Perceptual and attentional factors in detection of driving-relevant visual events

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Abstract

Driving often involves multitasking, whether texting, viewing directions on the navigation system, or simply checking the rearview mirrors while maintaining lane position and monitoring the roadway for hazards. Multitasking, in turn, typically involves not only attending away from the forward roadway, but also looking away. Dual task human vision experiments have attempted to separate the factors of attentional limits and fixation, but little work has been done to extend this methodology to stimuli and tasks of relevance to driving. It is not immediately obvious that dual task results with artificial displays and often-semantic tasks generalize to cluttered natural scenes and navigation-related tasks. We asked subjects (n=30, 15 female) to watch forward-facing road video recorded around Boston, MA, and report brake light events in their lane of travel. We manipulated cognitive load by asking subjects to perform one of two secondary tasks at fixation (easy vs. hard), while independently enforcing fixation at one of 4 locations (center of video, corresponding to forward roadway, as well as 30° left, 30° right and 20° down from center). We found that looking away from the forward roadway significantly reduced brake light detection performance (-8%, p< 0.001), increased response time (+350 ms, p< 0.001), and, most dangerously in a driving context, dramatically increased the number of missed brake light events (+15%, p< 0.001), although differences between non-central locations were not significant. Increasing cognitive load, however, had a smaller effect, with no significant changes in performance, though trends towards increased miss rates, relative to the low cognitive load condition (+5%, p=.207), and decreased detection performance (-3%, p=.371), respectively. Drivers can detect many salient events using peripheral vision, but looking away comes with severe penalties.

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