President’s Message. Gord Lefebvre, gordlefebvre@gmail.com

Hello everyone,

Another season is coming to an end. I hope everybody has had a very enjoyable summer with family and friends. As days begin to get shorter and temperatures cooler it feels that summer has slipped away much too soon. It has been a great summer though.

I was honoured to attend the 2019 IABPA European Conference in Paris, France. It was a true privilege to be part of such a wonderful group people. Celine Nicloux and her team offered the attending delegates a most memorable conference. I was impressed from the opening ceremony through to the end of the conference. The conference kicked off with the French Military Band performing the National anthem of over 50 countries who participated in the conference. I believe everyone felt proud to hear their anthem played by the band. The expressions on their faces certainly displayed that sentiment. The speakers, presentations, and workshops and were excellent and very captivating. The social events were equally amazing, Versailles, Paris, banquet dinner at The Augustins with the French Military Band playing, then a night boat tour with the Eiffel in lights, ç’ magnifique!

I am now looking forward to our upcoming Annual Conference in Chicago. I know that Jeff Gurvis and Rebecca Hooks are working diligently in preparation for the conference. From the list of speakers and presentations I see it will be another wonderful conference. The Annual IABPA Conference is an important opportunity for you to learn and improve yourself within the discipline. I do hope many of you have planned on attending and I look forward to seeing you there. I also want to invite those of you who have something to present to please consider doing so. Many of you have been involved in some really interesting cases, conducted some research either relating to the practical application or theoretical aspects of BPA. Please reach out to Jeff or Rebecca and share your experience.

Best regards,

Gord Lefebvre, gordlefebvre@gmail.com
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Journal of Bloodstain Pattern Analysis
Jeremiah A. Morris, Editor
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The Journal of Bloodstain Pattern Analysis is published quarterly and is the official publication of the International Association of Bloodstain Pattern Analysts. The Journal of Bloodstain Pattern Analysis is committed to the dissemination of information relevant to the Association, its members, and the discipline of bloodstain pattern analysis.

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Make the science better — share your research and experiences!

The goal of the Journal of Bloodstain Pattern Analysis is to be the primary venue of information related to the IABPA as well as the science of bloodstain pattern analysis. The Publication Committee can gather information about the Association, upcoming training, and published papers; however, this is only a small part of the available information out there. We need your help.

We know members of the IABPA—practitioners, instructors, and researchers—are constantly learning new things about the science. Unusual patterns are observed at scenes, training exercises create patterns with unexpected features, or research fills in knowledge gaps. We are asking you to share this information with others in the discipline by submitting it to the Journal for publication. There are numerous possibilities:

- Images of a pattern with a brief description
- Summary of a case and lessons learned
- Results of experimentation
- Manuscripts of a research project
- Summary of published articles on a specific topic
- Review of new technology or a new product

All case reports, results of experimentation, research projects, and summary articles will go through a true blind peer review process in order to assure any content within these categories is scientifically valid and also of high quality. If you have any questions, please don’t hesitate to reach out to the Editor or anyone on the Publication Committee.

Organizational Notices

All changes of mailing address need to be supplied by email to our Secretary Anthony Mangione (amangione@iabpa.org). Members also need to update their contact information profiles on the website.

The fees for application of membership and yearly dues are $40.00 US each. If you have not received a dues invoice for 2019 please contact Anthony Mangione at amangione@iabpa.org. Also, apparently, non US credit cards are charging a fee above and beyond the $40.00 membership/application fee. Your credit card is charged only $40.00 US by the IABPA. Any additional fees are imposed by the credit card companies.

IABPA now accepts the following credit cards: Discover, Master Card, American Express, and Visa.
2019 Annual Training Conference

Conference Dates:  October 29—November 1, 2019

Conference Site:  Crowne Plaza Hotel—Chicago West Loop

Conference hosts:  Jeff Gurvis and Rebecca Hooks

Hotel information  Crowne Plaza Hotel—Chicago West Loop
25 S Halsted St, Chicago, IL 60661
Phone: (312) 829-5000

The hotel is located in the heart of the city. A special discounted rate of $169/night has been negotiated for the IABPA. Use the below link for booking. We expect a large attendance so it is strongly encouraged to book as early as possible.

Booking Link: IABPA Annual Conference

Cut-off Date: 9/18/19

Reservations must be made online or by phone (312.829.5000). Please mention Group Code BPA when making reservations.

Registration:  Registration is still open to members, non-members and students.
Click the links above to register for the meeting.

Updated travel Info:  The hotel is located in the heart of Chicago so you can fly into O’Hare or Midway Airports. You can take the trains into the city from either airport.

Specifically for travelers flying into O’Hare:
• You can take the CTA Blue Line train to UIC-Halsted Stop and then walk half a mile to the hotel. The total travel time is about an hour.
• Uber and Lyft will cost about $40 to $50

If you are driving, there is parking at the hotel.

Local attractions  Navy Pier  https://navypier.org/
Shedd Aquarium  https://www.sheddaquarium.org/
Field Museum  https://www.fieldmuseum.org/
Art Institute  https://www.artic.edu/
Magnificent Mile  https://www.themagnificentmile.com/
Willis Tower  https://theskydeck.com/
United Center for Bulls (NBA) and Blackhawks (NHL)  https://www.unitedcenter.com/
and 1000s more!
2019 Training Conference
General schedule of events

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General comments
The meeting will go from Tuesday-Friday 8:30-5:00 with Friday ending at Noon. There will be morning and afternoon breaks. Refreshments provided throughout the day.

The Hospitality Room will be in the Presidential Parlor.

A Bring Your Own Slides sessions is anticipated to be held one of the evenings of the conference.

Thursday night happens to be Halloween. There will be a dinner cruise on the Chicago River from 7:00 to 10:00 PM. Attendees are encouraged to wear a costume for the night.

Dining
Some of the more well-known restaurants in the area (e.g., the Girl and the Goal) may require reservations well in advance. Most other dining options do not require advanced reservations.

Activities
The United Center is a mile from the hotel. For hockey fans, the Chicago Blackhawks will play the Los Angeles Kings on Monday, October 28, 2019. For basketball fans, the Chicago Bulls will play the Detroit Pistons on Friday, November 1, 2019.
Upcoming presentations for the 2019 Training Conference

While the full conference schedule is nearing completion, the following workshops and presentations are planned to be presented during the conference.

Workshops

Communicating conclusions in bloodstain pattern analysis using principles from communication science
Jeremiah A. Morris, CBPA
Johnson County Sheriff’s Office

Communication is the action of transferring information and ideas from one entity to another entity. In bloodstain pattern analysis (BPA), this involves transferring ideas regarding pattern classification and, perhaps more importantly, reconstructive meaning, from the mind of the analyst to the mind of others who use this information for purposes of investigation, prosecution, or acting as the triers of fact. Bloodstain analysts communicate to others through written reports or verbal testimony. Communication science research has demonstrated this transfer of ideas is not a simple process and often there are failures for a variety of reasons in the accuracy of transferring these ideas from one person to another.

This workshop will review the theory of communication, reasons why accurate transfers often fail based upon research, and how the bloodstain analyst can incorporate these concepts into written reports and testimony. The workshop will include a mixture of theory and examples based on actual cases.

Area of Origin Analysis using 3D Technologies
Eugene Lisco

3D Technologies have allowed new opportunities for bloodstain impacts. Very complex and difficult surfaces are now possible to be documented in less time than manual methods with the added benefit that an area of origin analysis can also be visualized in the context of a crime scene. This workshop will give a brief review of some of the 3D methods available today and provide attendees an opportunity to participate in creating an impact which will be documented using a laser scanner. The impact will then be analyzed using the FARO Zone 3D software and the results of the analysis can be compared between analysts and errors reported to the known area of origin.

Attendees are asked to bring a PC laptop if possible and copies of the FZ3D software will be provided for the analysis.
Upcoming presentations for the 2019 Training Conference

IAI Certification Preparation
Rebecca Hooks and Jeff Gurvis

This workshop will cover the requirements of certification and the components of the test. Sample questions and practical exercises will be provided and discussed.

Alginate/ IR-photography
Martin Eversdijk and Jasper van der Duin
Loci Forensics

Since a few years, patterns and visualisation of blood on textile is a common lecture topic during IABPA meetings. This growing interest is mainly caused by special bloodstain courses on Fabrics/Textile and the use of Infrared photography. This workshop focus on enhancing Infrared photography and the use of chemical blood search and enhance methods to recover and lift bloodstains from textile and skin.

The general outline of the three hour workshop is as follows:
1. Lecture and demonstration of I.R. photography and methods of chemical enhance bloodstains on textile
2. Lecture and demonstration of lifting bloodstain from clothing with the use of alginate and chemically enhance the lifted print.
3. Making your own lift from clothing with the use of alginate
4. Lecture of chemical blood search techniques (Luminol/Lumiscene) on textile
5. Demonstration Lumiscene
6. Summary, questions, comments and suggestions

All material will be provided, samples are made with cow blood and photo camera is welcome.

