Technical Note

Demonstrative Aid for Bloodstain Pattern Examiners

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In bloodstain pattern analysis (BPA), the ideal demonstrative aid for court would not only hold true to the theory offered by the testimony of the witness presenting the visual aid, but it would also pass the test of acceptability and admissibility before the court. The previous two IAI Educational Conferences (Ottawa and Las Vegas) afforded workshop attendees with the opportunity to create a theoretical model relevant to this forensic discipline.

The model is primarily composed of a varnished, 1-inch thick wood base, measuring 12 x 16 inches. Distributed across the top surface is a spatter pattern consisting of eight different shaped impact bloodstains. Elasticized string is tied to an embedded nail found at the leading edge of each stain and travels a straight course in alignment with the stain's long axis, where the opposing end of each string intersects to create the two-dimensional *area of convergence*. A short solid brass rod is fitted into the model where these strings converge and now the strings can be pulled up the rod. The group of intersecting strings is elevated off the wood base to illustrate the three-dimensional *area of origin*.

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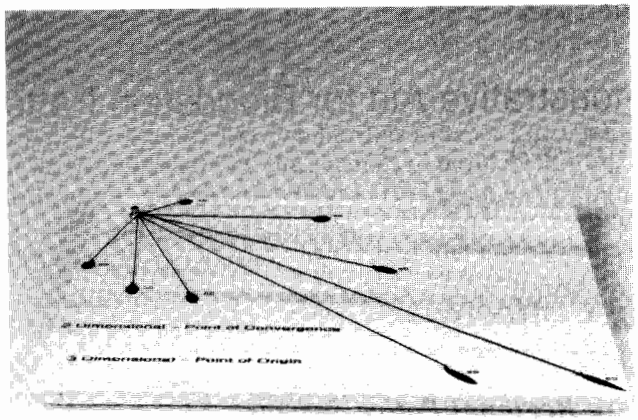

Figure 1

The model depicting the two-dimensional area (point) of convergence.

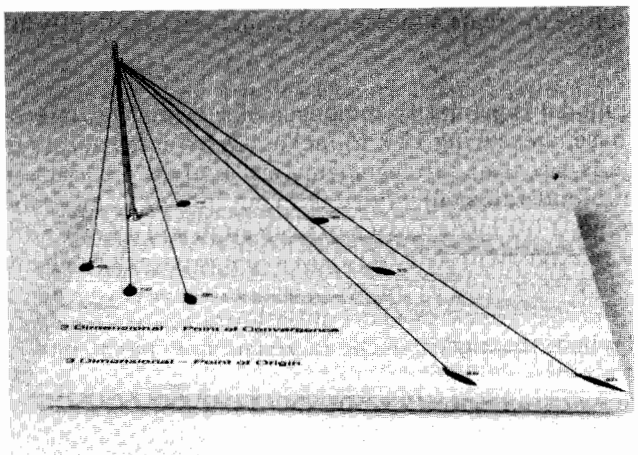

Figure 2

The model depicting the three-dimensional area (point) of origin.

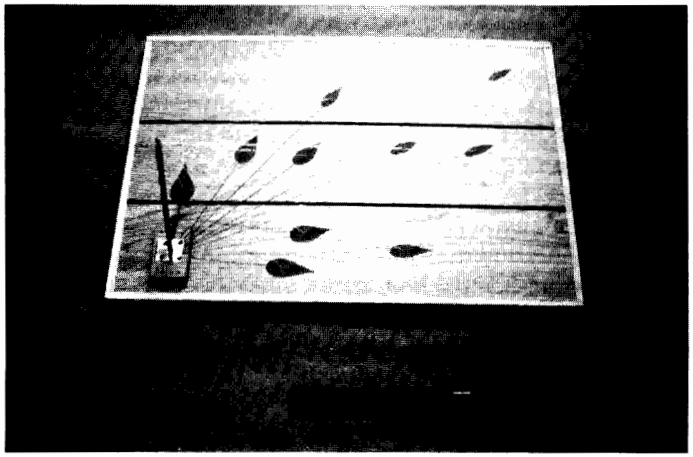

Figure 3

Herbert Leon MacDonell's original model design.

