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Development of Reasonable Doubt: Slip/Fall Hunting Accident or Murder?

by Jon O. Jacobson, Ph.D., P.E. (NAFE F401) and Michael K. Tasker, Esq.

On New Year's Day Kimberly and Bruce went hunting in a wooded area with their newly assembled muzzle-loading rifles. After climbing up the hill and through some lightly reforested woods, they entered the replacement grove forest where they stopped at a small clearing to rest. Bruce then continued up the hill for about fifty feet to attempt to locate an elk. He believes that he saw one in the distance and fired, but did not hit his target. He then heard a second shot from the region where his wife had stopped to rest behind him. Upon returning to the small clearing he found his wife lying on her back having been shot in the middle of the chest. Her rifle was across a log slightly uphill. Bruce picked up Kimberly's rifle to see if had been fired and, upon seeing that it had been fired, dropped it. He sought help, notified the local authorities and returned with the authorities to assist his wife, and later carried his wife's body from the woods. During the time that law enforcement, EMT's, and others attempted to assist Kimberly, Bruce vented his anger/emotions by picking up Kimberly's rifle from its position on the ground and pounded it into the first log Kimberly had slipped and fallen. The death was listed as a hunting accident and no further action was taken at that time. Approximately three months later Bruce was charged with murder whereupon he obtained legal assistance. The attorney, Michael K. Tasker then, in turn, engaged the services of a Forensic Engineer, Jon O. Jacobson, among others, to develop the defense in the case that was to support the hypothesis that the events as described by Bruce were, in fact, reasonable and that the death of Kimberly was an accident. Michael K. Tasker had the case for only one week prior to the initial schedule of the trial. Appendix 4 is the Affidavit prepared to request a delay for the proper trial preparation.

The evidence in the case amounted to the location of the body and the description of the scene where the deceased had been found, the location of her rifle, and the husband's statement that he had heard a second gun shot after he had fired once at an elk. A scene shows the deceased and the relative positions of the logs adjacent to the clearing.

In order to begin the investigation, it was necessary to travel to the scene of the incident to examine, photograph, video-tape, and survey the location for subsequent analysis. The clearing where the body was found was approximately a ten by fifteen foot oval clearing adjacent to a hill covered with some old fallen

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timber that extended upwards at approximately eleven degrees (11°) There was one six-inch diameter log adjacent to the clearing and a second log approximately five feet away of the same size, upon which rested the rifle of the deceased. A missing patch of covering moss was near the deceased feet.

The autopsy information indicated that the deceased had suffered a bullet wound to the center of the chest at approximately five degrees (5°) downward and approximately three degrees (3°) from the left, at about fifty inches up from the bottom of the feet. Appendix 1 illustrates the compilation of the field notes developed from the scene and preliminary positioning analysis.

The hypothesis that was drawn as to the scenario of the accident was that Kimberly had attempted to climb up the hill over the logs to the location where her husband had fired his weapon. She had slipped with her foot on the first log and, in the process of slipping backwards, had thrown her rifle forward which landed on the second log. The impact of the rifle on the log caused it to discharge just as she landed on the clearing surface below. The development of the presentation required analysis of the dynamics of the slip and fall coordinated along with the throwing of the rifle in a manner that would have it land on the second log, properly positioned to discharge, and produce a wound in the location where she had been fatally injured. In addition, it was necessary to examine if and how a muzzle-loading rifle would accidentally discharge from an impact upon being dropped. The accidental discharge mechanism was in question because, although the prosecution specialists were able to demonstrate a discharge when the rifle was dropped on a rigid surface such as a concrete floor, they were not able to show an accidental discharge when it dropped vertically in the same manner on a log.