Presentations during the week

Directional Analysis Uncertainty of Measurement
Kevin Winer, Kansas City Police Department

Directional analysis may reconstruct areas of convergence or areas of origin in attempt to determine the location(s) of a blood source when force was applied to blood. Methods for directional analysis include: utilizing limiting angles and voids, manual trigonometric methods and software-assisted methods. Qualitative or quantitative conclusions may be established by these methods. Relevant accreditation requirements and uncertainty of measurement (UOM) for each method will be discussed with a focus on whether or not UOM is applicable. The Kansas City Police Crime Laboratory approach for software-assisted directional analysis UOM will be presented. UOM components to be discussed include: inter-analyst variation, stain selection, linear measurements of stains’ locations, the laser range meter accuracy, camera angle deviations from perpendicular during image capture, gamma measurements, alpha calculations and the calculated origin. Casework applications of UOM will be presented.
The Head as a Source of Bloodspatter: A Dynamic Shooting Incident Reconstruction.
Alexander Jason, Independent Consultant
In this officer involved shooting incident a suspect was in a moving vehicle. A key question centered on where and when the bullet struck the suspect during the vehicles’ backward travel. This case required a comprehensive analysis to establish a reconstruction of the events and movements of the officers, the vehicle, and the suspects. 3D animation graphics are used to display the elements of the incident and to illustrate blood dynamics.

This presentation will discuss significant evidence items including GSR, bullet performance, blood spatter, ballistic penetration of glass, cartridge case ejection, and more.

Charts based on fluid dynamic simulations can help determine the relative positions of stains and blood sources, also on fabrics
Daniel Attinger, Iowa State University
Methods based on charts can be practical and affordable alternatives to software-based methods. This talk proposes to use charts to determine the area of origin of a blood spatter, a challenge that our group addressed at the recent IABPA Paris with a software-based method. Here we solve the problem with charts that provide insight on how the main parameters influence the determination of the area of origin. We formulate the problem in a fluid dynamics and inverse data search framework. The fluid dynamics that curves drop trajectories downwards is solved with Newton's equation of motion and a model for the gravity and drag forces. The parameters screened are the drop size, initial velocity and launch angle, as well as the relative height between the origin and target, and the height of the ceiling in the room of interest. Relations between stain size and the drop size and impact conditions are obtained for both fabrics and non-absorbing targets. The study commended the performance of more than 5 million fluid dynamic simulations. Results of the simulations have been searched for parameters directly measurable on crime scenes, such as stain size and stain ellipticity. The results are presented in simple charts, for both non-absorbing targets [1] and fabrics. For any given relative position between a specific stain and a blood source, in terms of horizontal distance and relative height, the chart determines whether or not that stain can originate from that blood source. The charts are easy to use, and only minimum knowledge of fluid dynamics from the analyst. The remaining steps towards developing these charts into tools directly useful to the practitioners is highlighted. These steps involve the quantification of uncertainty (in collaboration with the Center for Statistics and Applications in Forensic Science, CSAFE), and training of students and practitioners to the use of charts. Based on the proposed method, practical recommendations for crime scene documentation are drawn.

A logical framework approach for evaluating BPA evidence in casework
Leon Meijrink, Netherlands Forensic Institute
A woman sitting on her couch was murdered. She was beaten till death and had severe head injuries. Her husband calls the emergency center and the operator told him he has to give her CPR. When the police arrived they see that the woman is lying on the floor with the man sitting next to her attempting CPR. Eventually the victim passed away on the way to the hospital. The same evening her husband is arrested as the prime suspect in this case.
During the interrogation he stated that he arrives at home from the evening store and found his wife on the couch with injuries to the head. He claimed that he only resuscitated her.

The issue in this case is whether the suspect has beat his wife to death or someone else did this. The suspect was not there when someone beating his wife. He only give CPR to the victim. Based on this case, I will demonstrate how we address questions from the court on competing propositions. In this logical framework for case assessment and interpretation the blood present on the examined fabrics from the suspect are interpreted in the light of the propositions of the prosecution and the defense and the relevant context information. The outcome of this is an evidential value provided by means of a likelihood ratio. The likelihood ratio is a measure for the amount of support the findings provide for one proposition in relation to an alternative proposition.

Bloodstain pattern evidence interpretation should follow a probabilistic framework for evidence interpretation and reporting. But that’s logical…

Three Dimensional Documentation and Analysis of Cast-Off Stains
Eugene Liscio, ai2-3d
The use of 3D technologies such as the laser scanner and photogrammetry for documentation and analysis of bloodstains are powerful tools. Research in this area has shown that the accuracy and repeatability of determining the area of origin using these methods is in agreement with traditional methods. 3D technologies allows for more complex scenarios to be recorded with the added benefit of reducing documentation time. This opens up the door to highly complex bloodstain patterns that would otherwise not be attempted using conventional methods. Cast off stains have been an elusive type of pattern which has traditionally had limited utility. This presentation takes a second look at cast off stains and investigates how they might be able to provide additional information by looking at empirical test data.

AI and the Future of Forensic Science and BPA
Jeff Gurvis, Visionations/NFSL
Nearly every industry is rapidly adopting Artificial Intelligence to improve services and analytics. Forensic Science and BPA will be no exception. As technology incorporate these tools, workflows and methodologies will change, ideally for the better. This presentation will discuss what AI is and how it will impact forensic science and BPA.

IMS MAP360 BPA Workflow Validation
Amy Santoro, Senior Forensic Scientist, Johnson County Sheriff’s Office
Chenal Georget, Forensic Product Manager, MicroSurvey
Leica IMS Map360 is a software solution allowing users to easily create compelling courtroom presentations and evidence documents using data from multiple sources. The bloodstain pattern analysis workflow within Map360 allows users to integrate scan data and high resolution photographs and create area of origin calculations within a three dimensional data set. The workflow permits users to select stains for analysis, and the computer measures the stains and calculates the area of origin for the user. The area of origin is mapped within the scan data in three dimensions.
In this presentation, you’ll learn about this new feature within Map360 and see a brief overview of Map360 and the BPA workflow. An overview of the validation process will be presented, including examples of the resulting output results and reports.

**Latent fingerprints under blood, how can we recover them?**

*Martin Eversdijk (Loci Forensics) and Theresa Stotesbury (Ontario Tech University)*

It is not uncommon if at a crime scene a knife was found in a pool of blood, like the rest of the knife the handle was covered with blood. Revealing of fingerprints on the handle under the coagulated and dried blood could provide significant information beyond traditional BPA and DNA testing for solving the crime.

This research investigates the collection and enhancement of latent fingerprints found on and under bloodied evidence. Fresh whole human blood bloodstains (n=900) from different 4 donors were deposited on small glass plates containing a latent fingerprint, also deposited by the donor. After a minimum of 1 and 2 weeks the blood was removed by using the principles of solid-phase extraction, using a custom build apparatus. The latent fingerprint was studied for identification subsequent to whole blood removal.

In this presentation, we will highlight the process for removal of the blood as well our current research and future initiatives.

**Virtual Blood Droplet Trajectory Imaging**

*Dr Michael Taylor (ESR, Christchurch), Adrian Taylor (Revolution 3D), Alex Tompkins (University of Canterbury), Dr Natalia Kabaliuk (University of Canterbury), Roz Rough (ESR, Christchurch)*

An Augmented Reality (AR) application known as the DTI (Droplet Trajectory Imaging) app has been developed for a mobile iOS device and tested on a simulated impact spatter bloodstain pattern. The app recognises feature points in a bloodstain pattern and tracks these points between camera frames. The user can capture an individual bloodstain via the device’s camera. An image of the bloodstain, along with positional information of the stain in the pattern are sent to a server, running a Python-based application, for processing. The Python script fits an ellipse to the stain and returns ellipse parameters and reconstructed trajectory data back to the mobile app. Once several bloodstains have been processed, the iOS app can be used to visualise the projected trajectories in the scene. The user can move around the scene, using the device to visualise the trajectories from many perspectives, and in the context of real world objects. Some initial validation tests have been performed on the calculation of the droplet impact angle, a key parameter in the determination of drop trajectory. These tests have demonstrated the accuracy of the app in this calculation. The successful development of the DTI app has confirmed the potential value of this app. With on-going development and further validation, a crime scene ready tool will be achievable. This will enable a bloodstain pattern analyst to image and measure selected bloodstains and visualise droplet trajectories and areas of convergence in real time at a crime scene.

**The Improvement of McDonnell Formula and the Development of Smartphone App for the Calculation of the Impact Angle of a Blood Spatter**

*Young-IL Seo, Department of Forensic Engineering, National Forensic Service*

The result of impact angle calculation of blood spatters is used to estimate the area of origin of the blood and plays an important role in restructuring the violent behavior. The impact angle of blood...
spatters can be calculated according to the geometry of the bloodstain (the ratio of the short axis to the long axis of the elliptical shape). At present, there is a procedural difficulty in calculating the impact angle in the field, since the length of the major axis and the minor axis is directly measured by a naked eye using a loupe at a crime scene, and this value is substituted into the calculation formula of the impact angle of blood spatter. Therefore, a device that can easily and accurately calculate the impact angle of blood spatters in the field is required, and a program for smartphone that can calculate the impact angle of blood spatters is developed.

When the elliptical blood spatter is photographed by smartphone, ellipse is formed along the outline of the blood automatically, and the impact angle is calculated by the ratio of the short axis / long axis of the ellipse. The calculation formula for the impact angle calculation can be selected from both the conventional formula, the McDonnell formula, and the formula for improving the error of the formula, that is, the optimal formula for A4 paper and the optimal formula for the wallpaper developed by National Forensic Service in Korea.

This smartphone app has dramatically improved the existing method of measuring the impact angle of blood spatter in the crime scene in terms of function. Using this app, it is easier, faster and more precise to calculate the area of origin of blood spatters. Therefore, the use of this app is expected to help greatly in the analysis of blood-related crimes in the future.

