Welcome to the third edition of the Stevenson University Forensics Journal. The breadth and depth of this year's submissions are outstanding. We are pleased to bring you the finest work from our current students and recent graduates of the Forensic Studies and Forensic Sciences Master's Programs. In this edition, we are fortunate to have representation from a variety of programs and perspectives. Contributors address pressing issues in the fields of forensic science, investigations, accounting and law. Each submission has been peer reviewed by a current student and undergone the editing process with both faculty and outside editors.

Each year we strive to improve the Journal in both content and design. This year, we have added a new section titled, “Faculty Voices.” We encourage the input of all faculty interested in reviewing forensic studies or sciences books or journals. We also welcome faculty who are doing primary research to share their work with our scholarly community.

Our editorial board has been reduced for efficiency and effectiveness and now includes Abigail Howell, Stephanie Witt and me as well as faculty and administrative consultants.

Please let us know what you think as we strive to improve the Journal each year. Comments and questions are welcome at chjohnson@stevenson.edu.

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Editor and Publisher
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Page</th>
<th>Section</th>
<th>Author(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>FACULTY VOICES</td>
<td>A CAPSTONE COURSE: THE FORENSIC STUDIES MOCK TRIAL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PATRICIA ELLIS, M.B.A., J.D. AND MARIA HOWELL, J.D.</td>
</tr>
<tr>
<td>5</td>
<td>FACULTY VOICES</td>
<td>AN APPLICATION OF FORENSIC RESEARCH TO SOLVE A SPECIFIC PROBLEM:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>THE DEVELOPMENT OF AN ORGANIC GUNSHOT RESIDUE (OGSR) IDENTIFICATION METHOD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JOHN TOBIN, PH.D.</td>
</tr>
<tr>
<td>8</td>
<td>FACULTY VOICES</td>
<td>CORPSES DON’T LIE: ON DOUGLAS STARR’S THE KILLER OF LITTLE SHEPHERDS—A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TRUE CRIME STORY AND THE BIRTH OF FORENSIC SCIENCE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ALEXANDER E. HOOKE, PH.D.</td>
</tr>
<tr>
<td>10</td>
<td>FACULTY VOICES</td>
<td>A DAY IN THE LIFE OF JOYCE WILLIAMS…</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAROLYN JOHNSON, J.D.</td>
</tr>
<tr>
<td>14</td>
<td>FORENSIC DRUG ANALYSIS</td>
<td>BACKLOG REMEDY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUBRIE JACQUELINE ST.CLAIR</td>
</tr>
<tr>
<td>18</td>
<td>IS HIGH FREQUENCY TRADING THE PROBLEM WITH THE FINANCIAL MARKETS?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>COREY E. COSTA</td>
</tr>
<tr>
<td>22</td>
<td>FORENSIC ART: IDENTIFYING THE UNKNOWN</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>KIMBERLY PROCTOR</td>
</tr>
<tr>
<td>30</td>
<td>THINKING OUTSIDE THE BOX: USING FINANCIAL FORENSICS IN NON-FINANCIAL</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>INVESTIGATIONS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DENISE R. HARDING</td>
</tr>
<tr>
<td>35</td>
<td>THE MODERN DAY CRIME: EXPLORING CYBER CRIME IN THE UNITED STATES</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>DONYIEL CARR</td>
</tr>
<tr>
<td>40</td>
<td>FORENSIC ANTHROPOLOGY AND HUMAN REMAINS IDENTIFICATION</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SARAH KRANS</td>
</tr>
<tr>
<td>44</td>
<td>ANALYSIS OF ELECTRONIC INFORMATION AND RECORD RETENTION PROGRAMS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>JESSICA LYONS</td>
</tr>
<tr>
<td>49</td>
<td>THE EFFECTS OF PAPER-PACKAGING MATERIAL ON THE QUALITY OF LATENT PRINT</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>EVIDENCE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STEPHANIE WITT</td>
</tr>
<tr>
<td>55</td>
<td>AUTHOR</td>
<td>BIOGRAPHIES</td>
</tr>
</tbody>
</table>
Capstone courses are used in many programs across the country to assess the learning and skills acquired by graduating students as they synthesize their programs through various methods of capstone offerings. Two primary types include interdisciplinary capstones that measure the entire baccalaureate curriculum—both major and general education—and discipline-specific topics, which assess primarily the major. The Mock Trial capstone course in the Stevenson University Master of Science in Forensic Studies program is of the latter type. In that class (which, unlike every other course in the program, is worth six credits), students from each area of concentration (Accounting, Computer Forensics, Criminalistics, Investigations, Interdisciplinary, and Legal) work as part of a team (either the Prosecution or the Defense) to investigate, prepare and try a case.

According to Robert C. Moore of Elizabethtown College in Pennsylvania:

[Capstone] course[s] should be designed to assess cognitive, affective and psychomotor learning and to do so in a student-centered and student-directed manner which requires the command, analysis and synthesis of knowledge and skills. The capstone course . . . integrates learning from the courses in the major with the courses from the rest of the academic experience. It requires the application of that learning to a project which serves as an instrument of evaluation.1

Stevenson has worked diligently to ensure that the Mock Trial capstone assesses what the students have learned, both in terms of the core curriculum (involving courses such as Evidence and Criminal Justice) and in their areas of concentration (these include, for example, courses in forensic accounting or computer forensics). The class is entirely student-centered and primarily student-directed in that very little class time is spent on lecture. The bulk of the course work is done by the students as they, with guidance from the instructors, create their case.

Capstone courses often represent an experiential component as well, where students work independently and/or on teams developing a project and creating an experience which can be evaluated and assessed by one or more faculty members. As noted above, the Forensic Studies Mock Trial capstone requires students to work as part of a trial team. Their work is then judged by faculty in the areas of law, computer forensics and accounting.

Experiential learning has been discussed as part of higher education for at least the past thirty-five years. David Kolb, building on “the work of Piaget, Dewey, and Lewin,”2 set up a model in his learning circle using four different elements:

Concrete experience, observation and reflection, the formation of abstract concepts and testing in new situations. He represented these in the famous experiential learning circle that involves (1) concrete experience followed by (2) observation and experience followed by (3) forming abstract concepts followed by (4) testing in new situations (after Kurt Lewin). It is a model that appears time and again.

This is the model that influenced the creation of the Mock Trial course. Students come to the class with concrete experience and observations (from both their lives and their prior coursework). They then must conceptualize the meaning of the facts found in the case file they have been given. The final “test” is the trial, where a verdict is rendered and their performances are graded.

At Stevenson University, the Mock Trial is the culmination for the Forensic Studies Master’s degree candidates. As noted above, students are placed on either the prosecution or the defense team, and class members also testify as fact witnesses. In addition, students in the Computer Forensics and Accounting concentrations testify as experts in those areas. This experience has proved invaluable, not only in terms of learning, but also as a means to assess the master’s program and to introduce the students to the job requirements for which they are preparing.

1 users.etown.edu/m/moorerc/capstone.html
An Application of Forensic Research to Solve a Specific Problem: The Development of an Organic Gunshot Residue (OGSR) Identification Method.

John Tobin, Ph.D.

Forensic Science is defined as the application of the physical sciences such as chemistry, biology, physics, and geology to the criminal and civil laws that are enforced by police agencies in the criminal justice system. (Saferstein, 2010). More realistically, it is the combination of scientific theories and procedures that, when used within the legal world, unlock the story that is contained within the evidence collected at a crime scene. The forensic scientist then must convincingly, accurately, and ethically advise the judge or jury in a criminal trial of the true meaning of the story and its relationship to other facts in the case. It is then up to the judge or jury to apply the weight or merit of the testimony to the determination of guilt or innocence. This is also referred to as the preponderance of evidence.

Unfortunately, forensic laboratories are not uniform in their size or their capacity to perform forensic examinations. Those that perform analyses for large jurisdictions usually have the budget and resources to have the most modern and sophisticated equipment. Smaller laboratories therefore have to do so with the resources available and may choose not to perform certain analyses because of lack of such instrumentation. The development of a scientifically sound method for the analysis of evidence that can be performed by more crime laboratories within their available resources and instrumentation is therefore warranted. In order for these methods to be legally acceptable in a criminal trial, they must be measured by one or both of two legal doctrines governing scientific evidence. These are the Frye and/or Daubert Standards respectively.

The Frye Standard requires that scientific evidence presented to the court must be interpreted by the court as “generally accepted” by a meaningful segment of the associated scientific community (Frye, 1923). The Daubert Standard requires analytical methods and procedures to be based on sound scientific theory and empirical testing, measurements of uncertainty or potential error rate, and the degree to which they are accepted by the forensic scientific community. The Daubert Standard also requires that results gathered from using the method in question must undergo peer review and demonstrate the use of standards and controls (Daubert, 1993). As other forensic procedures become available, they too will have to undergo this scrutiny. In this way the integrity of the use of scientifically sound analytical procedures will prevail in the adversarial system. It is to this end that the following research dissertation is proffered, i.e., the development of a method that will enable smaller forensic laboratories to add gunshot residue screening to their repertoire of analyses performed.

The use of guns in the commission of homicides, assaults, robberies, and criminal activities has become disquieting to the public. The prosecution of such cases has also become a concern based on the availability of testing procedures that can confirm the use of a firearm. In 1993, the FBI’s Crime in the United States estimated that almost two million violent crimes of murder, rape, robbery and aggravated assault were reported to the police by citizens. About 582,000 of these reported murders, robberies, and aggravated assaults were committed with firearms. Murder was the crime that most frequently involved firearms; 70% of the 24,526 murders in 1993 were committed with firearms (Zawitz, 2000). The Center for Disease Control and Prevention (CDC) estimated 52,447 deliberate and 23,237 accidental non-fatal gunshot injuries in the United States during 2000 (CDC, 2000). The use of guns in the commission of crime is not just a US phenomenon. Povey et al. reported that between 2006/2007 there were 9,650 reported incidents involving firearms in England and Wales (Povey, 2000). Firearms were discharged in 40% of these incidents. The State of Maryland is certainly not exempt from this statistic. Maryland ranked 9th in 2009 with 1,707 guns used in crimes that came from out of state. New census and FBI crime data show that while Maryland is the richest state in the country, it remains one of the most violent, and 80% of the 238 people murdered in Baltimore in 2010 were killed by handguns (Fenton, 2010).

These data indicate a clear and emphatic use of guns in crime. In order to provide for better prosecution of firearm cases, there must be a means of making an association between the use of a firearm and the suspect. One of the means by which this association is sought is through the detection of the residue deposited on the hands, face, hair, and clothing of the shooter following the discharge of a firearm. This residue is collectively defined as gunshot residue (GSR).

Two types of residue have now been generated by the ignition of the primer and the propellant and both can be deposited in the immediate environment of the discharge which include the hands and clothing of the shooter. These residues are the inorganic GSR and the organic OGSR. Both of these areas can provide valuable markers for the characterization of GSR and provide the potential to be used as evidence. The plume of the discharge from a firearm can be seen

FIG. 1.1 Smith & Wesson Model 36 (38 Special). (Schwoeble and Exline, 2000)
in Figure 1.1. The discharge residue in this plume is now free to be deposited on all exposed surfaces. This research focuses on the process of correlating a relationship between unfired smokeless powder propellant, the OGSR residue found in spent cartridge casings at the crime scene, and the OGSR residue on the hands or clothing of a suspect. The most important correlation would be that of the residue in the cartridge casing with the residue on the suspect. This provides the key element of association to the crime scene.

As noted, the smokeless powder propellant used in small arms cartridge casings is also a source of GSR identification. Propellants may be defined as “explosive materials which are formulated, designed, manufactured, and initiated in such a manner as to permit the generation of large volumes of hot gases at highly controlled, predetermined rates” (Kirk-Othmer Encyclopedia of Chemical Technology, 2nd ed, 2003). These propellants are a mixture of materials that perform various functions in the design of the propellant. Some of the most common functions are energizers [nitrocellulose (NC), nitroglycerine (NG)]; stabilizers [diphenylamine (DPA), ethylcentralite (EC), N-nitrosodiphenylamine (N-nDPA)]; and plasticizers [dibutylphthalate (DBP), diethyl phthalate (DEP), 2, 4-dinitrotoluene (2, 4-DNT), and either 2 or 4-nitrodiphenylamine (2 or 4-NDPA) and 2, 4-dinitrodiphenylamine (2, 4-DNDPA)]. Plasticizers add strength and flexibility to the propellant. Mach et. al. have found 1-mononitroglycerine (1-MNG) and 2, 6-DNT as contaminants in smokeless powder formulations (Mach et. al., 1974). Others have found that 1-MNG is a degradation product of NG (Martel et al., 2005). These materials, when taken together, may have the potential to identify a residue as having come from a smokeless powder source. Different manufacturers add different additives in varying concentrations and forms based on the properties of the powder they wish to control. This makes the smokeless powder composition unique to the manufacturer and to the product marketed. It is this composition of additives and energetic materials that leads to decomposition products that may be characteristic or particular to a certain manufacturer (NRC., 1998). In this thesis, these materials will be referred to as OGSR to distinguish them from the inorganic GSR particles.

In the forensic arena, an analysis tries to provide identification, individualization, and/or an association (Saferstein, 2010). Individual characteristics are those that strive for the establishment of uniqueness in source, such as DNA or fingerprints. Other analytical methods may only be able to establish class characteristics of an item, i.e., it cannot be considered unique but can only be considered in the light of belonging to a class of materials. For example, a shoe print found on a floor is easily recognized as a shoe print. This puts the print into the "general" class of shoe prints. Perhaps the size may also be able to be determined. This would put the print into a subclass of shoes of that size. However, if the shoe print does not contain any unique wearing patterns such as cuts and nicks, it cannot be taken to a level of identification that would provide a one-to-one correlation with a known shoe. Smokeless powder is also of this classification. The third consideration is association. Here the analysis demonstrates a relationship or connection between victim and scene, victim and suspect, or suspect and scene. Ideally, the combination of a unique identifier coupled with a positive association of the suspect to either the victim or scene is sought. This would require the more costly instrumentation and therefore limit the abilities of some labs to perform the examination.

The development of a method that would provide class identification and similar association capabilities would also provide valuable evidence. It is obvious therefore that the characterization of a smokeless powder can provide some sort of relationship.

If the preponderance of this evidence were raised to a higher level, i.e., the combination of the aforementioned particle analysis with the analysis of the organic fraction of smokeless powder, then this would provide a more concrete conclusion that a residue collected from a suspect had an origin in the discharge of a firearm. The particle analysis primarily demonstrates the presence of materials originating in the primer mixture of a cartridge casing and the organic materials significantly point to an origin in the propellant component. Both the primer mixture and the propellant are found in cartridge casings of small arms weapons such as handguns and rifles. When taken together, their presence serves as a powerful argument for the origin of such residue resulting from the discharge of a firearm or that the person from whom they were removed was in an environment where a firearm has been discharged. The current state of gunshot residue analysis does not provide for the analyst to conclude that a person from whom the residue was taken unequivocally discharged a firearm. In fact the use of GSR as a forensic tool is currently under scrutiny.

On January 8, 2011 a man later identified as Jared Loughner openly gunned down 19 people at a Safeway in Tuscon, AZ who had gathered to meet their Congressional representative. Arizona Representative Gabrielle Giffords was shot in the head and at least 17 others were shot during a meet-and-greet with constituents at the supermarket. Six people died. The dead included a U.S. District Court Judge and a 9-year old girl (Baltimore Sun, 2011). In spite of the fact that the crime was witnessed by numerous bystanders and recorded on video camera, this incident represents a compelling reason for the development of the most convincing means of identifying evidence of gun usage.

The final product of this research method has been tested in two forensic laboratories, the Maryland State Police Lab and the Baltimore County Police Crime Lab. In each case it successfully identified the residues as having come from an OGSR origin. Since both of these labs possess the capability of analyzing gunshot residue by
particle analysis with Scanning Electron Microscopy, this method also proved that both methods can be used successfully in conjunction with each other. There are other aspects that are still available for exploration. This will be done by forensic graduate students who have an interest in this field.

It is hoped that this research will fill the gaps that currently exist in GSR analysis and return the examination of this type of evidence to a more prominent position in forensic science. Allowing forensic laboratories to provide some answer to the gunshot residue problem will allow for further leads in the case to be developed. The method for the detection of OGSR has been proven to work satisfactorily in the identification of gunshot residue. Additionally, it has demonstrated itself to be a plausible method in consideration of the legal standards of Frye and Daubert. Research in any area of science is its life’s blood. It doesn’t have to be performed in laboratories that have every scientific instrument available and a huge program budget. This success of this research performed at the Stevenson University Laboratory is an example of research can extend the body of knowledge in any given field.

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Frye v. United States, 293 F. 1013 (D.C. Cir. 1923).


Corpses Don’t Lie
On Douglas Starr’s The Killer of Little Shepherds—
A True Crime Story and the Birth of Forensic Science
Alexander E. Hooke, Ph.D.

“What makes a human monster a monster is not only that it is an exception to the form but also that it introduces disorder into the legal system…”
Michel Foucault (Foucault, 2003, p. 324)

THE STORY

For the millions of fans devoted to crime scene investigation television, a moment of reverent silence might serve as homage to the uncelebrated figure who gave birth to their daily entertainment. He is Dr. Alexandre Lacassagne, perhaps the first college professor to have directed the capture of a human monster. The case involved a serial murderer, Joseph Vacher, a shrewd vagabond who in 1890s France mutilated, dismembered and violated numerous helpless victims. The arrest, trial and execution of Vacher became a public sensation, similar to television stars such as Mr. Monk or The Mentalist nabbing a clever but crazed killer who caught the attention of a fearful public.

How Lacassagne convinced legalists of Vacher’s guilt, though, is the key to his legacy. Unlike conventional detective methods of his time—eyewitness testimonies, undercover spies, or tortured confessions—Lacassagne emphasized a scientific and systematic approach that focused on physical evidence rather than human perception and memory. This interdisciplinary approach gave birth to what we now call forensics.

Its story is remarkably presented by Douglas Starr, author of The Killer of Little Shepherds, where he portrays how a professor in legal medicine eventually proved that a solitary wanderer trekking through remote villages in France was the serial killer. Starr illuminates how Lacassagne and his assistants relied on a corpse’s details to learn about the time and method of the gruesome murders. Witnesses tend to distort, exaggerate, deceive, mislead and equivocate. Determination of whether they have poor memories or concealed motives, demands on-going suspicion and uncertainty. In contrast to living humans, corpses don’t lie.

Lacassagne’s research required forbearance. Without rubber gloves, he had to manipulate his bare hands inside decaying cadavers. Without refrigeration, the decomposed bodies emitted an odor that sickened his beginning students. When he and his examiners finally endured the smells of putrid flesh overrun with maggots, fleas and moths, they still tired of how many days the stench of death lingered on their own skin.

As presented by Starr, these efforts help us appreciate Lacassagne’s legacy in several ways. He founded a school in legal medicine, inaugurated a twist to the power/knowledge dynamic, and offered a fresh angle to the on-going debates about the born criminal and abnormal brain.

FORENSICS AS A THEORY SCHOOL

According to sociologists of knowledge (Tiryakian, 1986), a theory school that gains hegemonic status is a comprehensive research endeavor which comprises four components. First, it addresses a current intellectual and practical crisis. Second, it is guided by a charismatic and brilliant individual. Third, it has institutional support, such as a government bureau or university department. Finally, it provides the basis—through generations of students, journals, books—for further advancements and discoveries in the particular field of knowledge.

Candidates for developing an influential theory school in the nineteenth century include: Darwin, Marx, Freud, Durkheim and Pasteur. As depicted in Starr’s book, Lacassagne is a pristine model for how a theory school emerges and prevails. Attuned to everyday controversies, Lacassagne realized that many violent people escaped punishment and many convicts were actually not guilty of their alleged misdeeds. Innocent suspects of horrific crimes could be held in jail for weeks or months before charges were dropped.

A major reason for this ineptness is that before Lacassagne, criminal inquiries relied on the testimonies of witnesses and coercing suspects. Human testimony has always been considered as a hit-or-miss endeavor. People have erratic or self-serving memories, and confessions gained under physical duress (i.e., torture) are hardly convincing. As a professor in the department of legal medicine, Lacassagne realized that ascertaining true guilt or innocence required an alternative approach. For example, Lacassagne worked on a case involving the alleged poisoning of a husband by a distraught and angry wife, who had both motive and opportunity. Lacassagne learned that subsequent residents of the widow’s dwelling developed symptoms similar to those of the deceased husband. As a result of his investigation, he concluded that the cause of death was polluted air from an adjacent factory rather than homicidal poisoning.

By all accounts, Lacassagne was a charismatic figure. Colleagues and associates admired his kindness, sense of humor, work ethic, and commitment to on-going research conducted by graduates or local officials. He continually supplied the research lab with state-of-the-art equipment while overseeing publications for researchers and practitioners, ranging from The Journal of Criminal Anthropology to his Handbook for future forensics investigators. By the 1920s his students were working throughout much of Europe. He consistently employed the latest findings in chemistry, bacteriology and ballistics. Equally important was his eager embrace of the sophisticated improvements in microscope technology.

Thus he and his assistants learned to find clues in minute details that eluded the naked eye. Slivers of hair, particles of dust, drops of blood and flakes of skin were among the types of evidence that provoked an entirely new approach to criminological investigations. Moreover, no matter how well the killer planned his crime, he would invariably leave a trace or clue of his identity, awaiting discovery by Lacassagne and his team. In Starr’s poignant words, “Death leaves a signature, and they would learn to read the meaning.” (Starr, 2010, p. 19)
Chapter 8, “The Body Speaks,” provides a compelling visit into the minds and practices of Lacassagne and his assistants. Once having displaced human speech with the body’s own signs, the investigative teams formed a radically new concept of the corpse. After a person’s demise, the body is still host to all sorts of activity. Its temperature, muscular tissue and skin deterioration all change gradually but at different rates. Lacassagne thus wanted to find a corpse quickly in order to pinpoint the hour of death. If a corpse was discovered six months after reported missing, investigators were left to register the gradations of flies and their larvae that permeated the corpse in order to estimate the time of death. Asphyxiation was a common cause of death in Lacassagne’s time, so he had to train himself and his students to be able how to distinguish an accidental drowning from purposeful drowning or willful strangulation. Parenthetically, early forensics tested their hypotheses by placing—and killing—dogs in analogous situations.

