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As it stands, forensic science and its practitioners are held in high regard in criminal court proceedings due to their ability to discover irrefutable facts that would otherwise go unnoticed. Nevertheless, forensic scientists can fall victim to natural logical fallacies. More specifically, confirmation bias is "a proclivity to search for or interpret additional information to confirm beliefs and to steer clear of information that may disagree with those prior beliefs" (Budlowe et al., 2009, p. 803). To restore the integrity of the forensic sciences, the sources of confirmation bias need to be identified and eliminated. Accordingly, empirical studies have given substance to a subject that is intangible and thus difficult to recognize. Inherent and external sources of confirmation bias include the dependence and association of crime labs upon police agencies and the amount of extraneous information made available to verifying examiners. Potentially effective solutions offered to minimize its influence upon the conclusions made by forensic scientists include the privatization of crime labs, the establishment of educational requirements for forensic examiners, the separation of testing and interpretation, and the institution of double blind testing. This effort must be undertaken as the justice system relies on forensic sciences to provide meaningful evidence that can play a prominent role in the fate of those who stand trial.

Keywords
forensic science, confirmation bias

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Confirmation Bias: The Pitfall of Forensic Science

In a world full of bias and manipulation, the realm of science remains one of the last havens of objective thought. As members of the justice system and the scientific community, forensic scientists are charged with the task of preserving that objectivity. However, despite their best efforts, the effects of bias have managed to influence the findings of forensic scientists. More specifically, the psychological principle of confirmation bias prompts forensic scientists to interpret the results of their experiments to conform to the preconceived notions they form prior to testing (Saks, Risinger, Rosenthal & Thompson, 2003, p. 78). The results obtained from empirical research and the theories proposed in scholarly articles examine the forensic techniques that require humans to make subjective interpretations, such as fingerprint examination and bullet and hair comparison. These articles also identify the sources of bias and offer potential solutions.

Otherwise known as contextual bias, the existence of confirmation bias extends back to the origins of scientific inquiry. To alleviate the harm done by this phenomenon, the scientific method was developed. It sought to establish a rigid procedure on how to properly conduct an experiment. Using the scientific method, a series of tests are carried out to determine whether the null hypothesis can either be rejected or accepted. Rejection of the null hypothesis confirms that a statistical significance exists. The issue of confirmation bias presents a unique challenge in that it is intangible and thus difficult to quantify. Adding to that difficulty is the insufficient amount of

research that has been conducted regarding the reliability of forensic techniques. Dror and Rosenthal (2008) note that "Although it is critical to empirically and properly study the reliability and biasability of experts, this type of research is extremely scarce and almost nonexistent" (p. 900). The lack of research concerning forensic science techniques is startling considering the increased scrutiny of forensic sciences by an aggressive adversarial system. In court, forensic scientists and their analysis of evidence are held in high esteem as they provide accurate and irrefutable truths about a case. However, when the effect of bias is considered, the credibility of a forensic scientist loses its value.

Held to a strict code of ethics, the main objective of a forensic scientist is to interpret the information obtained from the appropriate application of scientific techniques (Saks et al., 2003). As such, forensic scientists must make objective interpretations and document all discoveries. Failing to uphold this standard can result in two types of errors. Considered to be the most egregious, Type I Alpha errors consist of a false positive that may result in the conviction of an innocent person. On the other hand, Type II Beta errors are false negatives that possibly allow a guilty person to walk free. The impact of the errors made by forensic scientists is far ranging as it touches upon all aspects of both the scientific process and the justice system. Accordingly, confirmation bias compromises the integrity of forensic sciences, as it profoundly impacts the conclusions reached by forensic examiners; therefore, the sources of bias must be identified and eliminated.

Literature Review

One of the biggest obstacles standing in the way of eradicating confirmation bias is that it occurs on both the conscious and subconscious levels. For that reason, it is difficult to determine the degree to which it affects a forensic scientist's analysis. Consequently, studies have been designed and conducted with the objective of detecting the presence of confirmation bias and quantifying the degree to which it affects the results of forensic investigations. Langenburg, Champod, and Wertheim (2009) evaluated the influence that extraneous information had on fingerprint specialists during the verification step of the Analyze, Compare, Evaluate, Verify (ACE-V) process. In this case, extraneous information is defined as information that is not pertinent to the matter under consideration. The ACE-V process requires that an initial examiner analyzes a fingerprint from an unknown source by identifying minutiae marks, comparing it to an exemplar fingerprint, and evaluating the prints by asserting an individualization, exclusion, or inconclusive result. A subsequent examination is then performed by a second analyst with the purpose of confirming or rejecting the conclusion reached by the initial examiner. The authors hypothesized that the more information available to the verifying examiner regarding the conclusion reached by the initial examiner, the more the verifying examiner is likely to tailor their conclusion to agree with the initial examiner despite any disparity that may be present. Participants in the study were verified as fingerprint specialists and divided into three groups, one serving as the control group, with the others representing a low-bias group and a high-bias group. Each participant was given the same six sets of latent fingerprints and corresponding exemplars. The control group did not receive any contextual information and were asked

to analyze each set of prints. The low-bias group was provided with the conclusions for each set of prints from an anonymous analyst who was described as being trained to competency. Finally, the high-bias group also received the conclusions concerning each set of prints; yet, these conclusions were arrived at by an internationally recognized fingerprint analyst who also provided specific reasoning for his conclusions. Results of the study revealed that in cases where uncertainty existed, analysts in the bias groups were reluctant to declare a definitive exclusion or individualization if it contradicted the previous expert. Rather, analysts in such situations opted for an inconclusive result. Conversely, participants in the control group exhibited a higher rate of definitive conclusions. As a result, the study confirmed the effect of extraneous information, and therefore bias, on the interpretations made by forensic scientists. Exposing the scientists to varying amounts of extraneous information, the authors discovered a tendency of scientists to alter their reports in the direction of what others are reporting, failing to form an opinion based on the results exclusive to their examination (Saks et al., 2003, p. 84). Given the proof of the presence of confirmation bias in the decision making process, crime labs and their overseeing bodies are urged to revise their current protocols to combat the issue.

