OSAC 2022-S-0030 Standard for Methodology in Bloodstain Pattern Analysis

Bloodstain Pattern Analysis
Physics / Pattern Interpretation Scientific Area Committee
Organization of Scientific Area Committees (OSAC) for Forensic Science

Draft OSAC Proposed Standard

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Bloodstain Pattern Analysis
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The STRP panel will consist of an independent and diverse panel, including subject matter experts, human factors scientists, quality assurance personnel, and legal experts, which will be tasked with evaluating the proposed standard based on a comprehensive list of science-based criteria.

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1. Introduction

In this document, the following verbal forms are used: "*shall*" indicates a requirement, "*should*" indicates a recommendation; "*may*" indicates permission; and "*can*" indicates a possibility or capability.

2. Scope

2.1 This document covers the process of examining bloodstains and bloodstain patterns to determine the significance of their presence or absence, what potential forces or mechanisms could result in those bloodstains or bloodstain patterns, and the significance of those determinations in regard to the scope or reason for the examination.

2.2 This document will address when to classify but not how to classify.

2.3 This document will not address documentation, preservation, or collection at the scene or on items of evidence.

3. Normative References

There are no normative reference documents. Annex A, Bibliography, contains informative references.

4. Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

4.1 Analyst: An individual trained and competent to carry out the step described

4.2 Assumptions: Something supposed as true, without adequate supporting evidence or certain knowledge.

4.3 Cognitive Bias: A set of influences that may affect the reliability and validity of one's observations and conclusions.

4.4 Event Segment: Time snapshots depicted by moments of activity.

4.5 Examination: The act or process of observing, searching, detecting, recording, prioritizing, collecting, analyzing, measuring, comparing, and/or interpreting.

4.6 Interpretation: Explanations for the observations, data, and calculations.

4.7 Mechanism: The action or event process resulting in a bloodstain or bloodstain pattern.

4.8 Observed Data: Any demonstrable information observed within a bloodstain or bloodstain pattern that an examiner relies upon to reach a decision, interpretation, or opinion.

4.9 Opinion: View, judgement, or belief that takes into consideration other information in addition to observations, data, calculations, and interpretations.

4.10 Post-incident Artifact: Any alteration to a bloodstain or bloodstain pattern resulting from the actions of first responders, medical personnel, or an individual occurring after the creation of that bloodstain or bloodstain pattern.

4.11 Task-irrelevant information: Information that is not necessary for drawing conclusions about the propositions in question, or if it assists only in drawing conclusions from something other than the physical evidence designated for testing or assists only in drawing conclusions by some means other than an appropriate analytic method.

4.12 Task-relevant information: Information that is necessary for drawing conclusions about the propositions in questions, from the physical evidence that has been designated for examination, or through the correct application of an accepted analytic method by a competent analyst.

4.13 Utility: The usefulness of a bloodstain or bloodstain pattern for a further step in the analysis.

5. Requirements

Prior to the start of analysis, the purpose and scope of the investigation and questions to be answered should be defined, as well as the information available to be utilized. List all these source materials. If a customer has made a request for analysis, this shall be included in the case documentation.

Bloodstain pattern analysts will be exposed to various sources and types of information throughout their analysis which may be task-relevant or task-irrelevant.[1] When considering how this information can influence their decision-making, they must consider and document the potential for cognitive bias. Where possible, this methodology follows linear sequential unmasking – expanded.[2] The analyst shall access information in the following order prescribed by the methodology. If information is accessed out of order, it shall be documented.

If the request is to evaluate a written statement, the bloodstain pattern analysis shall be completed prior to reading the statement. Once complete, the opinions rendered can be compared to support or refute the statements made.

[1] National Commission on Forensic Science, *Ensuring the forensic analysis is based upon task-relevant information.* It is available at https://www.justice.gov/archives/ncfs/page/file/641676/download

[2] Dror, Itiel E, and Jeff Kukucka. "Linear Sequential Unmasking-*Expanded* (LSU-*E*): A general approach for improving decision making as well as minimizing noise and bias." *Forensic science international. Synergy* vol. 3 100161. 13 Aug. 2021. It is available at https://doi.org/10.1016/J.FSISYN.2021.100161.

A request for analysis may be undefined, where much is unknown. In these cases, the analyst shall render opinions based upon the quality and quantity of the information available for analysis.

Some inquiries may not be answerable through bloodstain pattern analysis.

5.1 Observation and Data Collection:

The analyst shall utilize imaging (e.g., photographs, 3D-laser scanning) and notes to document observations of bloodstained items, areas, and voids to characterize stain and pattern size, shape, distribution, appearance, and location. Sketches or diagrams may also be utilized to aid documentation. It is understood that imaging may be provided to the analyst or produced by the analyst.