THE (AB)NORMAL BRAIN

After describing how the individual paths of Lacassagne and Vacher eventually converged—and the legal and social circumstances of that encounter—Starr concludes with a report on a professional and scientific dispute that still lingers. Namely, how can we explain an anomaly such as the human monster? Or, at least, what should the proper response be when an otherwise seemingly normal human commits a monstrous act?

Looking for an etiological anchor to criminal acts has always been a central task for legalists, criminologists, politicians, moralists and sociobiologists. Their findings, if accepted by authorities, could be used for an array of responses from the proper punishment of the miscreant to correcting or preventing the predisposition for committing the misdeed. Upon Vacher’s death his brain was dissected with sections sent to six different experts. To envision these specialists walking home with a section of a serial murderer’s brain offers a moment of grim humor—what did they dare hope to find?

They quibbled over which sorts of lesions or damaged tissues on Vacher’s brain were possibly relevant. One expert, focusing on the section that supposedly controlled speech, asserted this section of Vacher’s brain were possibly relevant. One expert, focusing on the section that supposedly controlled speech, asserted this section of Vacher’s brain were possibly relevant. Lacassagne thus wanted to find a corpse quickly in order to estimate the time of death. If a corpse was discovered six months after reported missing, investigators were left to register the gradations of flies and their larvae that permeated the corpse in order to estimate the time of death. Asphyxiation was a common cause of death in Lacassagne’s time, so he had to train himself and his students to be able how to distinguish an accidental drowning from purposeful drowning or willful strangulation. Parenthetically, early forensics tested their hypotheses by placing—and killing—dogs in analogous situations.

Experts continued hypothesizing on the correlation between a social violation (such as a cruel and pointless murder) and its physical correlation (such as a generally recognizable flaw in the brain). Now, it was clear that there were different rates. Lacassagne thus wanted to find a corpse quickly in order to estimate the time of death. If a corpse was discovered six months after reported missing, investigators were left to register the gradations of flies and their larvae that permeated the corpse in order to estimate the time of death. Asphyxiation was a common cause of death in Lacassagne’s time, so he had to train himself and his students to be able how to distinguish an accidental drowning from purposeful drowning or willful strangulation. Parenthetically, early forensics tested their hypotheses by placing—and killing—dogs in analogous situations.

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*Many thanks to students in INDS6, Spring, 2012—Law/Crime—for their thoughtful comments and suggestions.
Joyce Williams has more certifications than could fit on a business card. She is a Registered Nurse, an Advanced Forensic Nurse, a Certified Forensic Nurse Examiner, a Certified Sexual Assault Nurse Examiner and a Certified Abbreviated Scale Injury Coder. Dr. Williams is also trained in Critical Injury Stress Management and is a Diplomate to the American Board of Medicolegal Death Investigators and a Fellow in the American Academy of Forensic Sciences. Her list of awards is just as long. Notably, Dr. Williams was given an Achievement Award by the International Association of Forensic Nurses in 2007. Presently, Dr. Williams works as both a Forensic Nurse Examiner at Safe Place, a Child Advocacy Center in Maryland and as a Clinical Instructor at Johns Hopkins School of Nursing. Here, she shares some information about her life’s work.

**WHAT ARE THE DUTIES AND RESPONSIBILITIES OF A FORENSIC NURSE?**

Forensic nurses respond to victims of trauma, injury, accidents, neglect, abuse, exploitation and all forms of violence. These specialists examine and differentiate disease and injury (intentional and unintentional). They apply medical and nursing science to individuals and populations. Additionally, they collect evidence from suspected perpetrators or those who may have committed an illegal, criminal, or evil act against another person, identify their injuries and provide services in correctional settings where convicted persons are incarcerated.

**WHERE (OR IN WHAT AREAS OR Instances) DOES FORENSIC NURSING DIVERGE FROM TRADITIONAL NURSING?**

Forensic nursing is the intersection between nursing and the law. The types of patients that fall into this specialty are those who are victims of violence (intentional injury such as homicide, child abuse, elder abuse, interpersonal violence, strangulation, or sexual assault). Skills and areas of competence require one to be proficient in identifying and preserving evidence, documenting and interviewing at crime scenes, accidents, sites of trauma/violence, and in situations of victimization. Forensic nurses also provide consultation for government and private agencies that assess safety and risk management.

**WHAT EDUCATION AND DEGREES ARE REQUIRED TO BECOME A FORENSIC NURSE?**

Forensic nurses are licensed registered nurses. They have additional training specifically tailored to complement their specific area of work. Many nurses seek higher theoretical education in particular at the graduate level where higher level concepts are studied including human response to injury and wounds (victimization, trauma, crime). Other models incorporate survivorship, manipulation and boundary violations. Universities offer masters curricula leading to a clinical nurse specialist (CNS). There are programs at the doctoral level that award the Doctor of Nursing Practice (DNP) degree with a focus in forensic nursing. Throughout the process theories and frameworks are used from criminology, forensic psychiatry, forensic mental health, forensic science, public health, perpetrator theory, public health, and traumatology.

**WHAT TYPE OF FIELD TRAINING OR HANDS-ON WORK IS REQUIRED TO BECOME A FORENSIC NURSE?**

Each type of specific training requires clinical hours in order to complete the knowledge process. In Maryland for example, adult/adolescent sexual assault training is a 40 hour didactic course with an additional 40 hours of clinical training. This is where the specialized aspects are further learned through practice in a mentoring atmosphere. One example would include observing a sexual assault examination with each component of the lengthy procedure explained and demonstrated.

**WHAT SPECIALTIES ARE AVAILABLE FOR FORENSIC NURSES?**

Forensic nurses comprise a large community of prevention specialists. Exemplars are: Domestic Violence, Sexual Assault, Sexual Assault Primary Prevention, Sexual Violence in Tribal Communities, Elder Mistreatment, Primary Prevention, Death Investigation, and Mass Disasters. Other areas include mental health and psychiatric facilities, transportation safety, public health surveillance, and policy makers. As advanced practitioners, they develop and supervise systems of care for complex health problems nationally and globally. They are key stakeholders and leaders who work toward gender equality, health policy and related financial, judicial, ethical and political issues that impact forensic clients. Important in their role is education of healthcare practitioners as well as the community in prevention areas to decrease morbidity and mortality.

**WHAT TYPES OF SETTINGS HAVE NEED FOR FORENSIC NURSES? ARE YOU AWARE OF WHAT TYPES OF EMPLOYMENT OPPORTUNITIES ARE AVAILABLE FOR FORENSIC NURSES?**

Forensic nurses work as clinicians in hospital settings, free standing clinics, justice centers, governmental agencies, medical examiner offices and universities. That being said, they can be found working in areas that focus on prevention such as the National Highway Traffic Safety Administration (NHTSA), National Transportation Safety Board (NTSB), Food and Drug Administration (FDA), Consumer Products Safety Commission, and the DoD performing injury analysis, disease surveillance, mass casualty identification, critical incident stress management and mental health well-being follow-up. The role of forensic nurses has no boundary. Their expertise is invaluable to avert a potential danger and to mitigate those that have already occurred.
WHAT IS YOUR EDUCATIONAL BACKGROUND?

My nursing career began by earning a diploma in nursing followed by a bachelor in nursing. Obtaining significant experience as a clinician working with critical care patients and trauma victims motivated me to engage in graduate studies. This led to a MFSA (Master of Forensic Science Administration) and DNP (Doctor of Nursing Practice) with a specialty in Forensic Nursing. However, learning never ends as I attend many seminars and trainings where speakers provide the latest science, technology, and applications to keep me abreast in the field.

WHY DID YOU DECIDE TO BECOME A FORENSIC NURSE? HOW LONG HAD YOU BEEN A TRADITIONAL NURSE AND WHAT INSPIRED YOU TO MAKE THE CHANGE?

About 25 years into my career, I attended a conference with my husband (a dentist) and every lecture I attended brought to the foreground the significance of my current work with trauma victims in the emergency department. I was made aware of the intersection of nursing, medicine, and legal issues and how the law is so important when assessing, identifying injuries, and the interventions that are so necessary for victims to return to normalcy following a traumatic event. From that moment, I realized that I was already immersed in the forensic field. I began pursuing advanced educational opportunities and degree options. My thirst has continued to grow as I strive to enhance my knowledge through collaboration with practitioners and others who analyze injuries.

CAN YOU TAKE ME THROUGH YOUR CAREER HISTORY AND PROVIDE A DESCRIPTION OF YOUR DUTIES AND RESPONSIBILITIES FOR EACH POSITION OR CERTIFICATION?

• ANCC, Advanced Forensic Nurse, AFN

In comparison with other nursing fields, forensic nursing is a small specialty that offers board certification. Because of this, the IAFN (International Association of Forensic Nurses) has partnered with ANCC (American Nurses Credentialing Center) to provide a means for recognition of those nurses at the graduate level who demonstrate advanced practice knowledge. This process has been beta tested and awarded to those who met the designated criteria. I received this as one of those in the initial review.

As a member of the Forensic Nurse Certification Board, I was selected to be a member of the working group to collaborate on this project. We reviewed the essentials of forensic nursing, the scope and standards, and areas of practice to be sure that the portfolio process would be comprehensive and meet the criteria to be a rigorous form of competency.

• Maryland Board of Nursing, RN

My licensure for Maryland; this allows me to practice as a nurse in Maryland.

• Certified Forensic Nurse Examiner A/P, Maryland Board of Nursing

By fulfilling the requirements for adult and pediatric patient examinations set forth in the regulations of the Board of Nursing (BON), I am licensed to conduct specialized examinations on individuals seeking medical care and intervention. The didactic and clinical components are set forth by the BON. The license is renewed annually which requires eight hours of continuing education and a fee separate from a general nursing license. I work at Safe Place, a Child Advocacy Center, where I, with a multidisciplinary team (MDT), investigate reports of child abuse. The MDT includes child protective social work investigators (CPS), a family advocate, a mental health specialist, law enforcement, a states attorney, and the medical team. I perform forensic medical evaluations for clients who have been chronically abused by a known offender, often a family member or friend of the family.

• IAFN, Certified Sexual Assault Nurse Examiner (Adult)

Through the International Association of Forensic Nurses, I sat for the certification examination. It is renewed every 3 years by submission of contact hours in specific categories or retaking the examination.

• Diplomate-American Board of Medicolegal Death Investigators

The American Board of Death Investigators is an organization specializing in educating and testing the competence of those individuals who work as coroners or medico-legal death investigators (MLDI). This organization provides short courses at the basic and advanced (masters) levels. They are a resource for all who practice in this area.

For eight years, I worked for the Medical Examiner Office, State of Maryland investigating unattended deaths as determined by the Code of Maryland (COMAR) regulations for the state. During that time, I responded to several hundred death scenes. The types of cases involved motor vehicle crashes, drowning, suicides, trauma victims, hunting accidents, homicides, poisonings, pregnancy-related deaths, and occupational deaths. I would work with law enforcement to determine the series of events that led to the death of the person, interview all individuals involved in the incident, and obtain copies of medical records, social history, and any materials relevant to the resolution of the case to provide necessary information for the forensic pathologist so that following the autopsy, they could determine the cause and manner of the death.
**Certified Abbreviated Injury Scale Coder**

For five years I worked for the Department of Defense (DoD) working for the Armed Forces Medical Examiner System (AFMES) at the Armed Forces Institute of Pathology (AFIP). I was a part of the team in the mortality surveillance division where we examined all cases of combat mortality. The focus of the work was primary prevention and to determine ways to decrease morbidity and mortality in combat zones. My role was looking at injuries sustained to the deceased and to strategize on ways to improve the personal protective equipment for the person. I collaborated with a team of individuals who also investigated direct and peripheral aspects related to safety of the soldier. Specific aspects we investigated were the design and functionality of the combat helmet, the Small Arms Protective Plates (SAPI) worn in combat and other gear meant to improve the survivability of those serving our country.

Another part of the role was analyzing injuries and coding them in a specially designed tracking system and dataset. Here one could identify injuries that led to cause of death (COD). Collaboration also included stakeholders such as the Institute for Surgical Research (ISR) a facility instrumental in researching advanced methods of combat medical care and training at the field level.

**Critical Incident Stress Management, State of Maryland**

As a member of the Critical Incident Stress Management (CISM) team for the State of Maryland I respond when called to help defuse or debrief individuals who were involved in a stressful situation. The potential individuals needing these services might be a firefighter, EMS (emergency medical system) responder, or law enforcement. The work involves either a one-on-one or group meeting shortly after the incident in order to help those persons cope with a particularly difficult situation. Often the defusing will be within hours of the event while a debriefing is perhaps a few days out when it remains difficult to move on with self or work. Examples are child fatalities or officer shootings. Here the CISM volunteers would talk about what are normal reactions, appropriate ways to cope and inappropriate activities. When emotions or life does not return to normalcy, they are advised to seek further mental health counseling. This has been quite useful over the years as it provides a mechanism to look after myself, family and peers.

**CAN YOU TAKE ME THROUGH YOUR AREAS OF EXPERTISE AND EXPLAIN A BIT ABOUT EACH ONE?**

My passion is working with trauma victims (victims of violence—sexual assault [adult/pediatric], motor vehicle collisions, injury analysis). For about 12 years I practiced at a Level II trauma center where victims of abuse and violence were treated. Some cases were complex with injuries leading to the demise of the person. Some of these cases were prosecuted. Others were identified, provided medical interventions leading to recovery physically but had the mental injuries to contend with often taking much longer to resolve.

Not all trauma centers currently focus on the legal aspects of the trauma. The first concern is always saving a life! However, in these situations much forensic evidence can be lost. Instituting a forensic team to work in tandem with the trauma team, one can preserve the necessary trace evidence for prosecution. Working with law enforcement the forensic nurse can photograph and document the areas of injury, collect trace evidence found on the victim and ensure that when possible the trauma team, for example, is not inserting chest tubes or other diagnostic/treatments in areas that sustained injuries (ex. Bullet wound or stab wound). Also the forensic nurse will swab prior to washing and cleaning skin areas to obtain elements that can identify the perpetrator. The forensic nurse works side by side with the trauma team and criminal justice system to assess the injuries, gather the evidence and provide holistic care to the patient. Following the initial trauma treatment phase, their work is not finished. They will continue to work with the victim to ensure that appropriate mental health, advocacy, and long term care are put in place. There may be times when they will need to testify in court depending upon the case.

Another area of expertise that I am devoted to is post traumatic stress. The Critical Incident Stress Management (CISM) team for the State of Maryland utilizes forensic nurses as part of the group to provide a special level of care once they have been trained in the methods of CISM. Emergency Responder Wellness and Acute Traumatic Stress Management are paramount in the work of providers. Individual Crisis Response Intervention and 1:1 Peer Support are the tenets of CISM. Communication and responder self care strategies are aspects that we provide in order to help mitigate the stress of the incident. As a forensic nurse, I have experienced work as a trauma practitioner and understand that not all patients can be saved. I have spent endless hours with families over the years consoling them following the news of the death of a family member or friend. We often work in tandem with a mental health therapist or psychologist especially when there is slow resolution and the affected person is still feeling overwhelmed by life.

Mass Casualty Response is an area that has become important to me over the past 10 years. My direct experience has been with DMORT (Disaster Mortuary Operational Response Team) working as a member of the identification team either in the morgue or with the families (FACT) Family Assistance Center Team. I responded to Shanksville, Pa following the 9/11 crash of United flight 93 and also to Baton Rouge following Hurricane Katrina. My role in the morgue
following the crash of United 93 was to work as a team member in whatever capacity was needed. All members of DMORT perform multiple duties despite being specially trained in a forensic discipline. I spent 12 days in the morgue assisting in the identification of those who perished in the crash. My role for the first week was working alongside a forensic pathologist examining each body fragment recovered from the crash site. We noted every injury down to the most minuscule detail that would provide the means to identify the person as part of the post-mortem assessment. This documentation was then compared to the ante-mortem information obtained from the families as they compiled a description of the family member in the family assistance center. This is one part of the process used to identify the deceased. For an additional five days I worked with the DNA extraction team where we removed portions of bone, teeth or muscle to send to AFDIL (Armed Forces DNA Identification Lab). The process is very specific in order to preserve the specimen, avoid cross contamination, and record the exact numbered sample so the forensic lab can process the piece to create a DNA profile.

As the chair of the Nursing Education Committee of the World Association for Disaster and Emergency Medicine (WADEM) our goal is to advance the proficiency of nurses globally in the response to disasters. Other professional organizations in which I actively participate are the American Academy of Forensic Science, the MidAtlantic Association of Forensic Scientists, the International Association of Forensic Nurses and the Emergency Nurses Association. Each of these organizations offers educational opportunities to learn the latest scientific updates at their annual meetings.

I am also an educator in graduate forensic nursing. In the academic setting, there are a number of issues pertinent to this specialty that need to be addressed. For example, the role of the forensic nurse must be defined noting the diversity a forensic nurse can offer and in multiple settings. Meeting the needs of persons across the lifespan is essential during the course schedule as well as incorporating a schema that addresses working with individuals and populations. Forensic nurses work with persons sustaining traumatic injuries; they also work in communities where they are instrumental in developing prevention services and activities to make communities safe.

In addition to the work addressed above, I also sit on some community groups: the CFRT (Child Fatality Review Team), the SCIP (Strategic Community Improvement Program) and the Citizens Review Panel. The CFRT examines all fatalities of children between 6 months and 18 years of age. We review each child who dies and the mitigating factors, determining where we can improve services in the community regarding safety and prevention. I represent the committee as a forensic nurse looking at the injuries sustained and ways that we can protect the child (ex. improved helmets, not allowing children to ride 4-wheelers without supervision and so on).

The Citizens Review Panel examines the work of the Department of Social Services and while it is not necessary to be a forensic nurse to sit on this panel, the knowledge and background often adds to the examination of the records again pointing to the safety in homes and families and means to increasing prevention at the primary level.

SCIP is a group of citizens who provided a detailed assessment of the state of Washington County Maryland to delineate the needs of the community. We looked at health and well being, the current state of domestic violence, alcohol and drug abuse, STI’s (Sexually Transmitted Infections), pregnancy and other issues pertinent to the health of all.

I recently joined the Maryland Human Trafficking Taskforce Victim Services Committee. As I transition to Baltimore County from Washington County it is my hope to serve the community in many avenues. As a person who considers involvement in improving the lives of others, I will continue to make available my knowledge and experience when possible to those victims of violence by working on prevention initiatives to decrease casualties and expand the holistic approach to this population.

WHAT ELSE WOULD YOU LIKE PEOPLE TO KNOW ABOUT FORENSIC NURSING?

The life of a forensic nurse is diverse reaching out to those who have had unwanted or unexpected experiences leaving them physically and sometimes mentally traumatized. Nurses who work in this specialty are essential to helping each and every person restore their self-worth and to establish a comfortable routine where they can enjoy all that life has to offer.
INTRODUCTION

Marijuana is a greenish-brown mixture of leaves, stems and seeds derived from the plant cannabis sativa L. The active ingredient in marijuana is tetrahydrocannabinol (THC), which is highly concentrated in the flower and leaves (Trimm, 2005). Marijuana is the most commonly used illicit drug in the United States. According to the National Survey on Drug Use and Health (NSDUH), 15.2 million people reported using marijuana in 2008 and marijuana was the only drug used by 53.3 percent of illicit drug users (Volkow, 2002, p. 2). The Controlled Substance Act of 1970 placed marijuana as a Schedule I drug under federal law (Drug Enforcement Administration, n.d.). According to the Drug Enforcement Administration (DEA) 1,324 kilograms of marijuana were seized in 2008 (Drug Enforcement Administration, 2010). This was the most seized drug when compared to cocaine, heroin, methamphetamine and methylenedioxymethamphetamine.

Forensic crime laboratories are comprised of various departments specializing in the examination of specific types of evidence. The chemistry section is often called the controlled substances or drug section and routinely processes the largest number of cases and items submitted to the laboratory (Dale & Becker, 2007, p. 110). Marijuana evidence sent to the crime laboratory is examined using three different techniques. These include: morphological examination, chemical evaluation, and instrumental analysis. The morphological examination uses microscopy to identify characteristic plant features.

The Duquenois-Levine is the presumptive test used for the detection of marijuana. The Duquenois-Levine reagent consists of three parts. Solution A is a mixture of one percent acetaldehyde (CH3CHO) and two percent vanillin [(CH3O)(OH)C6H3CHO] in ethanol, solution B consists of concentrated hydrochloric acid (HCl), and solution C is pure chloroform (CHCl3) (Newton, 2008). The three solutions are added to a test tube containing a sample of marijuana. Solutions A and B together will produce a dark purple color. The addition of solution C will produce an additional lighter purple layer below the first layer. If a purple color extracted through the chloroform layer is produced then the sample is positive for marijuana.

The final step to positively identify marijuana is to use a scientific instrument, usually a Gas Chromatograph/Mass Spectrometer (GC/MS). Chromatography is a method for separating a mixture into its component parts, while mass spectroscopy is based on the electrical charge and the mass of a particle (Newton, 2008). GC/MS is a confirmatory test that allows for the identification of a drug based on comparison of the mass spectrum produced by the unknown drug with the reference spectra of a known drug (Lee & Harris, 2000).

As the number of drug cases rise, the amount of evidence submitted to crime laboratories also rises thus resulting in a drug analysis backlog. Several states throughout the United States have greatly decreased their drug backlog with the use of field drug tests. Field drug tests are small kits that a trained police officer uses to identify a controlled substance. The field test kits are small pouches or capsules that contain a series of chemicals that produce a color change for a specific drug.