**A study on the development of forensic artificial blood substitute: Focusing on Bloodstain pattern analysis**

_Sang-Yoon Lee, Department of Forensic Engineering, National Forensic Service_

Bloodstain pattern analysts should be able to educate them about the mechanisms by which bloodstain is produced and finally characterize the bloodstain. Based on this, the experiment confirmed the hypothesis that could explain the scene most clearly among the many hypothesis introduced to identify the cause of the formation of the target bloodstain or bloodstain type, and ultimately reconstructed the scene to secure scientific credibility should be able to secure the proof of evidence.

Human blood from the subjects blood collection, animal blood (pig or cow) supplied from the slaughterhouse, and artificial blood substitute (A and S and T Co. USA) developed overseas are used for bloodstain pattern analysis experiments and education.

In the case of human blood, there are problems such as objection to blood collection, possibility of odor and decay, risk of biological infection, problems with supply and demand when a large amount of blood is needed, and difficulty in controlling experimental conditions due to changes in physical properties due to the use of anticoagulant. In the case of animal blood, the likelihood of odor and rot, risk of biological infection, difficulty in supply and demand due to low marketability, difficulty in controlling experimental conditions due to differences in physical properties with human blood. In addition, in the case of artificial blood substitute, developed overseas aggravated economic burden due to high price, prolonged delivery period, insufficient verification through physical property measurement and experiment with human blood, there are problems such as manufacturing and selling according to the shape reproduction and functional separation of the luminol reaction.
The developed artificial blood substitute ‘A’ (tentative name) showed the most similar results in comparison of physical properties such as viscosity, surface tension, and viscoelasticity for human blood, animal blood (pig or cow), and overseas developed artificial blood substitute, the human blood comparison of the blood droplet impact angle coordinates and origin of impact spatter of physical properties the showed very similar results. In addition, the manufacturing method is relatively simple, easy purchase of materials needed for manufacturing, there are advantages such as the use of materials that are less harmful to the human body, the functional part was supplemented to enable luminol reaction experiments and pattern transfer (such as blood fingerprints and blood footwear impression) enhancement experiments.

In the future, further refinement of the physical properties of the developed artificial blood substitute, examine the effectiveness of various reagents or kits used in the DNA evaluation process through linkage with DNA, it will be used for research in various forensic science fields. The artificial blood substitute production method will be distributed to related organization such as the National Police Agency and the Ministry of Defense.

**Impact force measurements using household items as weapons**  
*Shawn Harkins, New South Wales Police Force*

Bloodstain pattern analysts have attempted to marry observable bloodstain patterns to a defined range of force for almost 50 years. Medium velocity impact spatter (MVIS) was said to occur with a force or energy for creation between 1.5 to 7.6 m/s. Research designed to calculate the impact force of a number of improvised weapons found great disparities between the reported literature and experimental results. In some cases, the range extended to double this reported maximum. These ranges and the resulting concepts of low, medium and high-velocity impact spatter were imprecise, subject to considerable conjecture, and were later abandoned. This study reimagines the problem using improved technology.

Volunteers are asked to swing a number of household items (including hammers, golf clubs and baseball bats) towards a target fitted with a load cell to determine the force at impact. Rotational inertia is determined using high-speed video footage through an analytical software package. The results aim to provide an experimentally validated baseline that can be used for the construction of impact force generators used in bloodstain pattern analysis.

These generators can aid in the reconstruction of crime and incident scenes.

**Understanding ISO/IEC 17020:2012 Accreditation in Bloodstain Pattern Analysis**  
*Celestin Ross, Montgomery County Sheriff’s Office Crime Laboratory*

This lecture will provide knowledge as to the requirements of obtaining BPA Accreditation in: Documentation, Area of Origin Determination, Bloodstain Pattern Determination, and Event Reconstruction for your agency or private practice.

Additional presentations scheduled for the conference but which had no abstract at this time:

**When is a bloody print not a transfer**  
*Cristina Gonzalez*

**Legal Considerations — Prosecutor’s perspective**  
*Amy Watroba*

**Legal Considerations — Defense perspective**
Abstracts from the 2019 European IABPA Conference

The following presentations were given at the 2019 European IABPA conference held in Paris this past June. Our deep appreciation is extended to Céline Nicloux and all other individuals who assisted her in putting together a very successful conference this year!

Abstracts for presentations

THE INFLUENCE OF NEURO TRAUMA UPON BPA
Silke Brodbeck, Blutspureninstitut
The development or existence of neurological symptoms often influences the creation of bloodstains at a crime scene or takes part in the development of actions during a crime. Often these influences remain unrecognized or wrongly analyzed due to different reasons. One fact is that autopsy is not able to document some of these changes in quantity and quality, some changes require a special knowledge from the doctor and some remain unrecognized due to the destructive nature of autopsy.

This presentation shows neurological influences upon crime scene work together with practical case examples. It shows how to approach cases with neurological findings in the persons involved and how the crime scene work is influenced and controlled in these situations.

EVAPORATING DYNAMICS AND PATTERNS OF DRYING BLOOD POOLS
Fiona Smith, Aix-Marseille University
The study of blood in the context of forensic science is becoming a widespread research topic, although the physics behind wetting and drying of blood is not yet completely understood. In the frame of a collaborative work, D-BLOOD ANR project, research on this topic has been realised in order to provide new evidences to investigators in crime solving. This work examined the different patterns that blood exhibits when drying. The drying pattern of blood pools appears more disordered than the pattern of drying drops of blood. However, similar disordered crack patterns are observed in the case of gels. The evaporation process of a gel has been, therefore, investigated and, then, compared to the particular case of a drying blood pool. By investigating this topic, which has incited recent attention from the scientific community, we aim to find features that could give information concerning the evolution of a blood pool over time to eventually lead to practical application of this knowledge. Empirical relations are established between final dried blood patterns and the generating mechanism, yielding possible application in blood pattern analysis for forensic investigations.

THE SELECTION OF BLOODSTAIN AT THE CRIME SCENE: IN SITU APPLICATION OF ANTIBODIES TO DISCRIMINATE BLOODSTAINS FROM THEIR BLOOD GROUP
Valintin Carlier, Université de Lausanne (Suisse)
At the scene of a bloody crime, investigators often face the task of collecting bloodstains. According
to the course of events, it can be expected that most of the bloodstains originate from the victim. However, the attacker’s blood may also be present at the scene, for example, if (s)he injured himself (herself) during the action. In such circumstances, it appears highly relevant for the investigators to differentiate the attacker’s bloodstains from the victim’s blood, especially for collection purposes. Presently, investigators have to rely on their personal experiences, circumstantial information, or the understanding of the course of events to guide their choices. This could represent a challenging task, especially in presence of a high quantity of blood and bloodstains. If blood pattern analysis can provide information on the process that had generated the bloodstains, it may hardly help distinguish bloodstains from different individuals. In this context, providing the investigators with a visual discrimination of the bloodstains originating from different sources in-situ would assuredly help them in their sampling task. This is the aim of this study.

A METHOD TO DETERMINE AREA OF ORIGIN OF BLOOD SPATTER PATTERNS WITH CURVED TRAJECTORIES AND STATISTICAL UNCERTAINITIES

Daniel Attinger, Ames Laboratory

This talk describes the development of a method to improve the accuracy of a method used by bloodstain pattern analysts known as Area of Origin determination, which is applied to impact spatter patterns at crime scenes.

This method has traditionally involved an assumption of straight line trajectories for spattered drops. Also, the estimation of the uncertainty in the determination of the area of origin is currently based on a range of experimental studies rather than on the characteristics of the individual spatter at hand. Recently, several attempts have been made at reconstructing ballistic trajectories backwards, considering the effects of gravity and drag forces. Here, we describe a method [1] to reconstruct the area of origin of impact blood spatter patterns that considers fluid dynamics and statistical uncertainties. The fluid dynamics relies on defining for each stain a range of physically possible trajectories, based on known physics of how drops deform, both in flight and upon slanted impact. Statistical uncertainties are estimated and propagated along the calculations, and a probabilistic approach is used to determine the area of origin as a volume most compatible with the backward trajectories. A publicly available data set of impact spatter patterns [2] on a vertical wall with various impactor velocities and distances to target is used to test the model and evaluate its robustness, precision, and accuracy. Results show that the proposed method allows reconstruction of bloodletting events with distances between the wall and blood source larger than ~1 m. Causes of error and uncertainty are discussed, and the effect of individual parameters on the uncertainty in the area of origin of a specific pattern are shown. The proposed method allows the consideration of stains indicating impact velocities that point downwards, which have typically been excluded from trajectory reconstruction. Based on the proposed method, practical recommendations for crime scene documentation are drawn.

THE CHARACTERISATION OF BLOODSTAINS ON CARPET FOR ADVANCEMENT OF CRIME SCENE INVESTIGATION

Laura Hugh, University of West London

While the behavioural dynamics of blood on hard surfaces have been established, a lack of understanding of how blood interacts with common porous surfaces found at crime scenes still prevails. Practitioners face examination of a wide range of porous surfaces which vary in complexity, in terms of variances in colour, surface texture, condition and location of item in the crime scene. All of these factors contribute to challenges in interpretation of bloodstain patterns.
Carpets are three dimensional, multi-layered, complex structures which vary in fibre construction, quality, pile length, pattern, and whether they are tufted, as well as having a range of primary and secondary backing materials. In addition to this, protective treatments, different cleaning methods and general wear and tear can contribute to changes in the carpet’s appearance and in some circumstances its construction. This presentation will raise awareness of objective methods of analysing bloodstain patterns on this type of textile floor covering.

