DriveSafe
DriveAware
Research Summary
Background
Responsibility for determining fitness to drive typically falls to the primary care providers (called General Practitioners in Australia and New Zealand). General practitioners report concern about their role in assessing patient fitness to drive, including the impact of withdrawing driving on the patient’s quality of life and the patient-doctor relationship. General practitioners also frequently report a lack of objective, valid, and reliable tools for predicting driving ability to assist them in this role (Schattner, Jones, Beveridge, Sims, & Rouse-Watson, 2010).

Improved survival rates after stroke or brain injury and an ageing population mean greater numbers of people with cognitive impairment who wish to resume or retain their ability to drive. Appropriately identifying “at risk” drivers is a growing challenge for society, general practitioners, and licensing authorities.

A standardised off- and on-road driving assessment conducted by a driver-trained occupational therapist is considered the gold standard for determining fitness to drive (Kay, Bundy, Clemson, & Jolly, 2008). This method of testing, however, is time consuming and costly. Due to a shortage of specialist occupational therapists, access to testing in remote areas can be limited and even urban areas can have long waiting lists.

For more than 25 years, researchers have examined a variety of clinical tests to identify an off-road assessment that can accurately predict driving performance without taking drivers on the road. The computer version of DriveSafe and DriveAware (DSDA) is the only test that has shown sufficient sensitivity and specificity to predict on-road performance accurately (Kay, Bundy, Clemson, Cheal, & Glendenning, 2012). This test has been used by occupational therapists as part of a clinical assessment of fitness to drive for more than 20 years.

A touch-screen version of the DSDA was subsequently developed as a portable, user-friendly test that can be administered in a medical or clinical setting by general practitioners or other health professionals without specialised training. Touch screen technology enables patient responses to be precisely captured and interpreted based on results of the development research.

Overview of the test
The touch screen DSDA consists of three subtests:

1. **DriveSafe.**

DriveSafe consists of 10 images of a 4-way intersection. Each intersection includes a number of people and vehicles. These objects are presented for 4 seconds then disappear. The patient is prompted to recall object type, location and direction of movement for each object.

2. **DriveAware.**

In DriveAware the patient’s self-rating of performance in the test, and their everyday driving, is measured against actual performance and the clinician’s rating. A discrepancy score is generated as a measure of the patient’s awareness of own abilities related to driving (or insight).

3. **Intersection Rules (Optional)**

This optional subtest assesses knowledge of right of way at intersections.

Testing time is approximately 10 minutes depending on the patient and whether or not the optional Intersection Rules subtest is included. This portion of the test can be self-administered under supervision. The DriveAware clinician interview takes 3-5 minutes to administer.

Validation Research
A prospective study was conducted to determine if the DSDA touch screen version was a valid, user friendly tool that general practitioners and other health professionals could administer to determine if older and cognitively impaired patients were able to manage the cognitive aspects of driving or if they required referral to a specialist driving service for further assessment.

The test was administered to a convenience sample of 134 older (60 years +) and cognitively impaired (18 years +) drivers referred over a 7-month period to ten driver assessment and rehabilitation clinics across Australia (Sydney, Melbourne, Perth and Brisbane) and New Zealand (Wellington, Auckland and Hamilton). The purpose of the study was to examine the psychometric properties of the test and its predictive validity as compared to the criterion measure of a standardised occupational therapy on-road assessment. Sixteen driver trained occupational therapists were involved in administering the test and conducting the on-road driving assessments.

**Inclusion criteria**

- Aged 60 and over and/or aged 18 and over with a documented cognitive/neurological disorder
- Completed schooling to at least Year 7
- Native English speaking
Exclusion criteria

- Learner or beginning driver
- Previously diagnosed with a psychiatric condition or developmental delay.

The final sample was predominantly male (70%) and aged over 60 years (75%; range 21-91 years; mean = 67 years). Participant diagnoses included Dementia (28%), CVA/TIA (29%), Other Neurological (17%), TBI (10%), Aged (7%); unsafe driving reports or deterioration in driving ability) Physical Deficits only (5%) and Other (2%).

All participants were administered DriveSafe DriveAware and the Mini-Mental State Examination as part of the off-road assessment. A standardised on-road driving assessment was used as the criterion measure for this study.

Reliability & Validity

Construct validity and internal reliability of the DriveSafe DriveAware subtests were examined using a Rasch modelling technique (Bond & Fox, 2007) via Winsteps Version 3.72.2 (Linacre, 2014). Rasch modelling constructs a linear measure from ordinal scores by converting raw scores into logit scale scores and assessing goodness-of-fit for both items and participants along the same measure continuum. An item and participant map is generated in which items are arranged in order of difficulty and participants are arranged in order of competence. The analysis generates two pairs of goodness-of-fit statistics; infit and outfit, expressed in two forms as mean square fit statistics (MnSq) and standardised fit statistics (ZStd). These statistics indicate how well data from each item and participant fit to the Rasch model with the assumption that easy items are easy for all participants and more competent participants perform better on all items.

