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Final Report

Project Title:

Assessing Methods of Enhancing Older Driver Performance

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Research has demonstrated improvements in neuropsychological measures following participation in cognitive training programs in normal aging individuals (Ball, et al., 2002; Ball, Edwards, & Ross, 2007; Willis, et al., 2006; Wolinsky, et al., 2006). While claims have been made that cognitive training reduces accidents up to 50% (https://www.drivesharp.com/), studies examining on-road driving performance to date have not provided comprehensive data on whether functional changes in driving performance, driving behavior, or the allocation of a driver's attention to the roadway are associated with the reported neuropsychological findings. In particular, this research set out to: (1) assess neuropsychological improvement following intervention with a commercial brain-training software program, Posit Science Cortex™ with InSight Drive Sharp™ and (2) examine whether measurable improvements in on-road driving performance can be quantified following intervention with the brain-training program.

A field driving intervention study encompassing highway driving and two secondary cognitive activities was conducted. Data was collected in a 2010 Lincoln MKS instrumented to record vehicle telemetry (speed, wheel movements, etc.), visual attention (Seeing Machines FaceLAB 5.0 eye tracker), physiological measures (NeuroDyne Medical MEDAC System/3 model 61), video of the surrounding traffic, driver face, and vehicle dashboard, and auditory recordings from the vehicle cab. Thirty-eight subjects (aged 60-75) were recruited and 32 completed the experimentation. Participants were randomly assigned to either a control or intervention (training) group. The intervention group members (16 individuals) were provided with a copy of Posit Science's DriveSharp (also known as DriveSharp with InSight) visual training computer program and asked to complete 8 hours of training (manufacturer prescribed dose). Active participants were assessed using laboratory neuropsychological measures and during field driving before and after training. Control participants were assessed at intake and again after 2 weeks (period allotted for active group training).

Results of this project provide further evidence that using the Drive Sharp™ training improve UFOV scores. Training, however, did not impact other neuropsychological measures, driving performance, or visual attention measures considered. In summary, the project did not produce evidence to support claims that training transferred to improvements in driving performance or a more optimal allocation of visual attention to the roadway. The degree to which these results are limited by the small sample size, the driving route selected, the relatively short period of training prescribed by the software manufacture, or the set of outcome measures assessed as part of this project is unknown.

In addition to the primary objectives of this research to evaluate the impact of DriveSharp training on older drivers, the field study was designed such that visual attention, physiology, and driving performance could be collected on two types of cognitive workload while driving. This effort aimed to assess whether the patterns of response observed in earlier studies of the n-back task (Mehler, Reimer, Coughlin & Dusek, 2009; Reimer, 2009; Reimer & Mehler, 2011; Mehler, Reimer and Coughlin 2012; Reimer, Mehler, Wang & Coughlin, 2012) are unique to the n-back or generalize to other cognitive tasks. The results of this effort are detailed in Yang, Reimer, Mehler and Dobres (2013). In brief, results show that response to the 1-back task and a visual-spatial Clock-task adapted from Schlorholtz and Schieber (2006) are highly consistent. This suggests that visual and physiological data observed in response to the delayed digit recall (n-back) task are likely generalizable to a larger number of cognitive demands and increase the relevance of employing this task in driving research. For further information on this research, please see:

Dobres, J., Potter, A., Reimer, B., Mehler, B., Mehler, A. & Coughlin, J. (2013). Assessing the Impact of "Brain Training" on Driving Performance, Visual Behavior, and Neuropsychological Measures. Paper to appear in the proceedings of the 7th International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design, Bolton Landing, New York, June 18-19, 2013.

Abstract: As the population has become both older and more technologically literate, a new class of "brain training" computer programs have gained in popularity. Though these programs have attracted substantial attention from scientists and consumers, the extent of their benefits, if any, remain unclear.

Here we employ neuropsychological tests and behavioral metrics collected during periods of real-world driving (with and without manipulations of cognitive load) to evaluate the effects of training with Posit Science's DriveSharp software. We find that DriveSharp's training effects appear in in-lab measures of Useful Field of View but did not translate to changes in actual driving performance or changes in visual behavior in consistent or quantifiable ways in the sample assessed. The implications of these results and relevant limitations of the present research are discussed.

Yang, Y., Reimer, B., Mehler, B. & Dobres, J. (2013). A Field Study Assessing Driving Performance, Visual Attention, Heart Rate and Subjective Ratings in Response to Two Types of Cognitive Workload. Paper to appear in the proceedings of the 7th International Driving Symposium on Human Factors in Driver Assessment, Training, and Vehicle Design, Bolton Landing, New York, June 18-19, 2013.

Abstract: In an on-road experiment, driving performance, visual attention, heart rate and subjective ratings of workload were evaluated in response to a working memory (n-back) and a visual-spatial (clock) task. Subjective workload ratings for the two types of tasks did not statistically differ, suggesting a similar level of overall workload. Gaze concentration and heart rate showed significant changes relative to single task driving during the extra tasks and the magnitude of change was similar for both, while driving performance measures were not sensitive to the increase in workload. The results suggest high sensitivity of both gaze dispersion and heart rate as measures of workload across these two different types of cognitive demand.

Potter, A. (2011). The Ecology of Cognitive Training and Aging. Unpublished doctoral thesis, University of Massachusetts, Boston.

Abstract: Older individuals represent the fastest growing portion of the population in the United States, and are threatened by the loss of mobility and independence. The present study examined the relationship of a computer-based training program, specifically Posit Science Cortex™ with InSight DriveSharp™, and performance on neuropsychological measures and an on-road driving paradigm in a normal aging sample. Participants, ranging in ages 60-75 and randomly assigned to the treatment group, completed the DriveSharp™ as did, subsequently, a wait-list control group. Identical neuropsychological and on-road assessments were conducted at each visit. Neuropsychological assessment of visual attention included the Useful Field of View test (UFOV; Edwards, Vance, et al., 2005), Attention Network Test (ANT; Fan, McCandliss, Sommer, Raz, & Posner, 2002), and the Trailmaking test (Franzen, Paul, & Iverson, 1996; Reitan, 1986). Results indicated improved performance on neuropsychological measures of attention after intervention. Analysis of the waitlist control groups across three visits, revealed possible practice effects for the ANT. However, this was not true for the UFOV test, which, revealed significant improvements between visits 1 and 3, suggesting that practice effects may not be a factor. During the on-road driving tasks, standard deviations of horizontal and vertical eye gaze were measured while participants completed auditory and visual working memory tasks. Given the improvements within the waitlist control group across three visits, it is unclear whether the improvements are resulting from the training or rather comfort in the vehicle. Overall results indicated there were trends in increased standard deviation of both horizontal and vertical eye gaze during the auditory working memory task. More robust improvements were seen during the visual working memory exercise, with significant improvements in horizontal gaze. These findings suggest more horizontal scanning behavior and possibly an increased field of view while driving. These results provided evidence that cognitive training may improve not only performance on neuropsychological tests but also on more ecologically valid outcome measures of driving. However, limitations of the current study may be addressed in future research by using a larger sample size, providing better control of practice effects on neuropsychological testing, and incorporating more direct measures of driving.