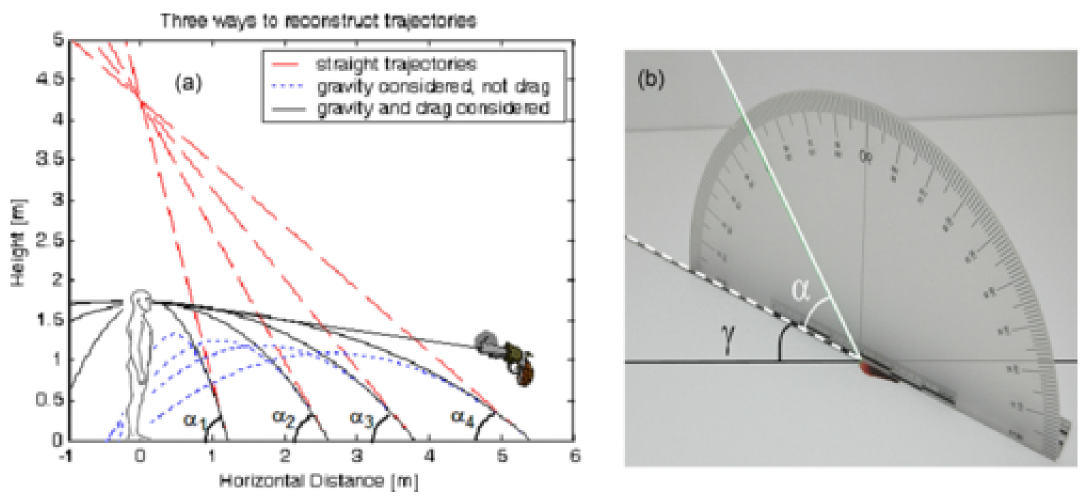
A more in-depth way to predict gunshot wound blood spatter

August 3 2016, by Bob Yirka



(a) Reconstruction of the trajectories associated with four bloodstains using straight trajectories versus ballistic trajectories and the geometry (locations of the stains, of the victim, and the impact angles). Panel (a) is reproduced from teaching material graciously provided by H. McDonell. Drop size is assumed to be 3 mm, implying velocities in the 5.3–7.5 m/s range. (b) Definition of the angle of drop impact α and directional (sideways) angle γ, which is equal to the angle between the vertical plane containing the drop trajectory and another vertical plane containing the bullet trajectory and the target. Credit: (c) *Physical Review Fluids* (2016). DOI: 10.1103/PhysRevFluids.1.043201

(Phys.org)—A small team of researchers from the University of Illinois and Iowa State University has developed what they describe as a theoretical model for both interpreting and predicting blood-spatter that results from a gunshot wound. In their paper published in the journal *Physical Review Fluids*, the group describes the factors they took into consideration in developing their model and how well it worked in experiments conducted with pig blood and sponges.

When a person is shot dead and there are no witnesses, forensic investigators attempt to use every bit of evidence they can find at a crime scene to figure out what happened; one source is blood spatter that occurs when a victim's blood is sent flying against walls or onto the floor as a bullet enters the body and then again as it exits. In this new effort, the researchers have developed a model to help better describe spattering events which could lead to a more accurate depiction of a crime scene.

Up till now, forensic experts have used three basic types of spatter results to assist in identifying the type of bullet wound that caused it: high, medium and low velocity. Using such categories helps to identify the type of weapon used to propel the bullet. But this approach, the researchers claim, fails to take into account other factors such as gravity and air resistance which can cause blood to follow an arc as it falls. To correct that problem, the researchers built theoretical models meant to describe what happens when a dense liquid such as blood runs directly into a gas such as air. They also factored in the mass of the bullet, its speed and its angle as it strikes the body. The result was a mode that describes a resulting "blood cloud" for a given set of circumstances.

To test their model, the researchers soaked sponges in pig blood and shot them, taking measurements of the blood spatters that resulted. They report that their results were mixed, though they were within an order of magnitude of predictions. They plan to run more experiments using different types of guns and bullets to make their model progressively better. They believe that at some point the model will be good enough for use with real crime scenes.

More information: P. M. Comiskey et al. Prediction of blood back spatter from a gunshot in bloodstain pattern analysis, *Physical Review Fluids* (2016). DOI: 10.1103/PhysRevFluids.1.043201

ABSTRACT
A theoretical model for predicting and interpreting blood-spatter patterns resulting from a gunshot wound is proposed. The physical process generating a backward spatter of blood is linked to the Rayleigh-Taylor instability of blood accelerated toward the surrounding air, allowing the determination of the initial distribution of drop sizes and velocities. Then the motion of many drops in air is considered with governing equations accounting for gravity and air drag. Based on these equations, a numerical solution is obtained. It predicts the atomization process, the trajectories of the back-spatter drops of blood from the wound to the ground, the impact angle, and the impact Weber number on the ground, as well as the distribution and location of bloodstains and their shape and sizes. A parametric study is undertaken to predict patterns of backward blood spatter under realistic conditions corresponding to the experiments conducted in the present work. The results of the model are compared to the experimental data on back spatter generated by a gunshot impacting a blood-impregnated sponge.