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A literature review of major perceptual, cognitive, and/or physical test batteries for older drivers

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Abstract. Driving is one of the most complex tasks that humans perform on a regular basis, placing significant demands on human perceptual, cognitive, and motor capabilities, so age-related declines in these capabilities negatively affect driving performance. Although older adults create a risk on the road because of their high crash rates, it is important to note that not all older drivers have impaired driving performance or high crash risk. Thus researchers have developed test batteries to identify at-risk older drivers. The literature pertaining to the development and testing of at-risk driver assessment tools, including major assessment tools and evidence supporting their use is reviewed.

Keywords: UFOV; AAA; ADReS; DriveABLE; NHTSA

1. Introduction

Between 1997 and 2007 the number of older licensed drivers increased by 19%; whereas the total number of licensed drivers increased only by 13% [19]. Although older drivers have fewer crashes than their younger counterparts, they are overrepresented when crash rates are calculated in terms of the number of miles driven [8].

1.1 Driving and age-related declines

Several changes occur in the human eye with age making the visual system operate less efficiently [22]. For instance, there is more difficulty in attending to the driving task and older adults are slower at processing information, especially in complex decisions. Older adults also tend to have slower motor responses [9], as well as loss of muscle strength, lack of coordination, and restriction in range of motion. Many older drivers suffer from medical conditions and/or take medications that affect functional capabilities crucial to driving.

1.2 Test batteries assessing at-risk older drivers

Most of these test batteries assess (1) *cognitive functions* (selective and divided attention abilities, processing speed, memory, intelligence, accuracy, reaction time), (2) *physical functions* (range of motion, strength in the extremities such as the foot, mobility), and (3) *visual functions* (static visual acuity, contrast sensitivity, visual field, visuospatial ability, dynamic acuity, useful field of view).

Most of these are meant to be used mainly as screening tools, or first steps in determining licensure, not to take away an individual's driving privileges based on cutoff scores.

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2. Useful Field of View (UFOV®)

2.1 Background

UFOV is the area over which individual can extract information in single glance, without moving his/her head or eyes [25]. The visual area is where information can be acquired within one eye fixation [14]. A normal, wide UFOV allows drivers to process information quickly about objects moving toward them [18]. It is typically administered on touch screen computer. There is a measure of processing speed to predict driving performance and other functional abilities in older adults. It is by far the most prevalent battery used in older adult driving research in the U.S. [11]. It examines three factors of visual attention: processing speed, divided attention, and selective attention.

2.2 Research findings

The UFOV overall score explained 23% of the variance in performance on a road driving test. Many studies have established that performance on the UFOV test declines with age [18]. Older drivers with poorer performance on the UFOV are at higher-risk of crashes relative to other older drivers who perform well [24]. The UFOV significantly related to measures of central and peripheral vision sensitivity loss and night visual acuity [7]. The correlation between crash frequency and UFOV was found to be .52 ($p < .01$). The UFOV and mental status were the only variables tested having a direct effect on crash frequency. Further, including the UFOV in a test battery maximizes the prediction of crash frequency [13]. [15-16, 20-21] show that the UFOV is a valid and reliable predictor of mobility outcomes and vehicle crashes in older adults. [14] claim that the benefits of UFOV training for all age groups lasted for up to 6 months. [6] discovered that mean UFOV scores significantly improved for stroke victims after 20 training sessions.

3. DriveABLE™ Test Battery

This battery is a series of computer-based tests administered by a trained guide, followed by a road test. It can evaluate the driving competence of drivers with medical conditions and/or medications that may impair ability to drive safely [2, 3]. It was developed and validated with over 1000 healthy drivers and drivers with clinically confirmed medical conditions. DriveABLE researchers show established cut-off scores for the in-office exam allowed exceptional (95%) accuracy in identifying the most dangerous drivers and the most competent drivers.

4. Roadwise Review™ AAA Test Battery

Developed by AAA, this battery is conducted on a computer and based on research by NHSTA and the National Institute on Aging. It assesses eight physical and mental fitness elements related to driving. One broad area is vision and one's capacity to react, another is memory, and the third is strength and upper body flexibility. It takes about 30 minutes to complete [12, 23] and involves a do-it-yourself driving checkup and video clips explaining the relevance of tests checking visual search and memory skills. If results indicate a possibility of impairments, the program advises users to take additional steps (i.e. seeing an ophthalmologist if having difficulty discerning low contrast objects).

5. Assessment of Driving-Related Skills (ADReS)

This in-office assessment [4], focuses on visual performance, cognitive performance, and motor/somatosensory performance. It was published by the American Medical Association [1]. It contains several parts. The vision component tests static far visual acuity and visual field. The cognition component uses the Trail-making test (TMT) part B, a test of general cognitive function assessing working memory, tests visual processing, visuospatial skills, selective and divided attention, and psychomotor coordination. A significant relationship between poor performance on the TMT part B and poor driving performance has been found [17]. Another test in this battery is the Clock Drawing Test (CDT), assessing patient's long-term memory, short-term memory, visual perception, visuospatial skills, selective attention, abstract thinking, and executive skills. Researchers have found an association between specific scoring elements of the CDT and poor driving per-

formance [5]. Lastly this battery assesses physical functioning, which includes the rapid pace walk, a manual test of range of motion, and a manual test of motor strength.

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