STUDENT CAPSTONE PRESENTATION PROGRAM

SATURDAY, APRIL 9TH, 2022

FORENSIC SCIENCE PROGRAM

ITINERARY & CONTENTS

8:30 AM   **REGISTRATION & COFFEE**
Room KN108, Kaneff Building/Innovation Complex
(next door to the Second Cup café)

9:00 AM   **OPENING REMARKS**
Matthews Auditorium, Room KN137
Kaneff Building

DR. TRACY ROGERS
Director, Forensic Science Program
Department of Anthropology, University of Toronto
Mississauga

9:10 AM   **WELCOMING STATEMENT**

DR. ALEXANDRA GILLESPIE
VP & Principal, University of Toronto Mississauga

UNIVERSITY OF
TORONTO
MISSISSAUGA

**FORENSIC SCIENCE
PROGRAM**

9:20 AM STUDENT INTERNSHIP PRESENTATIONS
SESSION CHAIR: SHELBY SCOTT
PhD Candidate, Department of Anthropology, University of Toronto

9:20 AM **EVENGELINE STRICKLAND** 12
Early intervention, accessibility, and awareness of palliative care resources for crime prevention

9:30 AM **TYAIBAH BISWAS** 13
Systemic issues and the senior resident-on-resident homicide rate in Ontario long-term care homes from 2010-2019

9:40 AM **KATHRYN BEAUDOIN** 14
Understanding the relationship between substance use, child welfare, toxicology and suicidal ideation

9:50 AM **TAYLOR CORBETT** 15
Occult vs. apparent head trauma in infants: a ten-year review

10:00 AM **TASNIM ISLAM** 16
Ethical and Humanitarian Considerations of Implementing a DNA databank

10:10 AM **CYNTHIA STEPHEN** 17
Human remains detection dogs' ability to detect human remains in open water environments

10:20 AM **MAYA COMEAU** 18
Age and autofluorescence of bone

10:30 AM **HO WYLIE LAM** 19
Influence of sex on estimating adult age with radiographs of the proximal femur

THE 26TH ANNUAL FORENSIC SCIENCE DAY

12:30 PM **SHIAN VALLES** 30
Distortion in Bureau Voor Dactyloscopische Artikelen gel-lifted footwear impressions

12:40 PM **LUNCH BREAK**
A 50 minute recess at the Blind Duck Pub, UTM Student Centre.

1:30 PM **POSTER SESSION**
30 minutes in the Kaneff Building.

2:00 PM **VIRGINIA CHIU** 33
Does the Phadebas press test dilute samples and affect DNA yield?

2:10 PM **HOLLY REAUME** 34
Effect of fabric pre-treatments on DNA recovery from blood-stained textiles

2:20 PM **VANESSA LITTLE** 35
Evaluation of three manual extraction methods for performance, accuracy, and reliability in forensic genetics

2:30 PM **NELLA VEKIC** 36
Forensic significance of two novel psychoactive benzodiazepines

2:40 PM **TAYLOR HUGHES** 37
Substance use disorder and the effect on psychotic disorder diagnoses and symptoms

2:50 PM **YASHIKA SHROFF** 38
Motivational influences and trajectories in the context of major mental illness

3:00 PM **COFFEE BREAK**
Brief intermission, presentations resume at 3:15 AM

FSC483H5 COLLABORATIVE RESEARCH INTERNSHIP
POSTER PRESENTATIONS

FORENSIC SCIENCE AT THE UNIVERSITY OF TORONTO MISSISSAUGA

The UTM Forensic Science Program attracts some of the brightest students from across the country and the world to take part in our unique educational experience. Due to the interdisciplinary nature of forensic science, our students acquire knowledge and skills in scientific fields such as anthropology, biology, chemistry, and psychology, and apply it to the legal system. Forensic theory and foundational knowledge are paired with practical lab experience, seminars, or tutorials that tackle current events and recent debates in the field. Experiential opportunities inspire students to translate their academic training into real world applications. The Forensic Science Program provides students with the tools to be ethical, accurate, and trusted scientists in the forensic profession, as well as to contribute in meaningful ways to the safety and improvement of their local community.

The Forensic Science Program has established important ties with forensic science institutions worldwide. Such institutions provide students with research and work experience, valuable tools that not only emphasize the learning experience but also help students develop their curriculum vitae during their undergraduate career. Our courses are taught by professionals who bring their expertise and unique field experience to the classroom.

Setting the standard for all subsequent Canadian forensic programs that flourished in the wake of the CSI phenomenon, our vision for the future is to continue our pioneering role in this country and to extend our influence abroad.

Today, we celebrate the hard work and success of our specialist degree students.

INTERNSHIP IN FORENSIC SCIENCE AND THE IMPORTANCE OF MENTORS

All graduates of the Forensic Science Specialist Programs at UTM are required to complete a capstone experience that applies their acquired skills and knowledge, preparing each student for the next step in their own unique career pathway.

In addition to spending approximately 200 hours working on their internships, students in 481 participate in on-the-job training or job shadowing, assist with routine tasks, and collaborate with a professional forensic specialist on an original research project. Students in 483 gain a similar set of skills, while undertaking a collaborative research project with faculty at UTM. Experiential learning, combined with a first class science degree, is the keystone of the UTM Forensic Science Program. Successful internships benefit the student, the mentor, and the agency through an exchange of ideas, learning opportunities, and resources dedicated to addressing a research problem or question of interest to the forensic agency and its employees. Forensic Science Day is the culmination of these partnerships.

The guidance of our mentors contribute to the growth of our students' professional skills, in combination with in-class experiences such as: the submission process of ethics approval, job interview training, CV development, and a mock trial based on their research. Many of these students and their mentors present and/or publish their research at conferences and in peer-reviewed journals.

It is our pleasure today to thank the mentors and to praise the initiative and efforts of these exemplary students.

FSC481Y5

INTERNSHIP IN FORENSIC SCIENCE

SESSION CHAIR: SHELBY SCOTT

PhD Candidate, Department of Anthropology
University of Toronto

EVENGELINE STRICKLAND

Early intervention, accessibility, and awareness of palliative care resources for crime prevention

ABSTRACT

Purpose: The purpose of this research is to determine awareness of palliative resources and address the relationship between illness and stress through online surveys and a case study of palliative patients. This research is significant as recommendations can be made to improve the health literacy of Ontarians. **Background**: Palliative care supports patients and informal caregivers (families) experiencing life-limiting illnesses. Early intervention is most effective to limit caregiver burden. Frustration, anger, and stress have been independently linked to illness and familial violence. Canadian research has not assessed the relationship between informal caregiver stressors and patient quality of life. **Methodology**: Two online surveys were distributed, assessing demographics and palliative knowledge, for the public and healthcare workers (n=159). A case study of palliative patients (n=56) was used to assess informal caregiver stress. Descriptive statistics, Chi-square, and Fisher's Exact tests addressed potential relationships between these variables. **Results**: Over 85% of public participants (n=130) could not identify the organization that provides palliative care in Ontario and 91% of healthcare workers (n=23) could not identify the average cost of palliative resources. A Fisher's Exact test revealed a statistically significant relationship between minority status and palliative knowledge (P=0.00). Chi-square tests revealed statistically significant relationships between palliative knowledge, age (χ^2=30.89, P=0.04), and region (χ^2=16.48, P=0.01). **Conclusion**: There are gaps in the knowledge about palliative care resources in Ontario by region, age group, and minority status.

Keywords: forensic science, accessibility, crime prevention, health literacy, informal caregiver, life-limiting illness, palliative care

Supervisor: Liana Goodfellow-Newby, RN BScN PCC, Home and Community Care Support Services.