This presentation will show results obtained from an initial study on the characteristics of bloodstains resulting from individual droplets of blood falling onto carpet through gravity. This research was conducted to test and understand the effects of varying the impact velocity of a drop of blood on the resulting bloodstain on two different carpet types. The results showed that the stains behaved very differently between the two carpet types. The stains were larger in overall size on the 80/20% natural/synthetic blended carpet and tended to stay on the surface and not penetrate the carpet as deeply as the 100% synthetic carpet. The stain on the synthetic carpet was smaller and quicker to absorb into the carpet, which occurred to a greater depth.

The researcher’s investigations will improve expert understanding of the interaction of blood with common household carpets in a way which will improve practitioners’ knowledge and provide more confidence in evidence evaluation in the criminal justice system globally.

EFFECT OF FABRIC AGE ON BLOODSTAIN FORMATION AND APPEARANCE
Sherini Koh, Health Sciences Authority, Singapore
Blood behaves differently on porous surfaces such as fabrics than it does on non-porous surfaces. The interaction between blood and fabrics appears to be complex and is not well understood. When blood impacts a fabric, the resultant bloodstain may be profoundly distorted by the absorption characteristic of the fabric, wicking properties or other variables such as fibre content, fabric structure and wear condition. In this study, fabric types used in commonly encountered garments worn in Singapore were used as the target surface. Equine blood was dripped at a fixed height at five different impact angles onto fabrics that have been subjected to wear and laundered for zero, four, ten and thirty washes. The angle of each of these bloodstains was calculated immediately after impact and after the bloodstain was left to be completely dried, to study if there is any effect on the bloodstains examined several hours or days later in the laboratory after the crime had taken place. Errors associated with each impact angle was calculated for each fabric type and preliminary findings point towards an under-estimation of the calculation for the impact angle.

BPA AS USEFUL TOOL TO RECONSTRUCT CRIME DYNAMICS
Paolo Fratini, RIS (Reparto Carabinieri Investigazioni Scientifiche) of Rome
This paper concerns about technical activities we conducted at the various crime scenes and the analytical approach we adopted, based on BPA as well as on ballistic effects (for murders committed by firearms), studied and collected during CSI.

Due to the specific shape and number of blood stains spattered, we decided to select the best important areas where it was worth applying the BPA both as qualitative and as quantitative approach. On this regard quantitative BPA analyses applied to the bloodstains allowed us to determine different points of origin related to hits inflicted on the victims. A model of bloodstain trajectories was then reconstructed using computer software.

Following this integrated analytical approach, it was possible to understand the reciprocal positions
between victims and assailants and thus reconstruct the dynamics of the events.

ACCOMMODATING THE MULTIPLE PERSONALITIES OF BPA: INVESTIGATION, EVALUATION & REVIEW

Jo Millington, Millington Hingley Ltd

significantly from crime scene to court. Through this process BPA evidence can be considered by multiple actors with various remits, from the initial investigation into the subsequent court process … and beyond. The investigator may initially use the distribution of bloodstains to identify possible mechanisms of production. When suspects are identified, the bloodstaining will be evaluated in light of the accounts that have been provided. But throughout the criminal justice process, the bloodstain pattern analyst will be required to present an evidence-base that substantiates their observations and supports the conclusions that they present to the court. This can include to decision-makers whose only experience of BPA is from the television.

The BPA findings may also be assessed by other scientists, instructed on behalf of the defence or as part of a post-conviction review, and their role may include consideration of the original case record against a completely new set of propositions.

The original bloodstain pattern analyst must therefore ensure that their records can support every stage of the process. Their case record must be consistent, comprehensive and complete, so that anyone who reviews the original analyst’s work can investigate the bloodstains as though they were looking through their eyes. How on earth do we do this?

In this talk, I will discuss the role of bloodstain patterns across a number of criminal case investigations, including those where there was a requirement to review complex bloodstain evidence from the notes that were contained in the original case file.

THE SUBMARINE CASE - EXAMINATION OF A BLOODSTAINED COVERALL

Esben Bager, Danish National Police

An evening in August 2017 the suspect sailed from Copenhagen in his own home build submarine. On the submarine was the Swedish journalist Kim Wall. The next day the submarine was missing - including both the suspect and Kim Wall. A large rescue operation with boats and helicopters started up. Hours after a private boat located the sinking submarine and found the suspect standing on top of the submarine. After a short swim the suspect came onboard on the private boat. When they arrived the coast, the suspect was turned over to the police. The suspect, who wore a coverall, was shortly after arrested.

The primary examination of the coverall showed small amounts of tissue and blood. Further examination of the coverall was carried out. Tests with a similar coverall was used for experiments in sea water.

BPA IN QUEBEC : TRAINING, PROGRAM, ACCREDITATION OF BPA AND CASEWORK

Jacinthe Prevost, Laboratoire de Sciences Judiciaire et de Médecine Légale

The Laboratoire de sciences judiciaires et de médecine légale (LSJML), Quebec government’s forensic laboratory, located in Montreal and founded in 1914, was the first forensic science institution in North America. The laboratory employs 162 persons and comprises several departments covering most forensic disciplines: firearms, toolmarks, arson and explosions, questioned documents, chemistry, DNA/biology, toxicology, forensic pathology, odontology,
anthropology and digital imaging. The LSJML DNA/Biology service itself employs 38 forensic scientists performing exhibit examination, serological and DNA analysis, as well as overall result interpretation, report writing and court testimony. Four of these scientists also perform bloodstain pattern analysis (BPA). The LSJML BPA team serves every police force in the province of Quebec (population 8 million, area covered 1.6 million km2).

The LSJML has developed an extensive training program that is mandatory for biologists who carry out BPA activities. The biology specialist must undergo a mentorship-based program, dispensed by at least two experienced bloodstain pattern analysts. The trainee accompanies each mentor on multiple blood shedding events (at least 50). Field related lectures and presentations, practical exercises, case studies and case report writing are also part of the structured training. The program includes shadowing of mentors during court testimony. Training duration is approximately two years prior to independent BPA on crime scenes.

The LSJML has been accredited under standards ISO/IEC 17025 : 2005 and CAN P 1578 since 2010. The BPA team was first audited in February 2017 and the accreditation was maintained following the LSJML reassessment. The extension of the established QS for BPA required the formalization of existing processes. All of the practices were converted into guides, protocols and forms to tie them in with the processes already in place for serological and DNA analysis. The LSJML is currently working on the transition from ISO 17025: 2005 to ISO 17025: 2017 in preparation for the upcoming external audit in November 2019.

LIFE OF BLOOD : EXVIVO

Christophe Martinaud, Army Health Service

Blood transfusion is only possible through the preservation of blood products. Outside the body, the blood coagulates; preservation solutions have allowed both the maintenance of a fluid character and the preservation of the qualities of the various elements. Plasma, red blood cells and platelets are the main constituents used in blood transfusion, white blood cells, or leukocytes, being reserved for highly specialized indications. The conservation solutions available, associated with the temperature conditions, have the objective of maintaining the physiological qualities of these constituents by providing the essential elements for the metabolism of these cells or by preserving the properties of the proteins. Despite this, a number of changes occur during the storage of blood products, grouped under the name “storage lesions”. For plasma, the concentration of the different coagulant proteins or their ability to generate thrombin are the main indicators of these changes ex vivo. For platelets, the metabolism, the spinning index and especially the recirculation capacities make it possible to understand the consequences of storage. Finally, for packed red blood cells, hemolysis, proteomic and cytometric analysis are the tools of choice to evaluate the impact of conservation on their properties. Despite the many tools available, many questions remain as to the consequences for the patient of these alterations. New data from large-scale clinical studies provide some answers but leave much room for innovation and research in this area.

LAWYER OF THE VICTIMS VIEW POINT ON BPA

Corinne Hermann, Lawyer at the Court Paris

Morpho-analysis from the point of view of the Advocate, and more specifically from the Victims’ Advocate - or how does it endure it? How does he use it?

During the instruction:

The Lawyer approaches the subject on the occasion of files in which this technique has been used, he
must understand and decrypt the work done by the expert, then with regard to the other elements of the information. He can discuss the results, request supplements etc. with all the risks that this entails.

The Lawyer himself requests before the Examining Magistrate the use of this technique in search of the manifestation of the truth - he must master his file and have a good knowledge of the technique to form his requests - that can bring this technique to his record?

At the hearing:
The Lawyer discusses the results obtained at the hearing and questions the expert himself - (examples)
In conclusion a more general opinion on the technique itself.

**MAGISTRAT VIEW POINT ON USE OF BPA**
*Francois Lales, Vice President Examining Magistrat at High Court*

Criminal magistrates, who all share the same objective of establishing the truth, can not remain indifferent to a discipline that offers them a new perspective on a bloody crime scene.

However, prosecutors, investigating judges, judges, do not all share the same point of view on bloodstain pattern analysis. Faced with the same bloody crime scene, different magistrates, all of them from the same school and having benefited from the same teachings, will consider the bloodstain pattern analysis in very different ways.

Indeed, despite the prospects it offers, this technique is not unanimous, some judges considered it useless to establish the truth, even source of errors because of its “unscientific” character. Others seem to expect a lot, perhaps too much, seeing it as an opportunity to reliably reconstruct the crime scene.

