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Unreliable Forensic Science

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The Effectiveness of Forensic Science

Research in progress for CRIJ 1301: Introduction to Criminal Justice

Faculty Mentor: Stefanie LeMaire

Sarah Ciuffetelli uses critical thinking to examine the effectiveness of forensic sciences during criminal investigations. The assignment requires students to find the most prominent scholarly research in forensic sciences and discuss its efficacy. Further, the research leads students to discuss the potential limitations investigators must consider when examining forensic evidence. Lastly, students find at least six scholarly sources to provide an in-depth analysis of the research.

Sarah begins by discussing the history of forensic science and the ever-increasing technology used in criminal investigations. She discusses some of the limitations and concerns surrounding bite mark analysis, arson investigations, hair comparisons, and their use during criminal prosecutions. Beety & Oliva (2019) highlighted the questionable evidence regarding arson investigations because of the lack of qualifications of its investigators. Also, hair comparisons have limitations because there is quite a bit of subjectivity used during the analysis, leading to reliability issues (Mills et al., 2018). Sarah also features the significance of Garrett & Neufeld's (2009) research that suggests that one bite mark may not be unique enough to match only one human being to its bite mark. She concludes the discussion with suggestions for improvement, such as compiling improved data for wrongful convictions so that criminal justice agencies can better examine any deficiencies with these forensic science methods and their relationship, if any, to exonerations.

Unreliable Forensic Sciences

Sarah Ciuffetelli

Forensic sciences have been helping criminal justice agencies solve crimes as early as 200 B.C.E. when fingerprinting was used during burglary investigations (Xiang-Xin & Chun-Ge, 1988). Since then, many new forensic science techniques have been developed to assist investigators in identifying the perpetrators of crimes, such as ballistic comparisons, blood splatter analysis, and deoxyribonucleic acid (DNA) profiling, to name a few. Although the field of forensic science has continued to advance throughout the years with these increasingly available technologies, some scholars, scientists, organizations, and attorneys are now questioning their evidence and efficacy. Some forensic sciences that have been questioned for their reliability because little statistically significant evidence supports their accuracy include bite mark analysis, arson investigations, and hair comparisons. Opponents of bite mark analysis have pointed out inconsistencies and a lack of scientific basis for this forensic discipline. Some studies have shown that the field of bite mark analysis likely has the highest error rate of any method of forensic identification (Beety & Oliva, 2019b). Arson investigations have been questioned for their validity because of the lack of qualifications of the arson investigators (Beety & Oliva, 2019a). The validity of hair comparisons is questioned because of the subjectivity required (Mills et al., 2018). Despite some of the inaccuracies of these forensic disciplines, there are some methods to improve the

credibility of these evidences, and professionals should consider these methods to increase accuracy when using them for criminal investigations.

Bite Mark Analysis

One area of forensic science that has received the most scrutiny in recent years is bite mark analysis, which is centered around the belief that no two people have the exact same mouth shape or teeth size and alignment (Swetha & Ganapathy, 2019). Therefore, a bite mark found on a victim could be compared to a suspect's teeth to determine if they were the one that created the mark. The pattern of bruising and superficial abrasions left on a victim's skin depends on the force and length of bite time, along with any defensive movements made by the victim (Swetha & Ganapathy, 2019). To preserve a bite mark found on a person, an analyst can either photograph the pattern on the skin or make a mold impression of it. When a suspect is identified, an impression is made of their teeth or dentition (Beety & Oliva, 2019b). Analysts usually employ two techniques to compare the bite mark to the suspect's dentition. The direct method uses a model of the suspect's teeth placed on a scaled picture of the bite mark to show any matching points. The indirect method uses a transparent overlay of the bite mark and places it over a scaled photograph of the suspect's teeth to observe common points (Swetha & Ganapathy, 2019). Some scientists agree that bite mark analysis fails because it cannot differentiate human bites from others, accurately associate bite marks to a suspect's dentition, or estimate the frequency of that association (Beety & Oliva, 2019b).

It was shown that bite mark experts cannot even reliably identify whether a bite mark was from a human or another species after a group of certified members from the American Board of Forensic Odontology (ABFO) could not come to a consensus on whether sample bite marks were human or had any features to ensure their uniqueness to an individual (Beety & Oliva, 2017). The ABFO could not come to a consensus on whether sample bite marks were human or had any identifying features to ensure their uniqueness to an individual. Other issues that result in the unreliability of bite mark evidence are the subjectivity of the comparisons and how bite marks on humans are distorted because of skin elasticity, location on the body, and the position of the body (Swetha & Ganapathy, 2019). Little research has been completed to determine the error rates for bite mark analysis. Saks et al. (2016) mentioned how some forensic examiners have produced inaccurate results that cause scholars to question its efficacy.