Field test kits were first invented in 1970 in order to provide a portable kit for the rapid detection of a narcotic, dangerous drug, or other drug (U.S. Patent No. 3,748,098, 1973). A qualitative analysis device, which allows for the serial extraction and reaction of vegetable matter to determine if the vegetable matter contains cannabis material, was patented on February 6, 1973 (U.S. Patent No. 3,715,189, 1973). Sarkie Nighohossian and John J. Tobin, Jr., inventors of this device, hoped to create a reliable and viable apparatus that could be used in the field by law enforcement officers to test for marijuana.

The Duquenois-Levine color test has been used in crime laboratories for presumptive testing on marijuana since the 1970s with over 90% of crime laboratories still using the same reagent and method today (O’Neal, Crouch, & Fatah, 2000, p. 190). The field test kits are comprised of a small portable pouch with a pre-measured amount of the Duquenois-Levine reagent. Each marijuana field test kit contains three separate ampoules within a single pouch (See Figure 1). The police officer is able to test for suspected marijuana in the field, using the same validated color test that forensic crime laboratories use for the presumptive testing of marijuana.

If a police officer uses this test and the result is positive, the suspect can be arrested at the scene. The officer provides an affidavit regarding the test which is then used at a preliminary hearing. The affidavit contains the results of the test, a statement regarding the police officer’s qualifications and certification to conduct the test, and the expiration date of the reagents contained in the test kit.
RESEARCH METHODOLOGY

Research was comprised of four phases: Phase I Literature Review; Phase II Development of Survey Questionnaire; Phase III Deployment of Survey; Phase IV Survey Analysis.

Phase I: Preliminary research consisted of open source review of applicable literature. Subjects included: crimes involving use and possession of marijuana; organization, layout, and function of forensic crime laboratories; drug testing materials, processes, analysis, and procedures; and the field investigation drug officer (FIDO) program components.

Phase II: A survey questionnaire was developed to solicit information regarding marijuana testing processes, procedures, backlogs, and manpower requirements in forensic laboratories. The survey included a cover letter explaining the survey’s purpose, intended use, and seven questions as follows. (1) On average, how many drug cases does your laboratory receive every month? (2) Of those drug cases received, what is the approximate percent of marijuana only cases? (3) On average how long does it take to fully examine a single item marijuana case in your laboratory? (4) How many forensic drug chemists are currently employed at your location? (5) Of the total number of drug cases received per month, what is the approximate percentage of cases containing at least one exhibit of marijuana only cases? (6) Of the cases you examine each month, what percent of those cases would you estimate require testimony by the analyzing chemist? (7) On average, how many hours a month do your forensic drug chemists spend in court for drug cases?

Phase III: A survey deployment was accomplished by sending out 35 questionnaires to forensic crime laboratories in 16 different states. The 16 states included: Maryland, Virginia, North Carolina, South Carolina, West Virginia, New York, Georgia, Arizona, Idaho, Kentucky, Florida, Connecticut, Arkansas, Alabama, Iowa and Montana. Of the 35 questionnaires sent, 23 responded. South Carolina, West Virginia, New York, Georgia, Florida, Arkansas, Iowa and Montana all returned one questionnaire. Four different labs in Maryland, three labs in North Carolina and Arizona and two labs in Alabama, Idaho and Kentucky returned questionnaires. This is a 65% return rate. The responses from the questionnaires were analyzed.

Phase IV: A survey analysis was conducted to verify how various state forensic crime laboratories analyze drug cases and to obtain data that was not available in the literature. Of the 23 responses received, almost all the laboratories reported that they processed 100-500 drug cases each month, with five laboratories reporting they processed over 500 cases per month. Eight laboratories responded that they currently use a combination of crime laboratory tests and field test kits for at least one of the four most popular drugs: marijuana, cocaine, heroin, and methamphetamine.

There was a wide range of answers for the amount of time it takes to fully examine a single marijuana case as noted in Table 1.

<table>
<thead>
<tr>
<th>Amount of Time it Takes to Examine a Single Marijuana Case</th>
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<tbody>
<tr>
<td>Time</td>
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<tr>
<td># Of Responses</td>
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**TABLE 1:** Responses from 23 laboratories on the average amount of time it takes to fully examine a single marijuana case.

Table 1 shows the responses from each laboratory on the length of time required to examine a single marijuana case. The majority of labs responded that it took 10-30 minutes. Each lab has different standard operating procedures and requirements which could contribute to the variance reported.

<table>
<thead>
<tr>
<th>Maryland’s Forensic Laboratories Responses</th>
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<tbody>
<tr>
<td>Number of cases lab receives in One month</td>
</tr>
<tr>
<td>Percent of Marijuana cases</td>
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<tr>
<td>Average number of Drug Chemists Employed in lab</td>
</tr>
<tr>
<td>Average amount of time Chemists spend in court in 1 month</td>
</tr>
<tr>
<td>Average % of cases that require testimony by chemist</td>
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</table>

**TABLE 2:** Statistics from Maryland’s forensic crime laboratories questionnaire responses.

Table 2 shows the statistics from the Maryland forensic laboratories which responded to the questionnaire. The Maryland laboratories reported that 50%-75% of the drug cases received are marijuana cases or cases that contain at least one marijuana exhibit. On average, for the 23 responses, there are 6 drug chemists employed in a forensic laboratory who spend 7.6 hours a month in court for drug cases. In contrast, Maryland’s six forensic chemists average 11.6 hours per month in court. The responses to the questionnaire, including Maryland’s responses, indicated that less than 10% of all drug cases examined by a chemist required the chemist to testify in court.

ADDITIONAL FINDINGS

During the course of the survey analysis phase, results from the Field Investigation Drug Officer (FIDO) program were cited by various
respondents. Many states across the United States have programs where police officers are trained to use field drug test kits and testify in preliminary hearings. One program, the Field Investigation Drug Officer (FIDO) program, is being used today in Utah, Florida, and Arizona. These three states have greatly reduced their drug backlog with the use of the FIDO program.

Using field drug tests can reduce the drug related backlog in crime laboratories, as well as, decrease the processing turnaround time for drug cases. Field drug tests can be used by the police officer who then testifies as an expert during preliminary hearings. This further reduces the number of samples submitted to the crime laboratory, which clears or reduces the laboratory’s backlog. The laboratory’s focus would be to perform analyses on felony drug cases, drug cases that go to trial, after a preliminary hearing, or cases where a field test kit produced an unclear result.

As of 2009, the Florida Department of Law Enforcement crime laboratories and the Utah Bureau of Forensic Services laboratories have posted a zero drug chemistry analysis backlog. Before the use of the FIDO program, Phoenix Arizona’s police department laboratory received approximately 12,000 analysis requests per year. As of 2007, that number has been reduced to 3,741 requests for analysis (See Figure 2).

Both the Phoenix Arizona Police Department and the Utah BFS have posted impressive results with the use of the field drug tests. Each laboratory has demonstrated the value of the FIDO program in the reduction of drug related testing backlogs in crime laboratories. This program, and programs similar to it, reduce backlogs, save time, and save money. The estimated cost for a single item laboratory analysis is approximately $50.00, while the cost of one field test kit is approximately $1.00 to $2.00 (Kanable, 2008).

**DISCUSSION**

Field drug test kits have been available for several decades but police departments did not start using them until recently. Chemical color tests are popular because they rely on simple chemical reactions and produce visible results that can be interpreted with the naked eye and are inexpensive (O’Neal, Crouch, & Fatah, 2000, p. 190). Within the last ten years, police departments around the United States started using field drug test kits to test for narcotics.

Various states are using these field drug tests to reduce their backlog. The National Forensic Science Technology Center (NFSTC) developed a program that trains law enforcement officers in the field to test for controlled substances (Sylvester, 2009, p. 6). The Field Investigation Drug Officer (FIDO) program trains officers to perform presumptive color tests and to testify in court about their results. The Utah Bureau of Forensic Services was the pilot site for the program and has dramatically reduced its testing backlog for drug related samples.

The FIDO program supplies training materials to agencies, who can then tailor the training to suit their specific needs (Sylvester, 2009, p. 7). The FIDO training program provides class outlines to agen-
cies which include safety and legal considerations, evidence control, substance overviews, field testing procedures, report writing and courtroom testimony, as well as, written exams an officer is required to pass in order to become certified (Sylvester, 2009, p.7).

Police officers performing field drug tests can eliminate the need for small amounts of narcotics to be sent to the laboratory. Other samples may be sent to the lab for complete analysis if the police officer thinks the test produced a false negative, or an ambiguous presumptive result. The laboratory, no longer tasked by small cases, would have more time to work on complex felony cases until the analysis was required for trial, thus saving time and money (Kanable, 2008).

CONCLUSION

Maryland’s forensic crime laboratories could reduce their drug backlog with the use of marijuana field test kits. Providing police officers with the adequate training and tools to perform these tests will save time and money for forensic laboratories, thereby saving money for the state. If a single laboratory in Maryland received and examined 250 marijuana cases in one month, the cost of examining those cases is approximately $12,500. If marijuana field test kits were used on 50% of the 250 cases, with the laboratory examining the remaining 50%, the total cost for the examination of 250 marijuana cases in one month would be $6,500. This would save a single Maryland laboratory approximately $6,000 a month and $72,000 a year.

The FIDO program utilized in various locations across the United States, has successfully reduced those laboratories’ drug analysis backlog problem. Maryland’s forensic crime laboratories receive numerous drug analysis requests to be completed within a certain time period. More than 50%-75% of the drug cases Maryland’s laboratories receive are marijuana or have at least one marijuana exhibit. The chemists in the forensic laboratories not only have to analyze each sample but may be required to go to court for the cases in which they examine. Although less than 10% of the cases that forensic chemists examine require the chemist to testify, this still represents a significant manpower cost. If field drug test kits were used in Maryland, forensic chemists would not have to appear in court as often. They could use this time in the laboratory conducting drug analysis for felony cases. This would reduce the drug related backlog in Maryland’s forensic crime laboratories and save money for the laboratory and the state.

REFERENCES


Is High Frequency Trading the Problem with the Financial Markets?
Corey E. Costa

INTRODUCTION

High Frequency Trading (HFT) is a computerized means of capitalizing on minute changes in pricing and executing transactions quickly using complex trading programs. Used honestly, it provides best execution for customers in the form of faster trades at better prices and supplies liquidity to the marketplace. Implemented by the unscrupulous, it manipulates prices for the trading firm’s benefit, takes advantage of other HFT firm algorithms, and fails to stabilize markets in times of crisis. These negative effects are why regulators and many financial market analysts are posing the question, “Should High Frequency Trading be allowed and, if so, how do regulators encourage the positive aspects of HFT while minimizing the negative?”

High Frequency Trading and Algorithmic Trading (AT) are sometimes used interchangeably but they are not the same thing. HFT is only one form of AT. Algorithmic Trading, like HFT, employs mathematical formulas to determine the timing, pricing, and size of transactions, but AT does not have the same short-term focus. Most institutional investors employ AT to assist in executing large institutional orders efficiently. Many of these purchases are held for days, weeks, and months in institutional accounts such as pension and mutual funds (Zhang, 5). However, HFT transactions typically result in a short-term holding that lasts seconds or minutes. These short-lived transactions have led to the overall decrease in the average holding period of securities (Spicer and Lash).

High Frequency Quoting (HFQ) is a lesser used term but one that is gaining currency as regulators continue to dissect the impact of HFT on the financial markets. HFT firms submit orders in a rapid fire pattern with most orders posting for fractions of a second before they are cancelled. Cancellation rates as high as 90 percent have been reported (Spicer and Lash). This practice has been coined “quote stuffing” and is described as the practice of “flooding the marketplace with bogus orders to gain an edge” (Spicer and Younglai). High Frequency Trading firms may attempt to place orders in the market to gain insight into other participants’ strategies or upcoming activity as well as determine the lowest (highest) price the market will bear for a bid (offer). Markets and exchanges do not charge firms to place or cancel orders so there is no cost associated with high frequency quoting.

HIGH FREQUENCY TRADING—GOOD OR BAD FOR THE MARKETS?

The debate regarding the positive and negative effects of HFT on the markets focuses on the impact of HFT activities on liquidity, pricing, and market transparency.

1. LIQUIDITY

Investopedia defines liquidity as, “The degree to which an asset or security can be bought or sold in the market without affecting the asset’s price. Liquidity is characterized by a high level of trading activity.” Using this definition, one would have to conclude that HFT would improve market liquidity. But this definition, while acceptable in a pre-HFT world, is simplistic and misleading now. A more accurate description of liquidity would require that a matching bid and offer for a matching size and price are available when needed (Sornette and von der Becke, 6).

Several researchers and analysts have provided input on the topic of liquidity and provided data to both prove and disprove that HFT firms provide liquidity, but most agree that, at least during the May 6, 2010 “Flash Crash,” even HFT firms did not provide adequate liquidity (Brogaard, 2010, 5). The “Flash Crash” resulted in an approximate 600 point drop in the Dow Jones over a five minute period only to regain those losses several minutes later. An in-depth study conducted by X. Frank Zhang, showed a strong inverse correlation between HFT provided liquidity and market volatility wherein HFT firms provided a decreasing amount of liquidity as a security’s price became increasingly volatile (Zhang, 3). However, since most HFT firms are not market makers they have no obligation to maintain liquidity for the securities they trade or provide market stability when markets become unstable and require liquidity the most.

2. PRICING

When analyzing price there are two factors to consider: best price and price volatility. Best price is defined as receiving the lowest price available for purchases or the highest price available for sales. The difference between the bid (purchase) and offer (sale) prices is called the spread. Analysis, including those from X. Frank Zhang (Zhang, 6) and James A. Brigagliano (Brigagliano, 2009, 3) consistently show that HFT has contributed substantially to closing the spread. In this way, HFT provides a positive effect on the market and pricing in particular.

3. TRANSPARENCY

Investopedia defines transparency as “the extent to which investors have ready access to any required financial information about a company such as price levels, market depth and audited financial reports.” Market depth is (1) the market’s ability to handle orders without affecting the security’s price and (2) availability of a location or locations to execute transactions. The first part of this definition concerns market liquidity. As discussed above, liquidity is more than just transaction volume; however, volume is an important component of market depth. Volume works in concert with the second part of
this market depth definition regarding transaction execution locations. Traders must have access to a location with sufficient volume to execute their order.

The current market structure is fragmented. There are several entry points available for traders, both retail and institutional, to execute their orders. The prices for a given security may vary slightly depending on the entry point due to quoting activity displayed in the given market. In addition, not all entry points are visible to one another. One example is “dark pools.” Dark pools are used by institutional investors. Typically, they are used to conceal large block trades from the investing public and other large investors.

James Brigagliano notes that dark pools are scrutinized for both their lack of transparency and their limited availability solely to institutional investors. Retail investors, in particular, argue that dark pools put them at a competitive disadvantage because they cannot see the true demand for a security and may miss out on the best price. Institutional investors argue that disclosing large block orders will prevent them from receiving best execution in the form of best pricing because HFT and other electronically nimble traders will be able to benefit from the pricing changes that the large institutional orders generate. Meanwhile, regulators are also disadvantaged because only trades, and not quotes, are displayed on the consolidated tape. The consolidated tape is further limited for dark pools in that it only displays the trade without providing additional information such as who the parties involved in the transaction were or where the trade took place (Brigagliano, 2009, 5-6).

Market transparency derives from the real time display of all open orders on the various consolidated tapes. Orders are classified as either market or limit orders. Market orders are those orders entered into the marketplace for immediate execution at the best bid or offer price. Market orders are rarely cancelled since their execution is virtually instantaneous for most securities. Limit orders are conditional i.e. limit orders will only be executed if specific conditions are met.

The concept of a limit order is important because until a limit order is executed or cancelled it is considered a valid quote i.e. a price for a certain number of shares that an investor considers a reasonable deal. Quotes are displayed real-time on the market or Exchange’s quotation system so that all market participants can view them. Different marketplaces may employ different quotation systems. This is a contributing factor to market fragmentation which is discussed in detail below.

In a dark pool, orders (quotes) are only displayed on the pool’s proprietary systems and are visible only to pool participants on a real-time basis (Brigagliano, 2009, 5). Dark pools must report executed trades only. Transparency into dark pools will force faster execution of large block orders which will impact price volatility more than they currently do under the dark pool model when blocks can be segmented and executed over a longer period of time.

4. STUB QUOTES

A stub quote is “an offer to buy or sell a stock at a price so far away from the prevailing market price that it is not intended to be executed” (SEC Approves 1). Market makers are obligated to provide liquidity, especially in times of volatility, such as May 6, 2010. The obligation to provide liquidity involves supplying transactions on both sides of the market. On May 6th the volatility of the market accelerated the rate of price movement and caused some stocks, such as Accenture, to plummet. Maintaining a market for these shares required constant re-evaluation of quoted positions resulting in more sell orders than buy orders. The nearly valueless quotes executed that day were stub quotes, and were not intended for execution.

As a result of the May 6 “flash crash,” the Securities and Exchange Commission (SEC) approved certain rule changes on November 8, 2010 designed to prevent future problems attributed, at least in part, to stub quotes. These rules became effective on December 6, 2010. The rules require market makers to provide both buy and sell side quotes during market hours (SEC Approves 1). These quotes must be within 8 percent of the National Best Bid and Offer (NBBO) price for securities subject to the SEC’s new circuit breaker rules except between 9:30 and 9:45AM and 3:35 and 4:00PM (1). This circuit breaker rule applies to all securities listed on the Standard & Poors (S&P) 500 or Russell 1000 indexes (2). Select exchange-traded products are also subject to the circuit breaker referred to as the Single Stock Circuit Breaker (SSCB). The circuit breaker halts trading for five minutes on any individual security whose price fluctuates more than 10 percent in a five minute span of time (Arnuk & Saluzzi, 2010, p. 1). During the minutes just after the markets open and just before the markets close the circuit breakers do not apply. For these time periods, the rule requires the quotes be within 20 percent of the NBBO (SEC Approves 1). For securities not subject to the new circuit breaker rules quotes must be within 30 percent of the NBBO (SEC Approves 1).

These new restrictions on market maker quotes will likely have a stabilizing effect on the market. However, most High Frequency Trading firms are not market makers so the circuit breaker rule will not impact those firms. This rule places a heavier burden on the market makers and some HFT firms who are market makers to provide liquidity during times of market volatility.

COMMON QUESTIONABLE AND MANIPULATIVE STRATEGIES

HFT firms engage in many legitimate strategies while others practice manipulative strategies to generate profits. Some strategies may have both legitimate and questionable motives. One such practice is the order discovery strategy, which is closely related to some predictive strategies (Angel & McCabe, 2010, 11). Predictive strategies attempt to find indicators of upcoming price changes. Knowing upcoming price changes allows an HFT firm the opportunity to execute trades
to take advantage of that price change by using their superior speed to market. Predictive strategies are legitimate practices because they are executed having the same information available to others in the market (Angel & McCabe, 2010, 10). However, due to their faster access to the market HFT firms can capitalize on the anticipated price ahead of their competitors, thus upsetting market equilibrium.

THE NEED FOR SPEED

One of the most significant keys to HFT’s success is speed. HFT firms need information quickly. They must process it rapidly, submit quotes, and execute transactions faster than their competition. There are a few ways firms generate speed. The first is through computer technology and fastest processors. Another way is to pay for the best, quickest, data feeds. A third is through collocation. Collocation is a new twist on an old concept. Collocation involves an HFT firm placing their computers directly into an exchange's data center. Decreasing the physical distance the electronic signals must travel can provide a firm a few milliseconds advantage over its competitors. “It takes about five millionths of a second for light to travel one mile. An investor sending in an order from the opposite coast 3,000 miles away would experience a delay of approximately one one-hundredth of a second” (Angel & McCabe, 2010, 15). When the majority of trading occurred on an exchange floor, firms used to buy seats on the floor to give them access to the data and trading booths to speed up trade execution. Collocation of computers provides comparable benefits in a technologically driven business world.

CASE HISTORY

There is usually a lag between the advent of new technology, products or concepts and the regulation and rule enforcement of those areas. HFT is no exception. Below are three examples of recent cases brought against HFT firms by the Financial Industry Regulatory Authority (FINRA).

One of the first substantial regulatory investigations of HFT firm practices began in 2007. FINRA opened an investigation of Trillium Brokerage Services’ fourth quarter 2006 quoting and trading practices of several of their traders (FINRA Letter of Acceptance - Trillium). According to the Letter of Acceptance, Waiver and Consent (AWC) between FINRA and Trillium, during the period from November 1, 2006 through January 31, 2007, Trillium “engaged in a repeated pattern of layering conduct to take advantage of trading, including algorithmic trading by other firms” in Nasdaq listed securities executed on both the Nasdaq and NYSE Arca marketplaces (FINRA Letter of Acceptance – Trillium 5). Trillium manipulated the price of certain securities by spoofing other traders with non-bona fide orders. Specifically, violation 2 notes “after entering a buy limit order into [Nasdaq], a Trillium Trader repeatedly entered numerous layered, non-bona fide, market moving sell orders through [Nasdaq] on the opposite side of the market from the limit order at prices primarily outside the Nasdaq Best Bid” (5). The traders “knowingly and intentionally” engaged in this activity to “create an appearance of substantial pending sell orders in the security for the purpose of inducing the sale of his limit order,” according to violation 3 (5). They repeated this pattern at least 46,152 times, resulting in profits of approximately $575,765 (6).

On July 14, 2010, Trillium and eleven of its employees accepted several sanctions without either admitting or denying the findings; standard language for an AWC. Trillium accepted a fine of $1,000,000 and agreed to pay disgorgement (to pull back ill-gotten gains) of an additional $173,357. 49. In addition to the corporate sanctions, eleven employees were fined between $12,500 and $220,000 with one receiving no fine due to a demonstrated inability to pay. The employees also agreed to pay disgorgement ranging from zero dollars up to $78,244. 84. Additionally, they agreed to suspensions ranging from six months to two years. The total sanctions for these violations were $1,802,500 in fines, $465,300 in disgorgement, and 14 years and eight months total suspension time (FINRA Letter of Acceptance – Trillium 11-2).

