminal justice system.

First, we are deferential to Morrison et al. in their argument that the forensic-inference systems *they* have developed are transparent and explainable [1]. Our work [4] was in no way a challenge to the specific algorithms they have developed, nor should it be viewed in that way. We do, however, encourage Morrison et al. to consider these issues related

[1] Contrary to what Morrison et al. imply, we do not argue that forensic evaluation systems that calculate likelihood ratios necessarily lack transparency and explainability. We do, however, recognize that forensic evaluation systems that are based on certain machine learning methods could have limitations with respect to their transparency and explainability.

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to the use of machine learning algorithms in a broader context outside of their own individual contributions.

Second, we are concerned that Morrison et al. is promoting a false claim, suggesting that *any* algorithm developed using machine learning is fully transparent and explainable [1]. The reality is that concerns over the transparency and explainability of some machine learning methods and the appropriateness of their applicability to sensitive domains, such as criminal justice, has been the subject of public discourse amongst researchers, advocates, and policy-makers [5–18]. Our intent was to elicit participants' views on this important issue so that we can better understand how to navigate various concerns across stakeholders as it relates to the design, development, and implementation of computational algorithms in forensic science. Indeed, participants' perspectives on issues relating to the use of computational algorithms are often different based on the extent to which they are transparent and explainable [4]. As such, we contend that the premise to the question we posed to participants in Ref. [4] provided relevant context that was appropriate for the purpose of the question.

Finally, we appreciate Morrison et al. offering their opinion on what they believe should be necessary for the admissibility of computational algorithms in court. However, we also recognize that their opinion represents one perspective and is not dispositive. We are concerned that Morrison et al. is downplaying important issues related to the design of computational algorithms that can have downstream legal implications. We do not argue that computational algorithms that have been developed using machine learning methods are inadmissible or should be inadmissible by fiat, nor do we propose to disregard superior scientific methods available in favor of inferior methods. To be clear, we are advocates for promoting more robust methods supporting the evaluation of forensic evidence and consider computational algorithms as an important means for doing so. Although legal scholars argue computational algorithms are likely admissible based on explicit evidentiary rules, the open question is whether certain factors related to the design, development, and implementation of those systems could raise admissibility concerns from a Constitutional dimension specific to the American criminal justice system. Many of these issues are summarized in Ref. [19] and indeed some of the same concerns were raised by participants in Ref. [4]. As such, we contend that Morrison et al.'s argument of the admissibility of computational algorithms based solely on evidentiary rules is incomplete.

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