The specifics of a muzzle-loading rifle that were unique and contributed to this accident involved analyzing the muzzle-loading trigger mechanism. The feature of a muzzle-loading trigger mechanism is that it uses multiple triggers. It has a primary trigger which activates the firing pin, but, also, has a secondary trigger, or a set trigger, which reduces the finger pressure necessary to discharge the rifle. The use of the set trigger increases the likelihood of the muzzle loading rifle accidentally discharging. In addition, if the primary trigger is partially moved or touched prior to impact, this further reduces the necessary impact conditions for accidental discharge. Upon disassembling the muzzle-loading trigger mechanism it was also determined that the dynamic weighting of the mechanism would make it more likely to discharge when the rifle was dropped upside down, that is, with the trigger up and the barrel down, producing the greatest likelihood of accidental discharge when it landed on the second log. Tests were run to illustrate that this was the most likely mechanism by which the rifle would accidentally discharge. In addition, for demonstrative evidence

to the jury, a video-tape was prepared illustrating the operation of the muzzle-loading trigger mechanism to show how dropping the rifle could cause the weapon to accidentally discharge.
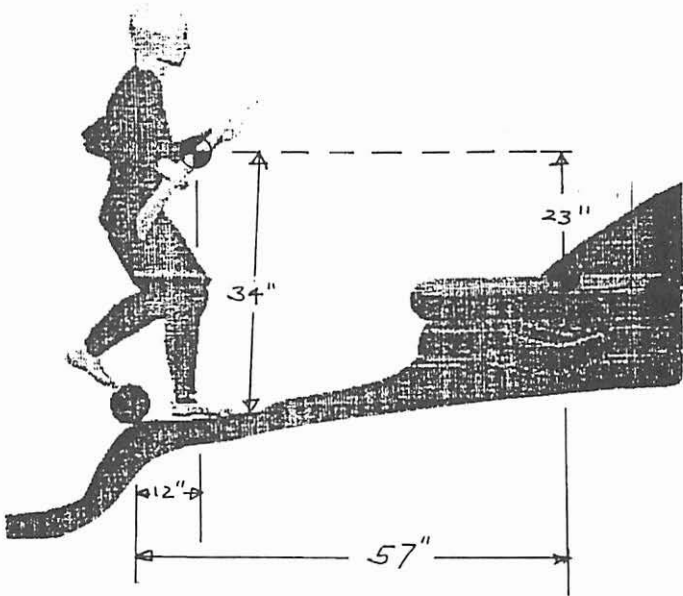
The development of the slip and fall dynamics are illustrated in Appendix 2. The initial slip from standing on the first log above the clearing to making contact with the clearing surface below was done by making various estimates of the slip and fall timing. These were done with a series of hand timed trials of slipping in this manner at which point an estimated fall time from the log to the lower surface was determined to be approximately seven-tenths (.70) of one second. An analysis was made of the trajectory of the rifle that would travel from the victim to the log in seven-tenths of a second to predict the flight path, hand motion, and forces necessary to cause this to occur. This analysis, shown in Appendix 2 gives the cartesian coordinates of the hand forces necessary to throw the rifle from the position carried diagonally across the front of the victim while standing on the first log to the landing position across the second log pointing back in her direction in order to have the rifle accidentally discharge towards the middle of her chest.

In order to illustrate this for demonstrative purposes to the jury, a videotape was prepared which showed the events related to stepping on the log, slipping on the log, throwing of the rifle, and discharging into the chest region of the victim. This video tape was completed utilizing different views from side, back and top to show how this event could have taken place.

In addition to the analysis and demonstrative video, an actual simulation with the subject of the same physical characteristics of the victim was conducted utilizing a muzzle loading rifle identical in size and weight to that involved in the accident. The experimental demonstration illustrated that the accident could have occurred in an accidental manner in this case. This was recorded on video-tape and presented as demonstrative evidence to the jury.