In another case, FINRA permanently barred Edward S. Brokaw, a former broker with Deutsche Bank. Brokaw manipulated the price of Monogram Biosciences (ticker symbol: MGRM) stock to benefit his personal account and that of a hedge fund client (FINRA Hearing Panel Bars, 1). The maximum benefit available to Brokaw was $188,000 and $16 million to his hedge fund client (FINRA Hearing Panel Bars, 1).

A third case resulted in the suspension of Robert T. Bunda for 16 months, a fine of $175,000 and restitution in the amount of $171,740. Bunda agreed to an AWC with FINRA on April 13, 2011 for engaging in manipulative trading activity through eleven undisclosed accounts in a spoofing scheme (FINRA Suspends 1). Bunda entered over 4,000 small trade orders through his employer’s account. Once these trades altered the security price, Bunda executed several large orders from his undisclosed accounts to take advantage of the price change. Bunda then cancelled the orders he originally entered through his employer’s account. He received $171,740 in profits from 400 trades (1).

CONCLUSION

The original question posed was, “Is High Frequency Trading the problem with the financial markets?” Research has highlighted the complexity of 21st century financial markets and the challenges for regulators to balance investor protection and capitalist creativity. Some of the widely agreed upon benefits of High Frequency Trading are smaller spreads and greater liquidity during most market conditions. Smaller spreads benefit investors, with more money going toward the principal investment and less to the executing firm. Greater liquidity means faster execution of trades.
High Frequency Trading also presents disadvantages. HFT increases short-term market volatility. Short-term volatility places additional valuation risk primarily on short-term investors, such as day traders. It also makes comparison between market price and a company’s fundamental value more important for long-term investors. Finally, HFT brings an incredible volume of trading and quoting activity. This activity places an execution strain on the various marketplaces and a supervisory strain on regulators.

Beyond the more easily quantifiable pressures HFT activity places on the market, HFT also highlights other weaknesses in the current market system. These weaknesses include transparency problems, increased use of dark pools, fragmentation of the marketplaces, and the lack of a singular consolidated tape system to report all orders from all markets.

Regulators have addressed some of these deficiencies. Implementation of the Single Stock Circuit Breaker and the elimination of stub quotes will likely add some stability to the market and help avoid crashes similar to the May 6th “flash crash” but these solutions do not provide a complete failsafe. Additional analysis is required to study how the circuit breaker rules will impact competition between market makers and non-market maker High Frequency Traders. Another dilemma is how to dissuade quote stuffing. This could be accomplished with new fees but finding the right fee charge or criteria to discourage quote stuffing without impacting legitimate, liquidity-providing quotes remains a conundrum.

Finally, market fragmentation and transparency must be addressed if long-term market stability is to be achieved. Implementation of the SEC proposed Consolidated Audit Trail will go far in alleviating the market fragmentation risks by providing a singular place to supervise trade orders. Improving transparency is probably a greater challenge. While a Consolidated Audit Trail will help, dark pool activity remains problematic. As part of regulators’ ongoing analysis of the current market environment they need to find a way to improve transparency into dark pools without impacting the quality and timely execution of large institutional orders.

REFERENCES


One morning in November of 1971, John Emil List shot and killed his mother, wife, and three children in their New Jersey home. In an effort to cover up the murders, List left the lights on in the home and music playing as he drove to the nearest airport. A few weeks had passed before the neighbors realized that something was wrong in the List home. By the time law enforcement officials were notified, List was long gone and nowhere to be found. John Emil List thought he had committed the perfect murder. Almost two decades later and unbeknownst to List, forensic artists would help convict him in the murder of his family (Ramsland, n.d.).

WHAT IS FORENSIC ART?

Forensic art can be defined as the use of artistic methods and techniques employed to aid law enforcement in the identification, apprehension and conviction of criminals; to assist in missing-persons cases; and in the identification of unknown deceased persons. Forensic art encompasses a number of disciplines including composite art drawing, image modification, post-mortem reconstruction, age progression, and demonstrative evidence (Mancusi, 2000).

THE HISTORY OF FORENSIC ART

The face presents an arrangement of interesting characteristics that when combined, produce a pattern of readily identifiable features. This allows a person to recognize many faces, often attributing names, personality, age, lifestyle, racial and ethnic background, and other characteristics to them. A person is capable of mentally encoding a large collection of faces and filing them for later retrieval.

In the 1880s, Dr. Alphonso Bertillon, called the father of scientific detection, created the first criminal identification system known as the “Portrait Parle” or “speaking picture.” Dr. Bertillon believed that keeping careful records on file could help to predict recidivism rates among known offenders (Ramsland, n.d.). The system consisted of a cluster of facial features taken from photographs with specific details such as measurements of the face and body. Initially, Dr. Bertillon intended for the catalog to assist in the identification of local prisoners, but it later became useful in obtaining descriptions of unknown criminal suspects. The “Portrait Parle” provided a foundation for modern recall systems that would assist in creating sketches, as well as the development of composite kits, catalogs and computer systems (Ramsland, n.d.).

For hundreds of years, law enforcement agencies used composite sketches to assist in investigations where evidence was limited and the perpetrator was unknown. In 1910, early drawings were created to help apprehend Dr. Hawley Harvey Crippen and his young secretary Ethel le Neave (Figure 1). Dr. Crippen’s wife, Cora Crippen, vanished in 1910. His alibi statement was that his wife had left their home in London to unite with another man in the United States. Later, le Neave moved in and began to wear Mrs. Crippen’s clothing and jewelry. Crippen was questioned by an inspector from Scotland Yard about his wife’s disappearance. Subsequently, he fled, leaving his home vulnerable to a search that produced the buried remains of his wife. A police artist prepared an updated drawing of Dr. Crippen based on old photographs, which assisted in his immediate capture. He was returned to London for trial and hanged for the murder of his wife. Below are earlier examples of composite sketches and a “wanted” poster from the Crippen case (Figure 2):

FIGURE 1: Portrait of Hawley Harvey Crippen [Left]. Portrait of Ethel Clara Le Neave [Right]. (Mary Evans Picture Library, 1910)

FIGURE 2: Wanted Poster from the Crippen case (Camden News Journal, n.d.).

During the 1950s, the use of Identi-Kit, which is a process of assembling a composite facial drawing from multiple witnesses, became a standard procedure. Identi-Kit consisted of clear stackable sheets called “foils” which illustrated many types of hand-drawn facial features (Ramsland, n.d.). Subsequently, other kits used photographs of facial features with the same general principle. By the 1970s, police artists moved away from using kits and reverted back to the use of...
The success of a composite image is based exclusively on how an investigator utilizes the image. A composite image helped investigators apprehend Richard Allen Davis in the kidnapping and murder of Polly Klaas. Polly invited two of her friends over for a pajama party on October 1, 1993. As the three girls played quietly in Polly’s bedroom, a large man who smelled of alcohol suddenly entered the room through an open window and threatened them with a knife. Davis quickly bound Polly’s two friends and kidnapped Polly. The two girls were terrified, but they managed to free themselves and alert authorities. They described the man to the 911 operator and mentioned that he had worn a yellow bandanna tied around his head. According to crime scene investigators, the abductor had left a palm print in the room. Although the palm print was important, authorities still requested a good description of the suspect from Polly’s two friends. The two girls tried their best to give the forensic artist enough details for a composite drawing, so that a “wanted” poster (Figure 4) could be completed and distributed throughout the country. The forensic artist used an array of images from a police book with more than 900 faces, so that the victims were able to match them from their memories. The girls chose from an array of images until the forensic artist had enough details to sketch an entire face (Figure 5). Despite a massive effort, Polly’s abductor was not immediately apprehended. The forensic artist met with the girls again to see if he could obtain any additional details of the suspect. After several hours, the girls and the forensic artist finally came up with a face of a man with wrinkles, a mustache and beard.

Approximately, six weeks later Richard Allen Davis was arrested and identified from the palm print that was on file because of two previous kidnapping convictions. At the time of capture, he was on parole. The composite sketch on file matched his previous mug shots and helped scale the search. This allowed authorities to close in on him. On December 4, Davis led law enforcement to Polly’s body.

The primary technique

Composite drawings are the most common activity for the forensic artist. The goal of composite images is to assist detectives during an investigation. A composite portrait taken from several eyewitnesses can provide law enforcement with a good portrait of the person for whom they are searching. A composite image is a freehand drawing made by combining various parts into a single graphic image. There are two techniques available to complete a composite image: the hand-drawn or computer-generated and assemblage methods. Despite advances in computer technology the primary and proffered method remains the hand-drawn process. The forensic artist, through interviewing victims and witnesses, prepares a hand-drawn image from reference images selected by the witness. These images comprise the best representation possible based on the witness’ or victim’s memory recall (Figure 3). The composite drawing does not have to look exactly like the suspect. In many cases a general or close similarity will stimulate recognition on the part of the viewers (Jackson, 2004).

FIGURE 3: Composite Sketch and Photo (Ramsland, n.d.(b))

FIGURE 4: Reward Poster with Composite sketch for Polly Klaas (Dolan, 2009).
Forensic art also includes forensic facial approximation. This process of facial reconstruction is difficult. In cases of severely decomposed or completely skeletonized remains, a facial reconstruction on the skull is one option that is used to assist with identification of unknown remains. Reconstruction is often the last resort in the identification process and is usually sought after procedural processes have been exhausted: a thorough check of national missing persons records, national fingerprints databases, or a comparison of dental records. There are two types of reconstruction: two-dimensional and three-dimensional.

Two-dimensional facial reconstruction was pioneered by Karen T. Taylor, a portrait artist in the 1980s, and may be used when unidentified skeletal remains are found. The two-dimensional reconstruction method is initiated by using the same information as used for the three-dimensional clay reconstruction. The process starts by gluing on the proper tissue markers in the proper pre-determined places (Figure 6). The skull is then placed on a stand in the Frankfort Horizontal position. The Frankfort Horizontal position is a horizontal plane represented in profile by a line between the lowest point on the margin of the orbit and the highest point on the margin of the auditory meatus. The skull is photographed; profile and frontal views, at a 1:1 scale, with a ruler positioned to the side of the skull. The photos are then enlarged to life size, or 1:1 dimension (Figure 7). The frontal and profile photos are then taped, in the Frankfort Horizontal position, directly aside one another on two separate flat boards. Upon completion of the process, transparent natural vellum sheets are taped directly over the printed photographs. Next, the sketching begins where the artist follows the contours of the skull, along with utilizing the tissue markers as guidelines. Measurements for the mouth, nose, and eyes, is the same for the two-dimensional process as it is with the three-dimensional process. Hair type and style is determined by samples found on the scene by investigators, or by an educated estimation determined by the victim’s race, gender, and/or ethnic background. Information provided by the Forensic Anthropologist and other professionals are also used. All procedures are documented and working notes collected. This method has also been tried and proven over the years. Benefits of this method over the clay reconstruction are cost and completion time.

The three-dimensional method begins with the collection of accessible crime scene information. This information includes descriptive specifics such as clothing size, clothing style, and accessories such as jewelry which highlight the uniqueness of the victim. Next, an anthropological analysis of the skull is needed to make a scientific determination of gender, race, and an accurate age range. Although this can be accomplished with only the skull, a much larger amount of information can be learned from the entire skeleton. After obtaining all available scene and anthropological information, the physical facial reconstruction can begin. There are several methods to achieve a reconstructed face. The primary method used to reconstruct a face is the tissue depth or American method. This system is based on the “Rhine/Moore” depth tables which require the placement of tissue depth markers on 21 different anthropological landmarks on the facial plane of the skull (Jackson, 2004). Clay is used to fill in a large number of specific facial feature measurements in order to reach a close approximation of the person’s facial features in life (Figure 8). If performed correctly, the likeness of a facial reconstruction is assured because the skull dictates an individual’s facial proportions in life.
FIGURE 8: 3-D Facial Reconstruction (Ramsland, n.d.(c))

The anatomical method requires the placement of known facial muscles, one at a time (Figure 9). The combination method is a combination of the tissue depth method and the anatomical method. Upon completion of the facial reconstruction, the requesting investigator prepares fliers and news coverage in an effort to obtain positive identification based on the reconstruction (Jackson, 2004).

SUPERIMPOSITION OF A FACIAL PHOTOGRAPH

The identity of a murder victim can be confirmed by superimposing a facial photograph with a properly aligned and sized image of the skull. Forensic superimpositions are formed by placing an image on top of an existing image to add to the overall image effect. It is also done to conceal something, as when a different face is superimposed over the original face in a photo or over an X-ray of the unidentified skull. Superimposition is used when there is knowledge of the victim. The anatomical features of the face should line up perfectly if the skull and the photograph are of the same person.

A photo of murder victim Caylee Anthony (left) and her mother, the defendant Casey Anthony (right) (Figure 10) was used by a prosecution witness to superimpose a photograph (Figure 11) of Caylee’s skull to indicate where duct tape found on the remains would have been placed over Caylee’s nose and mouth.


POST-MORTEM RECONSTRUCTION

Postmortem reconstruction is a depiction of facial features of an unidentified deceased person or decomposed skeletal human remains (Horace, n.d.). This method of forensic art is performed when bodies are not severely decomposed and the forensic artist is needed to create a reasonable facial likeness based on morgue, crime scene photographs, or by viewing the actual body (Taylor, 2001, p. 303). The purpose of post-mortem drawing is to provide a connection between an unidentified person and the records (such as dental records) required to positively identify him or her.

Forensic artists create post-mortem images under two types of circumstances. The first type includes unknown deceased persons whose photographs are not suitable for media distribution or viewing by family members because of trauma or post-mortem effects on the face. The second type includes unknown deceased persons who have been buried for a period of time before personal identification has occurred and only photographs remain (Taylor, 2001, pp. 303-304). These images are created by sketching, either digitally or with clay. The first image will display trauma to the victim and is repaired digitally or by applying paints directly to the photograph, thus covering the injured area and making the features recognizable (Figure 12). The drawing repairs the trauma to the victim so that the final image will be more presentable when requesting law enforcement or the public’s assistance in identifying the unknown victim. The final reconstruction is used as an investigative tool to assist law enforcement in obtaining accurate identification (Pratt, 2008).
THE ART OF AGE PROGRESSION

Computer-generated and hand-drawn age-progressions are used for both suspect and victim identification. The primary usage for the age-progression technique is to assist with the capture of wanted fugitives. Suspects are frequently not identified because the only available photographs are from a younger age. In that case, the artist considers all variables involved with the natural aging process. Data is gathered on the suspect or victim, such as lifestyle, genetics (for weight considerations), hair loss, occupations, smoking, illicit drug usage, alcohol consumption, allergic reactions, diet over time, psychological trauma and sleeping patterns (Martin-Bailey, 2009). By using all this information, the artist produces an estimation of how the individual would look. When performing age-progressions, computer programs are used to paint directly on a digitized photo of the suspect or victim. When a quality photograph is not available, a hand-drawn sketch may be done in lieu of a computer-generated image.

THE USE OF PHOTOSHOP IN THE AGE PROGRESSION PROCESS

According to the U.S. Department of Justice, an estimated 800,000 children are reported missing each year (The National Center for Missing and Exploited Children, 2011). Since its inception in 1984, the National Center for Missing and Exploited Children (NCMEC), a private non-profit agency established by Congress, has acted as a resource for parents and guardians who have lost a child. One important tool used by NCMEC is age progression. When a child is reported missing, the NCMEC receives a photo with a report. As time goes on, the photo becomes less valuable, especially if the child was very young when he or she disappeared. This is where age progression comes in. In an effort to create the best possible progressed image, forensic detectives begin with a photo of the child and the biological parent – a photo of just the father if it is a little boy and a photo of just the mother if it is a little girl – at the age the child would be when he or she disappeared. Next, the team uses Adobe Photoshop CS4 to manipulate the photographs. The face is stretched to approximate growth, blended with the photos of the parent(s), and a hairstyle is placed on each child. Clothing for the appropriate age is added (Katayama, 2009). With computer software such as Adobe Photoshop CS4, an age progression photo can be completed in about three hours.

Age progression is most prominent on ADVO cards. ADVO cards have an ad on the front and a picture of a missing child or victim on the back. These cards are then distributed all over the country in an effort broaden a search. These images are generally of children; however age progression can also prove to be an effective tool in the fugitive recovery process (Martin-Bailey, 2009). Figure 13 is an example of an ADVO card:

FIGURE 13: Age Progression of Children Missing Two or More Years
Row 1: Joseph Carson: Missing at age 2; Age Progression age 7; Recovery age 7
Row 2: Sara Eghbal-Brin: Missing at age 3; Age Progression age 7; Recovery age 8
Row 3: Jonathan Ortiz: Missing at age 1; Age Progression age 10; Recovery age 10 (Forensic Assistance, n.d.).

1 ADVO cards are printed and distributed by ADVO, a 73-year old direct marketing company based in Windsor, CT. ADVO cards are sent out to more than 77 million homes per week. ADVO’s search for missing children began in 1984 (Tinsely, 2002).
THE IMAGE ENHANCEMENT PROCESS

Image enhancement is used on images obtained from bank surveillance photos, convenience store videos, parking lot surveillance cameras, and unclear photographs of suspects. The artist scrubs photographs that are very dark, very light, scratched or damaged by using graphics and photo retouching software such as Adobe PhotoShop, MATLAB and FACES LE. Image enhancement can also be used as a means of image manipulation. By using image enhancement, items such as hats, hairstyles, mustaches, beards, glasses, earrings, tattoos, and other accessories can be added to the photograph. When a photograph cannot be enhanced a sketch may be done. Several photos of the same individual taken at different times and or angles allow the artist to piece together different features of that individual.

Figure 14 is an enhanced surveillance camera image of missing Indiana University student Lauren Spierer, captured a few hours before the 20-year old was last seen. An updated description of Spierer’s clothes had been released five days after her disappearance. Through the process of image enhancement, a new image was created to show Spierer in that outfit.

**FIGURE 14:** Enhanced surveillance camera image of Lauren Spierer. (Stevens & Quigley, 2011)

FORENSIC ART AND THE LEGAL PROCESS

Demonstrative evidence is an art technique used in courtroom presentations to give a verbal reference a visual impact. Demonstrative forensic evidence is defined as visual materials used during legal proceedings as part of a courtroom presentation or visual materials used as investigative aids. These images include courtroom sketches for illustration of cases, visual demonstrations of investigatory techniques, wanted poster sketches, missing person posters, portrayals of suspects for publication in newspapers, medical drawings and autopsies, court ready line-ups, photo-lineups, drafts of a properly measured sketch of a murder scene, and photo enhancements (Mancusi, 2000). However, the still photograph is the most common and effective example of demonstrative evidence. Still photographs provide the jury with visual evidence of injuries that may have healed months or years after the accident or murder occurred and before the trial has begun. Modern computer-generated still photographs can show the exact injury (Demonstrative Evidence - Further, n.d.).

Graphs and charts can be presented in a variety of ways and vividly illustrate crucial elements of a case such as a timeline of events, a decline in life expectancy, and past and future medical bills. Well-constructed charts that make good use of color can also help a jury arrange complex events in a chronological manner (Demonstrative Evidence - Further, n.d.). Physical articles and objects such as a knife or a blood stained vase are also forms of demonstrative evidence. They can be used to help a jury understand the testimony in addition to actual evidence. X-rays, medical models, and illustrations can be very helpful in physical injury cases. They can help the jury “see inside” a victim to understand the nature and extent of the injury (Rychlak, 2002). Also, modern computer-generated images can show the exact injury, as opposed to a basic injury depicted in a medical photograph.

Today, computer enhanced graphics represent the leading-edge of demonstrative evidence. They are used to combine many different forms of demonstrative evidence into an organized and dramatic whole (Rychlak, 2002). For example, still images of a kidnapping can be followed by a digital camera showing the abductor in action. The images can be stored in a computer and presented in court with minimal set-up (Rychlak, 2002).

DRAWBACKS IN USING FORENSIC ART

According to researchers, composites depend on verbal descriptions that are not always accurate. One shortfall is that photofits (photographs of individual features) mostly consist of shape and very little texture. These contours are embellished with limited skin texture, and lack of other details that would make a person recognizable. According to researcher Gary Wells, psychological research has shown that people store faces in memory in a holistic way. “If faces are stored holistically, the best retrieval is holistic.” Wells further stated that “witnesses really don’t have a good retrieval access to individual features. Any task to retrieve individual features is going to be deeply difficult” (Rogers, 2007).

The most distinct failings of using assemblage and computer-generated composite images are the lack of facial features and the costs to run or access the systems. Faces vary in limitless ways. Mechanically assembled images can only offer a limited number of facial features. The more features that are available with the programs, the more likely the artist will have a hard time accessing the feature. This will most likely confuse and frustrate the victim or witnesses in the process. A system that offers unlimited access to the facial features of 18
to 30 year old black and white males fails to account for the crimes committed by the occasional female, Asian, Latin, or older suspects. Some systems offers separate race and gender packages but at an additional cost. In most programs the artist is left with using what they have and that may not be enough to complete the task because of excessive costs (Jackson, 2004).

Another critical issue relates to the information used to average the facial tissue thickness. There is a problem with the lack of methodological inconsistency in approximating facial features because an official method has not been established for reconstructing the face. (Reichs & Craig, 1998, 491-511). Also, there are certain accuracy limits that may occur during the facial reconstruction process. Sculptors can only guess hairstyles and cannot produce the expressions on a person's face that make the sculpture completely life like (“Facial Reconstruction,” 2004). Reconstructions only reveal the type of face a person may have shown because of artistic subjectivity. Generally, the position and shape of the main facial features are accurate because they are significantly determined by the skull (Helmer & Isacan, 1993, 229-243).