5.1.1 Locate all areas where blood is present.

5.1.2 Locate all areas where blood is notably absent.

5.1.3 Characterize stain and pattern sizes.

5.1.3.1 If measuring individual stains, measure in millimeters.

5.1.3.2 For spatter stains, sizes of stains refer to the widths.

5.1.3.3 For non-spatter stains, sizes refer to overall dimensions.

5.1.3.4. Measurements for the overall dimensions of the stains grouped into patterns may also be documented.

5.1.4 Characterize stain and pattern shapes.

5.1.4.1 Circular

5.1.4.2 Elliptical

5.1.4.3 Irregular

5.1.4.4 Linear or curvilinear

5.1.4.5 Edge characteristics, to include observable characteristics such as clearly defined sharp edges, spines, feathering, etc.

5.1.5 Characterize stain distribution

5.1.5.1 Stain arrangement: radiating, linear, curvilinear

5.1.5.2 Size distribution within a pattern

5.1.5.3 Angle of impact distribution (directionality)

5.1.5.4 If stains within a pattern converge to an area

5.1.5.5 2D or 3D deposition - e.g., located on the top surface only or penetrating the target substrate

5.1.6 Characterize stain and pattern appearance in terms of:

5.1.6.1 Coloration, dilution, thickness

5.1.6.2 Degree of wet, dry, flaking

5.1.6.3 Clotted

5.1.6.4. Altered

5.1.6.5 Flow, gravity effects

5.1.6.6 Impression patterns: Friction ridge detail, footwear

5.1.6.7 Vacuoles and mucous strands

5.1.6.8 Repeating pattern of the same characteristics

5.1.7 Characterize the surface the stains are present on.

5.1.7.1 Fixed versus moveable objects

5.1.7.2 Porous, non-porous

- Construction and materials of fabrics and textiles

5.1.7.3 Smooth, irregular, textured, treated, flexible, etc.

5.1.7.4 Curved, flat, angled

5.1.8 Document other observable material e.g., tissue, hair, bullet holes

5.2 Designate areas of blood into groupings of stains/patterns.

5.2.1. Organize patterns by stain size, shape, distribution, appearance, and location.

5.2.2 Not all bloodstains can be organized into patterns because their observable characteristics do not provide enough information to proceed.

5.2.3 Determine the utility of bloodstains or bloodstain patterns. A utility determination can be decided based on a multitude of reasons.

5.2.3.1 The observed characteristics of the bloodstains and bloodstain patterns may have ambiguous information that can be attributed to

multiple pattern types and the determination is made that a meaningful or helpful interpretation is not possible based on the scope of the request.

5.2.3.2 The lack of quantity of stains present may not allow the analyst to definitively exclude any mechanism or make any meaningful interpretation.

5.2.3.3 The bloodstains or bloodstains patterns may exhibit characteristics of alteration to an extent that the original deposition cannot be reliably interpreted.

5.2.3.4 The bloodstains or bloodstain patterns may be deposited on a surface that would result in unreliable characteristics leading to unreliable interpretations due to the interaction that the blood and target surface would have.

5.2.3.5 The bloodstains or bloodstain patterns appear to be overlapping in such a way that it cannot be reliably determined which stains are associated and which stains are not associated.

5.2.4 The analyst should be able to justify why a stain/pattern has not been classified. The value and potential significance of these stains/patterns will be assessed based upon the scope and purpose of the investigation.

5.3 Classification of Patterns from Observable Characteristics

Classification of bloodstains and bloodstain patterns is the process that utilizes observable characteristics to include those mechanisms that cannot be excluded, resulting in an interpretation. At this step/stage the analyst shall only use observable stain(s) and pattern characteristics to make their initial interpretation(s).

5.3.1 The analyst should consider potential mechanisms or means of deposition that can be excluded. The analyst shall then note all pattern types that will be given further consideration during the refinement process. Pattern types can be assigned based on mechanism or force and can be as definitive as using the ASB BPA terminology or generally describing a mechanism or force (e.g. Passive, gravity, airborne, or transfer)

5.3.2 When applicable, the analyst should determine which collected samples will be submitted for additional forensic analysis (e.g., amylase testing). Forensic analysis may assist in refinement of the pattern classification and the logical exclusion of mechanisms.

5.3.3 Where applicable, the analyst may utilize methods to apply to pattern areas to aid in determining flight path characteristics, area of origin, area of convergence, etc.

5.4 Refinement of Interpretations applying Task-Relevant Contextual Information

Refinement is the logical exclusion of pattern types included in the interpretations above with the addition of forensic biology/DNA, and medical/pathology reports. This refinement is only relevant when assessing whether to exclude impact, expiration, forward and backspatter, or projected patterns. Examples of refinement which can be made based on review of this task-relevant contextual information:

- If there is no pathological evidence of a gunshot injury, backspatter and forward spatter may be excluded as possible pattern types.
- There is no evidence of blood in the airway from medical reports and/or alpha-amylase testing is negative, expiration may be excluded as a possible pattern type.

5.4.1 The analyst shall only consider information relevant to source and/or blood-letting injuries necessary for pattern interpretation refinement. The analyst shall document and apply this information to eliminate pattern types not supported by blood-letting injuries.

