3D SPATIAL ATTENTION EFFECTS ARE INDEPENDENT OF PROJECTED 2D SIZE AND LOCATION FOR OLDER AND YOUNGER DRIVERS

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The current experiment was designed to assess whether 3D spatial attention effects persist in a driving scene when projected size and position are experimentally controlled

Background

- The useful field of view (UFOV; Sekuler & Ball, 1986), a measure of 2D spatial attention, provides evidence that the scope of 2D visual attention is reduced in older adults
- At the last Driving Assessment conference we reported that the shape of visual spatial attention in the horizontal dimension was different for older and younger observers for targets far in depth but not near in depth (Pierce, Bian, & Andersen, Driving Assessment, 2011).

Experiment

Drivers:

- 24 younger drivers (*M* age = 21.75 years; *SD* = 1.03 years)
- 24 older drivers (*M* age = 73.50 years; *SD* = 4.48 years)

Dual Task:

- Car Following Task
- Light Change Detection Task

Independent Variables

- Light Change Distance (30m, 45m, or 60m)
- Horizontal Light Change Position (1.2m, 2.4m, 3.6m, or 4.8m)
- Light Size / Height
  - Small: 41.25mm / 4.16m
  - Medium: 61.88mm / 3.42m
  - Large: 82.50mm / 2.68m

Dependent Variable: Reaction time (RT) for a judgment indicating whether the light change occurred on the "right side" or "left side" using manual response paddles.

Task Parameters: The lead vehicle had a target headway distance of 20.5m. It averaged a speed of 60 kmph. The light array had 11 lights, and measured 13.2m × 0.83m.

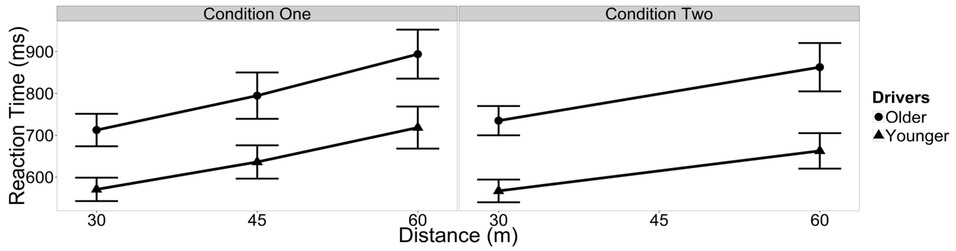
Conditions of Interest

Conditions of light change distance, horizontal position, size, and height that yielded identical projected sizes and positions

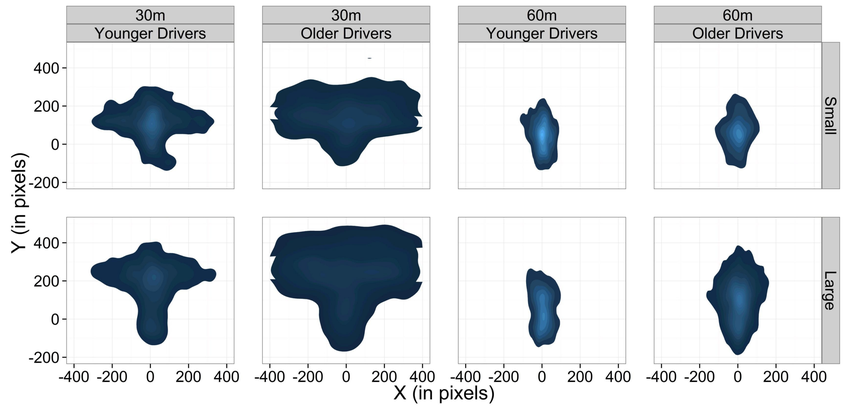
- Condition 1:
  - Distance 60m, Horizontal Position 4.8m, Large Light
  - Distance 45m, Horizontal Position 3.6m, Medium Light
  - Distance 30m, Horizontal Position 2.4m, Small Light
- Condition 2:
  - Distance 60m, Horizontal Position 2.4m, Large Light
  - Distance 30m, Horizontal Position 1.2m, Small Light

Alpha blended overlay of large green lights @ 60m and small red lights @ 30m bounded by a line representing the region of typical eye fixation

Reaction times across for conditions in which projected size and position were experimentally controlled as a function of simulated distance and age



Heat map of eye fixations at the moment of light change by distance condition and age. Lighter colors represent greater eye fixation density.



Results

Reaction time increased as a function of simulated depth for light change stimuli equivalent in projected size and position for both conditions of equivalent stimuli, $F(2, 92) = 94.03$, $p < .001$ and $F(1, 46) = 72.09$, $p < .001$, respectively.

Reaction time to light change targets was slower for older drivers than for younger drivers for both conditions of equivalent stimuli, $F(1, 46) = 45.04$, $p < .001$ and $F(1, 46) = 91.05$, $p < .001$, respectively.

However, there was no statistically significant interaction between the effect of age and the effect of simulated depth on reaction time for either condition of equivalent stimuli, $p = .39$ and $p = .22$, respectively.

Linear mixed effects regression models including visual angle separation of the light target from the focus of attention, visual angle separation of the light target from the location of fixation, 2D size of the target, simulated depth, simulated horizontal position, and age group demonstrate a unique effect attributable to simulated depth.

Conclusions

- 3D attention effects are not dependent on projected size or position.
- The mechanism of 3D attention is present in younger and older observers.
- Similar effects of spatial attention along the depth axis were found for both older and younger drivers.
- 3D attention effects were observed in this experiment even though the stimuli did not have binocular disparity. Therefore, effects of 3D attention *can* be obtained from pictorial information alone.

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