**FUTURE IMPLICATIONS**

There has been much debate on the accuracy of composite images. In an effort to improve this low-tech process, two research groups in the United Kingdom have invented similar solutions as to how to create a better “facial composite” of a perpetrator in a more psychologically natural manner. Peter Hancock and Charlie Frowd at the University of Stirling, Scotland, have produced a system called EvoFIT, which is a computerized facial composite system. EvoFIT faces are initially presented to a witness with random characteristics, but through a process of selection and breeding, a composite is “evolved” (Frowd, Hancock, & Carson, 2004, 1-21). At the same time, Chris Solomon at the University of Kent, England, has developed a similar system called EigenFIT. EigenFit involves a genetic algorithm-based application, which is similar to EvoFit in concept but applies a different algorithm for generating each new crop of faces.

**CONCLUSION**

The age progression process played a vital role in the apprehension and conviction of John Emil List. The List case was featured on “America’s Most Wanted” in 1989. To assist in the case, producers brought in forensic sculptor, Frank Bender. Bender studied the photographs of Mr. List when he was in his mid-40s, and imagined how he would look eighteen years later. He theorized that Mr. List’s face would be sagging and he would still be wearing horn-rimmed glasses. On May 21, 1989, Fox televised the segment and displayed a composite of an older List. It is estimated that 22 million people saw the show including one viewer from Richmond, Virginia. She believed that the photo looked like a neighbor, Robert Clark, a churchgoing accountant who wore horn-rimmed glasses. The woman immediately contacted authorities. Agents went to the home of “Robert Clark,” and confronted his stunned wife. They arrested List at his office ten days after the updated photo was shown. Fingerprints confirmed that he was John List. Through the use of forensic art, Bender and many others like him will continue to use their talents to bring criminals to justice.

**REFERENCES**


IMAGES


Thinking Outside the Box: Using Financial Forensics in Non-Financial Investigations
Denise R. Harding

On September 11, 2001, nineteen individuals hijacked four commercial aircraft. The first two were flown into the World Trade Center towers in New York City. The third was flown into the Pentagon, and the fourth crashed into a field in Shanksville, PA. While first responders were conducting search and rescue operations, law enforcement agencies began the investigative search to identify the hijackers. Investigators and financial analysts joined forces to track each hijacker’s history in the United States and beyond. Investigators used forensic accounting techniques to identify information found in credit card transactions, bank records, rental histories, and travel patterns to piece together the stories that led them back to the terrorist training camps in Afghanistan and to Al Qaeda. Ten years later, accountants and investigators have returned to their traditional roles; but should they wait for another catastrophic event to break those molds? Terrorism, organized crime, and violent crime leave behind traces of information and applying forensic accounting techniques to non-financial criminal investigations could provide valuable information for solving those crimes.

WHAT IS FORENSIC ACCOUNTING?

Forensic accounting is the use of accounting methods and techniques to identify financial evidence suitable for use in a court of law. The practice of forensic accounting consists of two primary branches: civil litigation and investigative accounting. Civil litigation support involves testimony by an expert witness and the critique of other expert witness reports, while investigative accounting focuses on the financial investigation (Zysman, n.d.). Both branches use similar techniques to identify assets, calculate losses, and reconstruct financial transactions and activity. Alan Zysman states in “Forensic Accounting Demystified,” that forensic accountants are, “trained to look beyond the numbers” (Zysman, n.d.). Forensic accountants are not just accountants; they must have an understanding of criminal law and criminal investigative techniques. The American Institute of Certified Public Accountants’ Forensic and Litigation Services Committee describes a forensic accountant as a professional who uses a combination of skills in accounting, auditing, finance, the law, research, evaluation, analysis, and written and oral communication to interpret financial information and report their findings (Houck, Morris, & Riley, 2006, p. 68).

Forensic accountants use their knowledge of accounting systems, business records, Generally Accepted Accounting Principles (GAAP), and Generally Accepted Auditing Standards (GAAS) to analyze and interpret financial transactions (Freeman, n.d.). They are also experts in managing information. To interpret the information collected in an audit or financial investigation, accountants are trained in data organization and management. In a speech discussing information management in July 2004, the Information Commissioner of Canada, who is responsible for managing and protecting the privacy of personal information collected and maintained by the Canadian Government, identified eight core skills involved in financial investigations: knowledge of the information available for the investigation, the ability to find and compile information, the ability to evaluate the information for relevancy, accuracy and authenticity, documentation and record keeping, organization, data protection, working with others, and the ability to learn and adapt with technology (Kennedy, 2007, p. 396). Like forensic scientists, forensic accountants also use a scientific methodology to hypothesize what occurred and test the hypothesis through investigation (Freeman, n.d.).

THE NEED FOR FINANCIAL FORENSICS IN NON-FINANCIAL INVESTIGATIONS

The methodology, education, training, and experience of forensic accountants rivals that of other forensic scientists, but Certified Public Accountants, Certified Fraud Examiners, and business professionals focus on financial investigations and rarely offer assistance on non-financial criminal investigations. Annual training conferences in forensic accounting and fraud investigations offered by the American Institute of Certified Public Accountants and the Association of Certified Fraud Examiners focus on financial investigations and financial motives (Association of Certified Fraud Examiners, 2012; American Institute of CPAs, 2012). Financial experts are taught in school and throughout their continuing education that their expertise is for investigating financial crimes and fraud. Non-financial investigations are not typically discussed.

Non-financial criminal investigators are often unaware of the information forensic accountants can identify. Most law enforcement officers do not have training and expertise in financial crimes and transactions. Local, county, and state law enforcement agencies focus on violent crimes, such as rape, robbery and homicide. The limited number of officers trained in financial crimes often have too many property, white collar, and asset forfeiture investigations to have the luxury of applying their skills to non-financial investigations (Manning, 2005).

Some federal law enforcement agents are beginning to recognize the benefits of applying forensic accounting to non-financial crimes. Naval Criminal Investigative Service (NCIS) Supervisory Special Agent (SSA) Charles King began his career in law enforcement as an officer with the West Virginia State Police. He joined NCIS in 2005, and spent the majority of his law enforcement career working death investigations and violent crimes against persons. SSA King claims “financial capabilities are underutilized” in criminal investigations. Over the past fourteen years, SSA King conducted criminal investigations regarding questionable deaths, narcotics, rape, assault and battery, property theft, counter-intelligence, and counter-terrorism (King). For the past year, SSA Charles King worked as a supervisor assigned in the Economic Crimes Program at the Naval Criminal Investigative Service. This experience gave him a new perspective on
the potential uses of financial information in non-financial investigations. He has used forensic accounting and financial forensics in property crimes, counter-intelligence, and counter-terrorism investigations where financial investigators could review the financial information and provide recommended leads, additional investigative steps, and direction to the case agents. SSA King stated that if a financial expert can provide “clear, concise, and timely” assistance, they would be an asset to any investigation (King).

In the non-financial cases SSA King worked, financial records were rarely considered to support the investigation or develop additional leads. Bank accounts and insurance records were pulled for question-able deaths only to identify insurance policies as a potential criminal motive. The detectives did not typically consider the records for potential leads. As an agent with NCIS in Jacksonville, Florida, SSA King began working with agents who specialized in financial crimes. His experiences working with financial investigators caused him to consider the potential for using financial specialists on non-financial crimes. He described a brass theft case in Jacksonville, FL involving more than four people from different companies working aboard the naval base. To identify the persons and companies involved and develop the criminal scheme, the investigators reviewed years of scrap metal sales receipts. None of the agents working the investigation had financial or business backgrounds. SSA King stated if the investigative team included a financial forensic specialist, the investigation could have been completed faster with a higher recovery (King).

Academic experts are also beginning to recognize a need for forensic accounting in non-financial criminal investigations. In December 2003, at West Virginia University, Max Houck, Bonnie Morris, and Richard Riley researched the need for a college curriculum focusing on forensic accounting. In their report, “Forensic Accounting as an Investigative Tool,” the authors claimed the use of financial techniques to conceal the funding for the September 11, 2001 terrorist attacks illustrated the need for training in financial forensics (Houck, Morris, & Riley, 2006, p. 68). Law enforcement investigators need to be aware of the benefits of financial information and financial experts need to be aware how financial transactions and information can be used outside the financial world.

UTILIZING FINANCIAL FORENSICS IN NON-FINANCIAL INVESTIGATIONS

Investopedia.com defines financial forensics as the “combination of criminal investigation and financial auditing to identify …criminal activity” (“Financial Forensics,” 2012). Criminal investigations, financial and non-financial, are prosecuted on evidence and information. In both types of investigations, the investigator is pursuing information that will answer the questions who, what, where, when, why and how. It is almost impossible to function in society without leaving behind a trail of information, and financial investigations are information intensive (Kennedy, 2007, p. 372). Every activity leaves behind some trace of evidence. In the world of information technology, metadata is defined as information about a particular object. In forensic accounting, financial information is metadata about a person, a crime, criminal activity, or a criminal organization. Criminals will go out of their way to conceal the metadata they leave behind. They will consult with lawyers, accountants, and financial experts to identify ways to hide their existence and activities (Kennedy, 2007, p. 396). Law enforcement should have the ability to consult financial and business experts to reverse the criminals’ efforts at hiding their metadata. Financial investigators are trained to uncover these trails and “connect the dots” (Kennedy, 2007, p. 372).

Forensic accountants are trained to look for changes in behaviors or patterns. They are trained to identify “red flags” in financial transactions before fraud occurs. The article, “Holidays See Forensics Teams at Work,” quotes Randy Shain, a forensic accountant in New York who conducted background investigations on senior financial managers. Shain stated, “[the] work is not about catching people…Forensic accounting is trying to put together pieces after something has broken…(He) prefers to avoid a break in the first place. It can be a whole lot cheaper for everyone involved” (“Holidays See Forensics,” 2007). Red flags can be the change in a subject’s behavior or an unusual or suspicious transaction.

Financial investigators can also identify trends and behavioral patterns in financial transactions. An individual’s weakest character flaws can be intensified with increased social pressures. By looking for weaknesses in the financial records of a subject, forensic accountants may identify motives and pressures not known by the other investigators (“Holidays See Forensics,” 2007, p. 1). Behaviors revealed in financial transactions can be circumstantial evidence demonstrating the subject is a pathological liar or has narcissistic tendencies. This information can be used by criminal investigators during interrogation to develop rapport, confront the subject, and offer rationalization for their behavior (Perri & Lichtenwald, 2008, p. 78). Financial forensic investigators can utilize the same information developed for white collar crimes for any criminal investigation. Knowledge of a subject’s behaviors, actions, and lies assists an investigator during interviews and interrogations and may develop previously unknown leads.

CURRENT USE OF FINANCIAL FORENSICS IN NON-FINANCIAL INVESTIGATIONS

The Federal Bureau of Investigation developed forensic accounting techniques in response to the development of organized crime. These criminal organizations did not start out with complex business transactions, but began by committing more traditional crimes such as arson, assault, extortion, murder, and robbery. As the criminal organizations developed over time, members committed more sophisticated crimes of counterfeiting, fraud, prostitution, smuggling, and drug...
Financial forensic investigators are aware information contained in the documents obtained to authenticate each asset and liability for the net worth method, and income and expense for the expenditure theory can provide leads to unknown associates and relationships. Financial documents show the name and address of the party paying property taxes, can identify cosigners or beneficiaries, previously unknown associates and family members, former and current employers and can show increases or decreases in payments (United States Department of Justice, Criminal Division, 1998, p. 14-31). Correspondence with lien holders could reveal evidence of a target’s state of mind at a particular date and time; and a loan application could reveal additional bank accounts, the target’s federal tax returns, or the target’s credit history. Copies of cancelled checks will contain the endorsement signature of the person or business cashing the check, and the date and branch where the check was cashed or deposited (United States Department of Justice, Criminal Division, 1998, p. 30-32). This could identify previously unknown associates or business relationships, and the subject’s possible location at a specific date and time. The front of the check will have the natural signature of the person who signed the check, which can be used as a handwriting exemplar. Divorce court and bankruptcy court filings might identify children, dependents, former spouses, and creditors with information about the target (United States Department of Justice, Criminal Division, 1998, p. 10). Employers and co-workers may notice changes in the target’s behavior. All of these records contain information that can be used as leads in any criminal investigation.

Anti-money laundering records provide information about the financial activity of individuals and companies. Congress enacted the Bank Secrecy Act, 18 USC Sections 5311-5332, in 1970, to help control and track money laundering activities. The Bank Secrecy Act mandated banks and financial institutions maintain records for certain deposit and withdrawal transactions that might indicate money laundering activity (Sinason, Pacini, & Hillison, 2003, p. 18). Currency Transaction Reports and Suspicious Activity Reports contain the address and identification (such as a passport or driver’s license number) for the account holder, the address and identification for the individual conducting the transaction, the account number, bank branch address where the transaction took place, the amount of the transaction, and a description of the activity (United States Department of Justice 29). Casinos and businesses are required to file similar documents (the CTR for Casinos and the Form 8300) containing the same information for cash transactions over $10,000. The Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism (USA Patriot Act) expanded the definition of financial institutions subject to the Bank Secrecy Act requirements to include credit card companies, precious metal dealers, insurance companies, vehicle, boat, and aircraft dealers, real estate agents, pawn brokers, and travel agents. The USA Patriot Act also required each of these business entities to develop “know your customer” programs and provide training in identifying “suspicious” transactions for employees (Sinason, Pacini, & Hillison, 2003, p. 19). Financial accountants are familiar with the information that could be obtained from a review of these records and programs and could use the information to identify leads and persons of interest in non-financial investigations.

After September 11, 2001, federal investigators began applying the techniques used to investigate organized crime to international terrorism investigations. Before September 11th, organized crime and terrorism were viewed as two separate crimes because the federal investigators focused their investigations on the different criminal motivations of each organization. Organized crime is primarily motivated by financial gain and terrorists are primarily motivated by ideology (Perri, Lichtenwald, & MacKenzie, 2009, p. 16). The Federal Bureau of Investigation has separate squads to investigate organized crime syndicates and domestic or international terrorist organizations. Organized crime is considered the responsibility of criminal investigators and terrorism is the responsibility of counter-intelligence investigators. The combined efforts of counter-intelligence, financial, and criminal investigators in the days immediately following the September 11th attacks revealed many operational similarities between organized crime and terrorist organizations.
In the textbook, “Financial Investigation and Forensic Accounting,” George Manning defines an organized criminal group as a structured group of persons who uses criminal behavior and violence to achieve and maintain power or profit. Organized criminal syndicates operate as a hierarchical pyramid with only a few top authoritative figures. They are designed to outlive the individual members who must prove their loyalty to the group and agree to protect the group before themselves. Membership in organized crime families is restricted by a common trait, such as race, religion, or beliefs (Manning, 2005, p. 167-168). This definition also applies to international terrorist organizations, including Al-Qaeda and its affiliates.

International terrorism organizations have also developed beyond conducting terrorist attacks for pure ideology, which further blurs the lines between organized crime and terrorism. Attacks are conducted to gain economic or political power, or to deflect attention from their criminal activities (Perri, Lichtenwald, & MacKenzie, 2009, p. 16). Hamas and Hezbollah have both worked to obtain political power in multiple countries in the Middle East, and the Revolutionary Armed Forces of Colombia are now more involved in narcotics trafficking than terrorist activities (Perri, Lichtenwald, & MacKenzie, 2009, p. 21).

Manning defined the four stages of development for organized crime as: street crimes, illegal profitable activities, legitimate businesses, and complex industries (Manning, 2005, p. 201). Like organized crime, terror groups began with the tactical crimes of hijacking, assault, and murder. The groups then progressed to drug trafficking and human smuggling operations. For example, the Taliban traffics in narcotic grade opium and Lebanese Hezbollah and Al-Qaeda are both known for smuggling illegal immigrants into the United States. Al-Qaeda, Hamas, and Hezbollah appear to have matured to the point of using legitimate businesses and charities to conceal the funding for their operations. Frank Perri, Terrance Lichtenwald, and Paula MacKenzie claim in their article, “Evil Twins: THE CRIME-TERROR NEXUS,” which explores the similarities between organized crime and terrorism, that organized crime and terrorist organizations seem to be learning from one another. In some of the more developed countries, such as the United States, organized crime and terrorist operations appear to be coexisting and cooperating with each other. These relationships are established through arm’s length business transactions (Perri, Lichtenwald, & MacKenzie, 2009, p. 18). An examination of the business transactions could reveal these connections and advance the investigations of terrorist organizations.

Regardless of where the terrorist groups and organized criminal syndicates are located or the ideology behind their cause, every group needs money to operate. Jeffrey Johnson and Carl Jensen state in the article “The Financing of Terrorism,” tracing financial transactions might “provide the most obvious clues to group membership, organization, and intention” (Johnson & Jensen, 2010, p. 108). Following the money trail can identify couriers, cells, cell members, and business relationships. In response to the September 11th attacks, many foreign government agencies established Financial Intelligence Units similar to the United States Department of Treasury’s Financial Crimes Enforcement Network (FinCEN). These agencies cooperate with each other to share financial and investigative information (Johnson & Jensen, 2010, p. 107-108). Following the money might be the best way to counter future terror attacks and reduce organized crime.

Analyzing and comparing the crimes committed to fund each group can reveal links to other members and criminal organizations. Link analysis of financial transactions and the persons or businesses involved with those transactions can reveal previously unknown mentorships, relationships and indications of cooperation between groups. A review of financial transactions could reveal one person working for both organized crime and an international terrorist group (Perri, Lichtenwald, & MacKenzie, 2009, p. 23). Perri, Lichtenwald, and MacKenzie discussed a method used by the Republic of Georgia to investigate the crime terror nexus, the Preparation of the Investigation Environment (PIE). PIE uses intelligence analysis techniques to identify links and overlaps between organized crime and terror groups, and to identify gaps, leads, or other areas of interest for further investigation. The Republic of Georgia PIE reviewed financial transactions through a group of suspected “dirty banks.” The review identified previously unknown connections between known organized crime figures, the Georgian government, law enforcement officials, and businesses and persons related to terror groups (Perri, Lichtenwald, & MacKenzie, 2009, p. 18-19). PIE and the review of financial transactions can also be used to identify family and cultural ties for terrorist groups, as many individuals will send money back to family members in their home countries (Perri, Lichtenwald, & MacKenzie, 2009, p. 20). This same PIE technique could be used in investigations of organized crime, narcotics and other street crimes to identify links between individuals, groups, and businesses, and leads for further investigation. If law enforcement is unaware of the connection between an organized crime syndicate and a terror cell due to lack of knowledge about the financial information, then a vital lead in both investigations will be missed and the criminal activity will remain undetected.

CONCLUSION

September 11, 2001 served as a catalyst for many changes in the United States. Forensic accountants have begun to realize the potential for supporting the investigation of non-financial crimes, and law enforcement is considering reviewing financial information for new leads in traditional street crimes. Non-financial investigators are obtaining and reviewing some financial information in investigations of organized crime and international terrorism, but this is only the beginning. As Supervisory Special Agent King indicated, traditional
criminal investigators are not averse to working with financial experts, but they need exposure to the types of information available in financial records, how that information can contribute to their non-financial cases, and the persons who can provide that expertise.

Applying forensic accounting techniques to non-financial investigations can provide previously unknown information leading to resolutions of more crimes. Investigators with financial expertise can consult and advise on non-financial investigations occurring in their offices and agencies. Sessions on the use of financial information in non-financial investigations can be provided at financial and criminal investigative training conferences. Forensic accountants and investigators need to communicate with and teach each other about their capabilities and continue thinking outside the box.

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INTRODUCTION

Advances in technology have dramatically changed the way society, business, and individuals operate. This reliance on technology as the command and control vehicle for daily interactions raises a legitimate concern about the security of computer networks against cyber attacks. A 2011 study by Symantec, a company which specializes in computer security software, found that “…at an annual price of $388 billion globally based on financial losses and time lost, cybercrime costs the world significantly more than the global black market in marijuana, cocaine and heroin combined…” (Albanesius, 2011, September 7). Cyber crime is a global issue, and many cyber security experts agree that there is inadequate preparation to combat cyber attacks.

Shortly after being elected to office in 2009, President Obama stated cyber security is a serious economic and national security challenge that needs to be re-evaluated. On May 29, 2009 during a White House Press conference on Cyber Security, President Obama said:

It’s about the privacy and the economic security of American families. We rely on the Internet to pay our bills, to bank, to shop, to file our taxes. But we’ve had to learn a whole new vocabulary just to stay ahead of the cyber criminals who would do us harm -- spyware and malware and spoofing and phishing and botnets. Millions of Americans have been victimized, their privacy violated, their identities stolen, their lives upended, and their wallets emptied (Obama, 2009).

This paper examines cyber crimes in the context of how they are executed, investigated, and prosecuted with a primary focus on attacks that impact individuals, businesses or corporations, and critical infrastructure in the United States.

WHAT IS CYBER CRIME?

In his book, Essentials of Criminal Justice, Larry Siegel defines cybercrime as “the theft and/or destruction of information, resources, or funds via computers, computer networks, or the Internet” (Siegel, 2011, p. 504). Siegel further notes that there are three forms of cybercrime: cyber theft, cyber vandalism, and cyber terrorism (Siegel, 2011, p. 504). According to Siegel, cyber theft is the “use of cyber space to…distribute illegal goods and services to defraud people for quick profits;” cyber vandalism is the “use of cyber space for revenge, for destruction, or to achieve malicious ends;” and cyber terrorism is “an effort by enemy forces to disrupt the intersection where the virtual electronic reality of computers meets the physical world.” (Siegel, 2011, p. 505)

TRENDS

The increase in social media websites, online shopping, and online bill paying, enables cyber criminals to hack into computer networks to steal and/or destroy critical information. Unlike a physical crime where a criminal might walk up to someone at an ATM machine, point a gun, and force cash to be withdrawn, cyber crimes are committed every day with a key stroke by criminals who are hidden from view. Online criminals tend to organize in groups, allowing the ability to commit larger scale attacks on individual, business, and government computer networks.