5.4.2 Considering the results of the forensic analysis, the analyst should refine the previously documented list of potential mechanisms or means of deposition and further exclude any pattern types that are no longer logical given the results.

5.4.3 If the reliability of any piece of this contextual information is questioned, the analyst shall return to the interpretations prior to refinement.

5.4.4 An analyst shall not include a pattern type if it is not supported by the observed data regardless of contextual information.

5.5 Event Reconstruction

Event reconstruction in bloodstain pattern analysis is the process of incorporating and assimilating all observed data and interpretations to begin to determine the possible scene events that created the pattern(s)/stain(s). All outcomes at this step are termed to be *interpretations*. The interpretations may be generic (e.g. an impact occurred in this location or a transfer pattern is located on the floor) or specific to the case (e.g. a gunshot wound was created in this location or a bloody footwear impression is located on the floor). Reconstruction of events are first addressed in finite periods of time or event segments[3] where specific patterns may be associated with specific events. It is also possible for these event segments to be sequenced relative to one another as part of the event reconstruction. It is understood that not every event segment can be determined and therefore, it is not expected that every stain or pattern can be or needs to be interpreted.

[3] Gardner, R., 2018. *Practical crime scene processing and investigation*. Third edition. CRC Press.

Each interpretation involves the generation of a hypothesis and testing the hypothesis by considering other possibilities and either eliminating them or refining the original hypothesis to include them.

The analyst may apply case-specific, task-relevant information to inform their bloodstain pattern interpretations. The analyst shall document when the contextual information was accessed.

Examples of contextual information include

- First responder actions
- Investigative reports
- Other relevant forensic reports (e.g., footwear comparison, patent latent print comparison)

5.5.1 Where applicable and possible, the analyst shall make interpretations in regard to the following with the understanding that not every stain or pattern needs to be interpreted as stated above:

5.5.1.1 Interrelationship(s) of stains(s) and pattern(s) based on their locations. (e.g., satellite patterns adjacent to projected patterns or impact patterns on adjacent walls in a corner of a room). This interrelationship can be based on the physical proximity of two or more patterns, recognized repeating patterns throughout the scene, or potential correlating mechanisms of patterns.

5.5.1.2 Directionality of stains and patterns based upon their shapes and characteristics (e.g., within swipe and wipe patterns)

5.5.1.3 Potential sources of blood that contributed to stains or patterns such as wounds, pools, and objects containing blood which may be responsible for stains and patterns. Where possible, correlate potential blood sources to stains and patterns with potential location of sources during the mechanistic event (e.g., incorporating area of origin calculations to wound locations). Where applicable, source associations shall incorporate results from available DNA reports to further aid in determining sources.

5.5.1.4 Sequencing the order of deposition of stains and patterns

5.5.1.5 Voids and how they may have been created (e.g., limiting angles)

5.5.1.6 Repositioned objects/movement using voids or flow patterns

5.5.1.7 Identifying patterns that could potentially be pre- or post-incident artifacts (e.g., Insect stains, stains that appear to be very old, or medical personnel attempts to aid the victim)

5.5.1.8 Potential influence of environmental factors on blood deposition and patterns (e.g., temperature, humidity, or altered stains)

5.5.1.9 Indications of time since deposition (e.g., perimeter stains, coloration, or serum separation)

5.5.2 Concurrent with 5.5.1, the analyst shall determine and document all assumptions made and limitations that may have influenced interpretation.

Examples:

- Only one source of blood at the crime scene.
- Only Person X has injuries consistent with a projected blood source.
- Analysis was performed completely from photographic documentation without attending the crime scene.
- The deposition of all bloodstains occurred contemporaneous to the bloodletting event(s) in question.
- Possible scene alteration is present from medical intervention.
- Clean-up activities occurred.
- Analysis was performed from photographs only and was limited to the documentation provided.

5.6. Final Opinion (Case Conclusion in Report writing doc)

Assigning significance to interpretations

5.6.1 Upon completing and reporting all interpretations, the analyst, where applicable, should render a final opinion regarding the initial request or investigative questions. This opinion shall not use any unsubstantiated data (see Report Writing doc).

5.6.2 In cases where the request for bloodstain pattern analysis includes a specific question (e.g., homicide or suicide) or statement analysis (e.g., the suspect provides a statement on what happened, and bloodstain pattern analysis is used to support or refute such statements) the analyst must evaluate all proposed possibilities and document and report support for and support against each one. In some cases, the analyst may determine and propose that another possibility has more support based on the evidence and interpretations. In such cases, the analysis must document and report the basis of the proposed possibility.

Annex A
(informative)

Bibliography

1] Dror, Itiel E, and Jeff Kukucka. "Linear Sequential Unmasking-*Expanded* (LSU-*E*): A general approach for improving decision making as well as minimizing noise and bias." *Forensic science international. Synergy* vol. 3 100161. 13 Aug. 2021. It is available at https://doi.org/10.1016/J.FSISYN.2021.100161.

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