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# "Is the camera the same as the human eye?"

## A visibility expert discusses the complexity of using video photography to inform and persuade jurors

**Q: "Is the camera the same as the human eye?"**
**A:** "No."

This is as frequently asserted as a "gotcha" question during cross examination attacking a driver's eye visibility study.

**Q:** "Then the visibility study does not show what the driver could have seen!"
**A:** "That is not correct; the jurors have eyes."

The explanation then given is a basic, but little understood, fundamental of the presentation of a visibility study in court.

A visibility study depicts what is available to be seen by a person with normal, unimpaired vision under defined conditions similar enough to those at issue to provide relevant information about levels of visibility, lines-of-sight, timing of visibility, and to demonstrate expert witness(es)' opinions.

The content of a visibility study is an image of the subject scene, which may be from the driver's position looking through the windshield, the bicyclist glancing back over his shoulder – or whatever is relevant.

*The crucial factor is that the camera, video, and processing are all just means to an end.* That end is bringing into the courtroom, on a screen before the jury, an image of the real world which was in front of the driver/bicyclist/whomever when the subject incident occurred.

*Each juror's eyes close the loop.* This is where "the human eye" becomes a part of the visibility study process. Each juror looks at an image which is as close to life size as necessary for the issues of the particular case. This image includes the entire windshield A-pillar to A-pillar, the dashboard instruments, and the view out the side windows if relevant.

The complexity of human vision now comes back into play: The juror looking at the image on the screen sees a small central foveal area in his field of view most sharply; the edges of his visual

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image are increasingly fuzzy out toward peripheral vision; but, his eyes scan area-to-area subconsciously so quickly that the entire image seems in focus. The juror's "human eye" has now become the final part of the visibility study.

## Closing the loop for jurors

Essential to allowing the jurors' eyes close the loop is putting enough of the scene into the courtroom that relevant aspects are not trimmed out.

A driver's eye view provides the most common example. In automobile situations a minimum image – to replicate areas scanned by a driver – must include the entire windshield, the speedometer, other gauges, and the center rearview mirror. In some incidents, side window and mirrors must be included. This image width and height cannot be obtained from a driver's head position with typical consumer or prosumer video cameras; these normally have only a 40 degree angle of view. Professional HD or 4K cameras with a minimum 90 degree horizontal angle of view are required. (The only exceptions are the GoPro [and similar] sports cameras. These, however, do not allow sufficient manual exposure control to handle nighttime road scenes nor daytime scenes going in and out of shadows.)

If side windows and mirrors must be included, two or three professional cameras are mounted pointed at different angles in the head position and the several images spliced together during computer editor processing.

Specialized projection equipment is needed in court. A 7000 lumen projector – two to three times brighter than those typically available through courtroom services – provides enough brightness to override courtroom security lighting or window ambient illumination. This is particularly necessary when showing nighttime visibility studies.

In order to afford the jury as close to a life-size image as possible, a large screen is positioned close to them. A specialized 90 degree wide field lens allows an 8 foot-wide screen to be placed 8 feet from the jury box, yet with the projector below the jurors' line-of-sight.

Precise juror viewing distance from the screen is only critical if the limiting factor in hazard visibility and recognition is size, conspicuity (contrast against background), or subject angle-off-axis. In some cases where one of these factors was significant, judges have allowed pairs of jurors at-a-time to view the visibility study, one seated on each side of the projector lens, with the screen facing away from the jury box. Rotating the viewing through the jury in this manner usually takes less time than the arguments about whether to undertake the procedure.

## Foundation and the concept of *expectancy*

Proper foundation testimony is essential before showing a visibility study to a jury. There are two topics which should always be covered:

***First***, a visibility study is not a reenactment, recreation, nor reconstruction of what the driver/pedestrian/witness actually saw. Rather, it is a demonstration, prepared with described speeds, paths, timing and other parameters intended to provide information regarding visibility factors relevant to the other evidence – percipient and opinion testimony – in the case.

***Second***, there is a major difference between viewing a visibility study in court and being the driver behind the wheel on the road. *The viewer in court is pre-alerted.* After voir dire, opening arguments, witness testimony, scene photographs – each juror expects a red-clad 9-year-old to dart into the street from behind the second hedge in the block.

*The driver was what we term naive.* Not being clairvoyant, the driver had no expectation of what was about to occur, nor where, nor with what timing. This factor must be explained to the jury. the jury must be asked to look down the road – as would a driver – while viewing the video.

"Please do not stare at the hedge, waiting for the boy to emerge."

There are some devices which can be used to deal with pre-alerting. One is to obtain the Court's agreement that each visibility study sequence will be shown to the jury only once – period. No repeats, not even during cross-examination nor other expert's testimony. No slow motion. No freeze frame. The driver was not afforded a John Madden Monday-morning replay. Therefore it is misleading to provide prolonged photographic viewing of a driver's momentary incident visibility.

