

Determining Fitness to Drive for Older and Cognitively Impaired Drivers - DriveSafe DriveAware a Touch Screen Test for Medical Practice

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Extended Abstract

Every year thousands of Australians are diagnosed with a medical condition that may impact ability to manage the cognitive aspects of driving, such as stroke, brain injury or dementia. Licensing authorities manage large numbers of drivers with potential cognitive impairment who wish to retain their ability to drive. Appropriately identifying 'at risk' drivers is a growing challenge. Responsibility for determining fitness to drive ultimately falls to the primary healthcare physician. 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 frequently report a lack of objective, valid, and reliable tools for predicting driving ability to assist them in this role (Sims, Rouse-Watson, Schattner, Beveridge & Jones, 2012).

A standardised off and on-road driving assessment conducted 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, and access can be limited due to a shortage of specialist therapists. 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 DriveAware (DSDA) is one 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.

Computer administration of DSDA is limited to driver-trained occupational therapists because verbal responses need to be interpreted by trained professionals. The touch-screen version of the DSDA was therefore developed as a user-friendly test that would allow administration by general practitioners and other health professionals in clinical practice, without specialised training.

A prospective study was conducted to determine if touch-screen DSDA is a valid tool to use in determining if older and cognitively impaired patients are able to manage the cognitive aspects of driving, or if they required referral to a specialist driving services for further assessment.

Method

Touch-screen DSDA 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 the study. They were blind to the results of touch-screen DSDA.

Measures

DriveSafe

The DriveSafe subtest consists of 10 images of a 4-way intersection. Each intersection includes a number of people and vehicles, ranging from 2 to 4 objects in total. These objects are presented for 4 seconds then disappear. For each of the 28 objects presented, the patient is prompted to recall 3 pieces of information: type of object, object location and direction of movement. One point is awarded for each correctly recalled piece of information, allowing a maximum score of 84. The subtest is self-administered with written and audio instructions and includes practice items.

DriveAware

The DriveAware subtest consists of 7 questions. The patient rates his or her perceived performance on the DriveSafe subtest in two self-administered questions. The remaining five questions are part of an interview that the administrator conducts at the conclusion of the test. The final question requires the administrator to rate their level of concern for the patient's fitness to drive, based on clinical or personal indicators. A discrepancy score is calculated for each item based on the difference between the patient's self-rating and actual performance on the DriveSafe subtest, along with the clinician's rating. A final score is generated by converting the discrepancy score (-2 to 2) into a final score via a 5-point ordinal scale. This results in a maximum total score of 17.

DriveSafe and DriveAware scores are combined to classify patient ability and awareness into the three categories: Pass, Fail and Further Testing.

On-road assessment – criterion measure

A standardised 60-minute on-road driving assessment was conducted in a dual controlled vehicle with a qualified driving instructor present to provide instruction and monitor safety. A driver-trained occupational therapist recorded driving performance against license authority standards. Performance Analysis of Driving Ability (P-Drive) was the standardised on-road assessment tool used to score driving ability using 25 actions observable during driving (Patomella, Tham, & Kottorp, 2006). These items are grouped in four headings; Maneuvers, Orientate, Follow Regulations and Attending and Acting. They are scored using a 4-point criterion referenced rating scale, from competent to incompetent performance. The outcome of the driving assessment was determined as 'pass', 'fail' or 'intervention' based on the definition used in standardisation of the computer version of the test (Kay, Bundy, & Clemson, 2009).

Statistical Analysis

Construct validity and internal reliability of the 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 out-fit, 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. Items or participants with fit statistics outside the acceptable range should be considered for removal from the test.

The predictive validity of the DriveSafe DriveAware subtests was examined. Optimal lower and upper cut scores were determined using descriptive statistics. The lower cut score was set to identify those who were unsafe (i.e., Sensitivity and Positive Predictive Value) and minimising the proportion of drivers falsely categorised as unsafe (i.e., False Positive). The upper cut 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%.

Results

DriveSafe

Rasch analysis indicated that all DriveSafe subtest items have infit and outfit statistics within the acceptable range. The range of item difficulty was comparable to the range of participant ability, except for the most competent drivers. This is acceptable as the test is concerned with identify participants as 'pass' and not the level of competency within this category. All the statistics provided strong evidence for the unidimensionality and the construct validity of the subtest and indicated the test was sensitive enough to distinguish high and low performers.

DriveAware

The research version of the DriveAware subtest consisted of 8 items, however, 2 items were removed, as they did not perform. The remaining six items had acceptable infit and outfit statistics. All statistics indicated the subtest measured a unidimensional construct. As expected, the distribution of items in the item-person map confirmed that the DriveAware subtest should not be used as a stand-alone test. The hierarchy of items was conceptually logical and reflected a progression of awareness.

Predictive Validity of DriveSafe and DriveAware

To calculate predictive validity, the DriveSafe DriveAware subtests were used together to categorise participants who were predicted to fail an on-road assessment, those who were predicted to pass and those who required further testing to determine fitness to drive (such as referral to a driving clinic).

The optimal cutoff scores on the DriveSafe subtest were 57 and 72. The optimal cut-off scores on the DriveAware subtest were 10 and 13. The test identified unsafe drivers at the low cutoff score with Sensitivity of 91% (95% CI: 84 to 96) and 89% (95% CI: 82 to 97) for DriveSafe and DriveAware, respectively. The test identified safe drivers at the upper cutoff score with Specificity of 94% (95% CI: 87 to 99) and 91% (95% CI: 84 to 99) for DriveSafe and DriveAware, respectively.

The positive predictive value for the lower cutoff was 79% and 83% indicating that participants predicted to be unsafe had a high probability of being unsafe. The negative predictive values generated by the upper cutoff (65% and 57% respectively) indicated that participants predicted to be safe had a slightly high probability of being safe.

The predictive validity results provide the empirical evidence for DriveSafe DriveAware test with 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%.

Conclusion

The results of this study present evidence that supports the clinical utility of touch-screen DSDA 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.

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