TYAIBAH BISWAS

Systemic issues and the senior resident-on-resident homicide rate in Ontario long-term care homes from 2010-2019

ABSTRACT

Purpose: This study aims to determine if the potential rise of senior resident-on-resident (RR) homicides in Ontario long-term care homes (LTCs) is influenced by systemic LTC issues using secondary data collected from the Coroner's Information System (CIS) database. This study is significant as it suggests whether sudden and unexpected LTC deaths should be more frequently considered under the context of systemic harm during death investigations. **Background:** Geriatric research suggests that LTC systemic issues have impacted the quality of care provided to cognitively impaired senior LTC residents, resulting in a potential increase of RR homicides. Retrospective studies specific to Ontario, however, have not been conducted to assess the validity of such data. **Methodology**: Welch's t-tests assessed if the frequency of senior RR homicides increased relative to non-RR homicides from 2010-2019. Associations between systemic issues (overcrowding, aggression, and lack of staff supervision) and the RR homicide rate was assessed based on the frequency of witnessed and unwitnessed homicides in private and communal spaces, involving residents with and without dementia. **Result**: Welch's t-test was not statistically significant for increases in the RR homicide rate relative to the non-RR homicide rate (p-value=0.99). Chi-square and odds-ratio tests found statistically significant associations between degree of overcrowding and aggression and the RR homicide rate (p-value<0.05, OR=8.09). **Conclusion**: Systemic issues like overcrowding and aggression were strongly associated with the RR homicide rate, suggesting that future death investigations may require further consideration of the impact of systemic issues on senior RR homicides in Ontario LTCs.

Keywords: forensic pathology, long-term care homes, Ontario, resident-on-resident, senior homicides, systemic issues

Supervisor: Linda Kocovski, Forensic Pathologist, Ontario Forensic Pathology Service

KATHRYN BEAUDOIN

Understanding the relationship between substance use, child welfare, toxicology and suicidal ideation

ABSTRACT

Purpose: The purpose of this research is to determine the relationship between substance use, child welfare involvement and toxicology in individuals between the ages of 10-18 who have died by suicide. **Background**: Many variables have been determined as risk predictors for suicide in youths, however, much of the data is obtained from surveys and medical records of living individuals and there is a lack of data collected from individuals who completed suicide. **Methodology**: This research includes secondary data that was initially collected by researcher Jasmin Orr from coroner's case files and post-mortem records that were compiled into an excel sheet. In the same excel spreadsheet, the results of 97 toxicology reports were compiled and included all definitive results including trace amounts of substances. The substances found were then categorized as stimulants, depressants, antihistamines or other to simplify the data for statistical analysis. The coded results were then uploaded into R-studio to perform statistical analyses. **Result**: In initial observable patterns, the most commonly found substances were depressants and antihistamines and 65% of the toxicology reports reported substances found. **Conclusion**: As results are still pending, no conclusions can be drawn based on the available data.

Keywords: forensic science, forensic pathology, adolescent, child welfare, overdose, risk assessment, substance use, suicidal ideation, suicide attempt, suicide prevention, toxicology, youth

Supervisors: Dr. Christopher Ball, Forensic Pathologist, Ontario Forensic Pathology Services; Dr. Julie Erbland, Team Lead of Child and Youth Death Review and Analysis (CYDRA), Office of the Chief Coroner; Jenna Parsons, Research and Data Analyst for Child and Youth Death Review and Analysis (CYDRA), Office of the Chief Coroner; Diana Helmy, Program Analyst for Child and Youth Death Review and Analysis (CYDRA), Office of the Chief Coroner.

TAYLOR CORBETT

Occult vs. apparent head trauma in infants: a ten-year review

ABSTRACT

Purpose: To determine factors that may contribute to infant cause of death in cases of occult head trauma, through a review of post-mortem reports. This research aims to establish a tool for forensic pathologists to aid in the recognition of occult head trauma during death investigation. **Background**: Head trauma is the leading cause of death in children under two, but the ability to identify trauma is difficult, causing the manner/cause of death to be undetermined. Determining common variables associated with cases of infant death may improve occult head trauma identification. **Methodology**: 634 cases from 2010-2019 were evaluated indications of head trauma in infants aged 0-12 months. The cases of apparent (n=36) and occult (n=13) head trauma were assessed for unsafe sleep environment, family size, sex of caregiver, and presence of retinal hemorrhages. Chi-squared and odds ratio testing were used applied to determine the relation of these variables to cause of death. **Results**: The results demonstrated no statistical significance between variables. The presence of a retinal hemorrhage, however, was shown to be approximately 53% in occult head trauma, compared to 74% in apparent. Unsafe sleep environment (n=6) was seen in all cases of occult, but only 67% in apparent head trauma. **Conclusion**: The results indicated no relationship between the variables and cause of death in occult head trauma. Differences in frequency in retinal hemorrhage and unsafe sleep environment may warrant future investigation to understand their role in occult head trauma in infants.

Keywords: forensic pathology, pediatric forensic pathology, infant death investigation, occult head trauma, apparent head trauma, traumatic brain injury, head trauma, cause of death

Supervisor: Dr. Christopher Ball, Forensic Pathologist, MBBS, MScEng, FRCPC, Ontario Forensic Pathology Service (OFPS)

TASNIM ISLAM

Ethical and Humanitarian Considerations of Implementing a DNA databank

ABSTRACT

Purpose: The purpose of this research is to examine advantages and disadvantages of a formalized DNA bank from autopsied decedents at the OFPS for perpetrator confirmation in cold cases, identification of unidentified human remains (UHR), and specifications in genetic causes of death. The addition of a DNA bank provides direct access to decedent DNA. **Background**: The Christine Jessop case closed using Investigative Genetic Genealogy and unexpected sample retention of a deceased suspect. This emphasized DNA banking for advancing the identification of deceased perpetrators. **Methodology**: A literature review was done on ethical topics concerning DNA banking: access to a DNA source, confidentiality, consent, and quality assurance. The use of DNA in solving UHR cases and identifying deceased perpetrators in cold cases was examined alongside trends in DNA panels. Data analysis included descriptive statistics and independence testing using PAST for the UHR dataset. **Results**: Limited research regarding banking samples from decedents were found. All Toronto's cold cases were solved using DNA and the ratio of perpetrators alive vs deceased is ~50:50. 21 UHR cases were solved exclusively with DNA. The number of genes tested in genetic panels has increased. **Conclusion**: The DNA bank would bypass various legal issues due to its characteristics. Although DNA is not the primary method for solving Ontario's UHR, some cases would remain unsolved without it. Genetic panels have advanced over time. DNA is a strong source of information for genetic and UHR cases, and contributes to cold cases.

Keywords: forensic science, forensic pathology, cold cases, DNA banking, ethics, molecular autopsy, unidentified human remains

Supervisor: Amber Manocchio, Ontario Forensic Pathology Service

CYNTHIA STEPHEN

Human remains detection dogs' ability to detect human remains in open water environments

ABSTRACT

Purpose: This project determines if experience affects human remains detection (HRD) dogs' ability to detect human remains in water by performing a shoreline and dock search using human tissue samples submerged at various depths. This provides more information on the accuracy of HRD dogs to detect human tissue in water environments and provides insight into developing enhanced training aids. **Background**: When locating a body underwater there are a lack of indicators, thus HRD dogs and their enhanced sense of smell are highly beneficial. **Methodology**: Three samples of human tissue were wrapped in gauze and placed within individual ABS pipe containers. The samples were deposited at 15cm, 30cm, and 90cm along the trail of a privately owned lake. Six dogs were run consecutively, off leash, along the trail and told to search. Each dog was timed from a starting location and the time was noted upon indication at each sample. **Result**: Fisher's exact test results indicate that more experienced HRD dogs do not perform better than less experienced HRD dogs ($p=0.4$, $\alpha=0.05$). In addition Fisher's exact tests comparing cross trained and single purpose dogs, and dogs with and without previous water training were run and found that the dogs do not perform any differently ($p=1.0$ and $p=0.1$ respectively $\alpha=0.05$). **Conclusion**: The dogs' ability to detect smaller samples of human remains may allow more police departments with canine units to obtain real human training aids.

