D7 A Forensic Engineering Review of the TAU Phenomenon (Looming) and a Cautionary Application to Crashes

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The goal of this presentation is to inform attendees of the phenomenon of looming, namely the rate of change of the image of approaching objects on the retina, and its threshold values.

This presentation will impact the forensic science community by presenting alternative arguments and pointing out the contrasts to attendees, who will benefit from this discussion by appreciating the complexity of this topic and the apparent ten-fold variability in the threshold detection level of the human visual system.

This aspect of human vision has been studied for more than 40 years, and as yet, there is no general acceptance of this theory as being a critical determinant in crashes, in particular regarding rear-end collisions.

Nevertheless, some experts opine that this phenomenon entirely explains some crashes, neglecting the messy little details that limit or at least create doubt of the theory's applicability. This study presents the general topic and an example, which includes a matrix of specific calculations pertinent to a fatal rear-end collision involving a pickup truck and a commercial truck.

The study of human vision is an integral part of human-factors engineering, which pertains to the assessment of human capabilities in the real world, and includes physical, sensory, and cognitive elements of our daily performance.

An object approaching the eye projects an image on the retina. Initially, the image size appears constant or slowly increasing, but just prior to a potential contact, the rate at which the retinal image increases rises dramatically (exponentially). The projected image is defined by the subtended angle (in radians θ), and its rate of change over time is dθ/dt. The theory suggests that this retinal image rate of change can be used by the visual system to determine the Time To Collision (TTC) and is independent of other speed-related metrics. This ability has long been observed in animal behavior, including animals as diverse as fiddler crabs, chicks, monkeys, flies, and human infants, who all try to avoid looming patterns.

It is reasonable to believe that, in part, we use this aspect of vision as we run over irregular terrain and adjust our gait, or know when to duck under a branch, or, in the case of a diving bird, when to fold the wings. This looming theory has been popularized as a quick explanation of rear-end accidents, particularly trucks. The argument is that a stopped vehicle is not apparent to a driver closing at speed until they are so close that a crash is unavoidable. This simplistic approach ignores the fact that, as drivers, we use many other cues in the visual field, such as contrast, optic flow, textures, and gradients, and that the criteria (thresholds) for looming detection are highly variable.

The discussion of TTC and looming phenomena is straightforward with respect to simple physics, but is complex, and some say questionable, in its applicability to humans and the relationship to automobile crashes. This discussion will focus on a particular case, Kovalchuck v. System Transport, a Washington state jury case in 2017. The base data for this case are as shown in Figure 1, below.

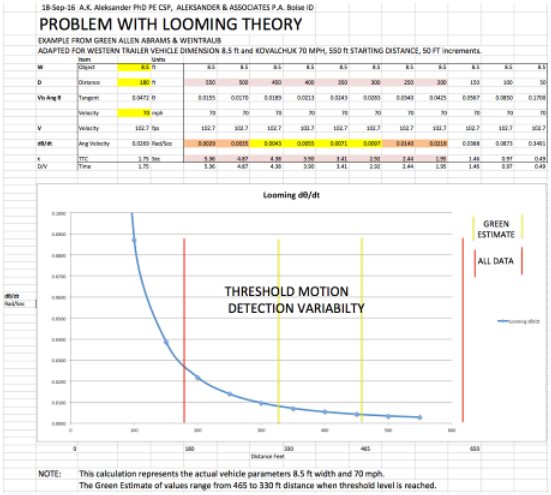

Figure 1. Base Case Parameters, Looming Threshold.

This diagram, the substantiating calculations, and alternative arguments will be presented. Contrasts will be noted for attendees, who will benefit from this discussion by appreciating the complexity of this topic, and the apparent ten-fold variability in the human threshold detection level. Findings of others will also be referenced, and a summary of work in this field will be included. This presentation will conclude with the jury finding.

TAU, Looming, Inattentional Blindness

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