Between the rejection of the discipline and the fantasies that it arouses, I propose to share my vision of the bloodstain pattern analysis, and that of some of my colleagues investigating judges, prosecutors, or judges.

Under what conditions does the French magistrate resort to bloodstain pattern analysis? What does he expect from this analysis at the different stages of the criminal proceedings, when he is in charge of conducting investigations, when he supports the prosecution or has to conduct a trial? What are the disadvantages of this expertise?

**CAN WE TRUST IN OUR MEMORY?**
*Pascale Gisquet-Verrier, Neuroscience Paris-Saclay Institute*

During this talk, I will shortly present the different types of memory, and more particularly, the autobiographical memory. We will see how these memories are formed, maintained and retrieved. I will present evidence indicating the determinant role of various factors such as perception, attention, context and emotion which are all known to greatly affect the memory formation/retention. We will also see how the way used to retrieve a memory may modify the retention. I will also introduce the notion of malleability and show how this characteristic of memory may be used for the normal functioning of memory, for therapeutical purpose, and also to create false memories.

**COGNITIVE AND HUMAN FACTORS IN FORENSIC DECISION MAKING**
*Itiel Dror, Cognitive Consultants International*

The workshop focuses on improving Forensic Decision Making. It is an interactive and engaging workshop and covers brain and cognitive issues relating to cognitive and human factors issues in
decision making. It then connects the cognitive science issues to practical and specific issues in forensic work. In addition to knowledge about the cognitive and human factors in forensic decision making, the program also provides practical solutions to address weaknesses as well as best practices to enhance forensic practices.

Conducting forensic work (from collecting evidence at the crime scene, to its examination in the crime lab) is similar to other expert domains that require perception and interpretation of information, such as in the military, medical, and financial domains. Information is perceived, encoded, represented, transformed, stored, retrieved, compared to other information, evaluated and assessed, to name just a few cognitive processes. The human mind is not a camera, as we actively process and compare information. It is naïve to think that we passively process information, and perceive the data as ‘it really is’. We engage in a variety of cognitive processes that organize and structure the information as it comes in from the external world. Information is then further interpreted and processed in ways that highly depend on the human mind and cognitive factors. As we dynamically process information, we affect what we see, how we interpret and evaluate it, and our decision making process. Thus, to enhance expert performance and understand that different factors may affect decision making, especially in a highly specialized domain such as forensic science, one needs to take into account the role of the human mind and cognitive factors. Although training is provided to forensic experts, there is a lack of training in psychological and cognitive factors involved in forensic decision making. Thus, there is a lack of systematic training and professional development in the influence of human cognition on forensic work and this workshop is a step towards addressing training in the cognitive and human factors involved in forensic decision making.

MEMORY AND ANALYTICAL REASONING: TRAPS OF OUR EMOTIONS AND INTUITIONS

*Bernard Anselem, Doctor*

Brain networks have evolved over time in order to rapidly manage a quantity of information, for survival and satisfaction of basic needs. Analytical reasoning and language have been later established in addition to these basic functions, they remain under the influence of emotional and memory networks. The result is a set of influences to make quick, intuitive and automatic decisions (heuristics), often sufficient, but sensitive to the context, emotions and recovery of memories, and therefore sometimes fragile and sources of error of appreciation. This knowledge allows us to take a step back from our perceptions, our value judgments and our intuitive decision-making, and to shed light on our critical thinking.

VIRTANGIO AND LINKS WITH BPA

*Christelle Pasqualini, Forensic doctor IRCGN*

Forensic pathologist may find different kind of injuries on a corpse. Each of them is interesting, because it could explain the way death took place with violences and the use of different weapons. So, it’s important to identify blunt, sharp, gunshot or other kind of injuries. The link with bloodstain pattern analysis is important to understand the environment and to confirm the injury mechanisms.

If CT-scan is now recognized as a very useful tool to complete the findings of the forensic autopsies, Multiphase post mortem CT angiography (MPMCTA) allows forensic pathologist to precise vessel injuries by increasing the visibility of all the blood vessels.
THREE DIMENSIONAL DOCUMENTATION AND ANALYSIS OF CAST-OFF STAINS
Eugene Lisco, Professional Engineer
The use of 3D technologies such as the laser scanner and photogrammetry for documentation and analysis of bloodstains are powerful tools. Research in this area has shown that the accuracy and repeatability of determining the area of origin using these methods is in agreement with traditional methods. 3D technologies allows for more complex scenarios to be recorded with the added benefit of reducing documentation time. This opens up the door to highly complex bloodstain patterns that would otherwise not be attempted using conventional methods. Cast off stains have been an elusive type of pattern which has traditionally had limited utility. This presentation takes a second look at cast off stains and investigates how they might be able to provide additional information by looking at empirical test data.

‘THE CUBE’: A NOVEL APPROACH FOR BPA TRAINING AND CRIME SCENE RECONSTRUCTION
Leisa Nichols-Drew, De Montfort University – Leicester
De Montfort University (Leicester, UK) offers a Chartered Society of Forensic Sciences (CSFS) accredited BSc (Hons) forensic science undergraduate course delivered by practitioners. To ensure a continually high quality educational provision, DMU has invested in the latest learning technology that could provide a paradigm shift in forensic science training and education. The presenter’s extensive experience in both delivering Technical Training for the former Forensic Science Service and conducting BPA exhibit examinations within an Evidence Recovery Unit (more recently Cellmark Forensic Services) provides the required understanding of the Criminal Justice System requirements. Here, a novel integrated approach is presented, involving a specialist immersive facility which promotes a unique BPA experience. ‘The Cube’ enables experts to physically enter a real world scenario via footage projected from the ceiling onto 4 screening panels, thus creating a 360° panoramic film with surround sound. Therefore, providing a dual possibility for BPA as an essential tool for the reconstruction of crime scene footage (useful for peer review) and as a training course simulation resource. Ultimately, these findings will be of paramount importance for practitioners in the casework environment, those delivering BPA training, along with colleagues in forensic science academia.

LATENT FINGERPRINTS UNDER BLOOD: HOW CAN WE RECOVER THEM ?
Martin Everskijk, Loci Forensics B.V.
It is not uncommon if at a crime scene a knife was found in a pool of blood, like the rest of the knife the handle was covered with blood. Revealing of fingerprints on the handle under the coagulated and dried blood could provide significant information beyond traditional BPA and DNA testing for solving the crime.

This research investigates the collection and enhancement of latent fingerprints found on and under bloodied evidence. Fresh whole human blood bloodstains (n=900) from different 4 donors were deposited on small glass plates containing a latent fingerprint, also deposited by the donor. After 1 and 2 weeks the blood was removed by using the principles of solid-phase extraction, using a custom build apparatus. The latent fingerprint was studied for identification subsequent to whole blood removal.

In this presentation, we will highlight the process for removal of the blood as well our current
research and future initiatives.

WATER CLOSET DRAMA
*Iris Dalley, Graff Investigative & Forensic Training*

A woman was found deceased from an apparent suicide in the water closet of her home. Cause of death was a gunshot wound to the head. However, bloodstain patterns provided evidence lending to a possibly different manner of death. When taken in context with other evidence, the bloodstain patterns in this scene posed serious questions to the initial theory of suicide. This lecture presentation evaluates a variety of bloodstain patterns from a violent blood-letting scene in context with other evidence, using basic free office suite software to test possible scenarios and evaluate evidentiary relationships.

A LOGICAL FRAMEWORK APPROACH FOR EVALUATING BLOODSTAIN PATTERN EVIDENCE CASEWORK
*Leon Meijrink, Netherlands Forensic Institute*

A woman sitting on her couch was murdered. She was beaten till death and had severe head injuries. Her husband calls the emergency center and the operator told him he has to give her CPR. When the police arrived they see that the woman is lying on the floor with the man sitting next to her attempting CPR. Eventually the victim passed away on the way to the hospital. The same evening her husband is arrested as the prime suspect in this case.

During the interrogation he stated that he arrives at home from the evening store and found his wife on the couch with injuries to the head. He claimed that he only resuscitated her.

The issue in this case is whether the suspect has beat his wife to death or someone else did this. The suspect was not there when someone beating his wife. He only give CPR to the victim. Based on this case, I will demonstrate how we address questions from the court on competing propositions. In this logical framework for case assessment and interpretation the blood present on the examined fabrics from the suspect are interpreted in the light of the propositions of the prosecution and the defense and the relevant context information. The outcome of this is an evidential value provided by means of a likelihood ratio. The likelihood ratio is a measure for the amount of support the findings provide for one proposition in relation to an alternative proposition.

Bloodstain pattern evidence interpretation should follow a probabilistic framework for evidence interpretation and reporting. But that’s logical…

THE VALUE OF BLOOD SPATTER ANALYSIS WITHIN SHOOTING INCIDENTS
*Alexander Jason, ANITE Group*

This presentation will include the case details, photographs, video, witness statements and other evidence within two actual shooting incidents. Both cases included blood spatter evidence and this presentation will discuss and demonstrate how the blood evidence was utilized to perform an analysis of the events and the reconstruction of the incident. Computer-based graphics will be used to illustrate significant points of analysis. Participants will learn how “minor” blood spatter elements at the scene can become important in recognizing the sequence of events and the movement of victims. Participants will also understand how empirical experiments with blood spatter can be utilized to test and support significant aspects of the reconstructive analysis.
THE MURDER THAT SHOOK A NATION
Ragnar Jónsson, Reykjavík Metropolitan Police, Iceland

In early morning of the 14th of January, 20 year old Birna Brjánsdóttir went missing in downtown Reykjavík. She had no police record and came from a good home. Signal from her mobile phone was picked up in nearby town around 05:50 am and CCTV showed Birna around 05:25 in Reykjavík! Her special shoes were found 72 hours later in the harbour area at nearby town. Police also picked up a rental car which had been seen close to Birna in the CCTV recording. When searching the car, we found blood in the seats and all over the car.

