DriveSafe and DriveAware:

A Promising New Off-Road Test to Predict On-Road Performance

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Abstract

Driving is an essential activity of daily life; however any loss of function may impact driving safety. Improved survival rates after stroke or brain injury and an ageing population mean there will be greater numbers of people with cognitive impairment who wish to continue, or resume, driving.

Researchers have long attempted to develop tests that can predict driving performance with a sufficient accuracy to avoid the need for on-road assessment. Drivers' awareness of their driving performance and the driving environment have been identified as important contributors to safe driving. DriveSafe and DriveAware are presented as assessment tools that can be used to identify 'at risk' drivers. These tests categorise drivers as unsafe, safe or requiring further testing and have the potential to reduce the number of people requiring on-road assessment by 50%. However, further research is indicated.

Successful identification of 'at risk' drivers is a community safety issue that DriveSafe and DriveAware can address. The tests have the advantage of being administered in an office setting. They have sufficient sensitivity and specificity to predict driving safety. Plans are underway to develop an electronic platform that could be readily used by doctors and other professionals. This new platform also will require research to validate, or establish new, test cut-offs

Driving a car is an essential activity of daily life in Australia because it allows independent mobility for work and social activities. It also is a powerful symbol of independence and personal identity. Driving is, however, a complex task involving integration of visual, physical, cognitive and psychosocial skills in a rapidly changing environment (Coleman et al., 2002). Any loss of function in these areas as a result of a medical condition, accident or the ageing process may impact a person's ability to drive safely.

Improved survival rates and longevity after stroke and brain injury has resulted in increasing numbers of people with cognitive and perceptual impairments; many of these wish to resume driving after a period of recovery and rehabilitation (Korner-Bitensky, Bitensky, Sofer, Man-Son-Hing & Gelinas, 2006). The increasing age of the general population, also contributes to a growing need to identify drivers who are 'at risk.' The proportion of the population aged 65 and over is expected to increase from 13.6% in 2010 to 26% to 28% by 2031 (Australian Bureau of Statistics, 2006, 2010) resulting in an increased number of older people who retain a driver's license (Fildes, 2004). Dementia, a common cause of cognitive decline among older people, presents a particular challenge. Dementia impacts 1 in 4 people over the age of 85; thus 591,000 people are expected to be living with dementia in Australian by 2030 (Access Economics, 2009). Many people continue to drive for a time after receiving a diagnosis of dementia (Alzheimer's Australia, 2010).

Identifying, but not over-identifying, 'at risk' drivers is a growing challenge for society, medical practitioners and licensing authorities. Determining fitness to drive following illness or injury is a particular public health issue and is essential for both community safety and the well-being of affected individuals. The purpose of this paper is to describe a new test for identifying 'at risk' drivers, DriveSafe and DriveAware and to provide an overview of its development and psychometric evaluation. Also future applications are considered.

Assessing Fitness to drive

In Australia, decisions about fitness to drive are guided by national medical guidelines (Austroads, 2003) which indicate that a practical assessment may be required. Occupational therapists specialising in driving provide these practical assessments in Australia and many other countries.

An occupational therapy driving assessment includes both off- and on-road components. Vision, physical function, cognition and road law knowledge are tested off-road, followed by on-road assessment conducted by a trained driving instructor and an occupational therapist working together. A rigorous on-road assessment includes: use of a dual controlled vehicle including a dual brake and engine cut-off switch (Baldock, 2008), separation of responsibilities for safety and scoring of driving performance (Fox & Bashford, 1997; Mazer, Gelinas & Benoit, 2004), duration of at least 1 hour, and a administration on a uniform route (Baldock, 2008; Mazer et al., 2004).

Limitations of a driving assessment

An occupational therapy driving assessment is comprehensive, but it does have limitations. Because it is time- and labour-intensive, it is costly. The cost usually must be borne by the driver. An increasing demand for testing has resulted in long waiting lists. Access in regional and remote areas is extremely limited. Further, there is always an element of risk. Consequently there is a need for readily-available tools that reduce the number of drivers requiring assessment by driver trained professionals.

Use of clinical tests to predict driving performance

The complexity of driving has been captured in theoretical modeling (Mazer et al., 2004; Heikkilä & Kallanranta, 2005) that deconstructs it in numerous ways. Over the last 20 years, researchers have attempted to predict on-road performance by evaluating component skills of driving (e.g., visual processing, cognition, executive functioning) (Innes et al., 2007; Stav, Justiss, McCarthy, Mann, & Lanford, 2008). Many neuropsychological tests are correlated with safe or unsafe driving but correlations are insufficient to predict driving performance accurately (Molnar, Patel, Marshall, Man-Son-Hing & Wilson, 2006).