Keywords: forensic science, forensic anthropology, canine water search, human remains, human remains detection dogs, underwater decomposition

Supervisor: Mike McGuigan, Sergeant, York Regional Police Canine Unit

MAYA COMEAU

Age and autofluorescence of bone

ABSTRACT

Purpose: The purpose of this research is to assess if age influences the autofluorescence of bone by analyzing images produced by the Carl Zeiss laser scanning microscope 800 (LSCM) and analyzing the images with Zeiss Zen 3.5 Blue. This research aims to determine whether there is a possibility of using LSCM to detect autofluorescence for skeletal age estimation. This research is significant as there is currently a lack of age estimation methodology for fragmented and dismembered skeletal remains. **Background**: Bones have a natural fluorescence known as autofluorescence. As we age the composition and structure of bone changes, including a decrease in collagen and bone resorption. **Methodology**: 10 iliac bone biopsy samples collected from individuals aged 30-57 years were imaged using the LSCM, with lasers at AF405 nm, AF488 nm, and AF555 nm wavelengths. Grey scaled images were imported into Zen and converted into the chosen red (555 nm), green (488 nm), and blue (405 nm) pixeled images. For all images, impurities were removed and then analyzed scoring each pixel on an intensity threshold from 4 to 255. The mean intensity for each wavelength was analyzed. **Results**: Pearson correlation test showed a very weak negative correlation between age and autofluorescence of bone with AF488 nm (r=-0.16, p=0.65), and very weak positive correlation for AF555 nm (r=0.10, p=0.78) and AF405 nm (r=0.17, p=0.64). **Conclusion**: Based on the limited sample size and weak correlation, future examination should include a broader age range and sample size.

Keywords: forensic science, forensic anthropology, autofluorescence of bone, skeletal age estimation, laser scanning confocal microscopy

Supervisors: Ashley C. Smith, M.Sc. University of Toronto Doctoral Candidate

HO WYLIE LAM

Influence of sex on estimating adult age with radiographs of the proximal femur

ABSTRACT

Purpose: This research introduces sex as a variable to Kim & Rogers' age estimation method of the proximal femur to determine if sex affects the method's accuracy rates. The technique should be revised if a bias exists. **Background**: Current existing methods of age estimation using radiographs of the proximal femur have a low accuracy rate. Furthermore, the resulting age range is too large for court purposes. Sex is expected to influence methods using the trabecular bone due to differences in the changes in hormonal levels as individuals age. **Methodology**: 50 males and 50 females were chosen from the UTM collection. 10 of each sex were randomly chosen for intra-observer analysis. 40 samples from Kim and Rogers' research were used for inter-observer analysis. **Result**: Quadratic Weighted Kappa (k) showed a weak level of inter-observer agreement for Kim & Rogers (k= 0.54). Males have a higher level of agreement than female samples (0.64 > 0.43). The intra-observer agreement of this study is high (k = 0.97). This level of agreement is shared between the sexes (k = 0.97). Significant differences between scorings of each sex were observed for individuals aged 20-59 years old. However, there is no significant difference between the sexes for individuals aged 60 – 90+ years old. **Conclusion**: With a low inter-observer agreement and a high intra-observer agreement, the description of the scoring criteria requires modification.

Keywords: forensic science, forensic anthropology, age estimation, sex, radiographs, proximal femur, trabecular bone

Supervisors: Jong In (J.I) Kim, H.B.Sc., M.Sc. Graduate Student. Dr. Tracy Rogers, PhD.

MICHAL BLECHMAN

Ancestry assessment using the proximal femur

ABSTRACT

Purpose: The purpose of this research is to assess ancestry for Japanese populations from the proximal femur using the platymeric index (PI) and the vertical head diameter (VHD). Three-dimensional models were used to develop ancestry assessment methods for diverse populations. The significance of this research is that it may verify that the PI and VHD can be used to assess the ancestry of an increasing Japanese population in Canada and can create an innovative methodology to collect data using three-dimensional models**. Background**: Forensic anthropologists must make connections between skeletal morphology and an individual's ancestral geographic region. The femur has specific measurements, PI and VHD, that are used to estimate ancestry, as these measurements can show variation between populations. **Methodology**: 64 three-dimensional adult human femora (32 European-Americans, 32 Japanese) were collected from the Nagasaki School of Medicine's modern anatomical collection and the William M. Bass Donated Skeletal Collection. Three-dimensional femora models were placed into Autodesk 3ds Max to retrieve measurements for the VHD and PI, which include the subtrochanteric anteroposterior diameter and the subtrochanteric mediolateral diameter. **Result**: The data appear normally distributed, and exhibit no significant difference following an unpaired t-test ($p > 0.05$). The discriminant function analysis has an accuracy of 48.4% and cross-validation of 45.3%. **Conclusion**: Ancestry assessment for Japanese individuals cannot be assessed from the PI and VHD with an accuracy over 80%.

Keywords: forensic science, forensic anthropology, ancestry, femora, Japanese, three-dimensional models

Supervisor: Alexandra Saly, PhD Candidate, Department of Anthropology, University of Toronto

COFFEE BREAK

Brief intermission, presentations resume at 11:10 AM

ZAHEER KHAN

The use of the stain width variance to distinguish cast-off and impact bloodstain patterns: A preliminary study

ABSTRACT

Purpose: The purpose of this research is to determine whether the variance in the stain widths between cast-off and impact bloodstain patterns are different. The significance of this is to build a foundation for the development of an objective pattern classification method in bloodstain pattern analysis (BPA). **Background**: It has been observed that cast-off patterns have relatively consistent stain sizes within the pattern, while impact pattern stain sizes are more variable, based on the way each pattern is created. Experiments in this research were performed to explore these claims. **Methodology**: Five cast-off and five impact patterns (n=10) were deposited onto foam core boards. Then, a 15cm x 15cm box was traced on each board to sample ellipse-shaped bloodstains. These traced regions on each board were photographed and uploaded to Adobe Photoshop, where the widths of the bloodstains were measured. **Results**: The variance in stain widths of cast-off and impact patterns were compared using statistics. **Conclusion**: There continues to be a need in BPA for the development of objective classification methods based on pattern characteristics.

Keywords: forensic science, forensic identification, bloodstain pattern analysis, bloodstain pattern classification, crime scene investigation, cast-off pattern, impact-pattern

Supervisors: Detective Robert Hofstetter, Peel Regional Police; Detective Clayton Asano, Peel Regional Police

VERONIKA VARECHOVSKA

Using alternate light sources to distinguish fly artifacts from bloodstains

ABSTRACT

Purpose: The purpose of this research is to examine fly artifacts from blood-fed flies, using alternate light sources (ALS) ranging from 350 to 850 nanometers, in order to distinguish them from bloodstains, as a way of aiding bloodstain pattern analysts at crime scenes. This research is significant, as it will offer an efficient way of distinguishing fly artifacts while utilizing equipment already available to investigative services. **Background**: When flies consume human blood, it is present in their digestive products and cannot be distinguished from bloodstains using traditional presumptive and chemical tests. Past research has focused on manual observation to distinguish the two, which can be time-consuming. **Methodology**: 300 *Lucilia sericata* flies were reared on human blood, sugar, and water. A sample of 125 defecate and 125 regurgitate artifacts, >1mm (n=250) were analyzed with 14 wavelengths of ALS and three colour filters (orange, red, yellow). Fluorescence was scored on a scale, from no fluorescence to full fluorescence, and compared to a positive control of non-blood-fed fly artifacts. **Results**: Chi-square test of independence showed that there was a statistically significant difference between the fluorescence of the positive control and the sample, with the sample fluorescing only 40% of the time compared to 99%. Fluorescence in both groups was noted only between 350-555 nm, with orange and red filters. **Conclusion**: While ALS cannot solely distinguish blood-fed fly artifacts from bloodstains, it can be used to reduce the number of artifacts that may need manual observation.

Keywords: forensic science, forensic identification, alternate light source, defecate, fluorescence, fly artifacts, *Lucilia sericata*, regurgitate

Supervisors: Clayton Asano, Detective Constable, Peel Regional Police; Robert Hofstetter, Detective, Peel Regional Police

VICTORIA BAKKER

The interferences of crime scene clean up on blood detection with Leucocrystal Violet

ABSTRACT

Purpose: The purpose of this research was to investigate the reactivity of Leucocrystal Violet (LCV) in the presence of various household cleaners through clean up scenarios. **Background**: To conceal valuable blood evidence, perpetrators occasionally make clean-up attempts resulting in interferences with blood detection. LCV is a blood reagent that produces a blue colour change in the presence of blood. Compared to reagents such as luminol and BlueStar that produce chemiluminescence, LCV is easy to photograph. Research regarding interfering substances with LCV is minimal. Awareness of interfering substances is required to make accurate conclusions at crime scenes. **Methodology**: 10 cleaners were tested in two clean up scenarios. In the blood clean up condition, 50µL of sheep's blood was cleaned from a ceramic tile. In the regular clean up condition, only the cleaner was deposited onto the tile. Cleaners that caused a false positive with LCV were allowed to rest for 60 minutes and 48 hours to negate interferences. **Result**: Cleaners containing bleach induced a false positive reaction that persisted despite a 60min and 48h rest period. Cleaners containing strong oxidizing agents removed blood and produced a presumptive negative. When used to remove blood, some cleaners caused interferences in the LCV colour reaction, resulting in pink and green colour changes. **Conclusion**: Cleaners that are readily available can interfere with LCV and hinder accurate blood detection. Interferants causing deviation in the LCV colour change may be used as indicators of a blood clean up attempt.