It should be noted that the human analysis of bite marks can also create some subjective variability between examiners. One way to minimize inaccuracies is to consistently use a standardized analysis technique so that the results are more reliable. It is significant to test these guidelines frequently for accuracy (Patil et al., 2013). Another important consideration to keep in mind is that the expert testimony from forensic dentists could be flawed as there may be little to no scientific evidence that a bite mark is so unique to one individual that we can reliably exclude all other suspects (Garrett & Neufeld, 2009). Rajshekar et al. (2012) discussed the use of digital imaging for crime scene investigations and showed how some images can be distorted and unusable for analysis. Sometimes another picture of the bite mark cannot be achieved;

therefore, extreme care should be taken to preserve the evidence with proper photographing techniques. Another cause for concern is secondary distortion when digital images are not taken perpendicular to the bite mark. Other types of distortion can occur, and these should be considered. When mistakes happen, the evidence may be inadmissible, and the defendant's criminal disposition could be impacted by improper procedures. If investigators are trained properly, they may be less likely to make significant mistakes.

Arson Investigation

Another discipline of forensic science that has some scholars questioning its accuracy is arson investigations. Henneberg and Morling (2018) suggested that arson investigation can be one of the most difficult investigations to complete. A fire investigator's goal is to determine the fire's origin and source and whether it resulted from an accident or arson. According to traditional fire investigation teachings, a fire can develop slowly or quickly, and a fast or high-heat fire indicates arson. Investigators can look for several burn indicators to determine the speed of a fire after it is out. A fast fire would create shiny, raised alligatoring on wood, while a slower fire would result in flatter marks. Spalling on concrete and crazing on glass are indicators of high-intensity fires. If a burn pattern is in the shape of a wide "V" then it was a slower fire, as opposed to the narrow "V" shape pattern of a fast fire that indicates an accelerant used by an arsonist. Floors can also show the appearance of accelerants since floors are not damaged as much as ceilings, even when a room is completely burned (Lentini, 2019). This helps

one understand the difficulty of an arson investigation and how many circumstances an investigator must consider.

Another investigative technique uses the negative corpus theory, which states that when an investigator determines the location of where a fire started, if there is no obvious source of an accidental fire, then it must have been started purposefully with something like a match that was then removed from the scene (Beety & Oliva, 2019a). Also, until a court ruled against it in the 1990s, if a canine detected an accelerant at a fire scene, labs stating otherwise were deemed irrelevant (Plummer & Syed, 2016). Henneberg and Morling (2018) studied fire investigations from four countries, including the United States, and found that Accelerant Detection Canine (ADC) alerts might cause tunnel vision where the investigator focuses on one suspect instead of broadening their scope to other potential suspects when the ADC alert is not confirmed by laboratory testing. The ADC alert is a catalyst for further investigation of the suspect and limits the investigation into what may be an accidental fire or a fire committed by another person not suspected by law enforcement. However, because of the ADC alert, the investigator no longer suspects an accidental fire or another suspect. This could severely impact a potentially innocent suspect if the investigator does not consider other persons or an accidental fire.

Another reason the field of arson investigations has been questioned is the lack of qualifications of some investigators. Fire investigators are often the first responders with no scientific background who have only been certified through short training courses taught by other similarly qualified instructors (Beety & Oliva, 2019a). Without a

strong background in scientific analysis, it is difficult for investigators to avoid expectation bias or tunnel vision (Beety & Oliva, 2019a). This can be especially true if an investigator speaks with an eyewitness prior to assessing the scene and is subconsciously influenced about the origin of the fire and whether or not it was even a case of arson (Beety & Oliva, 2019a). This impacts the remaining investigation.

Similar to other fields of forensic science, not enough empirical research has been completed on the methods of arson investigations to determine its error rate. Even so, several studies by government agencies have shown that accurately determining the origin of a fire is time-sensitive and should be done as quickly as possible. The Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) completed a seminar in 2005 where experienced fire investigators were tasked with identifying the origin of a fire. Only 5.7% of the students accurately identified the quadrant of the cell where the fire started (Carman, n.d.). If an investigator incorrectly identifies the origin of a fire, then the rest of the investigation could be derailed (Beety & Oliva, 2019a). In the 1990s, the National Fire Protection Association (NFPA) was a proponent for a more scientific approach to fire investigations and performed many studies and investigations to discredit commonly held myths in the arson investigation field. The NFPA were able to demonstrate how unreliable many of the common indicators of arson were after they studied 3,000 homes burned in a known accidental fire and found many of those so-called arson indicators (Lentini, 2019). Through other studies, they also showed that the amount of oxygen available is the only determining factor in the intensity of a fire, regardless of whether it was accidental or an arson. When an area has been fully

burning for more than a few minutes, it is only the ventilation of the room that affects the burn patterns (Lentini, 2019). The crazing on glass that was believed to have been caused by high intensity fires has since been proven to be a result of glass quickly cooling when sprayed with water from firehoses (Giannelli, 2018).