Sensitivity and specificity, descriptive statistics that consider errors in prediction, are required to evaluate a test's predictive ability (Portney & Watkins, 2008). Calculation of sensitivity and specificity requires a cut-off score. Sensitivity refers to the ability of a test to identify a problem when a problem truly exists (true positives). Specificity refers to the test's ability to obtain a negative result when there is no problem (true negatives). Data from a perfect screening test would yield specificity and sensitivity of 100%. While no test could be expected to be 100% predictive, we have reported a test, DriveSafe and DriveAware (Kay, Bundy & Clemson, 2009b) that trichomotises drivers into 'safe,' 'unsafe,' and 'needs further testing' and that has both specificity and sensitivity over 90. No other published test approaches this level of prediction. DriveSafe and DriveAware has been published by Pearson (The Psychological Corporation).

DriveSafe and DriveAware Description

DriveSafe measures awareness of the driving environment. It takes approximately 20 minutes to administer in an office setting. A series of 13 images of the same 4-way intersection (roundabout) are projected on a screen to simulate the view through a windshield. See Figure 1. The number and position of pedestrians and vehicles in the image vary. Clients are asked to view each image for 3 seconds then report details about the position and direction of travel of each object once the image is removed. The test is administered according to standard instructions and scoring methods.

DriveAware measures awareness of driving ability. The test consists of eight questions in which the client's response is compared with the clinician's rating using a structured marking guide. The clinician's rating is determined by information provided in the referral and the client's performance on clinical tests. A discrepancy score is calculated to determine awareness. DriveAware requires 10 minutes to administer.
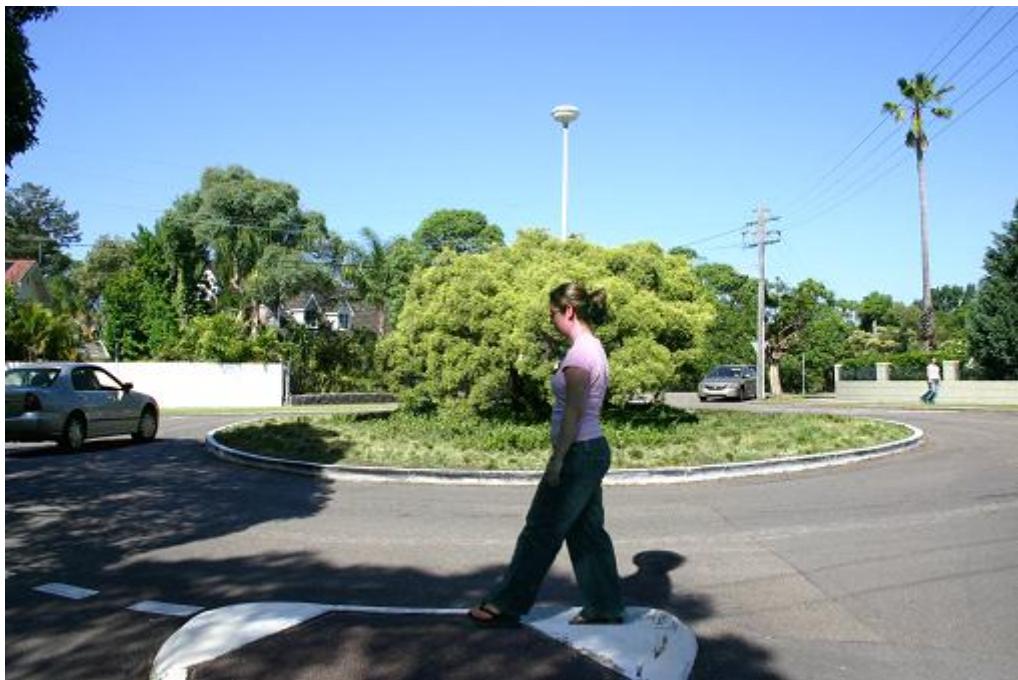
Figure 1. Example of a DriveSafe item

Development of DriveSafe and DriveAware

DriveSafe was developed from the Visual Recognition Slide Test (VRST–USyd), an assessment used by driver-trained occupational therapists in Australia for nearly 20 years. VRST-USyd was conceptually different from other driving assessments in that it did not attempt to break down driving into component parts but assessed global awareness of the driving environment. Anecdotally, therapists had reported that the test was useful for predicting driving performance but its psychometric properties had not been examined before we undertook this stream of research. We completed a series of studies using VRST-USyd (and later DriveSafe and DriveAware) to address the possibility of predicting on-road performance.