Keywords: forensic science, forensic identification, chemical blood detection , Leucocrystal Violet, LCV, cleaning, false positive.

Supervisor: Leslie Wyard, Detective Constable, Expert in Blood Pattern Analysis, Toronto Police Services: Forensic Identification Services.

EMILY SANTOS

AccuTrans as an effective technique for the recovery of bloody fingerprints from human skin

ABSTRACT

Purpose: This research aims to evaluate if AccuTrans can recover bloody fingerprints from human skin, and if Hungarian Red increases visibility of the fingerprint cast. Bloody fingerprints on a victim's body provide insight on events, roles and links between the suspect and the victim. This research can help develop a safe, non-intrusive method of collection. **Background**: Direct chemical enhancement is problematic for living survivors as several techniques have toxic effects. AccuTrans is a non-toxic putty material composed of polyvinylsiloxane and a hardening substance, commonly used to collect trace evidence and recover tool mark impressions. **Methodology**: Using 20 living and 5 deceased participants, 3 different bloody fingerprints were deposited per subject. 10µl of blood was spread around the finger for 5 seconds, dried for 10-15 seconds and deposited. Sufficient fingerprints were dried for 10 minutes then AccuTrans was applied, and allowed to set for 5 minutes. The cast was photographed, sprayed with Hungarian Red and re-photographed. The Bandey scale scored the fingerprints and a quality scale scored the quality of the fingerprint casts. **Result**: AccuTrans recovered > 80% friction ridge detail in 64% of cases. Chi-square analysis showed Hungarian Red does not significantly increase ridge detail visibility (x^2=0.33, d.f=1, p=0.57). Fisher's exact results showed better quality casts were recovered from living subjects (p=0.27). **Conclusion**: AccuTrans can be used to safely recover bloody fingerprints from human skin and Hungarian Red shows no difference in detail visibility.

Keywords: forensic science, forensic identification, AccuTrans, bloodstain pattern analysis, casting technique, crime scene investigation, enhancement, fingerprint impression

Supervisor: Irv Albrecht, Detective Constable, Forensic Identification Services, Toronto Police.

JUSTIN KHAN

Determining an effective technique for latent fingerprint development on red money packets

ABSTRACT

Purpose: The purpose of this research is to determine an effective technique for developing latent fingerprints on red money packets. This research is significant because it will lead to better development and visualization of latent fingerprints on red money packets in order for them to be submitted as evidence in court. **Background**: Red money packets are a high-volume evidentiary item during the holidays. They are commonly involved with money theft crimes and are a difficult surface to develop fingerprints on due to their colour and semi-porous surface. There is currently no published research on the development of latent fingerprints on red money packets. **Methodology**: A total of 120 fingerprints were deposited on 24 red money packets and 150 photographed fingerprints were scored as admissible or inadmissible (n=150). After 24 hours, 60 of the fingerprints were processed using the four proposed techniques and were photographed using a DSLR camera. After 1 week, the other 60 fingerprints were processed using the same four techniques and were photographed as well. **Result**: Scoring of the fingerprints shows green magnetic fluorescent powder as an effective technique for developing latent fingerprints on red money packets after 24 hour and 1 week time intervals. **Conclusion**: Green magnetic fluorescent powder produces effective development and visualization of latent fingerprints on red money packets after 24 hour and 1 week time intervals.

Keywords: forensic science, forensic identification, fingerprint development, fingerprint aging, semi-porous surface, crime scene investigation, photography

Supervisors: Jaclyn Slaney, Laboratory Specialist, Toronto Police Services; Cameron Power, Laboratory Specialist, Toronto Police Services; Mary Oliverio, Laboratory Specialist, Toronto Police Services

JUNSIK MOON

Development of latent fingerprints on Tim Horton's cups

ABSTRACT

Purpose: The purpose of this research is to determine an effective technique to develop latent fingerprints on Tim Horton's cups by comparing various fingerprint development techniques. As Tim Horton's cups are often found at crime scenes, this research will allow for the determination of an effective method of obtaining more evidence. **Background**: Surface type is an important factor in fingerprint development. Semi-porous surfaces, such as Tim Horton's cups, vary in porosity, making them difficult surfaces to develop fingerprints from. **Methodology**: Fingerprints were deposited onto Tim Horton's cups and left to age for three different time lengths (7days, 24hours, 2hours), before being treated with development techniques (Indanedione, diazafluorene-9-one (DFO), Fluorescent Nanopowders, Lumicyano™, Sudan Black, and Silver Nitrate). They were photographed with a DSLR camera, then graded by fingerprint analysts on a four-point scale. **Result**: 300 fingerprints photographed, and 19 were scored highly, and categorized as "good". Sudan Black was unable to enhance any fingerprints, and prints enhanced by Lumicyano™ were unable to be photographed. The "good" prints were developed using Indanedione (n=13), Silver Nitrate (n=5), and Nanopowders (n=1). Based on odds ratio comparison, Indanedione was the most effective technique for developing latent fingerprints from Tim Horton's cups. **Conclusion**: Tim Horton's cups are difficult surfaces to develop latent fingerprints. Although indanedione shows potential as an effective technique, additional methods should be studied for use on semi-porous surfaces.

Keywords: forensic science, latent fingerprints, semi-porous surfaces, chemical enhancement, physical enhancement, Tim Horton's cups

Supervisors: Brad Joice, Detective Sergeant, York Regional Police; Jennifer Hunter, Forensic Identification Assistant, York Regional Police; Shannon Goel, Forensic Identification Assistant, York Regional Police

SARAH CHEH

Post-mortem identification using 3D fingerprints

ABSTRACT

Purpose: The primary purpose of this research is to create a 3D model of the finger using photogrammetry by determining what lighting and camera settings create the cleanest model, which will help determine if it is possible to collect fingerprints in a contactless manner. The second is to determine the extent of distortion in 2D fingerprints relative to the undistorted finger by marking several points on the finger before creating the 3D model and 2D fingerprint to compare the difference in distance between the marked points on each, which will allow for a better understanding of how much impact distortion has on a fingerprint. **Background:** Collecting fingerprints from human remains is difficult because the skin on the fingertips can be extremely fragile, making them unfit for contact-based methods of recovery. Photogrammetry can be used to collect a 3D model of the finger while avoiding physical contact. However, 2D fingerprints have distortions caused by pressure and skin deformation, so when making comparisons between 3D and 2D prints, it is important to understand and explain the extent of these distortions. **Methodology:** The 3D model was made by taking photos with a Nikon D5700 camera and the 3DF Zephyr Free modelling software. The 2D fingerprints were created by photographing the finger from underneath when it was pressed against a glass scale using different amounts of pressure. **Result:** The results showed that the best 3D models were created using a minimum of eleven photos when the camera settings were ISO100, F32, and 1/200 second shutter speed. **Conclusion:** The development of a contactless finger recovery method can increase the number of options available to forensic analysts in the future when making post-mortem identifications of human remains.

