Tracking road vehicles in heterogenous vs homogenous colour sets

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Abstract

In order to avoid collisions when driving, it is often necessary to keep track of the positions of multiple moving objects at once. For example, in a highway driving scenario, drivers need to keep track of multiple vehicles in order to safely perform manuvers such as overtaking and merging. The current work extends our basic research on Multiple Vehicle Tracking, to investigate how drivers' ability to attend to multiple moving points in a simulated driving task varies with the composition of the vehicle search set. We demonstrate clearly that tracking set heterogeneity positively affects task performance.

Background

In the basic research on attention, there is an experimental task called multiple-object tracking that measures the ability to keep track positions of multiple moving items at once. Laboratory research into multiple object tracking suggests that young adults can typically track 3-5 items simultaneously, though there are some individual differences. These differences may explain why some drivers are more at risk of collisions than others when required to monitor the positions of multiple moving objects at once, (for example, in elderly or young drivers). Although object tracking has been studied for over 25 years in the experimental literature, there is very little research on the topic in the driving literature. This is possibly because the conditions in the classic laboratory tracking task are very different than those on the road

In this study we follow up our previous work on vehicle tracking (Lochner & Trick, 2014), by investigating how the composition of the target and distractor vehicle set impact tracking performance.

Method

48 Undergraduate students were tested in a Drivesafety DS600-C fixed–base driving simulator. The simulator body was made up a full-body Saturn sedan surrounded by viewing screens (5 screens in front and one in the back) on which a 300 -degree wrap-around virtual driving environment was projected (250 in the front and 50 degrees in the back, respectively). The simulator display operated at 256 colours and operated at 60 Hz. A standard 3-lane freeway style roadway simulation, with no turns, was modified such that the target and distractor vehicles appeared in front of the participant vehicle.

The participant viewed displays in which there were always 8 vehicles. These vehicles were either a homogenous set (i.e., all the same colour), a heterogeneous set (every vehicle had a different colour), or a set in which each target was paird with a distractor of the same colour, when there were four different colours (e.g. red, blue, green and yellow) in replication of the "Paired-4" condition in . Vehicle colours were distributed randomly across all vehicles at the start of each trial, and there were a total of 6 unique colour sets: 2 for each condition. Two possible versions of each condition (so, 2 versions of the homogenous, 2 versions of the heterogenous, and 2 versions of the "paired-4") were available to be presented during the experiment.

Results

Overall tracking accuracy was 80%.

A 3 x 2 x 2 mixed ANOVA was performed. The between-subjects factor Articulatory Suppression was non-significant, $F(1, 47)=2.239$, $p=.141$, $\eta 2= .046$, and as such the conditions were combined. The effect of Tracking Set Composition was significant at $F(2,94)=9.019$, $p<.001$, $\eta 2= .161$, indicating that, as expected, tracking accuracy was higher in the Heterogenous condition, as compared with the Homogenous and Paired-4 conditions. Likewise, the predicted effect of Task Load was significant at $F(1,47)=16.061$, $p<.001$, $\eta 2= .255$, indicating that tracking accuracy was poorer when the participant was required to operate the vehicle. Finally there was a Tracking Set Composition X Task Load interaction, consistent with the prediction, significant at $F(2,94) = 4.142$, $p < .05$, $\eta 2= .081$, indicating that the effects of the Tracking Set Composition differed across levels of the Task Load manipulation

Conclusions

We have shown that, as predicted, the composition of the tracking set does influence the ability of a participant to track multiple vehicles in a simulated roadway environment. Specifically, when the tracking set is made up of a heterogenous selection of colours, tracking accuracy was higher than when the tracking set was either all one colour (Homogenous), or when there was one target and one distrator in each colour (Paired-4). This is interesting because it indicates that, at least in terms of the composition of the stimuli, the classical multiple object tracking task may fail to take into account an important aspect of tracking objects in a realistic environment – namely that such heterogeneity often exists in naturalistic environments, and can be used to benefit performance.

References

Makovski, T., & Jiang, Y. V. (2009). The role of visual working memory in attentive tracking of unique objects. Journal of Experimental Psychology: *Human Perception and Performance,* 35(6), 1687.

Lochner, M. J., & Trick, L. M. (2014). Multiple-object tracking while driving: the multiple-vehicle tracking task. *Attention, Perception, & Psychophysics*. http://doi.org/10.3758/s13414-014-0694-3