The concept for this type of demonstrative approach is not new. The author has viewed a similarly designed model. As a result of observing the original version, a number of refinements have been added, creating a labeled and informative model of a projected spatter pattern.

The model (Figures 1 and 2) discussed here is the direct result of viewing, and then refining, a model (Figure 3) that was originally designed by Herbert Leon MacDonell [1].

Many acclaimed individuals in the field recognize MacDonell as the father of modern day bloodstain pattern analysis. The author created this particular model in 1997. Realizing the model was a benefit to the BPA community, the author wanted to share with others his refined version of MacDonell's original two- and three-dimensional bloodstain spatter board.

The theory contained within the model does not establish pertinent facts to the case itself, but it reflects time-tested physical science theory as it relates to BPA. This is not accomplished by merely stating a few key elements as they relate to the model. If this were the case, the author would mass-produce the model and sell them outright with an attached sheet of "frequently

asked questions". The theoretical model incorporates a level of artistic rendering. The preparation and make-up of the model has to alleviate, or at the very least minimize, actual and conceivable concerns raised when the model is introduced into court. To accomplish this, the creator (artist) and the witness (analyst) must be the same person.

There are many academic areas that must be studied by the BPA analyst. A good outline can be found in *Bloodstain Pattern Analysis* [2]. To provide the testimony that supports the demonstrative aid, and to be successful in court, the witness needs to know relevant areas in BPA. The following areas require specific knowledge:

- Background historical facts (citing published articles and materials relating to the topic from the first known writings to current times)
- Knowledge of the human body (specifically the biochemistry of blood)
- Physics (dealing with elementary laws of nature: fluid dynamics and ballistics)
- Elements of bloodstain pattern analysis (as it pertains to impact velocity and created impact spatter patterns)
- Trigonometry (fundamental "right angle triangles" and the relationship of sine, cosine, and tangent)

An integral part of an analyst's knowledge can only be gained through experimentation. The analyst must first learn the theory and then be able to confirm the validity of the theory by way of experimentation. This lessens courtroom arguments, because the model is based on the results of experimentation conducted with human blood. After all, the analyst is testifying to human bloodstains from a crime scene, so the model should be based on and reflect the behavior of human blood. The experiments center on passive drops and their impacts onto varying angled or sloped targets, while taking precautions to keep the fall height of the blood drops constant. Those individual passive bloodstains are eventually transferred to the model board to form a recognizable and random dispersion pattern of projected impact spatter stains.

Another educational aspect is the experimentation of projected impact spatter. (Because of the confines of the hotel meeting room, this experiment could not be accomplished during the conference.) This component is based on the premise that blood will spray out into the air in an ever-increasing conical-like pattern, provided the amount of impact energy delivered to the blood source is great enough. The next best option to actual impact spatter experimentation is available via a documentary film *Blood in Slow Motion* [3]. It illustrates this dynamic phenomenon at a very slow speed, and its accompanying narration literally speaks volumes.

The culmination of fluid behavior as a projectile and the inherent relationship between the shape of a projected stain will offer an approximate location of where the blood source was located when the physical action(s) took place. Or in other words, before there were bloodstains, there were blood drops in flight, and it is possible to determine from where those drops originated.

These areas of study can be illustrated by an explanation of a physical altercation that erupts between two combatants: Punches and kicks are thrown, contact is made, injuries build, bleeding begins, and more strikes are landed into the bloodied area, causing blood droplets to spray out from the impact site.