The pioneer of human-factors visibility science, Dr. Paul Olson, was adamant regarding this subject:

> If the case relates to a dynamic event, such as a motor vehicle collision, it is blatantly unfair to allow prolonged viewing of a scene, since the involved party did not have that opportunity. Having made the point the next question is what is the solution? For dynamic events, static photographs purporting to show the scene available to a moving operator are inappropriate. Jurors should only view moving scenes representing the view of the operator, taken at the speed the operator was going at the time. Furthermore, they should see it only once. Additional viewing time can be allowed before reaching the area in which the event of interest occurred to allow the jurors time to adjust to the scene being depicted. They should not be forewarned that they are now approaching the critical area and certainly not told where the object of concern will appear.

(Olson, P., Farber, G. *Forensic Aspects of Driver Perception and Response*, (2003), Lawyers & Judges Publishing Company, Tucson, p.306.)

A second method for reinforcing the concept of expectancy is to make visibility study runs lengthy enough that the jury does not recognize the accident scene as soon as the video begins, knowing then where to look for the event. A variation of this method is to mix in among the collision runs several in which collisions do not occur. This both reduces juror attention to the accident point and emphasizes the testimony concerning pre-alerting.

A third method is to insert into a corner of the video image a timing marker

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which designates the interval before impact, during which the hazard must become visible *and recognizable,* during which there is time available for an avoidance maneuver (braking or steering). This emphasizes to the jury that merely seeing the hazard prior to impact does not mean it can be avoided. The perception/recognition/decision timing range is provided by testimony from a human factors' expert, a reconstruction expert, or by citing relevant technical literature. It is important to note that the 1.5 seconds all-too-frequently cited for "reaction time" is simplistic – it does not apply in all situations.

The most frequent example of this is a nighttime hazard which becomes increasingly illuminated as the driver's headlights approach. The process is something like: "Is there something ahead in the lane... Is it an object, not a dark patch.. How close is it... Is it a pig... Do I brake or swerve?" Low visibility and violated expectation make the obstacle disappear and even a moment's hesitation to search or to think or to decide upon response can eat up seconds. The AASHO Redbook's view of PRT written in 1973 remains true today:

> Whenever the driver is confronted with a complex traffic or highway situation and is required to make choices, judgments, and decisions, his response time may increase to 2, 3, or even 5 seconds (p.278).

(Green Ph.D, Marc, "Let's Get Real About Perception-Reaction Time" (2009), Human Factors, Tucson)

## Doing it the wrong way

The flip side of this discussion of how to present the issue of *expectancy* (sometimes called the *issue of expectation*) relates to *how not to present it*. All too frequently one encounters animations, or "simulations" offered in evidence containing freeze-frame stop motion, slow motion, captions, arrows or highlighting pointing to what is asserted a driver should have seen. Any of these devices belongs in counsel's argument, but not in an expert's exhibit purporting to show the visibility available to a person during a dynamic (moving) event. Certain objections to the admission of visibility studies are encountered frequently. The most recurrent might be termed "The Light Meter (or Photometer)" issue.

Frame from bus driver's viewpoint about to hit girl running across in the rain. Bus interior, moving steering wheel, rain on windshield being swept by wipers, wet pavement with reflections – are all photo-realistic video elements inserted into video – not computer cartoon graphics.

**Q**: "Did you use a meter to measure the brightness of the streetlight bulbs and the darkest shadows under the cars when you did your nighttime study?"
**A:** "No."
**Q:** "Why not... Gotcha."

The answer is that there is no usable connection between light meter measurements of a scene and an image presented in court. All that the light meter is good for is telling a photographer whether his settings are adequate to record sufficient detail for subsequent processing into an image which can be calibrated – using an accepted (non-light meter) method. We use the nighttime calibration process of adjusting an image from the driver's eye video on a computer screen while viewing it from the photopoint. Experts at the scene agree upon an image which contains the same level of detail – in areas of the scene relevant to the case – as appear to them as they view the scene. The screen image is saved, used in the lab as a reference for calibrating the visibility study video settings, and shown as a comparison in court to validate the detail contained in the visibility study.

This calibration method has been accepted in the technical community for decades, evolving as more sophisticated tools have progressively made it easier to perform. The next nighttime visibility study objection/question most frequently encountered is:
**Q:** "What is the ratio from the brightest to the darkest areas in the accident scene."
**A:** "The streetlight bulbs are probably tens of thousands times brighter than the shadows under the parked cars."
**Q:** "And the ratio contained physically in the visibility study video?"
**A:** "A few thousand to one."
**Q:** "Gotcha...So the visibility study is not accurate!"
**A:** "Again, it is the jurors who furnish the component necessary to render a properly-prepared visibility study useful and not misleading."

In addition to bringing their eyes and visual systems into the courtroom to

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close the scene-camera-human eye loop, the jurors bring their experience in encountering thousands of different driving and pedestrian scenes, juxtaposed with their having viewed countless numbers of cinematic and television depictions of similar scenes. This experience allows jurors to interpret the representation of a bright streetlight bulb in a video as what it actually appears to be when driving down a nighttime street. The experience of the jurors in understanding automatically the appearance of streetscapes and other objects familiarly encountered in life – and in video representations – provides the basis for the utility of the visibility study.