Keywords: Forensic science, forensic identification, 3D technology, fingerprinting, photography

Supervisor: Eugene Liscio, 3D Forensic Analyst, ai2-3D Forensics, Adjunct Professor at the University of Toronto Mississauga

DAVID (MYLES) LATOUR

Canadian juries and the expanded fingerprint conclusion scale: an analysis on jury understanding of "support for same source"

ABSTRACT

Purpose: To examine Canadian juror understanding of "Support for Same Source" and "Inconclusive" with varying similar features in comparison to "Identification". This is accomplished by distributing mock trial transcripts differing in conclusion to a selection of Canadian eligible jurors, then surveying on perceived evidence strength, comparing response similarity, and analysing percent of "correct" responses if not similar. This ensures that the expanded conclusion scale is not misinterpreted, leading to wrongful convictions. **Background:** An expansion to the ACE-V three-conclusion scale has been proposed by the Organization of Scientific Area Committees for Forensic Science. A sufficient number of similar features must be reached before an "identification" (ID) can be concluded over "inconclusive" (INC). Interpretation of the new conclusion "support for same source" (SFS) by Canadian juries is unknown. **Methodology:** Five surveys containing mock trial transcripts with varying similar feature numbers and conclusions were randomly distributed to 178 participants who are friends or family, or contacts of those working in police institutions across Canada. Participants themselves must not work in police institutions. **Results:** Chi squared testing showed a relationship between responses and the three conclusions [X^2 $(16, N = 178) = 32.116, p = 0.009$]. There was no relationship between responses and INC or SFS alone [$X^2(12, N = 154) = 14.529, p = 0.268$]. **Conclusion:** Canadian jurors view ID testimony differently from INC and SFS. Cases fitting SFS criteria are perceived the same by Canadian juries when referred to as INC or SFS.

Keywords: forensic identification, expanded fingerprint conclusion scale, Canadian jury, five-conclusion scale, support for support for same source, support for common source
Supervisor: David Richard, Instructor, Forensic Identification Training Team, Canadian Police College

SHIAN VALLES

Distortion in Bureau Voor Dactyloscopische Artikelen gel-lifted footwear impressions

ABSTRACT

Purpose: The focus of this research was to determine whether the duration the gelatin sheet is left to rest before application affects distortion, using an accepted standard difference of <1mm. This research will aid forensic identification professionals in establishing standard operating procedures regarding the minimum amount of time a gelatin sheet must rest, after removing the cover, before evidence application. **Background:** The gel-lift method targets two-dimensional impressions on porous and non-porous surfaces. Previous literature has only focused on distortion in relation to pressure applied, and research involving time in relation to distortion is inconclusive. **Methodology:** The sample size consisted of 80 impressions, subdivided into five time variables of 30 seconds, one minute, two minutes, five minutes, and ten minutes. Latent impressions on a tile surface were developed using white fingerprint powder. After allowing the sheet to rest for the time of interest, it was applied to the impression and then scanned using the GLScan. Measurements of the lifted impression were obtained in Adobe Photoshop using calibration of the built-in scale along with the ruler tool. **Result:** Chi-squared testing showed the deviations between the observed and expected values of distortion were due to chance, with X^2(4, N = 80) = 6.704, p = .1524, using a significance level of 0.05 **Conclusion:** There exists a weak association between time before application after removal of cover and distortion in gel-lifted footwear impressions.

Keywords: forensic science, forensic identification, BVDA GLScan, distortion, gelatin lift, impression evidence, time before application

Supervisors: Amanda Lowe, Forensic Research and Training Analyst, Forensic Identification Services, Ontario Provincial Police; Wade Knapp, Professor, University of Toronto Mississauga

LUNCH BREAK

A 50 minute recess at the Blind Duck Pub, UTM Student Centre.

Forensic Science Day resumes at 1:30 PM
with the Poster Session in the Kaneff Building

POSTER SESSION

30 minutes in the Kaneff Building.

Speaker presentations resume at 2:00 PM

VIRGINIA CHIU

Does the Phadebas press test dilute samples and affect DNA yield?

ABSTRACT

Purpose: This research aims to determine if the Phadebas Press Test (PPT) dilutes and affects DNA yield and results from saliva significantly. This research will help to gauge the effects of presumptive tests on DNA concentration yield and downstream testing in forensics so that forensic labs may implement additional protocols for trace biological fluid. **Background**: The PPT is a common presumptive test used when saliva may be present on evidence. A limitation to such tests is that some quantity of DNA is consumed. For trace or degraded evidence, this could negatively impact the amount left used for DNA testing and profile generation. **Methodology**: Five 100uL aliquot replicates of each saliva dilution class (1/50 and 1/100) were deposited onto three different textile types; cotton, denim, and polyester (n=60). The PPT was applied to the experimental group. DNA was extracted using the QIAGEN DNA Investigator Kit and quantified using the Qubit Fluorometer 4 to report concentrations in ng/uL. **Result**: To date, the data exhibits a trend where after application of PPT, 40% of the 1/50 dilution and 80% of the 1/100 dilutions read "out of range" for quantification across all textiles. Across all control textiles, 13.33% of the 1/50 dilutions and 73.33% of the 1/100 dilutions read "out of range." **Conclusion**: This research stands to offer insight into the impacts of presumptive tests on trace biological fluid evidence, where significant consumption of DNA could hinder downstream amplification results and testing, negatively affecting investigation progress.

Keywords: forensic science, forensic biology, biological fluid, Phadebas, presumptive test, saliva, trace evidence

Supervisor: Dr. Nicole Novroski, Novroski Research Laboratory, Assistant Professor, University of Toronto Mississauga

HOLLY REAUME

Effect of fabric pre-treatments on DNA recovery from blood-stained textiles

ABSTRACT

Purpose: The purpose of this research is to investigate the effect of fabric pre-treatments on DNA recovery from blood stains on cotton and cotton-polyester blend clothing. This research is significant, as it will determine if the creation of new DNA extraction protocols for treated fabrics is warranted. **Background**: Biological fluids can end up on fabric surfaces through the commission of a crime. There has not been any published research to date that discusses the relationship between commercially available fabric treatments and DNA recovery. **Methodology**: The sample consisted of 48 blood-stained fabric swatches. 24 were deposited on 100% cotton and another 24 on a 50:50 cotton polyester blend. Four treatments were applied to each group, Scotchgard™ Fabric Protector, Static Guard™, Bounce® Rapid Touch Up 3-in-1 Clothing Spray, and control/untreated for a total of six swatches per treatment group. DNA was extracted using the QIAamp® DNA Investigator kit and quantified using the Qubit® dsDNA High Sensitivity Assay. **Result**: ANOVA testing resulted in a p-value of 0.00444 ($P<0.05$) for the treatment types and a p-value of 0.4756 ($P>0.05$) for the fabric types. A post-hoc Tukey test showed that no treatment group differed significantly from the control group. **Conclusion**: The fabric treatments investigated in this research do not affect DNA yield for the two tested fabrics. Future research should be directed at determining the quality of DNA recovered from treated fabrics.

Keywords: forensic science, forensic biology, biological fluid, bloodstain, DNA recovery, fabric treatment, Qubit® Assay

Supervisor: Nicole Novroski, Novroski Research Laboratory, Assistant Professor, University of Toronto Mississauga

VANESSA LITTLE

Evaluation of three manual extraction methods for performance, accuracy, and reliability in forensic genetics

ABSTRACT

Purpose: The purpose of this research is to evaluate the performance, accuracy, and reliability of three commercially available manual DNA extraction methods in forensic genetics (Promega's DNA IQ System, Invitrogen's PureLink Genomic DNA Mini Kit). **Background**: Most current larger laboratories and research bodies rely on automated extraction, creating a distinct gap in the literature regarding the validation of manual DNA extraction methodologies. **Methodology**: A total of 90 samples were extracted (45 whole blood and 45 saliva), with 7 controls (n=97). Each sample type and dilution (1:1, 1/10, and 1/100) were run in five replicates. Each extraction used 15μL of sample and followed manufacturer protocols. **Results**: The Kruskal-Wallis Rank Sum Test with a post-hoc Dunn Test showed that there was a statistically significant difference between the Invitrogen and Promega kits for both blood and saliva samples in the 1:1 dilution series ($p_{1:1\ blood}$ = 0.00886145, $p_{1:1\ saliva}$ = 0.0089384) and between the Promega and Invitrogen kits for the 1/10 saliva samples ($p_{1/10\ saliva}$ = 0.03421163). No statistically significant differences were found between the kits for the 1/10 blood trials ($p_{1/10\ blood}$ = 0.3725) or any 1/100 trials. **Conclusion**: Promega's kit is recommended for both 1:1 and 1/10 blood samples. Qiagen's kit is the casework applicable kit that performed the best for 1:1 saliva and is also recommended for 1/10 saliva. Invitrogen's Kit performed best overall for 1:1 saliva but is currently not validated for casework and therefore cannot be recommended.