The search for Birna was Iceland’s largest ever. More than 400 rescue persons and civilians were looking. More than 40 detectives were working on the case along with my unit of 12 people. We had connection with the National Forensic Center in Sweden for our DNA analysis, with Martin Eversdijk for advices concerning luminol and our forensic pathologist was a German, Sebastian Nico Kunz. This is our toughest case to date and we are so thankful for the support our Nordic colleagues and Martin. This case is good example for European cooperation in a criminal case.

BLOOD PATTERN AND BEHAVIORAL TRACE: PERFECT COMBINATION TO UNDERSTAND THE CRIME SCENE
Marie-Laure Brunel, Departement of Behavioral Sciences Cergy-Pontoise, France

To solve a violent crime it may be necessary to understand the criminal’s behavior before, during and after the commission of the crime. The goal of the behavioral analyst (BA) is to have the best possible understanding of the cause of complex and violent crimes, on the basis of observable elements of the offender-victim interactions. Understanding goes by the reconstruction of the more likely sequence of events and in order to achieve this goal, forensic sciences are the fundamental. Bloodstain pattern analysis (BPA) explains, among others, how events have taken place and who was involved. Information of the blood shedding events that took place on the crime scene are showing how people behave during the crime. Behavioral analysis theory posits that it is possible to determinate the psychosocial profile of individuals based on personality traits associated with specific criminal behaviors (e.g., aggressive and impulsive behaviors are likely to be associated with an antisocial lifestyle).

Describing the bloody episode is describing part of the behavior, to understand next the personality. This expression of the criminal behavioral is the behavioral trace. The offender lets on the crime scene expression of his behavior. As BPA collects bloody traces, BA does the same with behavioral trace.

The analysis of bloodstain pattern describes objectively behaviors during or around the violent crime. Criminal behavior is explained on crime scene by the reconstructions of actions, interactions but not only. The link between those two disciplines BPA and BA is so obvious — BPA analyses the bloodstain pattern and is able to tell to the protagonists the “story” of it. BA complete that story, and adds victimology, and all others objective information to make sense and reconstruction the crime (before, during and after), to help investigations to understand who have could committed it. BA describes the type of personality of who is able to act like this. As we said, understanding it is the first step to the truth.

In many cases, those two sciences are associated to provide a comprehension of who did it and why and based on these questions to elaborate efficient investigative suggestions.
ENFSI : THE 1ST ENFSI PROFICIENCY TRIAL AND COLLABORATIVE EXERCISE ENFSI : ISO17020 ACCREDITATION OF BPA UNDERTAKEN AT THE CRIME SCENE WHAT, WHY AND HOW?

Dan Beaumont, Eurofins Forensic Services
In 2018 the European Network of Forensic Science Institutes (ENFSI) blood pattern analysis (BPA) project group delivered their first European-wide proficiency trial and collaborative exercise to ENFSI member organisations. The exercise looked at the accuracy and consistency of blood stain and blood pattern classification, as well as the methods currently used to describe and report BPA evaluations. Twenty eight returns were received, representing organisations from seventeen different countries across Europe. In this presentation we will describe how we produced the exercise, look at the results returned and lessons learnt. With notable thanks to the contributions of Josita Limborgh (Netherlands Forensic Institute) and Céline Nicloux (Institut de Recherche Criminelle de la Gendarmerie Nationale).

As the practices of forensic scientists - including BPA specialists - comes under ever increasing scrutiny, it becomes more important than ever before to be able to demonstrate that the practices undertaken are accurate, reliable and impartial. The adoption of accreditation standards is important for organisations undertaking forensic examination - and for the individuals working within those organisations. Far more than just a box-ticking exercise, accreditation can demonstrate that the scientific processes undertaken are reliable, impartial and, most importantly, give the correct outcomes. Whist the ISO17025 standards are well established and widely understood, the ISO17020 crime scene standards are more recent and less widely understood. This presentation will give a brief overview of the accreditation standards for organisations undertaking blood pattern analysis in the United Kingdom, how some of the challenges of ISO17020 at-scene BPA accreditation were met by Eurofins Forensic Services as well as describing the benefits of ISO17020 accreditation.

Poster Presentations

THE VIRTUAL TOUR OF A CRIME SCENE
Franck Le Roux, IRCGN – ANH
The virtual tour is a single multidisciplinary support to present a complex crime scene and all the elements of interest related to it : collection of clues - results of analysis and expertise - ... This tool is a link to varied content as copies of technical or scientific reports, photos and videos, animations, 3D modeling (webshare), web pages ... Thanks to it, the user can move to the crime scene. He can visualize the items of interest to him thanks to customizable filters. The virtual tour is updated throughout the criminal investigation. During the trial, the virtual tour can be an aid to the deposition.

There are several aims regarding the virtual tour:
• Aims for monitoring purposes
• Aims for synthesis purposes
• Aims for presentation purposes

The result is an interactive 360-degree virtual tour which includes: 360° views, menus of the panoramas with thumbnails, textual information, Bing map, image gallery...
The virtual tour is an aid:
- to the understanding of a crime scene
- to studying the links between evidence

BLOODSTAIN PATTERN ANALYSIS AND 3D MODELING
Philippe Cloux, IRCGN

The virtual tour is a single multidisciplinary support to present a complex crime scene and all the elements of interest related to it: collection of clues - results of analysis and expertise - ...

This tool is a link to varied content as copies of technical or scientific reports, photos and videos, animations, 3D modeling (webshare), web pages ... Thanks to it, the user can move to the crime scene. He can visualize the items of interest to him thanks to customizable filters. The virtual tour is updated throughout the criminal investigation. During the trial, the virtual tour can be an aid to the deposition.

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HEMOVISION: AUTOMATIC AND PROBABILISTIC IMPACT PATTERN ANALYSIS
Philip Joris, KU Leuven, ESAT – PSI/MIC

HemoVision is a software package that uses computer vision techniques to automatically analyse bloodstain impact patterns without the need for tedious manual work. Bloodstains are analysed using a statistical shape model, whereas impact patterns are reconstructed from multiple images by using a system of fiducial markers. Analysing the convergence of stain trajectories, finally, is done by applying either the tangent or directional approach. In both approaches, however, the 3-dimensional (3D) area of origin (AO) is sought by first projecting the 3D space onto a 2D plane (e.g. the target surface or ground plane) and analysing the intersections in this plane. To avoid the need for such 2D projections, we propose an approach that analyses trajectories in 3 dimensions directly. By dividing our 3D space into regularly spaced voxels, and letting trajectories vote on voxels they cross, we can construct a probability map for the location of the AO. This approach has the advantage of being more intuitive, while it can handle linear as well as parabolic trajectories without making any changes to the method.

VERIFICATION OF TRIS-EDTA AND PHOSPHATE BUFFERED SALINE TO APPLY DNA AND PROTEIN ANALYSIS FROM DRIED BLOODSTAIN
Ho Joong Sung, Eulji University, Korea

Objective: Dried blood stains (DBSs) from crime scenes could provide key information and guide the line of investigation. Especially, DNA from DBSs is widely used to resolve an offence, making it imperative to properly preserve DBS samples until DNA extraction. Molecular grade water or distilled deionized water (DDW has been used to preserve such samples; however, it is unclear
whether DDW can conserve DNA without any damage.

Methods: We evaluated the preservative ability of DDW, by carrying out subsequent DNA extraction, and compared it with two different commercial solutions: tris-EDTA (TE) and phosphate buffered saline (PBS). Additionally, we tested the efficiency of protein extraction from the DBS samples. We evaluated the expression level of the housekeeping molecule, glyceraldehyde 3-phosphate dehydrogenase (GAPDH), whereby the GAPDH gene was analyzed using PCR and the protein by western blotting.

Results: DBS preserved in DDW for different durations showed weak signals of GAPDH at all time points, compared with that preserved in TE or PBS. Interestingly, protein expression was not significantly different among DDW-, TE- or PBS-preserved samples for up to one month.

Discussion and Conclusions: Our results suggest that TE and PBS might be better solutions to preserve DBS samples. However, further studies evaluating different housekeeping molecules and multiple conditions of DBS sample collection and storage are required.

THE INFLUENCE OF ATMOSPHERIC PRESSURE TO THE MAXIMUM RANGE OF BLOOD SPATTER
Michel Schwerer, Air Force Centre of Aerospace Medicine, Branch I 4 Germany

Background: The reconstruction of the course of events via bloodstain pattern analysis (BPA) involves the interpretation of blood depositions with a characteristic morphology. The respective blood patterns result from the basic physical properties of blood. Among the most informative blood patterns are impact spatter stains. Their formation results from the fine distribution of small blood particles following an impact with high energy on a blood-covered surface. Because of their very low mass, only a short spatter distance from the blood source is possible (1). The gravity and atmospheric pressure in the respective scene which is defined as the local airtight, are the factors which determine the kinematics of the spatter.