A more definitive, categorical explanation describing the same events could be stated with the following: Impact energy is directed into a blood source (biochemistry). The energy is transferred to the fluid, breaking it up into smaller volumes (physics). These drops are generally accepted as spherical shapes (fluid dynamics), which take the path of least resistance by traveling through the air (ballistics). As the drops take flight, they are traveling in a parabolic arc and concave downward (more ballistics), where the drops eventually hit and stain a surface. The shape of the stain is analyzed and the blood source location can be determined (trigonometry).

The bloodstains, which make up a projected spatter pattern, say all of this, simply by their mere presence. It is the analyst who must find them, either at the scene or on articles associated to a bloodletting, and then determine how they got there. All of this is made possible because of the above-mentioned background knowledge.

Another area of consideration for the witness/analyst is the degree or varying amounts of subjectivity concerned with formulated BPA conclusions. It is this area that opens the proverbial "window of opportunity" for the attack in court. For instance, DNA evidence, notwithstanding continuity or contamination issues, is based on computer analysis. It is what it is because of highly accepted computer technology. BPA is also based on technology, but it is dependent on the human element of analysis of the scene or item in question. It is therefore open to interpretation.

The BPA element of subjectivity is argumentative at best and, with this in mind, the study, discussion, crime scene experience, and most importantly, experimentation collectively increase BPA knowledge. Confirmation of one's ideas, by way of experimentation, will add validity to a subjective opinion. Consider this: You could be asked whether it is possible for a bloodstain to be found under the framed picture hanging on the wall without first moving the picture. Your opinion will be, "Yes" or "No". Your experiment to determine the feasibility of that possibility would help to reduce the subjective portion of the overall interpretation, and thus make it more objective.

Artistic impression is subjective by its very nature (i.e., a painting by Van Gogh is different than that of Rembrandt, yet both men are world-renowned artists). The significance of the artistically rendered spatter model board cannot be overlooked.

Now, imagine explaining all of this in court by introducing the model, the general concepts of which are being grasped by the members of the jury. You sense the connection between you and each juror. Then suddenly the model is deemed inadmissible because of an objection made by one simple question that you could not definitively answer: Why are there only eight stains on the model and not twelve? This can be answered if you are the model creator.

The workshop offers the attendee an opportunity to create a courtroom-tested BPA model, while attempting to cover all relevant matters. Attending, completing, and leaving with a model may meet the minimum for IAI workshop session requirements, but the ultimate test would be presenting the

demonstrative aid in court and having the model accepted for what it is.

To survive the test of court, additional areas were addressed by the workshop:

1) Review/reference guide: PowerPoint was used to illustratively explain the theory in the workshop. This was, in turn, created into a manual. The manual was expanded upon to become a review or reference guide for the attendee. As the analyst patiently waits in the hall of the courthouse for his or her turn to testify, theory can be reviewed as it relates to the model.

2) Human blood: The blood used in the experimental phase of the workshop was human.

3) Actual experiment bloodstained target: The passive blood drop experimental target sheet can be laminated and is suitable for court presentation.

The author believes his opportunities to testify are comparably less than those of other analysts, but nevertheless, the model has been successfully introduced in three different trials, the most recent being a jury trial for second-degree murder [4].

In preparation for the 2002 IAI conference in Las Vegas, the author contacted some of the most noted authorities in the field to gain some insight and to receive permission to use their material in the context of teaching. Everyone welcomed the chance to have his or her material distributed, provided it was rightfully acknowledged. To quote Tom Bevel, "To further the cause of BPA, while being recognized as a contributor, you can't ask for much more than that." [5]

Conclusion

The author believes a labeled model, built by the bloodstain pattern analyst, can enhance the analyst's testimony, because it allows the jury to not only hear theory, but also to see visual prompters that transform an abstract thought into a tangible concept.

Acknowledgments

Although many people were contacted in preparation for both workshops, particular attention must be made to the following individuals, because they deserve a special word of gratitude: Tom Bevel, Fred Carter, Paul Kish, Herb MacDonell, Chris Price, and Mike VanStratton.

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