The Effects of Texting and Driving on Hazard Perception and the Adoption of Driver Response Strategies

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Abstract.

Hazard perception has received little attention compared to measures of vehicle control in studies exploring the effects of texting on driving performance, despite being a more direct measure of crash risk. Twenty participants drove in a simulator while text-messaging in order to assess its affect on hazard detection. Analysis revealed a greater response likelihood (i.e., responding to a greater number of potential hazards) in a relatively easy text-messaging task compared to a more difficult one, $t(19) = -3.24$, $p < .01$. These findings suggest that the impact of text-messaging on the detection of driving hazards depends in part, on the nature of the text-message, particularly in the adoption of strategies to compensate for interference on the driving task.

1. Introduction

There are relatively few studies exploring explicitly, the effects of text-messaging on the detection of driving hazards, despite it being a more direct measure of driving safety than alternative measures of driving performance (Victor, Engstrom, & Harbluk, 2009). For example, text-messaging drivers have shown increases in lateral lane control and following distance variability, and an increase in missed lane change prompts, which are all measures of vehicle control (Hosking, Young and Regan, 2009). Thus, hazard perception should be explored more explicitly to provide a more direct measure of driving safety.

The present study utilizes a low fidelity simulator specifically designed to measure drivers' hazard perception. Furthermore, two types of text-messaging tasks will be used to explore the effects of interference from early (maintenance) and late (central executive) stages of information processing on performance (see Fougnie & Marois , 2007). Data will not only be recorded for correct detections, but also for false alarms (i.e., response to a non-hazard). In addition to measuring response performance, this will help assess the degree to which drivers are able to compensate for engaging in text-messaging while driving (i.e., shifting their response likelihood).

2. Experiment

Methods

Twenty participants (10 men, 10 women) completed driving scenarios in a simulator (DriveSim V.3.0) designed to measure hazard detection while text-messaging. An iPhone 4 (software version 4.2.8; Apple, California) with a touch screen QWERTY keyboard was used for the texting task.

The experiment consisted of 60 driving scenarios split into two counterbalanced blocks. One of which required participants to copy a 5-letter string (e.g., original text = dneja, participant response = dneja) and the other to alphabetize the 5-letter string before sending it back to the experimenter (e.g., original text = dneja, participant response = adejn). Furthermore, each block contained 15 hazard scenarios and 15 no hazard scenarios.

Results

Correct detections were recorded when participants successfully detected a hazard (i.e., collision with another car) and made the correct response (i.e., braking, speeding up, changing lanes). False alarms were recorded when a response was made where there was no imminent danger of collision. Percentage of correct detections and false alarms are shown as a function of texting condition in Table 1.

Table 1
Percentage of correct detections and false alarms

Texting Condition	Correct Detections (%)	False Alarms (%)
Baseline	82	9
Copy Text	82	20
Alphabetize Text	72	11

A repeated-measures ANOVA was used to examine the effects of texting condition on the measure of response likelihood. Response likelihood (i.e., response bias) varied significantly between the three texting conditions, $F(2,38) = 3.76$, $p < .05$, $\eta^2_p=.177$, with the copy text condition being higher than the alphabetize and baseline (no text) condition (see Figure 5). Furthermore, post-hoc pairwise comparisons show that that when completing the repeat text task (M = -0.76) participants were significantly more likely to respond to potential hazards than in the alphabetize texting task (M = -0.29), $t(19) = -3.24$, $p < .01$. This indicates that drivers in the copy text task were more likely to record false alarms (i.e., respond when a hazard was not present) compared to the other texting conditions. The difference between the no text (M = -0.38) and copy text (M = -0.76) conditions was only marginally significant, $t(19) = 1.83$, $p = .083$. No difference was found between the no text (baseline) and alphabetize text conditions, $t(19) = 0.55$, $p = .592$. This last finding was unexpected, showing that drivers adopted similar response likelihoods in both the easiest and most difficult conditions.

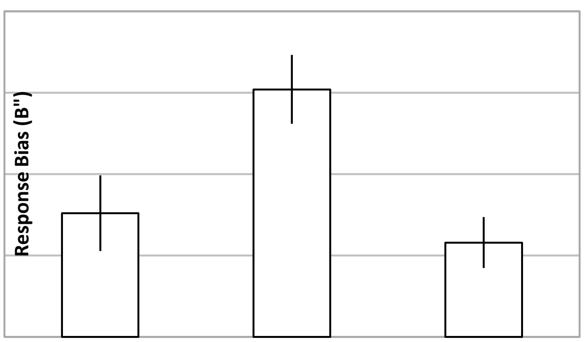

Figure 1. Response likelihood (bias) for the different texting conditions. (Bars represent +/- 1 standard error.)

Discussion

Response likelihood was found to be significantly lower in the copy text condition than the baseline and alphabetize text conditions, suggesting that participants attempted to compensate for the texting task by adopting a more liberal response strategy in that condition. That is, they were more willing to react to non-hazardous situations in order to ensure the detection of hazards when interfered with by text-messaging. It was surprising that this more liberal response bias was not also adopted in the alphabetize text condition, where it would seem to be even more advantageous. Thus, when performing the more demanding alphabetize task, participants showed a more conservative criterion (i.e., less false alarms and increased missed hazards) compared to the copy text condition. This suggests that the more demanding task of alphabetization interfered with the driver's ability to compensate for the texting task. Thus, it is apparent that the increasing the difficulty of the texting task impairs driver response performance.

3. Conclusions

The current study adds to the evidence for text-messaging negatively affecting driving performance beyond vehicle control by explicitly exploring hazard perception. Text-messaging caused participants to make more detection errors overall when exposed to driving hazards. In addition, the type of text-messaging task differentially impacted the nature of these errors, with simply copying the message resulting in a greater percentage of false alarms and alphabetizing the message resulting in a greater percentage of missed detections. These findings suggest that drivers attempted to compensate for the texting task by adapting a more liberal response strategy to ensure correct detection of hazards, at least when the texting task required the maintenance of information (copying). When manipulation of the information was required (alphabetization), however, the drivers were seemingly unable to pick up on the environmental cues of potential hazards. This circumvented the drivers' attempt to adopt the compensation strategy, resulting in a decrease in false alarms and an increase in missed hazards. This suggests that the hazard detection ability of drivers while engaging in text-messaging is dependent in part, by the nature of the text-message being sent (e.g., information that is somewhat automatic vs. generating a novel response), not only in the types of detection errors being made but also in the adoption of compensation strategies.

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[1] Fougnie, D., & Marois, R. (2007). Executive working memory load induces inattentional blindness. *Psychonomic Bulletin & Review*, *14*, 142-7.

[2] Hosking, S. G., Young, K. L., & Regan, M. A. (2009). The Effects of Text Messaging on Young Drivers. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *51*, 582-592.

[3] Victor, T.W., Engström, J., & Harbluk, J.L. (2009). Distraction Assessment Methods Based on Visual Behavior and Event Detection. In M.A. Regan, J.D. Lee, & K.L. Young (Eds.) *Driver Distraction: Theory, Effects and Mitigation*, (pp. 135-16). Boca Raton, FL: Taylor & Franc