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Crash Reconstruction Puzzler: Can You Find the Answers To Defeat the Defense's Expert?

Using the basic science of determining speed from skid marks, John Kwasnoski (Professor Emeritus of Forensic Physics, Western New England College, Springfield, MA) presents an example of how that equation is used by reconstructionists, how the defense often twists those results, and how, by using a sensitivity analysis, prosecutors can put defense experts on their heels. Along the way, he asks a few questions, so you can test yourself. If you just want the skinny, peek at the answers on the back page.

Facts: the police reconstructionist has determined the minimum speed of a vehicle involved in a pedestrian fatality, using the skid marks found at the scene and the generally accepted *speed from skid marks equation1*:

Speed (mph) = $\surd$ (30 (*friction or road drag factor)(length of skid)*)

The drag factor was measured to be 0.80 and the skid length was determined to be 140 ft.

Question 1. Using these numbers, what is the minimum speed of the defendant's vehicle?

Defense Strategy. The defense retains a highly credentialed and experienced expert who questions the accuracy of the police measurements at the scene. Coming to the case months after the crash occurred, the defense expert never made his own measurements. During trial, he testifies that there are "uncertainties" in every measurement because of the nature of reading scales and making judgments of tire mark appearance, etc. Furthermore, he says that these uncertainties pile up when more than one measurement is used in a calculation such as the one used above by the officer. Therefore, he testifies the speed determined by police could be highly inaccurate, but he offers no opinion as to the degree of uncertainty or level of inaccuracy.

Defeating the Defense. Use your *common sense*. Focus on the assertions that are being made by the defense expert. Is there an uncertainty in each of the policy measurements? Yes, but the important consideration is *how large is the uncertainty.*

- Published police investigation training materials suggest that in the measurement of drag factor the maximum uncertainty or variance would be +/-5%.

- Is there an uncertainty in measuring a skid mark on a paved surface? Yes, but visualize the officer laying a measuring tape next to a tire mark. How uncertain could such a measurement be? The jury can appreciate that carpenters use similar measuring tapes to measure dimensions and cut lumber. A very generous assumption would allow for an uncertainty of one foot in a measurement made with a tape measure.

- Construct a hypothetical with all uncertainties in favor of the defendant:

    a. Friction or road drag factor = 0.76 rather than the measured value of 0.80
    b. Length of Skid = 139 ft. rather than the measured value of 140 ft.

Question 2. Using the numbers in the hypothetical above, what is the minimum speed of the defendant's vehicle?

Sensitivity Analysis. Using values that are different from the actual measurements at the scene but possible is called a *sensitivity analysis*. A method for reconstructionists to attach some degree of certainty to a calculation, a sensitivity analysis should be done with every calculation in anticipation of attack by the defense. Be sure to ask your officer if this analysis was performed.

Prosecutors deal in reality; defense attorneys offer theories of how a crash happened. Here's the reality:

- The square root operator in the equation reduces the effect of any uncertainty in measurements by a factor of 1/2. This means that a 10% error in a value used under the square root sign yields an uncertainty of 5% in the calculated answer.

- The sensitivity analysis is so basic and intuitive to a reconstructionist that he/she may not routinely do it.

- The officer's original calculation gave benefit to the defendant since the answer was rounded down and, usually, the lowest measured drag factor value was used.

- Additionally, skid marks (for vehicles with conventional brakes) start *after* braking commences, so the measured length of the skid marks was already lower than the true braking distance.

The jury needs to have confidence in the officer's calculated speed to make its decision, and sensitivity analysis is a great "credibility coupon" that helps the officer establish that confidence.

Prosecutor / Police Reconstructionist Q & A

A. Yes.

Q. And what was the purpose of that calculation?

A. To determine the degree of accuracy of my original calculation.

Q. Does that type of calculation have a specific name?

A. Yes, it is called a sensitivity analysis.

Q. And is that a calculation that is generally accepted in the field of crash reconstruction?

A. Yes.

Q. Can you tell the jury what you did?

A. I recalculated the speed using values that reflect any possible uncertainty in the measurements that were made at the scene on the evening of our investigation.

Q. Would you explain to the jury what values you used?

A. [Explanation].

Q. And what was the result of your additional calculation?

A. 56 mph.

Q. And can you explain to the jury what that means?

A. If the greatest uncertainties in every measurement were considered, the minimum speed estimate would change from 57 mph to 56 mph.

Is it reasonable a police officer would miss measuring the skid mark by foot? No! But even if he did, the calculated speed of the car doesn't change significantly.

Question 3. If the police reconstructionist did not perform a sensitivity analysis, can you as the prosecutor take the defense expert through a sensitivity analysis during cross examination?

For more information on this subject, APRI's new Special Topic Series publication, Crash Reconstruction Basics for Prosecutors, *is available on-line at www.ndaa-apri.org. Click on NTLC - Traffic Law to view. Also, check out other Special Topic publications, such as* Admissibility of Horizontal Gaze Nystagmus Evidence.

1 You may frequently see *braking efficiency* (BE) included in this equation, but some authors incorporate this into the drag factor itself. For example, the drag factor with all wheels braking is .80. With a defective brake, BE may only be at 70% operational - i.e., 80 x .70 = drag factor of .56. This is also subject to a sensitivity analysis.