Keywords: forensic science, forensic genetics, blood, Invitrogen, manual DNA extraction, Promega, Qiagen, saliva

Supervisors: Nicole Novroski, Novroski Research Laboratory, Assistant Professor, University of Toronto Mississauga,

NELLA VEKIC

Forensic significance of two novel psychoactive benzodiazepines

ABSTRACT

Purpose: The purpose of this research was to increase knowledge regarding two novel psychoactive substances (NPS), flubromazolam and flualprazolam, in the province of Ontario. This research is significant because it provides insight on the prevalence of these drugs in forensic case work in Ontario. **Background**: NPS are substances of abuse that are not internationally controlled and are produced to mimic the effects of illicit substances. Flubromazolam and flualprazolam are two novel benzodiazepines which have depressant effects on the Central Nervous System. **Methodology**: Cases submitted to the Centre of Forensic Sciences' toxicology section between July 1st, 2021 and November 30th, 2021 where flualprazolam and flubromazolam were quantified were included in this study. **Result**: Concentrations ranged from <1.3-323 ng/mL (n=53) and <1.3-227 ng/mL (n=98) for flubromazolam and flualprazolam, respectively. The distribution of case types for flubromazolam was 81% drug impaired driving, 17% death investigation, and 2% sexual assault. The distribution of case types for flualprazolam was 78% drug impaired driving, 17% death investigation, and 5% sexual assault. Flubromazolam and flualprazolam cases consisted of 39 males and 14 females with an age range of 19-61 and 77 males and 20 females with an age range of 19-66, respectively. Flubromazolam and flualprazolam were detected in combination with opioids in 91% and 94% of cases, respectively. **Conclusion**: The results from this study provide valuable information for the forensic community regarding blood concentrations that arise following the use of these drugs and the different case types.

Keywords: forensic science, forensic toxicology, designer benzodiazepines, flualprazolam, flubromazolam, NPS, Ontario

Supervisors: Dr. Karen Woodall, Assistant Professor, University of Toronto Mississauga; Delaney Armstrong-Price, Forensic Toxicologist, Centre of Forensic Sciences

TAYLOR HUGHES

Substance use disorder and the effect on psychotic disorder diagnoses and symptoms

ABSTRACT

Purpose: This research aims to understand the relationship between psychotic disorders in not criminally responsible (NCR) cases and substance use disorder, investigating differences between symptom frequencies and if substance use disorder complicates diagnoses. **Background:** Patients found NCR must be diagnosed with a psychotic disorder that renders them unable to appreciate the nature of their crime or understand the consequences. Many cases cite a comorbid substance use disorder, and understanding this relationship can provide information to help avoid misdiagnoses of psychotic disorders. **Methodology:** The sample group consists of 64 NCR cases from Ontario in 2016 with patients diagnosed with both a psychotic disorder and substance use disorder. The control group consists of 38 cases of psychotic disorder alone. Data from Ontario Review Board (ORB) decisions in the first, third, and fifth years following the original finding of NCR were collected from the LexisNexis database. Information (diagnosis/noted symptoms by ORB) were collected and analyzed, with frequencies calculated for diagnostic trends, using a chi-squared test for correlations between symptoms/diagnoses. **Result:** Schizophrenia accounts for 49% of psychotic disorder diagnoses in NCR cases with a significant correlation between substance use disorder and the number of patients presenting symptoms. **Conclusion:** This research suggests substance use disorder concurrent with another psychotic disorder causes longer lasting symptoms.

Keywords: forensic science, forensic psychology, criminal responsibility, psychotic disorder misdiagnoses, psychotic disorder prevalence, substance use disorder

Supervisor: Craig Fraser, Sessional Lecturer at the University of Toronto, Mississauga, and member of the Ontario Review Board

YASHIKA SHROFF

Motivational influences and trajectories in the context of major mental illness

ABSTRACT

Purpose: The purpose of this research is to determine whether motivations for committing an index offence of violence differs between those who offend prior to versus following the onset of a Major Mental Illness (MMI). This research is significant, as it expands on the relationship between symptoms of illness and violence and identifies other criminogenic factors which may play a motivational role. **Background**: To determine motivation type, Hodgins proposed "early starters" as individuals motivated by criminogenic factors and "late starters" as individuals motivated by symptoms of their MMI. Hodgins typology bridges the concept of MMI age onset ("early vs. late starters") with motivation for violence, proposing that the age at which antisocial and violent behaviours emerge can be used to differentiate between offending that is primarily motivated by symptoms of MMI versus criminogenic factors. **Methodology**: 18 adult male forensic service users at the Centre for Addiction and Mental Health who have been found Not Criminally Responsibly by Reason of Mental disorder for an index offence of violence within the last 5 year participated in this study. Participants took part in a 90-minute structured interview, followed by a comprehensive review of their health record information.

Keywords: forensic science, forensic psychology, forensic mental health, major mental illness, motivation, violence, risk

Supervisor: Dr. Stephanie Penney, Independent Scientist, Centre for Addiction and Mental Health

COFFEE BREAK

Brief intermission, presentations resume at 3:15 AM

DESTINY WALSH

Assessing the effects of COVID-19 related segregation in SMI offenders

ABSTRACT

Purpose: The purpose of this research is to examine and emphasize the effects that COVID-19 related lockdowns may have on offenders with a serious mental illness (SMI). The research is significant as it will offer a natural opportunity to understand the probable impacts of segregation itself on SMI, including pre-to-post measurements, inclusion of female participants, and an analysis of segregation in a pandemic setting. **Background**: Previous literature has argued about whether the use of segregation in correctional settings is effective or harmful. However, these studies suffered from methodological shortcomings, including a potentially biased inmate selection process, lack of pre-segregation data points, and mainly focusing on male inmates. Furthermore, literature to date on segregation focuses on its use in regular day-to-day correctional settings, but little is said about the psychological effects it may have when mimicked under irregular conditions like the COVID-19 pandemic. **Methodology**: Clinical Global Impression-Corrections scores (CGI-C) were assessed for inmates located at two provincial jails in Ontario, Canada. The CGI-C scores were taken pre-segregation and post-segregation and assessed the severity of the inmates' psychological symptoms before and after being in confinement. **Result**: This research is using a Two-Way ANOVA within and between subject analysis. **Conclusion**: The results from this research will provide implications as to whether segregation is a beneficial or harmful technique, and will provide recommendations on how to provide and triage care for those with SMI.

Keywords: forensic science, forensic psychology, segregation, SMI, COVID-19

Supervisor: Dr. Cory Gerritsen, Clinical Psychologist, Centre for Addiction and Mental Health

ZOE COLCLOUGH

Determining whether clinical practice guidelines for traumatic brain injuries overlook those within the criminal justice system

ABSTRACT

Purpose: The purpose of this systematic review was to determine how many clinical practice guidelines (CPGs) for traumatic brain injuries (TBIs) consider individuals within the criminal justice system (CJS) and assess how they incorporate evidence about the CJS into their recommendations. **Background:** CPGs are recommendations that guide healthcare interventions. TBIs are disproportionately prevalent within the CJS. There is no prevailing standard for managing TBIs in CJS settings, thus identifying CPGs for TBIs that acknowledge the needs of those in the CJS is vital. **Methodology:** A peer-reviewed literature search was performed to identify CPGs. Prospective guidelines and their references were screened to ensure they constituted CPGs for TBIs. CPGs were categorized based on their inclusion or omittance of keywords for the CJS and coded for clinically relevant information. **Result:** Of the 4387 potential guidelines evaluated, forty-six constituted CPGs. Thirteen (28.26%) CPGs contained keywords for the CJS. Specifically, seven (53.85%) considered information about police interactions, seven (53.85%) mentioned general medico-legal data, five (38.46%) mentioned criminal records, two (15.38%) considered parole/probation, and one (7.69%) mentioned detention. **Conclusion:** Though thirteen CPGs for TBIs included evidence-based recommendations specifically for CJS-related populations, further guideline development is encouraged because no CPGs are primarily focused on the CJS.