The increase in mobile attacks is a growing trend. The Symantec study cited earlier predicts that almost 70% of adults will be a victim of cyber crime at some point in their lives, and with the increased dependency on mobile devices, mobile attacks will become more common. In a New York Times article, “For Hackers, the Next Lock to Pick,” author, Claire Miller, included a statement from Charlie Miller, a research expert from Accuvant, a company which specializes in security consulting. Charlie Miller noted that “…the bad guys are going to slowly follow the money over to your phones….most consumers, though they protect their computers, are unaware that they need to secure their phones…but the same thing that can happen on your computer can happen on your phone” (Miller, 2011).

CURRENT CHALLENGES

Some of the biggest challenges with cyber security include a lack of knowledge about how common cyber crimes are and inadequate preparation, particularly training. Even the most updated anti-virus software or cyber security team does not prevent a hacker from inserting a virus into a computer network. Some cyber experts are not optimistic that there are effective ways of combating cyber crime, and argue that it might never be eradicated because cyber criminals continually modify and create new materials faster than laws can be enacted or system protection can be developed.

Dan Kaplan, in his article “Bringing Justice”, argues there is not enough being done about cyber crime for the “little people.” Kaplan stated, “…sure law enforcement is more aware of threats, laws have been created or strengthened, and major cybercriminals busts are becoming common headlines. Yet, at the local and state levels, knowledge and capabilities needed to bring electronic fraudsters to justice are severely lacking” (Kaplan, 2010, p. 24). Kaplan noted that the public should be educated and that local and state law enforcement agencies need better training on how to work cyber crime cases (Kaplan, 2010, p. 24).

In a PC Magazine article, “White House Unveils Cyber-Security Plan,” author Chloe Albanesius discusses a White House proposed cyber security plan that was brought before Congress in May 2011 for future legislation. This proposed plan notes some challenges
surrounding cyber security. Its four main goals include: “protecting American citizens; protecting critical infrastructure; protecting the federal government’s computer systems; and protecting civil liberties” (Albanesius, 2011, May 12). The Department of Homeland Security, which plays a major role in investigating cyber crime, has no clear established responsibility in handling cases from the private sector. The new proposal would allow private, state, and local entities to request assistance from federal law enforcement agencies in cyber threat issues (Albanesius, 2011, May 12).

Another cyber security challenge is the lack of communication between the government and the private sector on how to address cyber security. Rodney Joffe, chief technologist at Neustar Inc., a technology and communications company, said that, “the U.S. government should engage the private sector more on cybersecurity issues, especially when it comes to sharing data on cyber incidents in government networks, because many government operations are at least partially dependent on private-sector networks running Internet traffic” (Johnson, 2011).

CYBER CRIMES AGAINST INDIVIDUALS

Identity theft is a common form of cyber crime committed against individuals. For example, a consumer may receive an invitation in the mail to open a new line of credit. Often, the consumer is not interested and discards the offer. Criminals then search through the trash, find discarded mail, such as a credit card offer, and open a line of credit in the victim’s name; they may even sell the stolen information on the Internet thus compromising this identity. Cyber criminals copy names of legitimate companies, create websites, and send emails that appear genuine to consumers who reply to the email, providing sensitive information such as passwords, social security numbers or credit card numbers, or open an email with a virus-ridden attachment. Credit card fraud, deemed a world-wide issue, has been on the rise, and with technological advances, it has become even easier to obtain consumers’ personal information. Criminals are committing crimes through online connections on social media networking sites such as Facebook, MySpace, and Twitter.

In a *PC World* article entitled “What to Do After a Data Breach,” author Nick Mediati noted that while it might be next to impossible to stop a data breach, there are some critical steps that one can take to limit the impact. Mediati suggests the following:

“immediately change passwords on the affected account, avoid clicking links in messages that may appear legitimate, be wary of mail that requests any form of personal information or money, constantly check bank and other financial statements, and if anything appears out of the ordinary, immediately contact the financial institution, place a fraud alert on your credit report, and do an annual credit report check” (Mediati, 2011, p. 1).

CRIMES AGAINST CORPORATIONS

Attacks against businesses and corporations occur with greater frequency than against individuals and are more sophisticated. Kevin Mandia, a chief executive at security firm, Mandiant Corp, notes that modern day hackers are gaining access to networks “by exploiting well-intentioned employees” (Fowler, 2011). One example of this occurred in March 2011 at EMC Corporation’s RSA security unit. EMC manufactures computer login devices for use by other companies. An email with an attachment entitled “2011 Recruitment Plan” was sent to several EMC employees. The email appeared legitimate so it was retrieved from the spam mail filter and the attachment was opened by an employee. The email however, was sent from a hacker and the attachment allowed a virus to infect the company network, giving the hacker access to confidential data and enabling attacks against the company’s customers (Fowler, 2011).

Lori Nugent, an attorney who specializes in breach cases, provides some insight on cyber attacks against companies. She notes that, “the public is forgiving when it’s apparent that the company is doing the right thing…in fact, if a company is on top of the technological problems and communicates well, it can build loyalty among its customers” (Worthen, 2011). Nugent says that once an attack has been identified, it’s common to shut off the machine, but this is the wrong step to take. Because malware “resides in a computer’s memory and not on the hard drive,” shutting off the machine erases evidence that could help investigators discover stolen data or trace the attack (Worthen, 2011).

THREATS TO CRITICAL INFRASTRUCTURE IN THE U.S.

On April 12, 2011, Gordon Snow, the Assistant Director of the FBI’s Cyber Division, provided testimony to the Senate Judiciary committee on current cyber threats facing the United States. Snow stated to the committee, “it is difficult to state with confidence that our critical infrastructure—the backbone of our country’s economic prosperity, national security, and public health—will remain unscathed and always be available when needed” (Snow, 2011). Snow advised that law enforcement agencies are working hard to protect the nation against cyber threats. “The FBI has identified the most significant cyber threats to our nation as those with high intent and high capability to inflict damage or death in the U.S., to illicitly acquire assets, or to illegally obtain sensitive or classified U.S. military, intelligence, or economic information” (Snow, 2011).

Snow referred to a breach against Nasdaq which occurred in February 2011. During a normal security screening, it appeared that malware files were installed on what was supposed to be a secure portion of Nasdaq’s network i.e. “Director’s Desk” which permits document storing and sharing by company boards (Barrett, 2011). Snow used the Nasdaq breach to emphasize that our financial infrastructure is not secure as it should be, and this is an area for concern. The Nasdaq
breach, like others, confirms that there are real threats against our nation, and emphasizes the need to implement better ways to target the perpetrators.

**CYBER CRIME LAWS**

The federal government has recognized the serious implications of computer-related crimes; however, some of the federal criminal statutes for computer intrusion and other computer and network related crimes, are not always applicable to all incidents of computer crimes. Currently, there are strong arguments in favor of the expansion of cyber crime legislation to include more computer crime incidents. In "Qualified Success Claimed Against Computer Worm," author, Keith Johnson, makes the point that "our nation is heavily dependent on private entities to keep our country running, but the current statutes in place to combat computer crimes are not inclusive" (Johnson, 2011).

**COMPUTER FRAUD AND ABUSE ACT (CFAA)**

Almost thirty years ago, changes in technology sparked intense debate among law enforcement experts about what constituted computer crimes. Some experts saw computer crimes as traditional crimes committed through the means of "new, high-tech devices" while others saw it as much more serious and not in any way similar to traditional crimes. With a sudden increase and dependency on computers, it was necessary to have laws in place that would aid in prosecuting incidents of computer abuse. In 1984, the Computer Fraud and Abuse Act (CFAA), codified under 18 U.S.C. § 1030, was passed by Congress and in 1994, it was revised (The Computer Crime and Intellectual Property Section, n.d.). Although it was initially enacted to address the growing rates of computer crimes, the CFAA broadened its scope over the years to include new types of computer crimes.

The first conviction under the CFAA was a result of United States v. Morris, 1991. The defendant, Robert Morris, a graduate student in Computer Science at Cornell University, was given explicit computer access. In 1988, he created a computer worm to expose security flaws in computer networks. Morris released the worm from a computer at the Massachusetts Institute of Technology in an effort to disguise the actual origin. Underestimating the rate of replication and re-infection, the worm spread quickly and impacted thousands of computer networks. In 1991, the Northern District of New York in the United States District Court found Morris guilty of violating 18 U.S.C. 1030(a)(5)(A), the Computer Fraud and Abuse Act (U.S. v. Morris, 1991).

The case, United States v. Lori Drew, 2008, exemplified the growth of the CFAA. The defendant, Lori Drew a forty-nine year old woman, assumed the persona of a fictitious sixteen-year-old boy named Josh Evans who befriended thirteen-year-old Megan Meier on the social networking website MySpace. Meier believed she had a legitimate online relationship with “Josh.” Drew, the mother of one of Meier’s former friends, used MySpace to obtain information about Meier’s feelings about her daughter. Drew began harassing Meier on MySpace and one day told her, “…the world would be a better place without you in it” (Jones, 2011). The jury determined Drew’s harassment led to Meier committing suicide. On May 15, 2008 Drew was indicted under the CFAA. This case was significant because it was the first time the CFAA was used in a case involving a social networking website.

**CATCHING THE “BAD GUYS”**

While it remains a difficult task to identify and prosecute cyber criminals, there are cases that demonstrate the hard work of law enforcement agencies is paying off. In the Christian Science Monitor article, “Hacker Arrests: Why Anonymous might Not be so Anonymous” author Mark Clayton admits that while it is not an easy task some “bad guys” get caught. He says, “often, perpetrators are caught bragging on online forums. [Others] are caught making elementary mistakes” (Clayton, 2011). Clayton points to the arrests of 21 individuals connected to the hacking groups Anonymous and LulzSec in July 2011. Most of the individuals arrested were connected to attacks against PayPal in December 2010. For several months, members of Anonymous and LulzSec taunted law enforcement, hacked into corporate websites, and bragged about it online. As a result of their bragging, the perpetrators were caught, and were indicted for their crimes (Clayton, 2011).

**ROYAL BANK OF SCOTLAND WORLD PAY SCAM**

The indictment of cyber criminals responsible for attacks on the Atlanta-based subsidiary of the Royal Bank of Scotland (RBS) on November 4, 2008, is an example of law enforcement’s success in catching the bad guys. Sergei Tsurikov and his Eastern European-based cyber gang stole $9.4 million from 2,100 ATMS in 280 cities in eight countries in twelve hours by cracking the encryption code which protected RBS’s WorldPay prepaid payroll cards and using the stolen data to create fake ATM debit cards (Clayton, 2010). The individuals who were extradited to the United States were charged in a 16-count indictment for "conspiracy to commit wire fraud, wire fraud, conspiracy to commit computer fraud, computer fraud, access device fraud and aggravated identity theft” (Department of Justice, Office of Public Affairs, 2009).

**MARIPOSA BOTNET**

Considered so far to be one of the largest botnets, the Mariposa involved the collection of millions of infected computers. Mariposa, a malware program, was discovered in December 2008. Three criminals from Spain were credited with the creation of Mariposa. It was used to steal passwords, credit card data, and sensitive banking information, and to launch DDoS attacks worldwide. An informal group
of volunteers from various security and law enforcement agencies, formed the Mariposa Working Group, which aided in dismantling Mariposa’s command-and-control servers (McMillan, 2010). The arrests of the three Mariposa operators confirmed more success for law enforcement and emphasized the advantages of having international cooperation.

CONCLUSION

As technology continues to improve, new ways of committing cyber-based crimes will evolve, therefore, new laws must be created to address these changes. As this discussion has pointed out, inadequate preparation and a lack of communication between the private and public sector are among some of the biggest challenges facing cyber security. We have seen how technology has been used to cause serious attacks, and it is evident that our nation’s critical infrastructure—power grids, electronic and communication systems—is at risk. Although it has never occurred, experts in the cyber security field would agree that the possibility of terrorist attacks being executed on our soil via technology is imminent. Citizens should not live their lives in fear, or stop using computers or other forms of technology, but rather, become more aware of their surroundings, and if victimized, report it to the authorities.

It is safe to make the assertion that cyber crime might never be eradicated, but to offer some hope, it can perhaps be controlled. Everyone has to take responsibility. Individuals need to be aware of their online activities and how they use technology. Simple steps such as changing passwords for online accounts, updating home and personal computers with the latest anti-virus software programs, monitoring credit scores, and being mindful of online communication, are necessary, at a minimum. Corporations and businesses need to educate their employees about how easily hackers gain access to sensitive and confidential information, i.e., using websites and emails that may appear to be legitimate. It is critical that more knowledge is provided to the public on cyber crimes, that laws geared toward combating cyber incidents are improved or created, and that additional training and other resources be dedicated to this growing and serious issue. If cyber criminals see these incidents taken seriously and that individuals are prosecuted, then maybe some might think twice before carrying out certain crimes.

The entities involved in protecting our critical infrastructure need to be given more attention. Over the next several years, the Computer Fraud and Abuse Act will continue to be amended and improved. President Obama has stressed the importance of working with “all key players in U.S. cybersecurity, including state and local governments and the private sector, to ensure an organized and unified response to future cyber incidents…” (Executive Office of the President of the United States, n.d.). It is critical that with more knowledge about cyber crimes and overall cooperation from all involved parties, the nation will be better equipped to handle cyber crime incidents.

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Forensic Anthropology And Human Remains Identification
Sarah Krans

"You know my methods, Watson. There was not one of them which I did not apply to the inquiry. And it ended by my discovering traces, but very different ones from those which I had expected." (Doyle, 1894)

Like Sir Arthur Conan Doyle’s character, modern forensic scientists must use multiple methods to determine the identity of human remains. Human remains identification utilizes the social and biological sciences, in both criminal justice and non-criminal justice situations, by creating a biological profile of the individual. This biological profile includes age, gender, height, weight, geographic characteristics, and other conditions present during life.

Even with advances in remains identification techniques, such as bone identification methods and deoxyribonucleic acid (DNA), forensic anthropologists face many challenges, including how bodies decompose and under what conditions. The researchers at the University of Tennessee-Knoxville’s “Body Farm” have been studying how bodies decompose since 1981. Despite decades of study, scientists still have much to learn about the decomposition process as well as the effects lifestyle and other factors during life have on the human skeleton. Collaboration with other scientists, such as geneticists and dentists, help increase the probability that forensic anthropologists and law enforcement officers will accurately identify remains and give closure to the family of the missing person.

DEVELOPMENT OF FORENSIC ANTHROPOLOGY
Archaeology is the sub-field of anthropology concerned with understanding the past, particularly the past prior to recorded history. “In general, archaeologists have tried both to describe the past and to explain it” (Wenke & Olszewski, 2007, p. 6). Archaeologists look for patterns in the past to help explain how human society has become what it is today. Archaeologists and forensic archaeologists look for the telltale signs a human had been at a location, namely soil disturbances. As the rings of a tree indicate weather patterns, the surface of the earth shows the death and renewal of the vegetation, distinguishable by soil striations. Digging holes disturbs these striations and loosens the soil. As archaeologists and geologists study the earth’s striations to determine age, forensic archaeologists use the earth over a grave to give an idea of how long ago a burial occurred.

Just as archaeologists investigate humanity’s impact on the material culture, physical anthropologists study the impact of life and death on the human skeleton. “Forensic anthropology is the application of the science of physical anthropology to the legal process” (What Is Forensic, 2008). Forensic anthropologists are highly trained specialists whose knowledge includes Osteology (the biological science focused on the study of human bones), remains identification, and archaeological excavation methods. Disease, nutrition, and occupations all leave distinct markers on bones. These indicators reveal information about the society, behaviors, and aid in forensic identification of the remains. Through the study of thousands of skeletons whose age and gender are known prior to study, physical and forensic anthropologists are able to determine the specific indicators for age-at-death and gender of a skeleton.

TECHNOLOGY AND HUMAN REMAINS IDENTIFICATION
Scientific understanding of the human body is constantly evolving. Scientists are continually learning more about how humans grow and develop. Medical students learn about the human body using cadavers; forensic anthropologists study skeletons and decomposing remains. Every human bone can tell a story about the life that was lived. Even with a greater understanding of DNA and mtDNA (mitochondrial DNA) forensic scientists still rely on classic archaeological studies of burial customs and bone identification during the initial identification process.

An issue with the study and documentation of age and gender of skeletons is the pool of skeletons to study. Many of the skeletons being studied are archaeological in nature (acquired through archaeological digs) or medical donations. With medical donations, the exact age-at-death, or a close estimation, is known. Archaeological finds have an age-range associated with them rather than an exact age. These inexact figures can lead to best estimates for the findings. Even with exact ages being known, no two people will display identical physical characteristics. Diet, nutrition, and genetics play key roles in the rate of the skeleton’s development.

There are 206 bones in the human body, thus the identification of human remains can be a daunting task. When these bones are found in a non-contained environment, it is critical to determine whether the bones found are human or nonhuman. Approximately 30% of the bones submitted to forensic anthropologists for identification are ultimately determined to be nonhuman in origin (Bass, 2005, p. 307). In the early 1990s, approximately 17% to 25% of the bones submitted to forensic anthropologists were determined to be of non-human origin. Dr. William Bass, of the University of Tennessee-Knoxville, attributes the increase of nonhuman specimens to popular literary and television accounts of investigations of remains (Bass, 2005, p. 307).

Anthropologists must determine which bone is being analyzed. Human bones are divided into five categories. Each category has unique characteristics and purposes: cranial (skull, including mandible and teeth), long bones (arms and legs), short bones (hands, feet, and clavicles), flat bones (pelvis, ribs, sternum and scapulae), and irregular bones (vertebrae, patellae, carpal and tarsal). Some bones can resemble other bones, such as the ilium and scapula, which may result in misidentification and analysis. Small bones such as the hyoid can also be easily lost or damaged if care is not taken during the excavation or improper handling of the scene occurs (Bass, 2005, p. 3).
defining a time-frame, as well as narrowing a list of murder suspects, decomposition rates help to narrow the list of potential identities by mining the identity of human remains since the early 20th Century. Forensic anthropologists have been consulting with it was not until the second half of the 20th Century forensic anthropologists realized the need to know exactly how a human body decomposes. The Pima County (Arizona) Office of Medical Examiner (ME) assembled a profile of the deceased (Anderson, 2008). Utilizing personal effects, geographic location, and racial characteristics, the ME assembled a profile. The United States Border Patrol documented geographic areas that are known for UBC and drug smuggling. Bodies found within these areas with personal effects typical of Mexican immigrants and exhibiting physical characteristics consistent with Southwest Hispanics are classified as an UBC (Anderson, 2008, p. 12). The biological profile is also compared with those of missing persons in that same area before officially being deemed an undocumented border crosser.

Caucasoid characteristics include a longer, narrower face, narrow nasal opening and a narrow high-bridged nose. Negroid characteristics include little or no nasal depression, rounded forehead, and a dense or ‘ivory’ texture to the bone. The teeth of the Negroid skull also protrude from the face. Mongoloids exhibit shovel shaped incisors, nasal overgrowth, and the zygomatic bones dip below the lower edge of the maxilla (Bass, 2005, p. 83-88). Students at the University of Wyoming have cataloged specific measurements of the interorbital features to determine race with a ninety percent rate of accuracy (Bass, 2005, p. 88-92).

The use of racial characteristics to identify bodies has proven useful in the southwestern United States, in areas of known illegal border crossings. Undocumented border crossings (UBC) mean an increasing number of unknown foreign nationals are succumbing to the high heat of the deserts in areas known for illegal border crossings. Racial profiles are necessary to help differentiate between known missing persons and unknown illegal foreign nationals.

The Pima County (Arizona) Office of Medical Examiner (ME) documented their findings of the methods used to determine the identity of the deceased (Anderson, 2008). Utilizing personal effects, geographic location, and racial characteristics, the ME assembled a profile. The United States Border Patrol documented geographic areas that are known for UBC and drug smuggling. Bodies found within these areas with personal effects typical of Mexican immigrants and exhibiting physical characteristics consistent with Southwest Hispanics are classified as an UBC (Anderson, 2008, p. 12). The biological profile is also compared with those of missing persons in that same area before officially being deemed an undocumented border crosser.

**TIME SINCE DEATH**

It was not until the second half of the 20th Century forensic anthropologists realized the need to know exactly how a human body decomposes. Forensic anthropologists have been consulting with police departments and the Federal Bureau of Investigation in determining the identity of human remains since the early 20th Century. Decomposition rates help to narrow the list of potential identities by defining a time-frame, as well as narrowing a list of murder suspects, if a criminal case is involved.

In 1971, Dr. William Bass, of the University of Tennessee at Knoxville, began the forensic anthropology program that ultimately resulted in the creation of the forensic anthropology research facility, or "Body Farm," to study post mortem changes. Dr. Bass has worked on excavated human remains, both archaeological and forensic, since the late 1950s. It was during a potential murder investigation that he determined how little forensic anthropologists know about decomposition under various circumstances (Bass & Jefferson, 2003, p. 89). The potential murder investigation involved an embalmed Civil War colonel. All forensic indicators, including condition of the body pointed to a murder and burial which occurred a few months prior to discovery. The county sheriff and his deputies investigating the remains all thought the victim had been dead only a few months. This time-since-death was thought to have been confirmed by the body’s state of decomposition. As the body had been found on top of the coffin, rather than inside, authorities believed it to have been because of a failed grave robbery. It was the clothing which gave clues to the corpse being older than the two to six months deceased originally postulated. Both the embalming process and the sealed lead coffin assisted in preserving the body from normal decomposition processes. What was originally believed to have been a murder of a few months prior turned out to be an attempted grave robbery of a 113-year-old body! (Bass & Jefferson, 2003, p. 68-69).