Aims of the study: To our best knowledge, studies on the range of blood spatter were investigated only in laboratories located in low altitude, e.g. by the BPA working group in the Institute of Legal Medicine in Munich, Germany (~1,700 ft) (2). Data from locations with lower atmospheric pressure like on Mountains or in aircraft on cruising altitude (cabin pressure 6,000 – 8,000 feet) have not yet been reported. The present study was aimed to examine the influence of defined altitude and its corresponding aerial pressure on blood spatter.

Methods: Spatter patterns were produced employing a drop tower positioned in the hypobaric chamber of the Air Force Centre of Aerospace Medicine, Aviation Physiology Training Centre, Koenigshueck, Germany. By constant temperature (20 ± 0.5°C) and humidity (30 ± 2%), predefined blood volume (3 ml), and energy amount transmitted to the blood covered surface, bloodstains were produced on a laid out paper role. The only variable was the air density and the corresponding airtight on the respective blood dispersions. A set of different pressure levels simulating elevations between ground level and 25,000 feet above Median Sea Level (MSL) was studied. We used human blood mixed with EDTA as an anticoagulant obtained from volunteers immediately prior to the experiments. The distance between the blood source in the basis of drop tower and the blood depositions on the floor level of the chamber was measured.

DETERMINING THE SEQUENCE OF ORIGIN DILUTED BLOODSTAINS ON TEXTILE
Martine Verhoeff, Netherlands Forensic Institute

In (putative) violent crimes, bloodstains often occur. The evaluation of the results of a bloodstain pattern analyses should preferably be reported in the light of the scenarios of the prosecution and the defence. In some casework textiles contain diluted bloodstains. Except of cleaning, other events can result in the dilution of bloodstains too. Since hardly any literature is available concerning this
type of bloodstains, we started a preliminary study on these ‘unknown’ kind of stains. We choose 100% cotton textiles with a plain weave as substrate on which drip stains were diluted. The aim of the research was to examine if we could determine characteristics which discriminate between two sequences of dilution. Therefore single bloodstains were either dripped on dry textile and moisturized afterward, on the other hand bloodstains were dripped on previously moisturized textile. Based on the results we determined seven characteristics for the two sequences of dilution. Two surveys were distributed among in-house analysts and experts who deal with the interpretation of bloodstains. One survey without the determined characteristics. During the second survey analysts were familiar with these features. The outcome shows that the seven characteristics assist to discriminate between the two sequences of dilution. The characteristics recorded during this study apply to 100% cotton textiles with a plain weave. Currently we explore if these features also appear on other forensic relevant textiles, like plain weave polyester, jeans (twill weave) and knitted cotton T-shirts. At the same time we explore if our findings can be translated into the forensic practice.

The set-up and results of our preliminary study will be shared with the forensic (BPA) community during a presentation.

Abstracts for workshops

SEARCH, VISUALIZATION AND LIFTING OF BLOODSTAINS FROM TEXTILE
Martin Everskijk and Jasper Van Der Duin
Since a few years, patterns and visualisation of blood on textile is a common lecture topic during IABPA meetings. This growing interest is mainly caused by special bloodstain courses on Fabrics/Textile and the use of Infra-Red photography. This workshop focus on enhancing infra-red photography and the use of other chemical blood search and enhance methods to recover and lift bloodstains from textile and skin.

A general outline of the two hour workshop is as follows:
Lecture and demonstration of I.R. Photography and methods to chemically enhance the bloodstains.
Lecture and demonstration of lifting bloodstains from clothing with the use of alginate and chemically enhance the lifted print. Other forensic uses of alginate.
Making our own lift from textile with the use of alginate.
Lecture of chemical blood search techniques (Luminol/ Lumiscene) on textile
Demonstration of lumiscene
Summery, questions, comments and suggestions.

All material will be provided, samples are made with cow blood and photo camera is welcome.

3D RECONSTRUCTION AND PANORAMIC VIRTUAL TOUR
Eugene Lisco
3D Technologies have allowed new opportunities for bloodstain impacts. Very complex and difficult surfaces are now possible to be documented in less time than manual methods with the added benefit that an area of origin analysis can also be visualized in the context of a crime scene. This workshop will give a brief review of some of the 3D methods available today and provide attendees an opportunity to participate in creating an impact which will be documented using a laser scanner. The impact will then be analyzed using the FARO Zone 3D software and the results of the analysis can be compared between analysts and errors reported to the known area of origin.
Attendees are asked to bring a PC laptop if possible and copies of the FZ3D software will be provided for the analysis.

COGNITIVE AND HUMAN FACTORS IN FORENSIC DECISION MAKING + HOW LIMIT NEGATIVE IMPACT OF COGNITIVE BIAS ON OUR OBJECTIVITY AND SCIENTIFIC RESULTS

Itiel Dror, Bernard Anselem, and Pascale Gisquet-Verrier

The workshop focuses on improving Forensic Decision Making. It is an interactive and engaging workshop and covers brain and cognitive issues relating to cognitive and human factors issues in decision making. It then connects the cognitive science issues to practical and specific issues in forensic work. In addition to knowledge about the cognitive and human factors in forensic decision making, the program also provides practical solutions to address weaknesses as well as best practices to enhance forensic practices.

Interested in Hosting the 2020 Annual Training Conference?

The Association is looking for volunteers to host and organize the upcoming 2020 Annual Training Conference. The 2020 meeting is scheduled to be held somewhere in the Mountain Region. This is a tremendous opportunity to not just help promote the discipline and educate attendees, but it is also to become more involved in the Association and expand your professional network.

Anyone interested in hosting the 2020 Annual Training Conference should contact either President Gord Lefebvre or the Mountain Region Vice-President Brittany Nelson.
Unusual Bloodstain Patterns: Postmortem Expiration Patterns in Extended Downtime Death Scenes

Amy Santoro, MFS, CSCSA
Johnson County (KS) Sheriff’s Office Criminalistics Laboratory
Olathe, Kansas

During the unusually hot summer of 2019, two very similar bloodstain patterns were observed at crime scenes involving unattended deaths. In both cases, the victims died in their secure residences and were not discovered for several days. At the times of their discoveries, both bodies exhibited significant signs of decomposition.

In the first case, a 46 year old adult male died alone in his residence from a methamphetamine overdose. His body was located on a futon style couch, and his abdomen, face and neck were extremely bloated and dark red purge flowed from his nose and mouth (refer to Figure 1). A bloodstain pattern was located on the wall adjacent to the victim’s face consisting of dilute red brown circular stains. Spatter stains were also present on a metal arm bar of the couch, located immediately above the victim’s mouth (refer to Figure 2).

In the second case, a 70 year old male died alone in his residence, apparently from improperly treated cardiac issues. The decedent was severely decomposed and there was significant insect activity present in the scene, including apparent maggot trails extending outward and away from a dark brown bloodstain on the wall, immediately adjacent to the deceased’s mouth. Dark brown foaming purge fluid was present in and around the deceased’s mouth. There were also dilute red brown elliptical stains within the pattern.
area (refer to Figure 3).

Both men were located alone in their secure residences, and neither decedent had bloodletting injuries. No signs of struggle were located in either residence. Both decedents were located in supine positions with their heads hyperextended backwards. Both decedents had dark red brown purge coming from their mouths. The bloodstains in both patterns were dark red brown in color, and neither was visually consistent with the typical appearance of a pattern made with fresh blood. In both cases, the patterns were located in areas consistent with being adjacent to the decedents’ mouth and nose in their positions at the time of discovery. Neither body appeared to have been moved or reoriented after death.

Both patterns were determined to be expiration patterns, created post mortem due to the presence of bloody purge in the noses and mouths of the victims coupled with the expulsion of gasses from these orifices due to the decomposition process.
Become a member of the IABPA

Prior to submitting an online Membership Application, please register [HERE](#) for our website and create your profile. This process allows members to view their membership status and access their payment history and all form submissions at any time.

There are three types of IABPA Membership for which to apply:

<table>
<thead>
<tr>
<th>Member type</th>
<th>Description</th>
<th>Online Application</th>
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</thead>
<tbody>
<tr>
<td><strong>Associate</strong></td>
<td>A member who has NOT completed an IABPA-Approved 40-hour Basic Bloodstain Pattern Analysis course but who desires to become a member of the IABPA for general interests.</td>
<td><a href="#">APPLY NOW</a> for Associate Membership</td>
</tr>
<tr>
<td><strong>Provisional</strong></td>
<td>A member who has been recommended by a Full Member in good standing and who has completed a 40-hour Bloodstain Pattern Analysis course that meets the recommendations of the IABPA Education Committee*. (Course content defined by IABPA Education Committee guidelines include supervised, practical, laboratory-based practical assignments).</td>
<td><a href="#">APPLY NOW</a> for Associate Membership</td>
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<td><strong>Full</strong></td>
<td>A member in good standing who has held the position of Provisional Member for at least ONE YEAR, and, who has been recommended based upon efforts in the field of study of bloodstain pattern analysis.</td>
<td><a href="#">Request for Promotion to Full Membership</a></td>
</tr>
<tr>
<td><strong>Distinguished</strong></td>
<td>A member who has rendered significant service to the discipline or the Association and has been awarded the designation by his or her peers*.</td>
<td><a href="#">View our current list of Distinguished Members</a></td>
</tr>
</tbody>
</table>

*Course Requirements

To nominate a Member in good standing for Distinguished Membership, submit a Nomination Form [HERE](#).
Bloodstain Training
United States and Canada