Keywords: forensic science, forensic medicine, clinical practice guidelines, clinical recommendations, criminal justice system, neurology, traumatic brain injury.

Supervisor: Dr. Vincy Chan, Associate Director of the Acquired Brain Injury Research Lab.

MAGGIE KU

The CSI effect on trial: does the presence of an opposing expert witness influence expert credibility and mitigate the rates of wrongful conviction in Canada?

ABSTRACT

Purpose: The purpose of this research is to determine if the presence of an opposing expert witness would influence the credibility of the Crown expert witness and mitigate rates of wrongful conviction. The goal of this research will be to make suggestions to the Canadian Legal System regarding the hiring of an expert witness from the Defence. **Background:** In Canada, the *voir dire* process is the only official test administered in a legal setting to determine if an expert witness has expertise in the field that they are asked to testify in during court. However, in the current legal system, there is no requirement for the Defence counsel to hire their own expert witness(es), meaning jurors are not exposed to other expert opinions that might have influenced their final verdict. **Methodology:** Jurors were recruited according to the Juries Act and equally distributed into the Control Group (ie. only heard expert testimony from the Crown's expert) or the Experimental Group (ie. heard from both the Crown and Defence's expert). Mock jurors were then presented with recordings were based off transcripts and court decisions taken from an old Innocence Canada case and asked to score the credibility of the expert witness testimony on a scale of 1 to 10. **Result:** The current sample size is 30 mock jurors, and a Chi-Square test will be applied to determine significance between the two groups. **Conclusion:** Currently there are no conclusions as the research is still ongoing.

Keywords: forensic science, miscarriage(s) of justice, expert witness, opposing expert witness, expert testimony, wrongful conviction

Supervisor: Claire Marie Horsnell, The Innocence Project at Osgoode Hall – York University

FSC483H5

COLLABORATIVE RESEARCH INTERNSHIP
POSTER PRESENTATIONS

WANYING CAO

Comparison of damage patterns on fabrics caused by the TASER probes

ABSTRACT

Purpose: This research aims to examine TASER damage on fabrics, and whether types of fabrics and TASER models are the impact factors of the damage patterns, by using a Keyence digital microscope for damage measurements. This research may help establish the intent and extent of an assault involving TASERs and provide in-depth data for future study. **Background**: TASERs are conducted energy weapons that are frequently used by police departments in Canada. TASERs have two modes of operation: drive stun and probe mode. This experiment will focus on the probe mode, in which two probes are released from a single cartridge when firing the TASER. **Methodology**: Three types of white fabric were used, including cotton, polyester, and polyester-cotton blend. Three models of TASERs (TASER X26P, TASER 7 and TASER X2) were shot onto each type of fabric, with five repetitions each. Each damaged area on the fabric caused by a probe was considered a sample (n=90) and was examined with the microscope. Pictures were captured by the Keyence microscope with measurements on the variables, including damage dimension, fabric condition, and signs of burning. **Result**: From general observations, polyester and blend fabrics exhibited visible shrinkage, which was different from cotton fabric. No visible signs of burning were found on all fabric types. **Conclusion**: The data analyses may determine if fabric types and TASER models would impact the formation of damage patterns.

Keywords: forensic science, forensic garment analysis, conducted energy weapon, mushroom-shaped morphology, natural fiber, synthetic fiber.

Supervisor: Eugene Liscio, 3D Forensic Analyst, ai2-3D Forensics, Adjunct Professor at the University of Toronto Mississauga

CORRIN DOUCETTE

TASER burn marks on skin in drive stun and probe mode using three TASER models

ABSTRACT

Purpose: The purpose of this research is to document and compare burns on skin from three TASER models in drive stun and probe mode. This research may contribute to identification and classification of burn marks for use in legal investigations. **Background**: TASERs function in drive stun mode for close range, and probe mode at a distance, by conducting electricity between probes or electrodes through the skin. Electrical energy produces heat at the contact surface, causing localized burns. These burns have been documented, but remain under-studied, despite increasing use of TASERs by police. Current literature relies on case studies and focuses on the X26P TASER model. **Methodology**: TASER X26P, TASER X2, and TASER 7 were applied directly to pork hock in drive stun mode for 5 seconds, and probe mode for 5 seconds. This was repeated three times with each TASER model. Images were recorded using a Keyence VHX 6000 Microscope, and subsequently scored for discolouration, texture change, number of burn marks, and burn mark size. **Result**: Preliminary results show no detectable burn marks from the drive stun application. Signs of discolouration were present surrounding TASER 7 and TASER X2 probe wounds. **Conclusion**: Pork hock may not be an ideal material for testing TASER burns due to its conductive properties and lack of inflammatory response to heat. Future research should utilize live human skin, or develop methodology using skin substitutes, to aid identification of TASER burns for medical and legal purposes.

Keywords: forensic science, thermal injuries, burn analysis, CEW, electrical injuries, TASER

Supervisor: Eugene Liscio, 3D Forensic Analyst, ai2-3D Forensics, Adjunct Professor at the University of Toronto Mississauga

HANNAH RUFFO

Characterizing the burn marks from the drive stun mode of a TASER on fabrics

ABSTRACT

Purpose: The purpose of this research is to establish a baseline for the expected damage the TASER drive stun mode does on clothing by examining fibers under high magnification using a VHX-6000 confocal microscope. This will allow investigators to identify TASER markings, classify burns, and corroborate their findings with other contextual evidence when concerns exist regarding if a tasing event occurred. **Background**: Current TASER research fails to address the appearance of burn marks on surfaces other than skin. One study examined the metallic deposits from TASER electrodes on clothing but did not note the overall characteristics of the burns produced. **Methodology**: The drive stun duration (1, 3, 5 seconds) of three TASER models (X26P, X2, TASER 7) were varied upon being applied perpendicularly to a surface of pork hock draped in three fabrics (white cotton, polyester, cotton-polyester blend) (n=81). Using the VHX-6000 confocal microscope, high magnification images were taken to observe any qualitative changes to the fabric. **Result**: Preliminary results indicate that polyester fibers melted and formed a brown discolouration visible to the naked eye. Under magnification, black discolouration of cotton fibers was observed. No apparent changes were noted for the fabric blend. **Conclusion**: Despite coinciding with what the burn science of fabrics predicts, these characteristics are not unique to TASERs. Continued efforts focusing on establishing any differences in burn marks between TASER models or drive stun durations will allow for confidence in the identification of TASER drive stun burns.

Keywords: forensic science, forensic garment analysis, burns, clothing, conductive energy weapon, TASER

Supervisor: Eugene Liscio, 3D Forensic Analyst, ai2-3D Forensics, Adjunct Professor at the University of Toronto Mississauga

YU RAN (DANNY) ZHOU

TASER distance determination for models X26P, X2, and TASER 7

ABSTRACT

Purpose: The purpose of this research is to establish a method of distance determination for TASER models X26P, X2, and TASER 7. This research is significant, as the developed technique can help contextualize relative locations of individuals during crime scene reconstruction. **Background**: TASERs are Conducted Energy Weapons (CEWs) used by law enforcement as electrical, non-lethal weapons. A TASER's long distance "probe mode" launches two barbed probes that embed into the target, before electricity is cycled from one probe to the other. The resulting muscle contractions help incapacitate the target, but a minimum 30cm spread distance between the probes upon contact is required. Different TASER models and cartridge types have varying probe launch angles and wire lengths to achieve the target spread. **Methodology**: Each of four probe cartridge types were launched for six repetitions towards vertical cardboard targets 3m, 6m, and 8m away (n=72). The probe spread distances on the targets were measured for each cartridge and plotted against TASER-to-target distance. Trendlines and standard deviations were generated for averages of each cartridge type. **Result**: Preliminary results demonstrated probe spread distances were generally proportional to probe launch angles, and greater TASER-to-target distances resulted in greater standard deviation. **Conclusion**: There is a linear relationship between probe spread distances and TASER-to-target distances for each of the examined TASER models and cartridge types. The rate of spread increase, launch angles, and probe spread distances combined are variables expected to determine TASER-to-target distances through blind testing.

