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Evaluating Driver Reactions to New Vehicle Technologies Intended to Increase Safety and Mobility across the Lifespan

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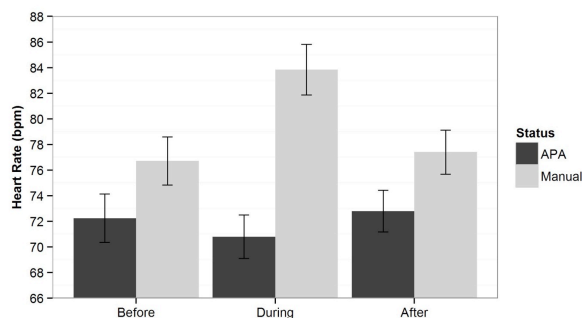
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Personal vehicle manufactures are introducing a wide range of new technologies that are intended to increase the safety, comfort, and mobility of drivers of all ages. Examples range from semi-autonomous technologies such as adaptive cruise control that automatically adjusts vehicle speed to maintain a safe headway distance from a lead vehicle to blind spot identification systems that provide operators with warning information on the presence of vehicles hidden from their field of view. While part of the challenge of developing and implementing such systems is technical, equally important considerations include the extent to which the general public is willing to trust these technologies appropriately and actually use the systems in ways that produce the intended benefits. This may be particularly the case for older drivers for whom many of these technologies represent significant challenges to their mental models of how to operate a vehicle and who may be less trusting of new technologies per se. This project evaluated drivers' reactions to a semi-autonomous system for parallel parking and a cross traffic warning alert system designed to warn drivers of encroaching vehicles when they are attempting to back out of a parking space. Both technologies are being promoted by the manufacturer, in part, as systems intended to reduce driver stress. Results of both studies are detailed in Reimer, Mehler and Coughlin (2010).

Further details on the evaluation of the semi-autonomous parking system were presented at the Human Factors and Ergonomics Society's Annual Meeting (Reimer, Mehler & Coughlin, 2011b). The behavior of 42 subjects distributed evenly across three age groups (20's, 40s and 60's) and equally by gender within the age groups, was assessed during manual parking and when parking with the assistance of the APA (semi-autonomous) parking system. Subsequent to being trained on the operation of the system and being provided with an opportunity to practice using the system (see Reimer, Mehler & Coughlin, 2011 for details), subjects were asked to make six evaluation parks (alternating between parking with and without the assistance of the APA technology). The figure below illustrates differences in driver heart rate during three key portions of the parking maneuver approaching the spot (before), during active parking and after the period just after the vehicle was placed in park.



The results suggest that use of the semi-automated parallel parking assistance system resulted in reduced stress / anxiety as participants approached the parking space when they knew the assistive technology was there to support the parking maneuver. The greater than 12 beat per minute difference in heart rate between manual parking and parking with the APA system during the active phase of the parking task is striking. The pattern of findings for these primary measures is consistent across gender and the age groupings in the population assessed in this study. It is hypothesized that the detailed orientation and guided training in the principles of how the system functioned and on the correct use of the assistive technology prior to assessment played an important role in the degree to which participants adapted to the use of the technology.

Reimer, B., Mehler, B. & Coughlin, J.F. (2010). An Evaluation of Driver Reactions to New Vehicle Parking Assist Technologies Developed to Reduce Driver Stress. MIT AgeLab White Paper. Massachusetts Institute of Technology, Cambridge, MA.
(http://web.mit.edu/reimer/www/pdfs/reimer_2010_parking_technology_and_driver%20_stress.pdf)

Abstract: A wide range of advanced technologies are currently being introduced into production automobiles that are intended to increase safety and comfort. If effectively implemented, some of these advanced technologies also offer the possibility of reducing driver stress. This study employed heart rate as an objective physiological arousal measure along with more traditional self-report ratings to evaluate the extent to which two recently introduced technologies impact driver stress levels. The technologies evaluated were a semi-autonomous system for parallel parking that detects appropriately sized parking spaces and actively steers the vehicle into the parking space while the driver controls the throttle and brake and a cross traffic warning system designed to alert drivers of encroaching vehicles when backing out of parking spaces. Two separate samples of 42 participants each were employed in the analysis and each sample consisted of three gender balanced age groups (20-29, 40-49 and 60-69). In both experiments, each participant experienced multiple exposures to the parking maneuver with and without the technology (within subject design). After becoming familiar with the technology, participants rated their stress levels significantly lower when using the assistive parallel parking technology ($p = .025$) and physiological recordings showed an average heart rate 12.6 beats per minute lower ($p < .001$) providing confirmation of a lower state of arousal. These findings were consistent across gender and age groups. Mean self-report and heart rate data were suggestive of some reduction in stress levels with the cross traffic warning system, although these differences were not statistically significant ($p > .05$). It was observed that drivers were more likely to appropriately stop and yield to an approaching vehicle during trials when the cross traffic alert system was active, potentially reducing the likelihood of accidents. While ratings of the systems were generally positive, some individuals experienced issues with the technologies. Additional analysis of self-report data and subgroups within the data study sample is ongoing. Developing a more complete understanding of why some individuals have issues interacting with these types of new technologies may provide important insight into how further gains in technology adoption and stress reduction can be obtained.

Reimer, B., Mehler, B. & Coughlin, J.F. (2011b). Using Self-Report and Heart Rate Measures to Assess Stress Reduction from a Semi-Automated Parallel Parking System. Presentation at the 55th Annual Meeting of the Human Factors and Ergonomics Society. Las Vegas, NV.

Abstract: A field study compared 42 drivers' self-reported stress and heart rate levels while using Ford's Active Park Assist™, a semi-automated parallel parking system, with manual parallel parking. Heart rate before, during and following the parking tasks, as well as self-reported stress following the maneuvers, were found to be significantly lower with the aid of the technology. Results show that heart rate, an objective measure of stress, was a more sensitive measure than self-report. Drivers' lower stress / anxiety as they approached the parking space was particularly notable as the participants had a relatively limited opportunity to develop experience and trust with the new technology.