Outcome

Although the information was developed in a manner that supported the claims of the victim's husband, the defendant in this case, two trials were conducted. The first resulted in a hung jury and the second resulted in a conviction, although the majority of jurors interviewed in the second trial fully believed from the demonstrative prepared, that the death could have been accidental. The development of the information illustrates how analysis and demonstrative evidence can be used in the defense.

$$\Delta h_{torso} \cdot 6''$$

$$46 + .6 = 46.6$$

$$51 - 46.6 = 4.4''$$

$$\ell_{eg} \ bend - 4.4''$$

use similar $\angle$'s

$$36\left(1 - \cos\theta\right) = 4.4$$

$$1 - \frac{4.4}{36} = \cos\theta$$

$$\theta = 28°$$

APPENDIX 1: GEOMETRICAL RELATIONSHIPS

Gun travel horizontal 50″

Gun travel vertical down 23″

Gun angle about vertical axis -

$$90° + 5° + 20°$$

carrying angle

angle of entry

rotation

$$= 115°$$

APPENDIX 2: GUN MOTION

Assume Applied Force for $\approx$ 1/6 second (.15 second) to push gun away during slip.

This will be 5 frames of video for animation.

Horizontal free flight of the gun is .7 - .15 = .55 seconds

Assume Overall Horizontal Force of the hands on the gun
Assume overall time of .7 seconds for the gun motion.

$$F_r + F_L = 1.4 \, W_g$$

Therefore the acceleration of the gun is:

$$a_h = (1.4)g = 44.8 \, ^{ft}\!/_{S^2}$$

Horizontal velocity of the gun is:

$$V_2 = a_h \Delta t = (44.8)(.15) = 6.72 \, ^{ft}\!/_{S}$$

Horizontal distance traveled during application of hand force on the gun:

S_1 = distance traveled with acceleration force

$$= \tfrac{1}{2} \, a_h t_1^2$$

$$= (\tfrac{1}{2})(44.8)(.15)^2 = .504 \text{ ft.}$$

S_2 = distance traveled after acceleration force

$$= V_2 \Delta t_2 = (6.72)(.55) = 3.69 \text{ ft.}$$

Total horizontal distance traveled by the gun in flight

$$S_t = S_1 + S_2 = (.504) + (3.69) = 4.2$$

$$= 50.4 \text{ inches}$$

Applied torque to spin gun about vertical axis

Total spin angle is $115° = 2.007$ radians

The force is applied for .15 seconds
Free rotation for .55 seconds

Torque is the difference between left and right hand horizontal forces times the moment arm.

Shoulder width is $18'' = 1.5' =$ moment arm

From the initial assumption

$$F_L + F_R = 1.4 \, W$$

Torque $= (F_r - F_L)$ Moment arm $= (F_r - F_L) \, 1.5$

Assume $F_r = W$ then $F_L = .4$

$$F_r - F_L = .6 \, W$$

$$T = (.6W)(1.5) = (.6)(8.4)(1.5)$$
$$= 7.56 \, \text{lb. - Ft.}$$
$$T = I\alpha$$

Mass moment of inertia of the gun (experimentally determined)

$$I = .284 \quad \text{lb. ft. - sec.}^2$$

$\alpha_1 =$ angular acceleration about vertical axis

$$\alpha_1 = \frac{7.56}{.284} = 26.6/S^2$$

$\theta_1 =$ angle change of gun during force application.

$$\theta_1 = \frac{1}{2} \, \alpha_1 \, \Delta t_1^2$$

$$= \frac{1}{2} \, (26.6)(.15)^2 = .29 \, \text{rad}$$

$\omega_2 =$ angular velocity about vertical axis.

$$\omega_2 = \alpha_1 \, \Delta t_1 = (26.6)(.15) = 3.99 \, R/S$$

$$\theta_2 = \omega_2 \, \Delta t = (3.99)(.55) = 2.19 \, \text{rad}$$

$$\theta_1 + \theta_2 = 2.48 \qquad \longleftarrow \text{too high}$$

This has produced too large a rotation to match the gun motion.

Itterate the solution by reducing the torque differential of the left to right hand forces.