Keywords: forensic science, forensic ballistics, conducted energy weapon (CEW), distance determination, probe spread, TASER

MADISON (MARD) DEWIT

The effect of different visual aids on jury comprehension of virtual expert witness testimony

ABSTRACT

Purpose: The purpose of this research was to determine if the use of visual aids in expert witness testimony in an online trial enhances jury comprehension, and if visual aids enhance comprehension, what type(s) of visual aids increase jury comprehension the most. This research is significant as it will allow experts testifying online to know if visual aids are beneficial and what type(s) of visual aids to use. **Background**: In previous studies, the use of visual aids has been shown to enhance jury comprehension in in-person courtrooms, especially 3D visuals. There has been limited research associated with online trials. **Methodology**: Thirty-seven participants were divided into four groups, who all participated in an online mock trial on Zoom where they were shown a pre-recorded video of an expert witness' testimony. Each group was presented with one of four approaches to the testimony: no visual aids; non-specific 2D diagram; case-specific 2D diagram; and a case-specific 3D diagram. After the trial, the participants were evaluated on their comprehension of the expert testimony via scores on a questionnaire with multiple choice questions containing a hypothetical scenario based on information conveyed in the trial. **Result**: Since the Chi Squared test had a χ^2 value= 5.6135 and a p value= 0.13201, no statistically significant results were obtained. **Conclusion**: No statistically significant correlation between using visual aids and increasing jury comprehension was obtained, although descriptive statistics indicate visual aids should be used in online expert witness testimony.

Keywords: forensic science, forensic pathology, courtroom, expert witness testimony, jury comprehension, online trial, visual aids

Supervisor: Caitlin Pakosh, Assistant Professor, Forensic Science Program, University of Toronto Mississauga

HARVEEN SRAN

The effect of different visual aids on jury comprehension of virtual expert witness testimony

ABSTRACT

Purpose: The purpose of this study is to investigate jury comprehension of online expert witness testimony assisted by different types of visual aids. **Background**: In order to reach a just verdict, a jury must appropriately weigh all available evidence at a criminal trial, including expert witness testimony. Due to the COVID-19 pandemic, courts have frequently been forced to shift to a virtual platform, which appears to be a promising and effective alternative to in-person trials. **Methodology**: Thirty-seven jury-eligible participants (n= 37) who have a device with internet access to Zoom were recruited to participate in virtual mock trials. The control group will involve no visual aid, and the remaining groups will utilize the assistance of the one of the following: (1 generic/non-specific visual aid, (2 case-specific 2D visual aid and, (3 case-specific 3D visual aid. Juror comprehension was measured using a questionnaire with 10 hypothetical multiple-choice questions based on the expert witness testimony. **Result**: Results from a chi-square analysis of independence showed no statistically significant relationship (p=0.13), although descriptive statistics show trends toward higher comprehension in the 2D case-specific visual aid group. **Conclusion**: This study aims to provide evidence that jury comprehension increases with visual aids in virtual courtrooms. Such evidence will prove to be valuable for the administration of justice to consider when determining whether virtual jury trials can be equally as effective as in-person, rather than delaying trials in the face of adversities such as a global pandemic.

Keywords: Forensic science, forensic psychology, jury comprehension, visual aid, expert evidence, virtual testimony

Supervisor: Caitlin Pakosh, Assistant Professor, Forensic Science Program, University of Toronto Mississauga

KATHITA PATHAK

The effect of different visual aids on jury comprehension of virtual expert witness testimony

ABSTRACT

Purpose: The purpose of this research is to determine whether visual aids used in conjunction with forensic expert witness testimony improves jury comprehension of the evidence presented during a virtual trial. **Background**: The jury is ultimately responsible for contextualizing forensic science evidence presented in court. Hence, it is critical to develop an in-depth understanding of the factors that influence jury comprehension of a virtual testimony presented by a Forensic Expert Witness, along with visual aids such as 2D and 3D diagrams. **Methodology**: This study recruited 37 juror participants (n=37) with access to Zoom. Participants were randomly assigned to one of the four study groups and presented with a visual forensic pathology expert witness testimony regarding a torso stab wound. Jury-participant comprehension was compared between four study groups: 1) no visual aid; 2) generic/non- specific 2D diagram; 3) case-specific 2D diagram; and 4) case-specific 3D diagram. Following the simulated mock trial, juror-participants' responses were scored based on knowledge-based hypothetical multiple-choice questions about technical language of expert's testimony. A chi-squared test was used to measure jury comprehension. **Result**: The results of this study show that the data was found to be not statistically significant. **Conclusion**: The results of this study will help further understand challenges influencing jury comprehension and contribute to more meaningful methods of presenting forensic evidence during a virtual trial.

Keywords: forensic science, forensic pathology, virtual courtroom, mock trial, jury comprehension, expert witness, evidence

Supervisor: Caitlin Pakosh, Assistant Professor, Forensic Science Program, University of Toronto Mississauga

PRIYAL BHAVSAR

The effect of different visual aids on jury comprehension of virtual expert witness testimony

ABSTRACT

Purpose: The purpose of this research is to measure the jury comprehension of virtual expert witness testimony assisted with different visual evidence presentation formats to determine which is the most effective as an explanatory tool. The findings of this study will benefit expert witnesses and lawyers looking to improve the efficacy of evidence presentations during virtual jury trials. **Background**: Expert evidence may be presented through visual aids, rather than oral communication alone, as it has shown to be a more comprehensible method of presenting specialized scientific evidence. Due to COVID-19 and the observed benefits of virtual trials, virtual jury trials may be considered in the future as an alternative to in-person jury trials. **Methodology**: Jury-eligible volunteers (*n*=37) with access to Zoom were randomly assigned to one of four visual evidence presentation approaches in a virtual mock trial setting: 1) no visual aids (control group), 2) generic 2D diagram, 3) case specific 2D diagram, or 4) case specific 3D visualization. Mock trials were recorded and played to participants through Zoom. Their comprehension of the expert witness testimony was measured through a hypothetical knowledge-based questionnaire that they completed online following the mock trial. **Result**: A chi-squared test for independence showed no statistically significant difference between the jury comprehension questionnaire scores and the type of visual evidence presentation (x^2= 5.61, p= 0.132). **Conclusion**: Differences in visual aid formats had no statistically significant impact on the jury comprehension of virtual expert witness testimony.

Keywords: forensic science, forensic pathology, comprehension, courtroom, expert witness, jury, mock trial, scientific evidence

Supervisor: Caitlin Pakosh, Assistant Professor, Forensic Science Program, University of Toronto Mississauga

ERICKA ELLAINE LIWANAG & OLIVIA O'CONNOR

The psychopathy label and psychopathy assessment tools: Their role in Canadian court cases

ABSTRACT

Purpose: Review and collect information about how psychopathy assessment (PA) tools are used in Canadian courts. This research is significant as there is currently little information about the use of PA in Canadian courts, despite reports about increased usage and concerns of misuse. **Background:** Research from the United States documents that the use of PA has been exponentially increasing, and that PA impacts trial outcome and juror perceptions. However, there are concerns about low field reliability and prejudicial effects of PA. **Methodology:** Search Canadian court cases from 2011-2022 in LexisNexis. Inclusion criteria where (a) accused was deemed a psychopath and/or; (b) a PA was used. Case details and information about the use of PA were captured and analyzed using a data form created through REDCap. **Result:** The search yielded a total of 461 relevant cases. Demographics: male (n=443), female (n=15), transgender (n=1). Mean age was 39.51 years. Ethnicity was ascertained in 32% of cases (n=149), of these 75% identified as Aboriginal (n=112). A total of 69.2% of the retrieved cases were Dangerous Offender hearings. The preferred PA tool was the Hare Psychopathy Checklist-Revised (68.3%), and in the majority of cases the prosecution introduced PA (62%). **Conclusion:** Novel findings include: (a) Aboriginals were disproportionately subject to PA, and (b) there is a stagnation in the use of PA in Canadian courts. Reasons for further investigation are discussed.

Keywords: forensic science, forensic psychology, psychopathy, psychopathy assessment, misuse, prejudicial effect, PCL-R

Supervisor: Dr. Rasmus Rosenberg Larsen, Assistant Professor, University of Toronto Mississauga

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JOSE SANCHEZ
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JESSICA PIEKNY
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