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Comparing Distraction Mitigation Methods: Post-Drive and Real-Time

In-vehicle distraction mitigation systems are designed to provide feedback to drivers about their level of distraction and associated driving performance. There are two main types of distraction mitigation methods: real-time feedback and post-drive feedback. Both types of mitigation methods differ in timescale and objective. Real-time distraction mitigation feedback is provided as the vehicle is being driven whereas post-drive feedback is provided at the end of the drive.

Real-time, or concurrent, feedback redirects drivers' attention to the roadway when distraction thresholds are exceeded. This most common form of distraction mitigation feedback may have an immediate impact on driving performance, but may not affect drivers' willingness to engage in distracting tasks. Post-drive, or retrospective, feedback aims to change driver behavior based on prior driving performance. The method displays patterns of behavior and performance to the driver that may better target attitudinal and cultural change regarding distracted driving.

A comparison of these two feedback methods was conducted to provide insight into the effect of timescale and feedback form on short-term and long-term driving performance and behavior. In addition to changing drivers' attitude and performance, it is important to ensure that drivers accept the system and trust its output. Thus, the study focused on the effectiveness of each mitigation method based on driving behavior, planned behavior, and user acceptance.

Method

The post-drive feedback used in this study was a series of report cards designed to compare each driver against peer drivers and assign an overall driver performance grade. The report card (Figures 1 and 2) was shown after each drive period.

Real-time feedback consisted of flashing lights and auditory alarms to redirect the driver's attention. For cognitive distraction, lights flashed on either side of the driver (Figure 3) and for visual distraction a light flashed in the center of the windshield.

Participants drove in simulated urban, interstate, and rural environments and were given three types of distraction tasks. Each driver drove an initial drive with no mitigation feedback and then drove a final drive with either of the mitigation types or a control (no mitigation feedback) drive. After each drive, participants were administered questionnaires to assess planned behavior, awareness of their driving performance, and mitigation system acceptance.

Figure 1.
Sample post-drive feedback report card comparing subject's distraction level to peers.

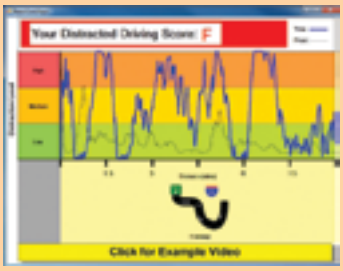


Figure 2.
Sample post-drive feedback report card detailing distracted driving data.

Figure 3.
Example of visual alerts used in real-time feedback.

Key Findings

- **Mitigation feedback has no strong effect on planned behavior.** In terms of intent to engage in distracting tasks and intent to delay engagement of distracting tasks, there was no strong difference between mitigation feedback groups (Figure 4).
- **Real-time mitigation feedback resulted in a decreased focus on the forward roadway.** As seen in Figure 5, the post-drive feedback resulted in an increased focus on the forward roadway for these tasks whereas the real-time feedback resulted in a decreased focus ($p = 0.0172$).
- **Drivers demonstrated a higher acceptance of post-drive systems than real-time systems.** As shown in Figure 6, the post drive group rated the system as more useful than drivers' experiencing the real-time system, $p = .020$. The ratings for ease of use and perceived value followed a similar pattern, $p<.001$, and $p = .0020$.

Conclusion

Data for forward roadway glances indicates that the post-drive feedback in this study was effective at improving driver attention to the road while decreasing unsafe glances away from the road. Real-time feedback caused opposite effects. Potential explanations for why real-time feedback resulted in increased unsafe glances are: Drivers might be using the warning to guide when it is necessary to look back to the roadway; the complexity of the underlying warning algorithm and multiple warnings might leave the driver unsure of how to respond to the feedback; or due to the frequency of warnings, the driver may not trust their accuracy and may chose to ignore them. These possible explanations are supported by the fact that drivers ranked the real-time feedback lower in terms of usefulness, ease of use, and value.

Figure 4.
The difference between survey responses before and after the study for questions about the frequency of engagement in distracting activities while driving.

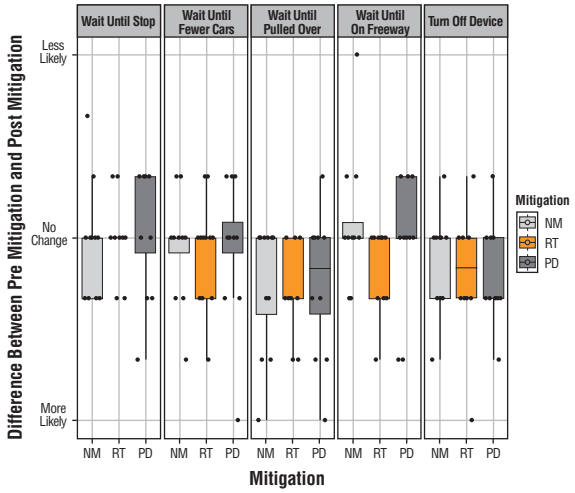


Figure 5.
Difference in Mean Percent Road Center by Mitigation for Visual Tasks.

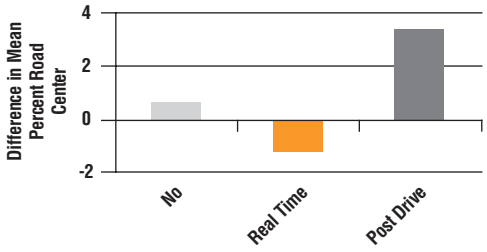
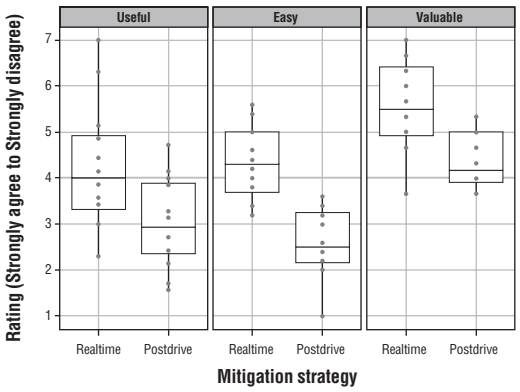


Figure 6.
Ratings of acceptance with lower levels of acceptance towards the top of the graph.



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This Vehicle Safety Research Note is a summary of the technical research report: *Distraction Detection and Mitigation Through Driver Feedback* (DOT HS 811 547). This report can be downloaded free on the Vehicle Safety Research section of NHTSA's Web site (www.nhtsa.gov).

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