B53 A Blind Trial Evaluation of a Practical Methodology for Deducing Impact Velocity and Droplet Size From Bloodstains

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After attending this presentation, attendees will learn the blind trial results of a novel technique that utilizes bloodstain diameter and number of spines to derive droplet size and velocity

This presentation will impact the forensic community and/or humanity by providing boodstain pattern analysts a methodology that could calculate droplet properties such as size and velocity. Upon the discovery of a bloodstain that meets the criteria (circular with radiating spines), investigators could derive the impact velocity and droplet volume and utilize these variables to:

1. Infer bloodshed forces by correlating impact velocity with an assault instrument.
2. Determine release height of passive droplets impacting on horizontal surfaces.
3. Incorporate projectile motion into trajectory calculations for bloodstains discovered on non-horizontal surfaces.

Crime scene reconstruction is dependent on the ability to establish past events from present variables. Investigators now have a method for uncovering droplet properties from bloodstains, leading to a more accurate interpretation of the crime scene.

Bloodstain diameter and number of spines are independent variables that can be combined to solve for impact velocity and droplet volume. This was established in a prior experiment that utilized mechanical engineering models to solve droplet properties from pig bloodstains. A blind trial study was subsequently undertaken to test the accuracy of this technique using a redesigned crime scene methodology.

Bloodstains found at the scene of a violent crime can often be used to reconstruct the events surrounding bloodshed. However, reconstruction would be enhanced if bloodstain morphology could be used to infer droplet properties. Investigators could then determine the source-of-origin and the forces surrounding bloodshed more accurately. At present, droplet properties are lost upon impact with the surface. As a result, a classification system based on stain diameter has been adopted to dissuade investigators from using bloodstains to estimate droplet properties.

Attempts have been made to correlate impact velocity with stain diameter. However, this has proven difficult since the size of a bloodstain is a function of two unknown variables (droplet size and velocity). Alternatively, Balthazard *et al.* was interested in using bloodstain spines to solve for impact velocity. Spines are commonly found radiating from the periphery of stains, and range in appearance from waves to sharp protrusions. As with stain diameter, Balthazard discovered that spines alone could not predict impact velocity, due to the additional influence of droplet volume. He concluded that a deeper understanding of droplet dynamics was required. Several mechanical engineering models that have since been developed show a predictable relationship between stain morphology (diameter and spines) and droplet properties (size and velocity).

In a previous study, Hulse-Smith *et al.* evaluated two mechanical engineering models for their ability to predict droplet size and velocity from bloodstains. Pig blood droplets were released over a range of diameters (3.0 - 4.3mm) and impact velocities (2.4 – 4.9m/s) onto four surfaces (glass, steel, plastic, paper). The resulting bloodstains were then used to predict droplet properties. A strong correlation was found between observed and expected results.

To determine if this technique would translate to the crime scene, a redesigned methodology was tested under blind trial conditions. An investigator was presented with images of human bloodstains and samples of each impact surface. The conditions used to create each bloodstain were not revealed. The investigator subsequently performed a calibration to derive two specific equations for each surface. This aided in eliminating any variation introduced by surface irregularities. Finally, the number of spines and stain diameter were quantified from each unknown bloodstain image and integrated into the respective equations to solve for droplet properties. Experimental results are revealed during this presentation.

Bloodstain Pattern Analysis, Blood Droplet, Spines

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