Use the ratio to match the required angle.

$$\frac{2.}{2.48} = \frac{1}{1.24} = .8$$

Reduce the torque by this correction factor:

Use Torque $= (7.56)(.8)$

$$= 6.04 \text{ lb. ft.}$$

The angular acceleration about the vertical axis is:

$$\propto_1 = \left(\frac{6.04}{.284}\right) = 21.3/S^2$$

The angular position change during the application of hand force is:

$$\theta_1 = \frac{1}{2} \propto_1 \Delta t_1^2 = \left(\frac{1}{2}\right)(21.3)(.15)^2 = .24 \text{ rad}$$

The average position change in free flight is:

$$\theta_2 = \omega_2 \Delta t_2 = (\propto_1 \Delta t_1)\Delta t_2 = (21.3)(.15)(.55)$$

$$= 1.75 \text{ rad}$$

$$\theta_t = \theta_1 + \theta_2 = .24 + 1.75 = 1.99 \text{ rad}$$

$$= 114°$$

If torque is 6.04 lb - ft.

$$\Delta F = (F_r + F_L) = T/_{MA} = \frac{6.04}{1.5} = 4.02 \text{ lb.}$$

$$\uparrow \text{(moment arm)}$$

$$= \frac{4.02}{8.4} = .5 \text{ W}$$

$$F_L + F_r = 1.4 \text{ W}$$

$$F_r - F_L = .5W$$

Right hand force: $F_R = .95\ W$

$\}$ Horizontal forces

Left hand force: $F_L = .45\ W$

Vertical Forces

Use equal upward forces which are similar to horizontal Right hand force

$$F_L\ up = F_R\ up = .95\ W$$

$$F_1\ up + F_1 up = (.95 + .95)W = 1.9W$$

Upward acceleration is from upward force above carrying the gun only.

$$F_u = 1.9W - W = .9W$$

$$F = ma \qquad m = \frac{W}{g}$$

$$.9 = \frac{W}{g}a \qquad F = .9W$$

$$a_1 = .9g = (.9)(32)\ ^{ft}\!/_{s\ 2}$$

Upward velocity after force application $V_1 = a_1\Delta t_1 = (.9)(32)(.15) = 4.32\ ^{ft}\!/_s$

Upward travel from force application $S_1 = \frac{1}{2}a_1 t_1{}^2 = (\frac{1}{2})(.9)(32)(.15)^2$

$$= 3.9''$$

Distance to top of travel $S =$ distance to decelerate to top of trajectory after force application

$$V_1 = a\Delta t_2$$

$$a = g$$

$$\Delta t_2 = \frac{V}{32} = \frac{4.32}{32} = .135\ seconds$$

$$S_{2v} = \frac{1}{2}gt^2 = \frac{1}{2}(32)(.132)^2$$

$$\simeq .29' = 3.49''$$

Vertical height of trajectory

$$S_1 + S_2 = 3.9 + 3.4 = 7.4''$$

Overall Free fall is drop from original carrying position of the gun above landing location (23") plus vertical upward travel 7.4"