Reduced to its basic absurdity, if credibility were given to the arguments about light meter readings and differences in intensity range between the real world and photographic depictions of the real world, all of the millions of photographs and videos admitted in evidence in the past century should have been excluded.

The California Supreme Court in 2012 issued a unanimous opinion which explicitly established a standard similar to that which we have outlined for decades in our foundation testimony. An animation (or, by analogy, a visibility study) is routinely admissible in evidence. (*People v Duenas* (2012) 55 Cal.4th 1.) This admissibility, however, is as demonstrative evidence, illustrative of expert opinion or for similar purposes, not for the truth of its content per se.

One imposing sounding requirement frequently cited in attacks upon admissibility is that the foundation elements for the exhibit be "substantially similar" to the scene at the time of the subject incident. This caveat, however, becomes relatively nonrestrictive upon a reading of the longstanding leading case, *DiRosario v. Havens* (1987) 196 Cal.App.3d 1224, usually cited for that proposition. In *DiRosario*, the expert preparing a visibility study video used a five-foot rather than four-foot tall pedestrian, a different time of year, a different sun position, a different level of traffic, and different lane markings. The *DiRosario* decision, after reciting the requirement of substantial similarity, ruled that these differences did not constitute lack of substantial similarity. The substance of this controlling decision is far more forgiving than the dicta usually cited out of context.


Camera on front of van at bus driver's eye level – driven along bus path – to capture base video used to construct video-in-video visibility study.

## Be careful what you askfor

Think carefully before you make a motion you do not want to win. On many occasions we have encountered opposing animations which were – to be polite – so fictional that counsel we were working for had to be persuaded to refrain from having them excluded with motions in limine.

## Video versus animation

Actual video has always been better than animation – also termed computer generated graphics (CGI) – for use in visibility studies. Video is more lifelike. Detail and the subtleties of lighting always appear artificial when not photographic. Some animators have tried to partially fix this problem by inserting computer-generated vehicles into driver's eye video. This is an improvement over entire animations, but the vehicles still appear cartoonish when scrutinized.

Current video technology allows us to assemble separate video components into a cohesive, natural-appearing whole. A good example we completed recently was a bus striking a pedestrian at night in the rain. The bus was equipped with 11 video cameras, a black box and GPS system. We downloaded the data and video from the bus operator's hard drives during a cooperative session. Our co-experts provided us bus and pedestrian positions to the nearest inch and tenth of a second.

We were not able to schedule an exemplar city bus and traffic in advance when we knew there would be a rainy night. How, then, did we get the bus drivers' eye view, at 16mph, rain hitting the windshield, wipers working, wet streets, striking a pedestrian running across 3 lanes from the left?

First, the view from inside the bus was acquired during a routine daytime parking-lot bus inspection using the accident-bus videos to locate our camera at the eye position of the driver.

Then, after midnight on a Sunday morning, video was taken at the accident scene. The reconstruction expert marked one-second intervals along the bus driver's head path and the pedestrian path. The camera used in the bus inspection

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was mounted outside the front of a van at the height and angles it had been in for the bus inspection driver viewpoint video. The van and pedestrian were run on a collision course (in slow motion) – with video being taken from the bus driver's eye position – during breaks in the early AM traffic. An exemplar oncoming witness car was synchronized to show the effect of its headlights. The nighttime calibration procedure was performed at a point 5 seconds prior to impact.

In the video lab the study was assembled. The nighttime video was calibrated to match the exemplar saved at the scene. The nighttime video was inserted into the windshield from the bus inspection driver's viewpoint. The interior from the bus inspection was darkened to match the nighttime illumination. The steering wheel was made to rotate to match the movements of the bus. The apparent bus speed was adjusted using the timing marks visible on the road. The pedestrian was lifted out of the van-camera video and repositioned frame-by-frame using the timing marks for precise accuracy. Falling rain, droplets running down the windshield, wet pavement with reflections changing as the bus moved were all inserted using physics-based photographic moisture programs. The windshield wipers were made to operate as shown in the accident night security video with the appropriate apparent effect upon the windshield moisture. The resulting bus driver's view of the rainy-night, 16 mph collision with a running pedestrian is as realistic as a Hollywood film.

*Paul Kayfetz prepares HD-video visibility studies and provides foundation expert testimony to get them into evidence, and to explain the results of the studies. He has testified as an expert witness in Engineering Photography more than 500 times across the country. In addition, he is the author, and co-author with* Human Factors Experts, *of five nationally-published technical papers on these topics. Attorneys retain him for consultation to keep opposing animations/simulations/visibility studies out of evidence — or to use judo to turn them against their promulgator. He also enhances hidden detail from video, and makes measurements from existing photos or video.*

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