In 1980, Dr. Bass was allowed to use an acre of land behind the University of Tennessee-Knoxville's hospital for his forensic anthropology research facility and received the first body donation in 1981. Bodies donated to the facility are placed in various situations and the effect these situations have on the bodies is carefully measured and studied. Situations include shallow graves, partial burials, exposed remains and even remains left in the trunk of a car. Dr. Bass described the reasons for starting the research facility as:

> The questions we hoped to answer were laughably elementary: At what point does the arm fall off? What causes that greasy black stain under decomposed bodies, and when? When do the teeth fall out of the skull? How long before a corpse becomes a skeleton? (Bass & Jefferson, 2003, p. 96)

As an academic research facility, the University of Tennessee-Knoxville has grown to be one of the largest forensic anthropology programs in the country. With academic programs, the research is limited only by the curiosity of the students (and the legality of the question). It is also because of the nature of the work and study being done the faculty and students are the subject of protests and negative publicity. To learn about death is to “sidestep society's customary treatment of the dead” (Bass & Jefferson, 2003, p. 206).

In life, as in death, all humans display individual visual characteristics. Skeletal remains not only show age-at-death and gender, but also racial characteristics. While long bones are able to provide some racial characteristics, the skull provides the majority of these racial identifiers. Racial characteristics are divided into three classifications, each with visual and measurable differentiations: Caucasoid, Negroid, and Mongoloid (including Native American). As with age and gender determinations, racial determinations are only estimations due to intermarriage as well as cross-characteristics (Bass, 2005, p. 83).
As Bass had experienced with the Civil War Colonel, being able to
differentiate between cemetery remains and forensic remains is impor-
tant. During the aftermath of Hurricane Katrina in 2005, forensic
anthropologists had to distinguish between the remains from ceme-
teries and victims of the disaster. Under normal circumstances, the
presence of personal items, such as jewelry or rosary beads, can lead
the forensic anthropologist to believe the body is a cemetery burial,
but that may not be true in a situation such as cleaning up after Hur-
rricane Katrina. One of the major differences is embalmed versus non-
embalmed bodies. Despite what the public may believe, embalming
does not stop decomposition, but rather retards decomposition.

The discipline of forensic taphonomy is “that part of forensic anthrop-
ology which focuses on reconstructing events during and following
death by collecting and analyzing data about the depositional context,
discriminating peri- and postmortem modification of the remains,
and estimating the postmortem interval” (Haglund & Sorg, 1996,
p. 13). Similar to the forensic anthropologist searching bones for
answers to who the person was, the forensic taphonomist searches for
answers to the how and the why of decomposition and burial. Tapho-
nomists study the bugs and animals that assist in the decomposition
process. A challenge to the study of decomposition is most research is
completed in controlled environments, whereas ‘real world’ situations
are unpredictable in their infinite variables.

DNA AND mtDNA

Deoxyribonucleic acid, or DNA, is considered the “building block of
life.” DNA contains information that makes individuals unique based on
the traits inherited from both parents. Those traits appear in the DNA
molecules. The closer the relationship is between two people, the more
similarity is found in their DNA traits. With every future generation, the
DNA strand will be altered by the introduction of new genetic material.

There is a strand of DNA that is passed through the generations with
very little change in structure. Mitochondrial DNA, or mtDNA, is
found in the mitochondria, or energy center of cells. The mtDNA is
passed almost unchanged from mother to child. Bryan Sykes, of the
University of Oxford, was one of the first to study mtDNA from old
bones and its use in genealogy and identification. He related how
mtDNA was used to determine the identity of remains found near
Ekaterinburg, Ukraine in July 1991. The bodies were believed to be
those of Tzar Nicolas II, his wife and their five children, their doctor
and three servants; only nine bodies were found where there should
have been eleven. DNA was used to determine four of the bodies
were not related to any others and five were closely related. It was
mtDNA that proved that the five related persons four had a mother-
child relationship and the fifth was not related. These findings fit a
family DNA relationship. The researchers were also able to compare
the mtDNA of the remains presumed to be the Tzar with a living
maternal relative, Count Troubetskoy. The mtDNA from the presumed
remains of the Tsarina were a match to her closest living maternal
relative, the Duke of Edinburgh (Sykes, 2001, p. 63-68).

A challenge with using DNA and mtDNA in the identification of
remains is the requirement for comparison data. Unlike the identifica-
tion of the remains in Ekaterinburg, attempting to identify remains
using only DNA will rarely result in a positive identification. This
method must be combined with osteological identification to nar-
row down the possible matches. Sometimes, however, a comparison
sample may not exist. Family members may be deceased. Adoption
can also limit the use of DNA in identification. Modern U.S. military
procedures require DNA of service members to be kept on file in the
event identification of remains through other methods is not possible
or to confirm the identity.

DNA is a sensitive molecule. It can break down quickly with time and
is susceptible to heat. Sykes studied the ways to extract DNA from
ancient remains, and insufficient amounts to run the necessary tests.
mtDNA was chosen because “cells have upwards of a hundred times
more of it than any other gene” (Sykes, 2001, p. 16). The chance of
mtDNA surviving in bones is greater than DNA. For identification
purposes, DNA shows whether two people are related and how closely
related; siblings will have more similar DNA than father and child.
In genealogy, DNA is used to trace paternal lines as the last name will
stay the same and, thus, easier to trace the genetic similarities. mtDNA
is a matrilineal gene; it is passed solely from mother to child with very
little change through the generations. For identification purposes,
either gene is useful, as long as the lineage of the person to be identi-
fied is known as there must be a sample to be compared.

JPAC AND FORENSIC SCIENCE

Another source of much study of human remains identification is
located on Hickam Air Force Base, Hawaii. In 1973, the U.S. Army
Central Identification Laboratory was commissioned to identify
U.S. service member remains from the conflicts in Southeast Asia.
In 2003, this laboratory merged with the Joint Task Force – Full
Accounting Command to form the Joint POW/MIA Accounting
Command (JPAC), establishing the world’s largest laboratory for
human remains identification. The mission of this command is to
“achieve the fullest possible accounting of all Americans missing as
a result of our nation’s past conflicts” (Joint POW/MIA Accounting
Command, 2011). In his Executive Summary from the 2010 JPAC
Annual Report, MG Stephen Tom states:

Since 1 October 2009, [JPAC has] identified 67
individuals including one from World War I, 36
from World War II, 17 from the Korean War,
and 13 from the Vietnam War. We deployed 77
JPAC teams to such places as France, Germany,
Belgium, Austria, Papua New Guinea, Vanuatu,
China, South Korea, Vietnam, Laos, and Cambo-
dia to conduct investigation, survey, and excavat-
tion operations associated to missing Americans
(Tom, 2010, p. 2).
JPAC utilized both archaeologists as well as forensic anthropologists, in addition to other specialists, in their recovery and identification of American service members. Recovery teams consist of archaeologists, forensic photographers, forensic anthropologists, linguists, medics, explosive ordnance disposal technicians, mortuary specialists, and others. As with their counterparts in the criminal justice field, JPAC has the good fortune of having records with which to compare remains for identification, and sometimes dog tags. The process of identifying remains is still long and tedious. Unlike the depiction in current television shows, recovery and identification of remains can take months and sometimes years (Tom, 2010, p. 5).

Once a location has been identified, and approved for excavation, a forensic anthropologist will help lead a team to excavate the site, collecting any bones and other contextual evidence to assist in a positive identification. Contextual evidence can include clothing scraps, dog tags, and other personal effects (Reichs, 2010, p. 20-26). Complete biological and medical histories are compiled for the remains, to be compared with known information about an individual. Even after identification has been made multiple professionals review the data to verify the findings are correct (Joint POW/MIA Accounting Command, Overview).

Not only do scientists at JPAC search for missing service members in the theaters of war, but they also identify remains of unknown soldiers in military cemeteries. An ongoing project is to identify the remains of Korean War Unknowns in the National Cemetery of the Pacific in Honolulu. Historians use primary and secondary resources, date of loss, battlefield information, etc., to compile a possible names list for use when remains are exhumed (Tom, 2010, p. 16). Not only does the historical information assist in identifying the unknown remains to be returned to family members, researchers are correcting information which was incorrectly filed in the 1950s, such as date of loss, using the many resources available.

Scientists at JPAC develop new methods to assist in identifying remains. Currently being researched are the use of chest radiographs to identify World War II and Korean War service members, sex and stature determination using the patella (knee cap), and the use of mtDNA to sort co-mingled remains (Tom, 2010, p. 17-21). These research projects are possible because of the ability to narrow the field of possible identities. These new methods of identifying skeletal remains not only assist JPAC team members to repatriate missing service members, but also forensic anthropologists to identify crime victims.

CONCLUSION

The identification of human remains is a difficult, yet rewarding task. Multi-disciplinary techniques are required as it is rare to find intact skeletal remains with photo identification. The field of possible identities must be narrowed using the social and physical sciences. Traditional archaeologists and forensic anthropologists, by training and experience, could be considered experts in the identification of human remains, determining their age at death, as well as gender and race. Because of the infinite number of variable situations in which remains are found, and the individuality of the remains, new methods to identify remains are always being advanced, limited only by the researcher’s questions.

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Analysis of Electronic Information and Record Retention Programs

Jessica Lyons

In 2005, Morgan Stanley faced a $1.6 million judgment when the company failed to completely turn over all electronic files pertinent to a suit brought by Coleman Holdings, Inc. (Smaroff, 2011). The company stated all information maintained had been provided to the prosecution during discovery; however this was not the case as several thousand files overlooked by management were found in various offsite locations (Smaroff, 2011). What went wrong? What could have prevented this costly oversight? Should electronic filing systems, soft copies, and electronic correspondence be subject to the same rules and regulations as paper documents, hard copies, and inter-office memorandums? What is management’s responsibility versus the employee’s responsibility for safeguarding, purging, cataloguing, or destroying company work products? The discovery process dictates exchange of information between the litigants upon request. How has the legal system modified or expanded its interpretation to include electronically-stored information?

In order to determine the answer to these questions, four variables must be analyzed. These include the nature of electronically produced information, the existence of and compliance with document retention policies, the reluctance of employees to destroy documents, and the varying regulatory requirements governing organizations.

NATURE OF ELECTRONICALLY STORED INFORMATION

Morgan Stanley’s failure to provide electronically stored information during the discovery process resulted in a loss of company assets as well as a change to how electronically stored information (ESI) was viewed from a legal standpoint. With the increased use of technology by organizations, the discovery process has moved from a hard-copy to soft-copy review of documents, including ESI (Lipner, 2006). Therefore, it is important for companies and end users to understand what types of ESI are discoverable.

The United States Federal Rules of Civil Procedure (FRCP) are regulations that dictate the procedural methods to be used in U.S. Federal cases. In 2006, the FRCP was amended to reflect current business practices specifically related to ESI. The amendments were created in order to ensure that ESI generated during the normal course of business is retained by corporate litigants and is done so in a manner that ensures it can be accessed when needed (Heer & Osterman, 2007). One year after the amendments were introduced, a LexisNexis study discovered that, “73 percent of companies have a document retention policy, and one-third of those had a policy that did not cover ESI” (LexisNexis Discovery Series, 2007). When considering the prevalence of ESI, this statistic is unacceptable.

Until recently, ESI primarily concentrated on e-mail products. The definition of ESI has expanded to include increasingly complex formats. These include, but are not limited to: text messages, instant messages, voicemails, personal digital assistants (PDA), and social networking sites (Barker, Cobb, & Karcher, 2010). Each form of ESI creates different challenges for organizations trying to capture, organize and manage the information.

An article appearing in The Information Management Journal stated that the inability to produce e-mails repeatedly requested by the prosecution was the “final straw” for the judge when issuing the $1.6 million judgment against Morgan Stanley (“E-mail Is Key in Judgment,” 2005). Although e-mails have been part of the normal course of business for the past decade, they continue to be a large area of needed improvement for an organization’s document retention policy (Barker, Cobb, & Karcher, 2010). One reason for this is end users who may not be fully aware of their organization’s retention policies are often held responsible for retaining the necessary emails (Irvin, 2010).

Instant messaging programs are also a growing form of correspondence commonly used to make quick decisions in organizations. Studies have revealed that the use of a messaging system can “improve work efficiency and effectiveness” because it eliminates voicemails and unanswered emails (Barker, Cobb, & Karcher, 2010). Due to this increased use, instant messages and any files attached can be requested by an opposing party during the litigation discovery process (Barker, Cobb, & Karcher, 2010). Therefore, such information must be identifiable and retainable by the organization.

PDAs and smart phones have proliferated as the primary tool of choice for business correspondence and operations. It has become common practice for employers to allow employees to synchronize their smart phones with their work computers to allow for increased flexibility (FRCP Readiness: 10 Practical, n.d.). While this opportunity may improve efficiencies, it also increases the number of devices on which ESI is retained, and therefore are liable to the discovery process. When litigation is looming, the ability to rapidly identify and locate relevant information contained on these myriad devices is compromised, thus consuming time, manpower, and revenue.

Within the past few years, social networking has become a resource for individuals as well as most organizations. Facebook pages and LinkedIn groups are used to recruit talent, improve the reputation and image of a company, and seek growth opportunities. Social networking sites are also a form of ESI full of potential evidence (Lender & Peck, 2011). Within the past three to five years, there have been several examples of individuals losing their jobs because of adverse Facebook posts (“Facebook Post Gets,” 2009). Because information created on social networking sites, as well as discussion boards and blogs, is now part of discoverable information during a lawsuit, organizations must be able to track, organize and retain the information as it is produced.
Another significant issue with the retention of ESI is the format in which it is retained. Most organizations backup their systems and servers on a periodic basis, however such backups are normally “snapshots” of information maintained for recovery purposes. As Heer and Osterman explain in their research paper, The Impact of the New FRCP Amendments on Your Business, there are three clear issues with the use of backups for record retention. First, backups are made of raw data which creates the inability to index the information for discovery at a later time. Second, older backup tapes are commonly unreadable and corrupt when maintained over a long period of time. Finally, because of the snapshot nature of backup tapes, they do not include information that is created and deleted between backups (Heer & Osterman, 2007).

Searching ESI increases the time and resources needed to adequately perform the discovery process. ESI is often difficult to search, find and obtain exactly what is needed by both parties in litigation. In a 2009 decision by Judge Andrew Peck, the “need for careful thought, quality control, testing, and cooperation with opposing counsel in designing search terms or ‘keywords’ to be used to produce emails or other electronically stored information” was emphasized (Vinson & Elkins LLP, 2009).

**INSUFFICIENT KNOWLEDGE AND APPLICATION OF CORPORATE POLICIES**

Despite a 73 percent document retention policy reported by companies, there remains lack of compliance by many employees. Policies created commonly go unnoticed or are completely disregarded by the employees required to abide by them (Diamond, 2010, June 29). This disconnect causes a gap between what an organization says it requires and how it actually operates, which is actually a riskier approach than not having a policy at all (Diamond, 2010, June 29). The inconsistent application of document retention policies raises "red flags" to regulators, and can make the company appear to have poor operations with higher risks for fraud and non-compliance (True, 2010).

**RELOCTANCE TO DESTROY DOCUMENTS**

Surveys conducted by Inside Counsel revealed that approximately 90% of employees retain documents beyond their required retention periods (Diamond, 2010, November 15). One common method in which this is done is via “underground archives,” which are files maintained by individuals to protect themselves from potential disputes (Diamond, 2011, March 21). Information and documents retained in violation of an organization’s document retention policy increases associated risks to the organization because the individuals responsible for oversight no longer have the ability to track, organize, and access the information for retention or destruction. This also increases the likelihood that the information will be maintained past its associated retention period thus becoming vulnerable to discovery.

Organizations often have a hoarding mentality, believing that one useful piece of information might be maintained to save a company or person during litigation. However, several professionals have argued that this is normally not the case. It is more probable that information maintained beyond its retention period will harm an organization more so than help it (Cisco, 2010). Given the survey results described above, this does not appear to deter employees from retaining the information.

Regardless of its form, ESI has become a type of information that organizations are loath to destroy. In an article published by Information Week, entitled “Appetite for Destruction,” Conry-Murray posits three reasons for this apprehension. First, organizations are not always confident that they are legally allowed to destroy their information. Second, companies are nervous that they will destroy relevant information that could later save them during litigation. Finally, organizations are not knowledgeable enough about their information to determine what can and cannot be destroyed (Conry-Murray, 2008). Given the reasons above, it is important to note that the apprehensions identified by Conry-Murray can be found present in most organizations and also apply to physical forms of documentation.

**REGULATORY REQUIREMENTS**

Industry and regulatory requirements usually dictate document retention policies in organizations. The plethora of regulatory federal and state agencies, in addition to professional associations which outline confusing and contradictory retention requirements for various types of information, can add to an organization’s failure to understand and comply. Further, continuously changing regulation requires organizations to stay abreast of updates and amend their operations accordingly.

The Internal Revenue Service provides guidance regarding the number of years a tax return is subject to audit and therefore should be retained. The general amount of time is three years. However, this becomes longer and sometimes indefinite when fraudulent or unfiled tax returns come into play (How Long Should, n.d.). As if the IRS’s guidance does not make it difficult enough for an organization to determine how long its records should be kept, the Sarbanes-Oxley Act of 2002 and the Securities and Exchange Commission (SEC) are two examples of a regulation and a regulatory agency which add another layer to the process. In 2002, after the infamous fall of Enron Corporation and its auditor Arthur Andersen, the Sarbanes-Oxley Act was created to protect shareholders and enforce stricter penalties for corporate scandals (Bumiller, 2002). Section 802 of the Act mandates that auditors of public companies retain all audit work papers for a minimum of five years after the end of the respective fiscal year (Sarbanes-Oxley Act, 2002). One year after enactment, the SEC released Regulation S-X, which increases the retention period of audit and review work papers from five to seven years (Final Rule: Reten-
Another aspect of regulatory requirements is the expectations of court proceedings. From a litigation standpoint, five standards of electronic discovery were created by United States District Court Judge Shira A. Scheindlin in response to Zubulake v. UBS Warburg. As part of these standards, “once a party reasonably anticipates litigation, it must suspend its routine document retention/destruction policy and put in place a ‘litigation hold’ to ensure the preservation of relevant documents” (Cogliano, 2007). Therefore, these standards stipulate that it is most important to retain documents and ESI when litigation is looming, unlike certain legislation which mandates a specific number of years. Overall, while an organization’s document retention policy will guide its business operations, it is the regulatory and industry standards that will take precedence and determine if the company is compliant and acting in good faith.

DETERMINATION

Based on the information gathered, it might be thought why not keep everything? Organizations would not need to develop a policy, worry about whether or not its employees are compliant, or stay abreast of changing regulations. However, hoarding documents and information is not the answer. Instead, it is both practical and realistic for companies of all sizes to have a document retention and destruction policy. Such policies are vital to a company, especially if litigation is likely. As part of the FRCP amendments, a “safe harbor” was put into place to protect companies who fail to provide relevant information because of the “routine, good faith operation of the party’s computer system” (Heer & Osterman, 2007). An example of routine, good faith is the development and implementation of a document retention policy. However, merely writing a policy and posting it to the company intranet site does not excuse the inability to produce information. Organizations must also be able to prove that the policy is monitored by, communicated to and complied with by its employees. In the event an organization cannot provide adequate evidence, courts can conclude that a company has not acted in good faith and is guilty of spoliation (Heer & Osterman, 2007).

BEST PRACTICES

Today’s organizations require a better way to organize and manage their information as well as efficiently respond to discovery requests while reducing the risk of non-compliance (Irvin, 2010). In order to mitigate the risks associated with inadequate preservation of documents, the implementation of a document retention policy has become an industry best practice. The following discussion identifies six common best practices and respective benefits of their implementation.

1. Identify, Classify, and Determine Applicable Retention Period. An effective document retention policy should identify all categories and types of information that must be maintained. Information found on individual laptops, email servers, removable thumb drives, printers and cell phones should be outlined and described in the policy. Retention periods should then be assigned to each category. It is imperative for the organization to gain an understanding of the regulatory and industry standards that mandate their operations and determine retention periods accordingly. It is equally important to know where the information is found and its purpose. Therefore, organizations should create detailed process maps that capture pertinent information along the way, such as the date the data was created and purpose of information (Irvin, 2010).

2. Implement A Records Management System. During litigation, the cost of discovery increases with the amount of information available to be searched (Conry-Murray, 2008). Eventually, there comes a point in time when the cost to provide and review historic documents outweighs the potential benefit gained during a lawsuit. Retaining older documents also causes the cost of storage to rise over time (Saffady, 2011). In an effort to decrease costs, improve compliance and facilitate the efficiency and effectiveness of discovery, organizations should use technology, such as an Enterprise Content Management system (ECM), to streamline the document retention process. Regardless of an organization’s size, varying ECM products and solutions are available to assist in such processes.

3. Provide On-Going Training to Personnel. According to survey results presented above, there is a gap between policy development and compliance. To remedy this, document retention training should become an on-going process that is provided periodically and monitored by upper management. Training should include the organization’s expectations of individuals as well as explanations behind the policy (e.g. regulatory requirements).

4. Collaborative Effort. While seemingly difficult at first, organizations should ensure the appropriate group of individuals is included in the development and implementation of the document retention policy and oversight process. Relevant departments will likely include Information Technology, legal and business unit leaders, but will also be unique to each organization (Hill, 2009).

5. Perform Annual Internal Audits of Compliance. Auditing compliance is one of the few ways to ensure and prove successful implementation (Smaroff, 2011). As stated by LexisNexis, “If a company’s policy is comprehensive and routinely audited, it can provide the court with assurance that a company has all of the information it is required to keep, and knows how to find it which can go a long way to protecting a corporation in the long run” (LexisNexis Discovery Series, 2007).
6. Review and Update Policy Annually. The best practice recommendations described above create a foundation for an adequately developed and implemented document retention policy; however, compliance and upkeep are ongoing processes. To ensure policies remain current with respect to business operations and required regulations, document retention policies should be reviewed and updated on an annual basis.