$$\text{Total drop is } 23'' + 7.4'' = 30.4''$$

$$\simeq 2.53'$$

Time to drop is

$$S_3 = \frac{1}{2} g \, \Delta t_3^2$$

$$\Delta t_3 = \sqrt{\frac{2S}{g}} \quad = \quad \sqrt{\frac{(2)(2.53)}{32}} \quad = .40$$
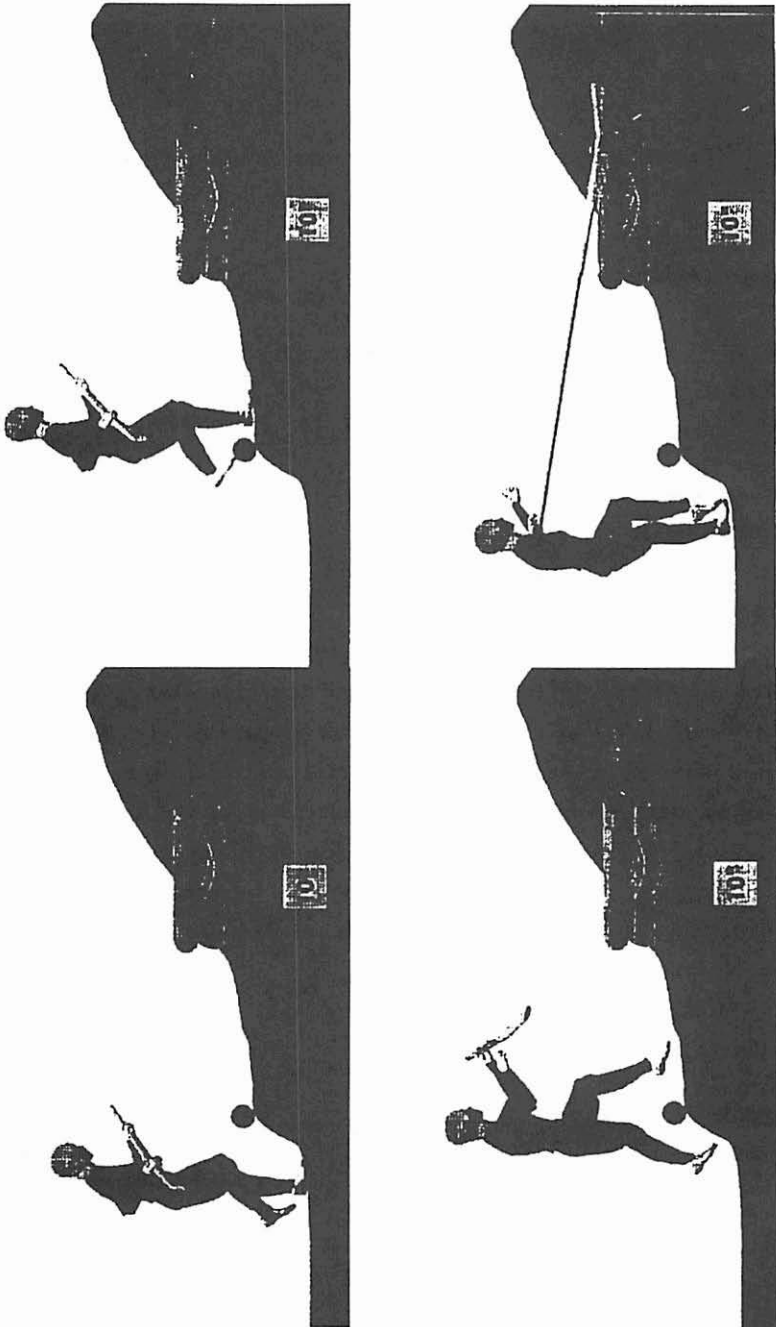
Total time is

$$\Delta T = \Delta t_1 + t\Delta t_2 + t\Delta t_3 = .15 + .135 + .40$$

$$\simeq .685 \text{ seconds}$$

Original Δt assumed $=$ .7 seconds

Δt error $=$ .015 seconds

<u>2% error</u>

APPENDIX 3: STILLS FROM VIDEO SIMULATION

1
2
3
4   IN THE SUPERIOR COURT FOR THE STATE OF WASHINGTON
5   IN AND FOR WHATCOM COUNTY
6
7
8 STATE OF WASHINGTON,   )   92-1-00218-6
9   Plaintiff,   )
10   vs.   )   AFFIDAVIT OF
11   )   JON O. JACOBSON
   BRUCE MULLIGAN,   )
12
13   Defendant.   )
14
15 STATE OF WASHINGTON)
16   ) ss
   COUNTY OF WHATCOM)
17
18   JON O. JACOBSON, being first duly sworn upon oath,
19 deposes and states as follows:
20   I have been retained by the Law Offices of Michael K.
21
22 Tasker pertaining to the Bruce Mulligan homicide case. I will
23 require certain documentation in order to prepare to testify at a
24 hearing such as a deposition or a trial in this case. I am
25
26 requiring that you provide all documentation as to the scene and,
27 if possible, provide me an opportunity for me to see the scene and
28 the location of the accident. This should be done as soon as
29
30 possible in order to facilitate proper development of analysis
31 prior to testimony.
32   Also, I would like to have what documentation is
33
34 AFFIDAVIT OF JON O. JACOBSON
   Page 1
35 MULLIGAN/JACOBSON
36 **APPENDIX 4: AFFIDAVIT**