Essential to the effort of addressing the issue of confirmation bias is the identification of its sources. Among the most prominent sources of confirmation bias is the organizational structure of crime laboratories. Despite the attempt to remain objective, forensic science is biased inherently as a result of its association and dependence upon police agencies (Whitman & Koppl, 2010). Forensic scientists often work under the assumption that they are a part of the prosecution. Such an

assumption is the product of the role effect, defined as the conformity of a person to the perception held by those with whom they most closely identify (Gianelli, 2010). Forensic scientists often infer that they analyze evidence that has been submitted by the prosecution. As a result, scientists are motivated to seek a result that favors the prosecution. Also, forensic scientists have direct contact with the investigators who provide explicit information regarding the case (Whitman & Koppl, 2010). For instance, detectives may disclose to the examiner that the suspect has confessed to the crime, instilling a result in the mind of the examiner before they have had an opportunity to analyze the evidence. Furthermore, forensic scientists face additional pressure from police agencies to expedite their analysis, leading them to report results favorable to the prosecution.

Moreover, the study carried out by Langenburg, Champod, and Wertheim (2009) confirmed the danger of extraneous information during verification. This form of confirmation bias is the product of the desire to conform. Under typical crime lab protocol, verifying scientists are informed of the original examiner's conclusion. Inevitably, the rate at which a verifying scientist declares a match rises exponentially when informed that the initial examiner declared a match (Whitman & Koppl, 2010). The mounting evidence regarding conformity and the power of suggestion exhibits the potent effect of confirmation bias. It would, therefore, be foolish to believe that scientists are immune to this danger. Perhaps the most infamous case involving extraneous information during the verification step is the case of Brandon Mayfield. In 2004, Mayfield was wrongfully identified as the bomber of the commuter train system in Madrid, Spain. An FBI fingerprint expert concluded that latent fingerprints

matched those belonging to Brandon Mayfield. Three additional experts verified the match, each with knowledge of the case and of the conclusions reached by the previous examiners. Ultimately, it was determined that Mayfield was not responsible for the Madrid train bombing. An FBI evaluation later revealed the "power of the automated fingerprint correlation was thought to have influenced the examiner's initial judgment and subsequent examination" (Gianelli, 2010, p. 2). Although it was temporary, Brandon Mayfield was subjected to treatment reserved for heinous criminals. In addition, the incident tarnished the reputation of the forensic sciences. In such cases, the ambiguity of the evidence is negated by the fact that another examiner has reached a conclusive result. Experts subconsciously allow extraneous information to alter their perceptions which ultimately shape and form their conclusions (Saks et al., 2003).

Conclusion

The forensic sciences are depended upon to deliver certainty to a process during which there are more questions than answers. However, the presence of confirmation bias undermines the objectivity and reliability that the justice system and the general public have come to expect. Considering the magnitude of the work of forensic scientists, it is imperative to eliminate all potential sources of error. When it comes to deciding a person's fate, diligence must be observed. To preserve the integrity of forensic sciences, the root causes of confirmation bias must be recognized and eradicated. Recent experiments have given substance to confirmation bias and demonstrated the manner in which it causes objective scientists to deviate from the truth. The sources of bias are found not only in the institutional structure of forensic science, but also in the minds of the scientists.

Recommendations

It is important to acknowledge that the complete elimination of bias is impossible. Rather, Dror, Champod, Langenburg, Charlton, and Hunt (2010) stress that an effort must be made to minimize the effect of cognitive and psychological contamination. To remedy the issue, Whitman and Koppl (2010) offer a number of solutions. The separation of crime laboratories and police agencies is the most prominent solution offered. The privatization of crime labs would effectively combat confirmation bias as police investigators would not be able to implant the notion of guilt into the mind of a forensic examiner. In addition, establishing educational requirements and quality training programs would inform scientists on how to properly handle the subjective nature of forensic examinations. Minimum education requirements and quality training would ensure that scientists are less susceptible to bias by teaching scientists ways to both avoid and identify bias. In receiving a quality education and training, forensic scientists would be better equipped to meet the demands of the forensic discipline (Budlowe et al., 2009). Furthermore, the separation of testing from the interpretation of results recommends that a lab completes only the tests necessary to analyze the evidence. A second lab would then be employed to interpret the results. Finally, Saks et al. (2003) advocate the idea of "Working Blind." As such, examiners should not be given any contextual information regarding the case and the evidence they are being asked to analyze. The goal is to avoid the context of the case from forming the expert's opinion prior to testing.

Similar to any scientific discipline, it would not be acceptable to be content with current protocols as the field needs

to improve continually. Forensic analysts also must hold themselves to a high standard. The fact that bias exists should be a constant reminder to seek data aggressively contrary to one's beliefs. Moreover, scientists must continue their best efforts to remain objective and competent. Fundamentally, forensic science serves as a means to discover the truth with as much certainty as possible.

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oad and still being developed. She could see myself conducting research, eventually filling a business role in biotech, or serving as an agent or officer for the U.S government. Her interests include exercising, surfing, motorcycle riding, baking, exploring new places, and meeting new people.