RITA Office of Research, Development, and Technology

UTC Spotlight

University Transportation Centers Program

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Driving With Dementia?

Computer simulated driving research investigates at-fault driving errors with Alzheimer's diseased patients.

Did you know that 76% of people with mild dementia could pass a driving test? How can experts determine who among people with cognitive impairments is still a safe driver and who is not? How can they test this without posing risks to other drivers? What elements make up an accurate diagnostic model? What social issues must be considered in this model? A collaborative effort to answer these questions is underway by a University of Tennessee research team from the College of Engineering, the Department of Psychology, and the Cole Neuroscience Center (CNC) in the Graduate School of Medicine.

University of Tennessee

The University of Tennessee's driving simulator is a fully integrated, immersive, high fidelity system for use in driver and vehicle safety research. Here, a young driver navigates a snow scenario in the driving simulator.

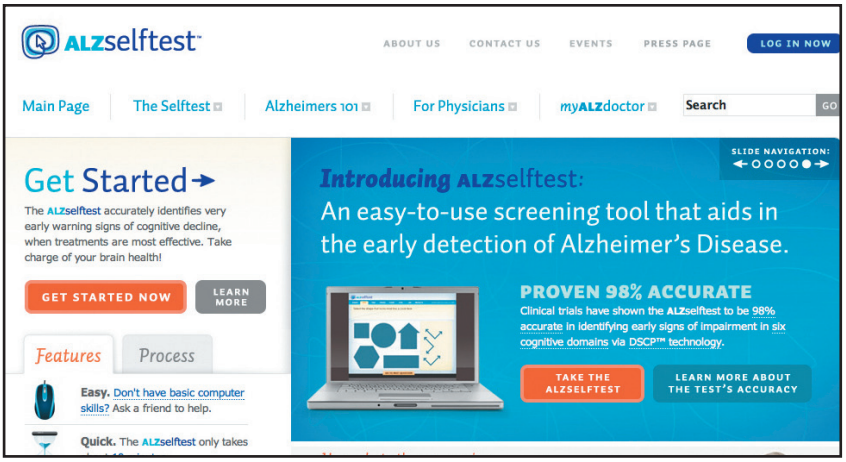
Lee Han, Ph.D., associate professor in Civil and Environmental Engineering, directs the Southeastern Transportation Center's (STC) high fidelity driving simulator laboratory (HFDS) in this study of older drivers and Alzheimer's patients. Han is working with John Dougherty, MD, CNC's medical director, and Rex Cannon, Ph.D., director of UT's Clinical Neuroscience Laboratory. Their goal is to determine the most robust neurocognitive model to predict impaired driving ability in patients with Alzheimer's disease (AD) using domain specific cognitive patterns (DSCP) and other standardized measures of executive functions and daily living activities. The researchers have demonstrated with 89% accuracy that this is a valid and sensitive measure to distinguish between mild cognitive impairment (MCI) and the variable stages of AD. They hypothesize that the DSCP and measures of executive functions associated with each study population provide an accurate model for predicting driving performance and safety.

To test their hypothesis, the team is collecting neurocognitive data from 20 young undergraduate students, 20 normal elderly volunteers (i.e., not cognitively impaired), 20 patients with MCI, and 20 patients with early stage AD, then correlating the data with these test subjects' driving performances and procedural knowledge associated with driving. Because executive functions are affected by dementia, they are used to determine the effects of youth, aging, and cognitive impairment on the procedural memory components of driving: general knowledge (signs and meaning, rules, laws, signals); mechanisms (brakes, gas pedal, instrumentation); planning (maps, directions, perceptual and spatial functions); and decision making (speed, reaction to other drivers and circumstances, best choice of actions). One of the more important considerations of driving related behavior is that it engages numerous neurological systems simultaneously.

Social issues the team must consider are affirmation of self-care, autonomy, self-efficacy, and locus of control in elderly individuals because being mobile and independent are important integrative functions in our society. The most desirable outcome is to balance the safety of all drivers and roadway users with the preservation of personal autonomy.

"We have been interested in elderly drivers' issues for quite some time because driver safety is an important consideration of the STC's theme of *comprehensive transportation safety*," said Han. "We have previously worked on driving safety of foreign visitors, new immigrants, and young drivers."

The multidisciplinary research team follows 2,000 Alzheimer's patients in East Tennessee for this project. "Some people with severe memory problems have a difficult time remembering how to get home. They get lost in the car," Dougherty says. "But also other things happen in Alzheimer's disease. That is, one's attention can be affected. You might see a dog or a child run across the street and may not be able to react as quickly." Han's driving simulator scenarios are designed to test such reactions.



The ALZselftest web site.

As a result of this research, Dougherty developed ALZselftest (www.alzselftest.com), an online written test that doctors anywhere can use to screen for possible cognitive problems and help seniors and their families make the right decisions about driving.

"What we want to do is develop a protocol using UT's driving simulator to make judgments about whether people can drive, good or bad, and what we can do to improve their situations so they can drive more safely," Dougherty says.

The ALZselftest focuses on six cognitive areas: memory, visual spatial skills, attention, verbal skills, orientation and executive function, and organized thinking. Dougherty says it is a useful diagnostic tool because individuals are able to take the test with ease, its questions monitor cognition, and it is administered and evaluated via the Internet.

This research is supported by the STC through use of its HFDS and a full-time graduate student, and is funded by The Lederer Family Foundation, a Knoxville-area private foundation. The principal investigators are currently developing joint proposals for the National Science Foundation, the National Institute of Health, and other potential sponsors.

About This Project

Rex L. Cannon, Ph.D. (rcannon2@utk.edu), is an assistant research professor in the Department of Psychology and director of the clinical neuroscience laboratory at the University of Tennessee, and director of the cognitive neuroscience laboratory at Cole Neuroscience Center, Memory Disorder Clinic. His research interests include neuroscience methods, neurophysiology, and biological psychology.

John Dougherty, M.D. (jdoughe4@uthsc.edu), is founder of Medical Interactive Education, the ALZselftest, and Medical Director of the Cole Neuroscience Center (Memory Disorder Program) at the University of Tennessee Medical Center in Knoxville. He is also an assistant professor of Medicine in Neurology and codirector of the Brain and Spine Institute at the University of Tennessee Medical Center. For the past 10 years he has specialized in dementia and Alzheimer's disease.

Lissa Gay (lissa@utk.edu) is the technology transfer coordinator for the Southeastern Transportation Center and the managing editor of the *Journal of Transportation Safety & Security*.

Lee D. Han, Ph.D. (lhan@utk.edu), is an associate professor of civil engineering in the College of Engineering at the University of Tennessee. Han's areas of research and expertise include operations, traffic control and optimization, emergency evacuation, safety, energy, infrastructure, and transportation sustainability. He directs the UT Driving Simulator Lab.

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