Prior to undertaking studies with VRST-USyd, we examined evidence for the construct validity and internal reliability of data gathered with the on-road assessment. This was important because we used results from the on-road test to determine cut-off scores for the VRST-USyd (Kay, Bundy, Clemson & Jolly, 2008). A cut-off score allowed us to calculate sensitivity and specificity.

Once we were satisfied that the on-road assessment was valid and reliable, we undertook a large (N~900) retrospective examination of VRST-USyd data from drivers referred for a driving assessment. The results yielded strong evidence for the construct validity, internal reliability and predictive validity (Kay, Bundy & Clemson, 2008). However, the sensitivity and specificity, while good, were not as high as we had hoped (81 and 89 respectively). Consequently we reviewed the records of all participants whose driving ability had been misclassified. Virtually all test protocols contained comments indicating that the driver seemed to lack insight into his or her driving limitations.

The importance of drivers' awareness of their driving ability had been acknowledged both clinically and in the literature (Hoeschen & Bekiaris, 2001). However, no test existed at that time to measure awareness specifically as it pertained to driving. Thus, we created and examined the psychometric properties of DriveAware (Kay, Bundy & Clemson, 2009a). That study provided preliminary evidence for construct validity and internal reliability of data gathered with DriveAware. However, we determined that internal reliability could be improved by increasing the number of items. Following addition of items, we re-examined the psychometric properties of data gathered with DriveAware (Kay, Bundy & Clemson, 2009c).

In a final study, we updated the photographs from the VRST-USyd, shortened it and renamed it DriveSafe. We also added three new items to DriveAware. We verified the psychometric properties of the modified tests and examined the predictive validity of the combined tests in a sample of people with cognitive impairments (N~100). We established upper and lower cutoff scores which allow classification of drivers as safe, unsafe or requiring further testing. The resulting sensitivity and specificity were 93 and 97 respectively (Kay, Bundy & Clemson, 2009b). As promising as these results are, further studies are required to replicate them.

Future Directions

In Australia and internationally the responsibility for identifying 'at risk' drivers is often left to the doctor who lacks objective, valid and reliable tools for predicting driving ability (Molnar et al., 2006). Not surprisingly doctors are reluctant to decide whether patients are fit to drive because they are concerned about the patient's loss of independence and quality of life and compromising the doctor-patient relationship (Bogner, Straton, Gallo, Rebok & Keyl, 2004).

Pearson (The Psychological Corporation) is currently undertaking to create an electronic platform (i.e., iPad or Android) for DriveSafe and DriveAware that will enable its widespread use by doctors and other professionals. Once this platform has been developed, additional research will be required to validate the cut-off points or to establish new ones.

Conclusion

People with cognitive impairments want to maintain their independence by continuing to drive. However, testing is required to ensure that they are safe to drive a vehicle. Currently people attend a comprehensive occupational therapy off- and on- road assessment to determine their driving safety. This assessment is expensive, time consuming and not always readily available.

DriveSafe and DriveAware can be administered in an office setting in approximately 30 minutes. The research underpinning the development of DriveSafe and DriveAware indicates that, when these tests are used together, it is possible to trichotomise drivers into categories of 'safe,' 'unsafe' and 'further testing required.' Only drivers in the 'further testing' category need to undergo an on-road assessment. In our research, only 50% of drivers with cognitive impairments fell into the category of needing to undergo an on-road assessment. On-road assessment is expensive. If

our findings are upheld in future research, approximately half of tested drivers (those who will almost assuredly pass or fail an on-road assessment) will be able to use their financial resources in other ways. The cost of completing DriveSafe and DriveAware is approximately 20% of the cost of a comprehensive driving assessment. Further, scarce clinical resources will become more readily available to those who need them most for testing or retraining.

In its current format, DriveSafe and DriveAware is best administered by an occupational therapist. However, on an electronic platform (e.g., iPad or Android) it could be administered in an office by an administrative assistant and the results interpreted by a doctor, clinical psychologist or occupational therapist. This would make the test more readily available, which, in the light of the scarcity of testing resources, could be an important contribution to public safety. In addition to making testing more readily available, an individualised electronic platform will overcome the need for verbal responses during testing, thus facilitating assessment of people who speak a variety of languages or who may have expressive language deficits. Also future refinement of the electronic platform may reduce the proportion of drivers that still require an on-road assessment. These possible future applications of DriveSafe and DriveAware represent other valuable directions for future research.

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