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available concerning the weapon and its sensitivity to discharge --
any reports, tests or other documentation in this matter would very
helpful.   Further, I would require any and all test results
pertaining to the weapon that caused the death of Mrs. Mulligan to
include, but not limited to, powder burn tests, powder spray tests,
any test that would indicate in any way the distance that the
weapon responsible for Mrs. Mulligan's death was from her at the
time of discharge . . . any and all testing of any kind which has
been done either by the defense or the State pertaining to the
weapon responsible for Mrs. Mulligan's death.

        In order to provide a documentation of the human factors
of the events surrounding the accident, it will be necessary to do
a reconstruction of the likely positions of the body and gun in
relation to the surrounding terrain, including trees and other
objects present.   This will include investigating all the likely
possibilities that could have taken place that would have resulted
in the accident occurring.   In order to do this, it will require
approximately 2½ to 3 weeks total time in order to investigate the
location, review all documented data, develop the scenarios in
relation to the dynamics of motion of the body and the gun and
kinetics of the firing of the weapon.   This information will be
utilized to subsequently develop demonstrative aids to be used at
the time of trial. This could take, at a minimum, 1-2 weeks in
addition to the final analysis being completed.   In total, the
analysis from the original starting point until the demonstrative

AFFIDAVIT OF JON O. JACOBSON
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MULLIGAN/JACOBSON

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Bellingham, WA 98225

1 aids are developed, would more likely than not take approximately
2 five weeks time. This may be somewhat longer if it is required to
3 go into a more sophisticated demonstrative aid that would include
4
5 a video reproduction of the accident scene. It would not be
6 unlikely to expect that this would take an additional 1-2 weeks,
7 making a total time for the initial analysis of the data and site
8
9 review until the final demonstrative aids are produced of at least
10 two (2) months. Any attempt to shorten this to the time scale as
11 short as one (1) month or less would seriously compromise the
12 quality of work.
13
14   My qualifications, in addition to those delineated by
15 the slightly out-of-date resume, in relation to human factors
16 accident reconstruction stem from the many litigation-related
17
18 matters which I have been involved in over the last 15 years. My
19 background as a member of the Human Factors Society and my
20 development of many accident reconstruction cases involving human
21
22 motions and subsequent injury and trauma related to human motion,
23 from simple trip-and-fall cases through accidents involving human
24 beings inside automobiles, should be considered. In addition to
25
26 this, accidents involving bicycles (both with vehicles and
27 individual bicycles, utilizing dynamics of bicycles and riders) and
28 pedestrians (walking and running, as well as being hit by
29
30 automobiles) have been included in the background of workups that
31 I have done in various cases.
32   I will be out of the country for the next two weeks and
33
34 AFFIDAVIT OF JON O. JACOBSON
35 Page 3
MULLIGAN/JACOBSON
36

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Michael R. Unsher
510 East Holly Street

1   will be returning prior to the end of the month and be able to
2   begin work on the project at that time.
3   FURTHER YOUR AFFIANT SAYETH NAUGHT.
4
5
6   /S/
                           ‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾
                              JON O. JACOBSON
7
8   SUBSCRIBED AND SWORN to before me this ____ day of
    October, 1992.
9
10
11   /S/ Michael L. Tasker
                           ‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾‾
12   Notary Public in and for the
                           State of Washington residing
13   at Bellingham
                           My Commission expires: _____
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