Rasch analysis indicates the DriveSafe subtest items have infit and outfit statistics within the acceptable range (from .63 to 1.38, Median = .97; Bond & Fox, 2007). The spread of items is acceptable for assessing the least competent drivers (the group of most concern). Item-to-total correlation coefficients are all positive ranging from .44 to .75 (Median = .63). This supports the validity of the DriveSafe subtest.

The unidimensionality of the test was also examined via a principal component analysis. When the empirical variance closely matches the modelled variance, and when the percentage of unexplained variance from the first factor is much less than the percentage of explained variance by the Rasch model, the test fits the expectations of the model as the evidence of unidimensionality and the construct validity of the test (Linacre, 2014). The principal component analysis yielded a high-modelled variance (56.4%) and closely matches the empirical variance (55.1%). The percentage of unexplained variance by the first contrast is 4.6%, which is much less than the variance explained by item (14.8%) or by person (40.4%). These statistics provide strong evidence for the unidimensionality and construct validity of the DriveSafe subtest.

Rasch modelling produces reliability estimates for both items and participants. A separation statistic provides evidence of internal reliability (ability of the test to separate groups of participants into levels of ability). The analysis indicated the test person separation is high (a model separation of 3.76), with a participant reliability index (Chronbach’s alpha equivalent) of .93. The item separation is also high (3.30) with an item reliability index of .92. These results indicate the test is sensitive enough to distinguish high and low performers and verifies the item difficulty hierarchy – all providing evidence for the internal reliability of the DriveSafe subtest.

Results of the analysis indicated that DriveSafe could be used as a stand alone test for predicting driving performance with substantial accuracy. DriveAware results are used to further refine categorisation for patients with reduced awareness of their own performance.

Predictive Validity

For the sensitivity and specificity analysis, two cases were excluded due to missing data, four older adult cases were excluded because intervention had been recommended only to provide training in the use of vehicle modifications (to accommodate physical limitations) and another sixteen cases were excluded for not having the classifications Pass or Fail (N=112). Among the sample of 112 participants included in the predictive validity study, a total of 53 participants (47.3%) passed the driving assessment, 47 (42.0%) failed, and 12 (10.7%) participants required driving lessons to improve driving performance.

The lower cutoff score for DSDA was set to identify those who were unsafe (i.e., Sensitivity and Positive Predictive Value) and minimise the proportion of drivers falsely categorised as unsafe (i.e., False Positive). The upper cutoff score was set to identify those who were safe (i.e., Specificity and Negative Predictive Value) and minimising the proportion of drivers falsely categorised as safe (i.e., False Negative). Sensitivity and Specificity were calculated with a confidence interval (CI) of 95%.

The DSDA scoring system and classification flowchart is illustrated in Figure 1. Final categorisation in DriveAware depends on the DriveSafe subtest outcome. For example, given a high DriveSafe score (≥ 72) and a low DriveAware score (≤ 10), a patient is classified as Further Testing. A low DriveSafe score (≤ 57) and a high DriveAware score (≥ 13) is also classified as Further Testing. Awareness is necessary for accurately self-monitoring driving performance and implementing strategies to compensate for any reduction in driving ability (e.g., avoiding complex traffic conditions). In
the first scenario, awareness is reduced, so further assessment is advised regarding fitness to drive. In the second scenario, the patient performed poorly in DriveSafe, but DriveAware results indicated a high level of awareness, so this patient has more potential for implementation of compensatory strategies. Further testing is therefore advised.

Using these cut-scores, DSDA correctly classifies drivers with a Specificity of 86% and Sensitivity of 91%, Positive Predictive Value of 83%, Negative Predictive Value of 92% and the overall Accuracy of Classification of 88%. Sensitivity is the efficiency of a test to correctly classify cases of the condition of interest (unsafe drivers). Specificity is the efficiency of the test to correctly classify non-cases (safe drivers). Positive predictive value is the proportion of persons classified as unsafe by DSDA indeed fail an on-road assessment (i.e., true positives). Negative predictive value is the probability that drivers classified as safe by DSDA, passed the on-road assessment (i.e., true negatives). The overall accuracy of classification reflects the total proportion of correctly classified cases.

Conclusion

DriveSafe DriveAware (DSDA) is a cognitive screening tool that measures a driver’s awareness of the driving environment and their own abilities related to driving. The test can be used when ability to manage the cognitive aspects of driving may be impaired by a medical condition, injury, or the ageing process. The results of the research study provide evidence that supports the clinical utility of the DSDA touch screen version in predicting with substantial accuracy, which patients with a cognitive impairment require an on-road assessment. People who are not a good candidate for an on-road assessment (i.e., those who will likely “fail”) can be advised not to drive and can be redirected to use their time and monetary resources in other ways. The research evidence supports the conclusion that the test has retained the strong psychometric qualities of the computer version of the test, including internal consistency, predictive validity and ability to classify drivers into ‘pass’, ‘fail’ and ‘further testing’ categories.

References