To assist arson investigators with their difficult task, Santtila et al. (2003) discussed how psychology can be used to create an arsonist profile. So, not only can arson investigators use the evidence from the fire, the investigation may also be strengthened from a criminal profile. The authors reviewed the model of arson behavior created by Canter and Fritzon (1998) and used this model to create an arson profile for the suspect. The authors examined a real arson investigation and compiled characteristics of the potential suspects and their possible location in proximity to the fires. The authors were not informed of the potential suspect prior to assisting the law enforcement agency. They reviewed the types of targets, the way the fires were set, the time of day, the location of the fire, and other variables. They created a report of their findings and sent it to the investigator to assist in their investigation. It was concluded that “there is fairly good correspondence between the characteristics of the suspect and the predictions made in the profile” (Santtila et al., 2003, p. 12). Perhaps when combining arson investigation and criminal profiling, more accuracy can be accomplished to substantiate the suspect’s arrest.

Hair Comparison

Hair comparison is another type of forensic pattern identification method that has become more recognized as unreliable evidence. This type of evidence has been

heavily used since hair sheds, and it is frequently found at crime scenes (Garrett & Neufeld, 2009). Any hairs found at a crime scene can then be compared under a microscope to a suspect's hair to see if they have any matching characteristics. With this method, examiners look at the shaft of a hair, which is the main part extending out from the skin. A hair's shaft consists of an inner core (called the medulla), the center layer that gives hair its color (called the cortex), and an outside covering (called the cuticle) that is formed by overlapping layers of transparent cells, like scales. An analyst examines the length of the shaft and looks for different characteristics, such as color, length, the shape of the follicle scales, or any patterns within the medulla (Hodge & Holjencin, 2020). Since a person's hair has many varying characteristics, when an examiner looks at the suspect's hair, they take an initial sample of about 100 hairs from around the head, then condense the sample size down to about 20 hairs that represent the suspect's hair (Garrett & Neufeld, 2009). The examiner then looks at the various characteristic of the hairs being compared to determine if the number of similarities between the suspect and the unknown hair outweigh the number of differences (Hodge & Holjencin, 2020).

Similar to the previous fields of forensic sciences discussed, the validity of hair comparison has been questioned because it is also very subjective. One issue with only conducting a visual comparison of this type is that variations of hair color are sometimes too subtle for the human eye to distinguish, especially since people's eyes can detect colors differently (Mills et al., 2018). The traits that examiners look for during their comparisons have not been clearly defined, and there were no standard guidelines they

must follow (Mills et al., 2018). This furthers the subjectivity of this type of evidence since examiners might use slightly different terms to describe characteristics or view them at varying levels of significance (Hodge & Holjencin, 2020). The characteristics of hairs being looked at are also general class traits, so comparisons would only be useful to exclude a possible suspect or to determine the donor of a hair from a small group of people rather than the entire population (Mills et al., 2018). Not enough research has been done to provide examiners with sufficient knowledge about the frequencies of these individual hair characteristics to have a definitive answer about the identity of the hair donor (Garrett & Neufeld, 2009).

This lack of research is also why a reliable error rate has not been determined for this type of analysis, although a 2008 study looking at DNA exonerations pointed to the unreliability of hair analysis. Of the 137 examined exoneree cases, 65 used hair comparisons, and of those cases, there were 25 that had incorrect testimony given by experts (Garrett & Neufeld, 2009). Since hair comparisons have been routinely used in previous cases, courts were reluctant to question the validity of this type of test despite new experts pointing out that it did not meet the “Frye or Daubert standards” of evidence (Hodge & Holjencin, 2020, p. 226). Instead of relying solely on a microscopic analysis of hairs, investigators need to also take advantage of the advances in DNA testing, which produces much more accurate results. Even when the follicle is not still attached to the hair, which allows for traditional nuclear DNA testing, mitochondrial DNA testing can be performed using the shaft (Hodge & Holjencin, 2020).

Improvements for the Future

Because of the lack of scientific validation of these and several other forensic disciplines, there is a high possibility of error when using these types of evidence in criminal cases (Olaborede & Meintjes-Van der Walt, 2020). Many new reports have been published, like those of the National Academy of Sciences and the President's Council of Advisors on Science and Technology, criticizing the accuracy of forensic science. Despite the growing number of experts calling for reforms to these areas of forensic science, very little has been changed with how these types of evidence can be used in criminal courts (Mnookin, 2018). In his research, Koehler (2017) suggests that this is partially due to the quasi-adversarial nature of forensic sciences, which work closely with law enforcement instead of having an autonomous role. Another improvement that needs action is the need for members of forensic science to advocate for more empirical studies. A potential problem that might lead to the increased scrutiny of these sciences are some inconsistencies with the wrongful convictions data. Some scholars might believe that more wrongful convictions occur due to inaccurate DNA evidence based on how the data is presented (LaPorte, 2017). Criminal justice agencies may need to improve their collection of wrongful convictions so that an accurate report can be published to determine the real extent of wrongful convictions and the culpability of these forensic science methods. In addition, more national guidelines, professional training for these analyses, and scientific evidence that defines their accuracy should be established and widely used.

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