Research Report Summary

SAFER SIM
SAFETY RESEARCH USING SIMULATION
UNIVERSITY TRANSPORTATION CENTER

David A. Noyce *6/30/2017*

Neural Correlates of Older Driver Performance

By 2030, older drivers are expected to account for nearly 25% of total driver fatalities. Driving skills decay with age but not at a deterministic rate. Therefore, no agreement exists on a cutoff point for drivers. Tests need to be developed to assess the cognitive performance of older drivers. This project provides a foundation that can be used to develop streamlined tests and validation procedures.

Objectives

- Summarize studies related to older drivers' function decay and identify the state of the research in the field of neuropsychological tests.
- Evaluate the feasibility of screening drivers in both an fMRI and a full-scale driving simulator.

Key Findings

Older drivers face challenges when navigating intersections, making left turns against oncoming traffic, merging into traffic, and making lane changes on limited-access highways.

Neuropsychological tests that assess cognitive abilities can play a key role in evaluating the skills of older drivers.

Multiple neuroimaging studies have demonstrated correlations between traditional driving performance measures and brain activity.

Functional MRI (fMRI) Tests

Using previous research as a foundation, tests were conducted to assess the feasibility of using fMRI equipment for large-scale evaluations of older drivers.

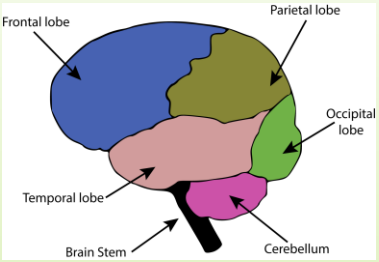
Tests involved the installation of a demagnetized steering wheel inside an fMRI machine to control a driving simulation scenario projected onto a screen and therefore partially visible to the subject inside the fMRI.

Implications for Next Stages

Future research will focus on the use of testing procedures that compare the performance of a group of subjects in the fMRI and the performance of a similar group in a driving simulator.

Findings will provide support the development of streamlined screening procedures that can identify potential safety issues in older drivers.

Neuroimaging Studies

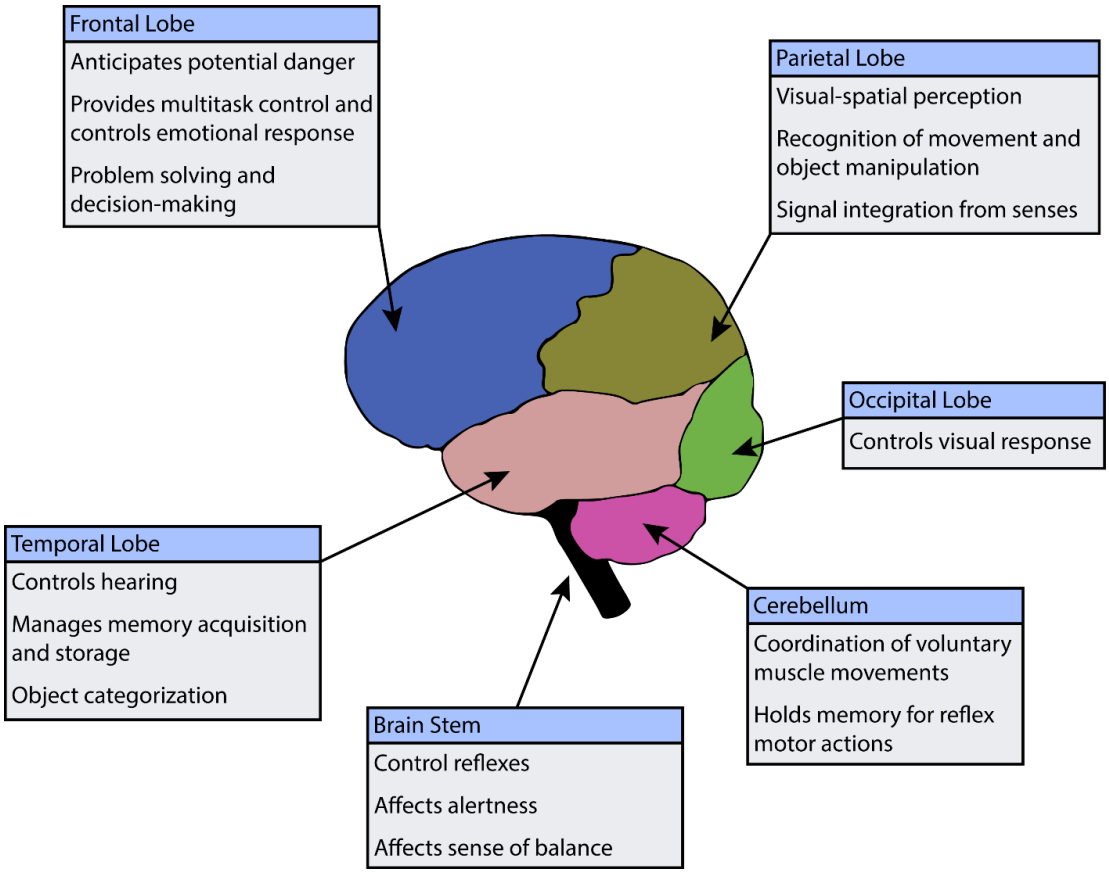


Individual brain regions have been found to be key to different tasks that are important while driving.

Feasibility tests were conducted inside an fMRI machine to determine the nature of experiments that can be conducted with the limited field of view and motion capabilities inside the chamber.

Driving Components Supported by Parts of the Brain

Multiple neuroimaging [1-7] studies have used driving simulators to examine the relationship between brain activity and specific driving tasks. These studies revealed that a network of brain regions, including the parieto-occipital cortices, cerebellum, and cortical regions, are more active during driving than during rest periods. The main reason for activation in these regions was associated with increased demands on vision, motor skills, and visuomotor integration, which are all important skills for driving.



References

1. F. X. Graydon *et al.*, "Visual event detection during simulated driving: Identifying the neural correlates with functional neuroimaging," *Transportation Research Part F: Traffic Psychology and Behaviour*, vol. 7, no. 4–5, pp. 271–286, Jul. 2004.
2. V. D. Calhoun, J. J. Pekar, V. B. McGinty, T. Adali, T. D. Watson, and G. D. Pearlson, "Different activation dynamics in multiple neural systems during simulated driving," *Human Brain Mapping*, vol. 16, no. 3, pp. 158–167, 2002.
3. Y. Uchiyama, "The neural substrates of driving at a safe distance: a functional MRI study," *Neuroscience Letters*, Sep. 2003.
4. H. Walter, S. C. Vetter, J. O. Grothe, A. P. Wunderlich, S. Hahn, and M. Spitzer, "The neural correlates of driving," *Neuroreport*, vol. 12, no. 8, pp. 1763–1767, 2001.
5. H. J. Spiers and E. A. Maguire, "Neural substrates of driving behaviour," *NeuroImage*, vol. 36, no. 1, pp. 245–255, May 2007.
6. K. N. Carvalho, G. D. Pearlson, R. S. Astur, and V. D. Calhoun, "Simulated driving and brain imaging: combining behavior, brain activity, and virtual reality," *CNS spectrums*, vol. 11, no. 01, pp. 52–62, 2006.
7. V. D. Calhoun and G. D. Pearlson, "A selective review of simulated driving studies: Combining naturalistic and hybrid paradigms, analysis approaches, and future directions," *NeuroImage*, vol. 59, no. 1, pp. 25–35, Jan. 2012.