The increased use of technology in today’s business environment has complicated the document retention and management processes. As a result, organizations are susceptible to inefficient response to a litigation hold or discovery demand in the event of a lawsuit. Thus, organizations should proactively develop and implement a sound document retention policy. More importantly, organizations need to be able to prove to a court that its policy is adequate and complied with by all personnel. The ability to do so will ultimately protect the organization from potential monetary sanctions and adverse judicial opinions.

REFERENCES


The Effects of Paper-Packaging Material on the Quality of Latent Print Evidence

Stephanie Witt

INTRODUCTION

Fingerprints are one of the most revelatory types of forensic evidence that a crime scene may yield. The process of linking a suspect to a crime scene or to another person by the presence of his or her fingerprints is crucial during the investigation of a case. Fingerprints allow investigators to make a positive determination as to who might have touched, or come in contact with, objects found at a crime scene.

COLLECTING, PACKAGING, AND TRANSPORTING LATENT PRINT EVIDENCE

Owing to the fragile nature of latent prints, a crime scene technician must determine if latent print evidence should be processed at the crime scene, or packaged, collected, and transported to a laboratory. If the evidence is processed at the crime scene, fingerprint powder is generally used. If the evidence is transported to a laboratory, more sophisticated techniques may be employed. While the use of advanced methods may prove beneficial to the preservation of the prints, the actual collection and processing process may compromise the evidence prior to its arrival at the laboratory. For this reason, it is imperative that proper collection and packaging procedures be followed in the processing of latent print evidence.

The procedures for collecting and packaging latent print evidence vary among agencies and among individual crime scene technicians. A myriad of packaging materials are available to forensic laboratories. Types of packaging material currently in use include: paper or plastic bags, cardboard boxes, metal tins, paper or plastic envelopes. The type of packaging material used is critical as some material may compromise or destroy the latent prints more than others. Previous research suggests that plastic materials have the potential to damage latent prints, the actual collection and processing process may compromise the evidence prior to its arrival at the laboratory. For this reason, it is imperative that proper collection and packaging procedures be followed in the processing of latent print evidence.

The present research was limited in scope and design: determine if paper-packaging material affects the quality of latent prints when objects found at a crime scene are collected, packaged, and transported to a laboratory for testing or tested on scene. Latent prints were placed onto objects, and the objects were either packaged in paper bags, or remained unpackaged. Packaged objects were then transported to and from the laboratory prior to being tested. Unpackaged objects represented evidence processed at the crime scene rather than transported to the laboratory for initial testing.

A review was conducted of 18 state laboratory manuals. These 18 sources concurred as noted: 1) strict attention to processing procedures used for latent print evidence is required in order to ensure quality prints are obtained; 2) objects collected must undergo minimal handling; 3) the object's position in the packaging material must ensure latent prints are not exposed to i.e. contamination by the material; 4) exposure to the packaging material may cause friction thus damaging or destroying prints. Areas of divergence among the agencies include: 1) four state laboratory manuals specifically prohibited non-porous latent print evidence from being packaged in plastic material; 2) two manuals recommended evidence be processed at the scene rather than transported to the laboratory for initial testing.

Although manuals suggested that latent print evidence be packaged such that the surfaces of the evidence do not come in contact with the packaging material, no manual offered suggestions as to how to achieve this goal. Some research studies suggest suspending the object in a box during transportation. Issues with this approach include: cost of supplies; man-hours; practical application; and failure to follow recommended protocols.

This research was limited to testing commonplace methods currently in use to ascertain overall efficacy, reliability, and replicability. The most effective packaging method may be the simplest, a plain paper bag.

EXPERIMENTAL CONSIDERATIONS

The present research was limited in scope and design: determine if paper-packaging material affects the quality of latent prints when objects found at a crime scene are collected, packaged, and transported to a laboratory for testing or tested on scene. Latent prints were placed onto objects, and the objects were either packaged in paper bags, or remained unpackaged. Packaged objects were then transported to and from the laboratory prior to being tested. Unpackaged objects represented evidence processed at the crime scene.

Owing to the random nature of latent print evidence, a variety of donors, mediums for deposit, and ages of prints were evaluated (See Table 1).

1 The author reviewed 18 state laboratory manuals. The state agencies are as follows: California Department of Justice Bureau of Forensic Sciences, Colorado Bureau of Investigation, Connecticut Department of Public Safety Division of Scientific Services, Florida Department of Law Enforcement, Georgia Bureau of Investigation, Illinois State Police, Missouri State Highway Patrol, Montana State Crime Laboratory, New Jersey State Police, North Carolina State Bureau of Investigation, Ohio Division of State Fire Marshal Forensic Laboratory, Oregon State Police, Rhode Island State Crime Laboratory, Tennessee Bureau of Investigation, Texas Department of Public Safety, Washington State Patrol Forensic Laboratory Services Bureau, West Virginia State Police, and Virginia Department of Forensic Sciences.

2 Colorado Bureau of Investigation, New Jersey State Police, Ohio Division of State Fire Marshal Forensic Laboratory, and Virginia Department of Forensic Science.

3 Washington State Patrol Forensic Laboratory, Bureau of Investigation, and Virginia Department of Forensic Sciences.
<table>
<thead>
<tr>
<th>Experimental Design #1</th>
<th>Group</th>
<th>Medium</th>
<th>Packaged/ Not Packaged</th>
<th>Controlled/ Uncontrolled</th>
<th>Age of Prints</th>
<th>Number of Bottles</th>
<th>Number of Prints</th>
</tr>
</thead>
<tbody>
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<td>A</td>
<td>Lotion</td>
<td>Not Packaged</td>
<td>Controlled</td>
<td>8 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Lotion</td>
<td>Packaged</td>
<td>Controlled</td>
<td>8 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Lotion</td>
<td>Not Packaged</td>
<td>Uncontrolled</td>
<td>8 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
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<tr>
<td>D</td>
<td>Lotion</td>
<td>Packaged</td>
<td>Uncontrolled</td>
<td>8 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Lotion</td>
<td>Not Packaged</td>
<td>Controlled</td>
<td>14 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Lotion</td>
<td>Packaged</td>
<td>Controlled</td>
<td>14 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Lotion</td>
<td>Not Packaged</td>
<td>Uncontrolled</td>
<td>14 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
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<tr>
<td>H</td>
<td>Lotion</td>
<td>Packaged</td>
<td>Uncontrolled</td>
<td>14 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Lotion</td>
<td>Not Packaged</td>
<td>Controlled</td>
<td>21 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>Lotion</td>
<td>Packaged</td>
<td>Controlled</td>
<td>21 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Lotion</td>
<td>Not Packaged</td>
<td>Uncontrolled</td>
<td>21 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
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<tr>
<td>L</td>
<td>Lotion</td>
<td>Packaged</td>
<td>Uncontrolled</td>
<td>21 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
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<td>M</td>
<td>Lotion</td>
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<td>Controlled</td>
<td>4 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
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<td>Lotion</td>
<td>Packaged</td>
<td>Uncontrolled</td>
<td>4 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
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<tr>
<td>O</td>
<td>Lotion</td>
<td>Not Packaged</td>
<td>Controlled</td>
<td>8 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
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<tr>
<td>P</td>
<td>Lotion</td>
<td>Packaged</td>
<td>Uncontrolled</td>
<td>8 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>Q</td>
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<td>Not Packaged</td>
<td>Controlled</td>
<td>12 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
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<td>Lotion</td>
<td>Packaged</td>
<td>Uncontrolled</td>
<td>12 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>Lotion</td>
<td>Not Packaged</td>
<td>Controlled</td>
<td>4 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>T</td>
<td>Lotion</td>
<td>Packaged</td>
<td>Uncontrolled</td>
<td>4 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>U</td>
<td>Lotion</td>
<td>Not Packaged</td>
<td>Controlled</td>
<td>8 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>Lotion</td>
<td>Packaged</td>
<td>Uncontrolled</td>
<td>8 days</td>
<td>3</td>
<td>(3 donors x 5 prints each) = 15 total prints</td>
<td></td>
</tr>
</tbody>
</table>

**Total:** 330 prints

**TABLE 1:** Summary of Experimental Designs
EXPERIMENTAL DESIGN #1

The processing method consisted of an initial experimental design, followed by two additional smaller-scaled designs. Design #1 included: 12 test groups (A-L); group contained three bottles, i.e., one bottle with deposited fingerprints for each donor; not packaged, controlled; packaged, controlled; not packaged, uncontrolled; packaged uncontrolled; time scale (8-21 days); and print grooming medium (hand lotion).

EXPERIMENTAL DESIGN #2

A second experimental design was created in order to introduce differential data. Differences between design #2 and design #1 include: fewer test groups (6 instead of 12); elimination of packaged, controlled and unpackaged, uncontrolled groups; abbreviated time scale (4-12 days); and print grooming medium (ridge builder and sebaceous residue instead of hand lotion).

EXPERIMENTAL DESIGN #3

A third experimental design was developed to further test the effects of paper-packaging material on latent prints. Differences between design #3 and design #2 included: fewer test groups (4 instead of 6); abbreviated time scale (4-8 days); and print grooming medium (sebaceous residue).

MATERIALS AND METHODS

MATERIALS

- Fifty (66) ten-ounce Sauce Bottles – Specialty Bottle Company.
- Paper bags
- Evidence Tape
- Evident® Conventional Black Fingerprint Powder
- Sirchie® Fiberglass Filament Fingerprint Brush
- Bath and Body Works “Sweet Pea” Hand Lotion
- Evident® Ridge Builder

Glass bottles were chosen as test surfaces because glass is a non-porous material which is easily processed with latent print powder.

MEDIUMS FOR DEPOSITION

Owing to the large quantity of prints being deposited, a variety of techniques were used to maintain consistency among deposits. All of the experimental setups involved “grooming prints” by various means thus ensuring the print quality remained consistent at the time of their initial deposit. “Grooming prints” refers to the preparation of the donor’s fingerprints prior to the prints’ being deposited. Donor prints were groomed using three different mediums: hand lotion, Evident® Ridge Builder, and natural sebaceous residue.

PACKAGING

Bottle packaging procedures conformed with the Maryland State Police Forensic Services Division, Crime Scene Unit Standard Operating Procedures4 and the Maryland State Police – Forensic Services Division, Guidelines for Submitting Physical Evidence5 manuals. Paper bags used were the same as those used by the Maryland State Police for actual evidence collection. According to Maryland State Police Crime Scene Unit Supervisor, Kris Amspacker, these bags are purchased in bulk from various paper product manufacturers. The only requirement for the paper bags is that they be “clean and unused” (Amspacker).

CONTROLLED ENVIRONMENT

In order to examine the effects of the latent prints when placed in a controlled environment, 18 bottles, nine packaged (Groups B, F, and J) and nine unpackaged (Groups A, E, and I) were left undisturbed at the laboratory. The nine packaged bottles were placed into one box and set on a shelf in the storage room until processed. The unpackaged bottles were placed into three boxes (three bottles per box), and set on a shelf in the storage room until processed. The boxes were not sealed or closed. Aside from the movement of the items into the boxes and onto the shelf, the evidence remained unmoved or undisturbed until removed from the shelf for processing.

UNCONTROLLED ENVIRONMENT

Eighteen bottles were subjected to the same uncontrolled environment. This included placement in the trunk of a vehicle, movement from one location to another, and transportation to the laboratory.

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4 Maryland State Police – Forensic Services Division, Crime Scene Unit SOP Manual states the following: “Evidence must be put into approved container.” (§2.26.2) “The evidence must be properly sealed (Refer to Maryland State Police Guidelines for Submitting Physical Evidence).” (§2.26.3)

5 Maryland State Police – Forensic Services Division, Guidelines for Submitting Physical Evidence states the following: “The use of evidence tape with the collector’s initials across the tape and onto the container constitutes the proper sealing of evidence.” (p. 12)
PROCESSING METHOD

The processing method employed Evident® Conventional Black Fingerprint Powder, a standard black latent print powder. This product method was chosen owing to its ease of application. For each processing, the fingerprint powder was applied to the bottle with a Sirchie® Fiberglass Filament Fingerprint Brush, a standard fingerprint brush. The brush was dipped into the fingerprint powder and then brushed onto the surface of the bottle with a circular, whirling motion until the latent prints darkened. When the latent prints became visible, all excess powder was brushed from the surface. Evident® Clear Fingerprint Tape was then applied to the surface of the bottle. The tape was placed onto the surface of the bottle by covering the darkened prints with the adhesive side of the tape. Pressure was then applied to the tape in order to remove any air bubbles. The tape was then removed from the surface of the bottle and placed onto the surface of a fingerprint lift card, essentially an index card with a section on the back for recording pertinent information. This same method was used for all prints processed.

EVALUATION OF PRINTS

After all prints were processed using latent print powder, each individual print was evaluated for quality. An evaluation scale was chosen, to provide a proper range of values and a standard. Due to the researcher’s lack of expertise, a scale that evaluated the physical characteristics of the prints, rather than their quality, was needed for comparison purposes. The evaluation did not take into account the prints’ suitability for comparison. The evaluation scale was adapted from a journal article by Helen L. Bandle, entitled “The Powders Process, Study 1: Evaluation of Fingerprint Brushes for Use with Aluminum Powder,” originally published in The Fingerprint Development and Imaging Newsletter, May 2004 edition by the (United Kingdom) Home Police Scientific Development Branch and is shown in Figure 1. Examples of ratings 1-4 are illustrated in Figures 2 through 5.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>no development</td>
</tr>
<tr>
<td>1</td>
<td>no continuous ridges. All discontinuous or dotty</td>
</tr>
<tr>
<td>2</td>
<td>1/3 of mark continuous ridges. (Rest no development, dotty, smudge or infill)</td>
</tr>
<tr>
<td>3</td>
<td>2/3 or mark continuous ridges. (Rest no development, dotty, smudge or infill)</td>
</tr>
<tr>
<td>4</td>
<td>full development. Whole mark continuous ridges</td>
</tr>
</tbody>
</table>

Prints were given a rating of zero when there was absolutely no ridge detail developed or was recoverable.

DISCUSSION

The inherently random nature of latent prints poses a challenge for the researcher. In order to obtain sufficient and reliable results, it was necessary to consider a number of variables, which in turn had to be controlled so as not to influence or alter the results.

The present research was conducted using three mediums for depositing prints. The results of these prints can only be compared to other prints that were deposited in the same manner. Lotion, Evident® Ridge Builder, and sebaceous residue were all used as depositing mediums, and all yielded distinct results.

In addition to the variable mediums used, the research also relied on a wide range of donors. The use of multiple donors permitted a more realistic representation of the general population, since no two individuals deposit prints in the same way. This approach required careful controlling and monitoring because each donor secretes different amounts of oil. Therefore, the quality of deposited prints varies from one individual to the next. This is an important issue to consider as comparison between or among individuals might not be possible.
Another important variable that requires further scrutiny is the age of the prints. Several different ages of prints were evaluated throughout this study. Prints tend to degrade as they age, therefore; only prints of the same age can be successfully and reliably compared with one another in order to reach the most accurate conclusion.

RESULTS

EXPERIMENT #1

DONOR 1

There are few reliable conclusions that can be made from the prints deposited by Donor 1 because the lotion adversely affected the prints’ quality from the initial deposit onward. The lotion caused the bottle to slip within the donor’s hand, thereby leaving poor quality prints at the onset. This occurred on several occasions; however; it did not occur every time. As a result, definitive findings from this data set were not possible.

Regardless of the problems posed from the analysis of this variable, there is some indication that packaging does have an effect on print quality. Observations of and comparison between the unpackaged, controlled groups (Groups A, E, and I) with the packaged, uncontrolled groups (Groups D, H, and L) revealed anomalies when comparing eight-day-old prints and 21-day old prints to other prints of the same respective ages.

Additionally, when comparing the packaged, controlled prints (Groups B, F, and J) to the packaged, uncontrolled prints (Groups D, H, and L), the results do support the contention that a controlled environment is better suited for maintaining print quality than an uncontrolled environment. This is a reasonable conclusion, as the bottles in Groups B, F, and J were not subjected to excessive movement, handling and transport, as opposed to the bottles in Groups D, H, and L which were subjected to such conditions. It would be expected that the additional transportation and movement experienced by Groups D, H, and L would increase damage when compared to Groups B, F, and I.

DONOR 2

Donor 2’s prints were very difficult to compare to one another. The use of the lotion, coupled with the high level of perspiration from the donor, had adverse effects on the quality of the resultant prints. The quality of prints proved inconsistent and irregular, thereby precluding meaningful analysis.

One issue raised when analyzing this data set is: When comparing the results of the unpackaged, controlled groups (Groups A, E, and I) with the packaged, controlled groups (Groups B, F, and J), there is an indication that the packaged groups yielded prints of slightly lesser quality than those in the unpackaged groups. Even though the examination of these data sets supports this assertion, no valid conclusions could be made due to Donor 2’s print issues. Although no definitive conclusions were made, the results did illustrate that print quality differs from one individual to the next based on organic variations.

DONOR 3

Of the three donors who participated in this study, Donor 3’s prints yielded the highest quality prints due to less smudging. Therefore, Donor 3’s prints provided results that were more accurate than any others in this study for the purpose of comparing prints from the various groups. While most of the prints were of good to decent quality more deterioration was visible in the packaged, uncontrolled groups (Groups D, H, and L) than in the unpackaged, uncontrolled groups (Groups C, G, and K). This set of data suggests that packaging material is capable of damaging prints to a degree; however, it does obliterate the prints thereby rendering them valueless. The prints recovered from the packaged, uncontrolled groups yielded prints with ratings of 3 and 4.

These data also suggest those bottles packaged and left in a controlled environment experienced less deterioration than those packaged and subjected to an uncontrolled environment. Thus, these data support the observations made for the prints from the Donor 1 group. Transportation and movement will exacerbate damage caused by the packaging material. These data indicate that if bottles are packaged, they should be subjected to minimal movement.

EXPERIMENT #2 – EVIDENT® RIDGE BUILDER

The second experiment used Evident® Ridge Builder as the depositing medium for Donors 1 and 2 and sebaceous residue for Donor 3. This experiment differed from Experiment #1 in that the packaged, controlled and unpackaged, uncontrolled groups were eliminated.

The test prints were included to demonstrate successfully developed prints during initial processing. All donors deposited quality prints. However, the poor quality prints over time showed that Evident® Ridge Builder is not an effective depositing medium. Within a short time span of as four days, it was evident that the prints recovered were either of very poor quality (resulting in a rating of 1 for Donor 2) or were not recovered at all (Donor 1).

While no valid conclusions can be drawn based on these data, it should be noted that Evident® Ridge Builder is not effective as a depositing medium. It is apparent from the research conducted that the ingredients contained in the Evident® Ridge Builder product cause fingerprints to degrade quickly. It is possible that the Evident® Ridge Builder evaporates shortly after depositing, thus leaving little or no fingerprint. This is a topic that is beyond the scope of the present study, but should be researched further.
EXPERIMENT #2 - SEBACEOUS OIL

Experiment #2 included the use of sebaceous oil as a depositing medium by Donor 3. Sebaceous residue was obtained by the donor wiping his/her fingertips across their face and hair prior to each deposit. The test results demonstrate that paper-packaging material does not have any noticeable effect on the quality of the prints. There is no indication from this set of data that print quality is affected by either the passage of time or from the use of paper packaging material.

EXPERIMENT #3

The last of the three experiment setups follows the same guidelines as those used for Experiment #2 with the exception of sebaceous residue used as the sole depositing medium. The other difference between these two experiments is that Experiment #3 only included prints that were four days old and eight days old. This setup provided the most consistent results of the three experiment designs.

DONOR 1

The quality of prints deposited by Donor 1 indicates that packaging material may in fact cause damage to the prints. The results did highlight adverse effects caused by the packaging material. A definitive conclusion cannot realistically be drawn from this set of data since other variables (not known or visible to the present researcher) could have been present thus influencing the results.

DONOR 2

As is the case with the results from Donor 1, the results from Donor 2 indicate that the paper-packaging material has the potential to cause damage to latent prints. Again, the results could be attributable to other variables typically present in this type of research.

DONOR 3

Donor 3’s prints gave the best results insofar as determining whether paper-packaging material adversely affects the quality of prints. This set of results clearly demonstrates that the packaging material can cause damage to the quality of latent prints. However, the results are not significant enough to arrive at a concrete conclusion that paper-packaging material will damage prints to the point of their having no evidentiary value. Even the damaged prints were of good to decent quality, with ratings of 2 and 3. More in-depth testing would need to be conducted in order to further understand the potential effects of paper-packaging material on the quality of latent prints.

CONCLUSION

As with all latent print experiments, the present research was difficult to conduct in a manner that would ameliorate the introduction of any external variables. While the majority of results point to the potential for paper-packaging material to have adverse effects on the quality of latent prints, the research is ultimately inconclusive. Research findings indicate: paper-packaging material does not render prints unusable or valueless; onsite processing is preferable to off-site processing; and if packaged, the item should be subjected to as little movement as possible. The results suggest that transportation and movement contribute to print damage. Additional research should be conducted, to identify other variables with the potential to compromise latent print recovery at the crime scene.

REFERENCES

MSD-FSD Crime Scene Unit SOP Manual (2011, March)(Section 2, Revision 9 ed.).

STATE LABORATORY MANUALS SURVEYED

1. California Department of Justice Bureau of Forensic Sciences
2. Colorado Bureau of Investigation
3. Connecticut Department of Public Safety, Division of Scientific Services
4. Florida Department of Law Enforcement
5. Georgia Bureau of Investigation, Division of Forensic Science
6. Illinois State Police
7. Missouri State Highway Patrol Crime Laboratory
8. Montana State Crime Lab
9. New Jersey State Police, Special and Technical Services Section
10. North Carolina State Bureau of Investigation
11. Ohio Division of State Fire Marshal Forensic Laboratory
12. Oregon State Police
13. Rhode Island State Crime Laboratory
14. Tennessee Bureau of Investigation
15. Texas Department of Public Safety
16. Washington State Patrol Forensic Laboratory Services Bureau
17. West Virginia State Police
18. Virginia Department of Forensic Science
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