**Bloodstain Pattern Analysis II**
September 23-27, 2019
Bevel, Gardner & Associates
Kent County Sheriff's Office
Grand Rapids, MI
Ross M. Gardner / Tom “Grif” Griffin

**Advanced Bloodstain Pattern Analysis**
September 23-27, 2019
Forensic Pieces
Cullman Police Department
Cullman, AL
Jan Johnson

**Advanced Bloodstain Pattern Analysis**
October 07-11, 2019
Forensic Pieces
St. Charles County Police Department
O’Fallon, MO
Jan Johnson

**Bloodstain Interpretation**
October 07-11, 2019
Institute of Police Technology and Management
Jacksonville, Florida
Jerry Findley
Nancy Sulinski-Steffens

**Basic Bloodstain Pattern Recognition**
October 14-18, 2019
See More Forensics
Worcester Police Department
Bolyston, MA
Craig C. Moore

**Basic Bloodstain Pattern Analysis**
October 14-18, 2019
Forensic Pieces
North Palm Beach Police Department
Pasadena, CA
Jan Johnson

**Bloodstain Pattern Analysis II**
October 14-18, 2019
Bevel, Gardner & Associates
Lubbock Police Department
Lubbock, TX
Ross M. Gardner

**Bloodstain Pattern Analysis**
October 21-25, 2019
GRAFF Investigative & Forensic Training / Tritech Forensics Training
St. Louis County Police
St. Louis, MO
Iris Dally Graff / Gary Graff

**Documenting – Report Writing – Presenting**
October 21-25, 2019
See More Forensics
Worcester Police Department
Bolyston, MA
Craig C. Moore

**Bloodstain Pattern Analysis**
October 28 – November 01, 2019
Forensic Pieces
North Palm Beach Police Department
North Palm Beach, FL
Jan Johnson

**Bloodstain Pattern Analysis**
November 04-08, 2019
CSI Academy of Florida
Alachua, FL
Kimberly Long
Bloodstain Training
United States and Canada

Fluid Dynamics of Bloodstain Formation
November 18-22, 2019
ESR
Pacific Region Training Center
Chilliwack, BC, Canada
Mark Jermy and Rosalyn Rough

Advanced Bloodstain Pattern Analysis Workshop
December 02-06, 2019
CSI Academy of Florida
Alachua, FL

Introductory Bloodstain Pattern Analysis Workshop
December 09-13, 2019
Noslow Forensic Consultation, LLC
Miami-Dade Public Safety Training Institute
9601 NW 58th St, Doral, FL
Toby L. Wolson, M.S., F-ABC

Bloodstain Interpretation
April 20-24, 2020
Institute of Police Technology and Management
Jacksonville, Florida
Jerry Findley
Nancy Sulinski-Steffens

Advanced Bloodstain Pattern Analysis Workshop
February 03-07, 2020
Noslow Forensic Consultation, LLC
Miami-Dade Public Safety Training Institute
9601 NW 58th St, Doral, FL
Toby L. Wolson, M.S., F-ABC

Bloodstain Pattern Analysis on Fabrics with an Introduction to Digital Casework Workshop
March 16-20, 2020
Noslow Forensic Consultation, LLC
Miami-Dade Public Safety Training Institute
9601 NW 58th St, Doral, FL
Toby L. Wolson, M.S., F-ABC

Advanced Bloodstain Pattern Analysis
July 20-24, 2020
Forensic Pieces
Fort Bend County Sheriff’s Office
Gus George Law Enforcement Academy
Richmond, TX
Jan Johnson

Advanced Fabric BPA Training Course
May 11-15, 2020
Omnium Forensics
Forensic Science Training Center
Cedar Crest College
Allentown, PA
Ted Silenieks and Mark Reynolds

Advanced Bloodstain Pattern Analysis
October 05-09, 2020
Institute of Police Technology and Management
Jacksonville, Florida
Jerry Findley
Nancy Sulinski-Steffens

Advanced Fabrics Bloodstain Pattern Analysis Course
August 10-14, 2020
Ontario Police College
Aylmer, Ontario, Canada
Mark Reynolds and Ted Silenieks

Introductory Bloodstain Pattern Analysis Workshop
December 07-11, 2020
Noslow Forensic Consultation, LLC
Miami-Dade Public Safety Training Institute
9601 NW 58th St, Doral, FL
Toby L. Wolson, M.S., F-ABC

Advanced Bloodstain Pattern Analysis
October 26-30, 2020
Forensic Pieces
North Palm Beach Police Department
North Palm Beach, FL
Jan Johnson
<table>
<thead>
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<th>Course</th>
<th>Dates</th>
<th>Location</th>
<th>Instructors/Suppliers</th>
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<td>Basic Bloodstain Pattern Analysis Course</td>
<td>September 09-13, 2019</td>
<td>Loci Forensics</td>
<td>Martin Eversdijk / René Gelderman</td>
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<td>Haverstraat 49 2153 GD Nieuw-Vennep</td>
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<td>Martin Eversdijk / René Gelderman</td>
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<tr>
<td>Intermediate (Level 2) BPA Course</td>
<td>September 16-20, 2019</td>
<td>Thames Valley Police Training Centre</td>
<td>Martin Eversdijk / René Gelderman</td>
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<td>Jo Millington / Gillian Leak</td>
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<td>Advanced Bloodstain Pattern Analysis</td>
<td>October 21-25, 2019</td>
<td>Loci Forensics</td>
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<td>Bloodstain Pattern Analysis on Textile Course</td>
<td>November 04-08, 2019</td>
<td>Loci Forensics</td>
<td>Martin Eversdijk / Alessandro de Bernardis</td>
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<td>La RA.SE.T. Formazione, Ricerca e Sviluppo in collaborazione</td>
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<td>Roma, Italy</td>
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<td>Martin Eversdijk / Alessandro de Bernardis</td>
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<tr>
<td>Basic BPA (English)</td>
<td>November 25-29, 2019</td>
<td>Usingen, Germany</td>
<td>Silke Brodbeck, MD</td>
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<td>Basic Bloodstain Pattern Analysis Course</td>
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<td>Visualization of Latent Bloodstain Course</td>
<td>November 18-22, 2019</td>
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<td>Bloodstain Pattern Analysis on Textile Course</td>
<td>June 29 – July 03, 2020</td>
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A list of recommended terms and definitions for bloodstain pattern analysis is presented. These terms and definitions address basic bloodstain pattern types and related concepts.


This document applies to the validation of procedures for bloodstain pattern analysis casework and new equipment. It also applies to the internal validation of established procedures existing within the BPA community when such procedures are being used for the first time within an agency.

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**Need assistance from our membership**

The Journal will add a new feature to assist our membership. A list of all published standards to bloodstain pattern analysis, including links to the standards, will be included in every upcoming issue so members can have immediate access to the relevant documents to assist them in following best-practices.

The only standards currently published are those from the American Academy of Forensic Sciences Standards Board. The Publication Committee is seeking assistance from our international community to include other BPA standards from other bodies across the globe.

If you know of any published standards which we did not include in the Journal, please contact the Editor or anyone on the Publication Committee so we can include it in the next issue.
Recent BPA Articles

Published in the Scientific Literature


Did we miss something?

Although the Publication Committee works hard to find as many of the training opportunities as we can to include in the Journal, there are likely some courses which we missed. If you know of any upcoming bloodstain-related training which we did not include in the Journal, please contact the Editor or anyone on the Publication Committee so we can include it in the next issue.

Additionally, if you know of any open access, online resources which are related to bloodstain pattern analysis, please let us know. Our goal is for the Journal of Bloodstain Pattern Analysis to be a primary source of information around the world regarding bloodstain pattern analysis. You can help us meet this goal by sharing information about resources with us.
Online Resources

**Bloodstain Pattern Analysis subcommittee of the Organization of Scientific Area Committees (OSAC) for Forensic Science**
Development of standards and guidelines related to bloodstain pattern analysis

**Bloodstain Pattern Analysis Video Collection**
High speed digital video analysis of bloodstain pattern formation from common bloodletting mechanisms.

**BPA-related Presentations at the 2012 Impression Pattern Evidence Symposium**
Recorded webinar on presentations on approximation of blood drop trajectory, contextual bias, collection of pattern evidence from a body, reasoning and the scientific method in BPA, and developing and implementing BPA SOPs.

**Bloodstain Documentation and Collection Methods**
Recorded webinar on a methodology for the documentation, collection, and preservation of blood evidence.

**Swipes, Wipes and Transfer Impressions**
Recorded webinar on the different types of these patterns and recognizing the value of them.

**Error & Uncertainty in Bloodstain Pattern Analysis**
Recorded webinar on a general introduction to the concepts of error and uncertainty and how these concepts apply to quantitative and qualitative aspects of bloodstain pattern analysis.

**The Sherlock Blood Spatter Analysis System**
Freeware developed at Trent University to assist in processing field data and to determine the point of impact for the collected dataset.

**A data set of bloodstain patterns for teaching and research in bloodstain pattern analysis: Impact beating spatters**
This is a data set of sixty-one impact patterns scanned at high resolution, generated by controlled impact events corresponding to forensic beating situations. This data set is suitable for training or research purposes in the forensic discipline of bloodstain pattern analysis.

**A data set of bloodstain patterns for teaching and research in bloodstain pattern analysis: Gunshot backspatters**
This is a data set of gunshot backspatter patterns scanned at high resolution, generated in controlled experiments. This data set is suitable for training or research purposes in the forensic discipline of bloodstain pattern analysis.