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Beth Cheal
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Chapter 1.
Introduction

Purpose

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. General practitioners and other health professionals can use the touch screen DSDA to accurately predict which patients with a cognitive impairment require an on-road assessment. Occupational therapists who specialise in driver assessment and rehabilitation can also use the touch screen DSDA as part of their off-road assessment of fitness to drive.

The touch screen DSDA is used to assess two areas that are critical for safe driving—global awareness of the driving environment and awareness of one’s own abilities related to driving. Awareness is necessary for a driver to be able to monitor his or her own performance and employ compensatory strategies where necessary (e.g., avoid driving at night or on unfamiliar roads). Awareness is, therefore, critical for safe driving (Kay, Bundy, & Clemson, 2009b).

The touch screen DSDA consists of three subtests:

1. DriveSafe
2. DriveAware
3. Intersection Rules (Optional)

The touch screen DSDA was designed so that most items can be self-administered by the majority of patients. The DriveSafe subtest, two of the seven DriveAware subtest questions, and the optional Intersection Rules subtest, can all be self-administered. The remaining five questions from the DriveAware subtest are administered by a general practitioner or health professional in a brief interview.

As part of the development research, use of the touch screen DSDA was examined in a prospective study with 134 older (60 + years) and/or cognitively impaired drivers across Australia and New Zealand (see Chapter 5 for study results). The statistical analysis undertaken within this study revealed the Intersection Rules subtest (which was included as part of DriveAware in previous versions of the test) should be removed from the DriveAware subtest and included in the test only as an optional, separate addition. This optional subtest provides a brief screening of knowledge regarding right-of-way rules at intersections and qualitative information, such as ability to follow instructions and plan responses. This subtest can be skipped to reduce test time.
Testing Time

Test time is approximately 10 minutes, depending on the patient and whether or not the optional Intersection Rules subtest is included. The DriveAware clinician interview takes about 3 to 5 minutes to administer.

In the development research, the DriveSafe subtest and self-administered DriveAware questions took an average of 6 minutes to complete. The optional Intersection Rules subtest took an average of 3 minutes to complete.

Test Components

The touch screen DSDA is currently available only on iPad®. You need the following test components to administer the test as it was standardised:

- iPad with iOS operating system 7 or later (an iPad mini or iPhone® cannot be used)
- DSDA touch screen version
- Tablet stand angled to 20 degrees
- Stylus (optional depending on patient preference and ease of use)
- Headphones (optional, depending on sound distractions in the room, hearing impairment, and patient preference)
- Desk or table
- Suitable upright chair (e.g., office or kitchen chair)

Downloading DSDA and Purchasing Reports

Download DSDA from the Apple® App Store directly to the iPad. Then you (the administrator) must register as a test user with Pearson Clinical Assessment. Follow this link to complete the registration form: https://www.pearsonclinical.com.au/accounts/create. You will receive a welcome email confirming your username and password.

To purchase report usages online, go to www.pearsonclinical.com.au/sessions/create. You can administer the test without report usages, but you will not receive results or a report. If you do not have access to WiFi, telephone the client services team and order additional credits at the following contact numbers:

- Australia: 1800 882 385 (toll free)
- New Zealand: 0800 942 722 (toll free)

When you log into the test with your DSDA username and password, you are prompted to create a 4-digit PIN. The PIN security ensures that the patient only ever has access to the DSDA test. If the patient tries to access other information within the test after it has begun, the test locks and can be unlocked only by entering the PIN. Never give the PIN to the patient and keep it private. The practitioner administering the test is the only person who can enter the PIN.
Who Can Administer DSDA?

Only general practitioners, medical specialists, occupational therapists, speech pathologists, physiotherapists and psychologists may administer the DSDA and interpret the test results. A practice nurse may administer the test under the direction of a registered medical practitioner.

Who Should Complete DSDA?

DSDA should be administered to patients when cognitive capacity for driving could be impaired by a medical condition, injury or the ageing process. Practitioners should use caution when considering touch screen DSDA administration with patients who have:

- physical deficits that may impact driving,
- reduced literacy or English language skill,
- been diagnosed with a psychiatric condition, and / or
- are learner or beginning drivers.

Patients With Physical Deficits

All patients with physical deficits that could impact ability to operate car controls should be referred for an occupational therapy driving assessment. Vehicle modifications or licence and vehicle restrictions may be required for these drivers. However, the DSDA test may still provide useful information on the new learning capacity for this group if cognitive impairment is also present.

If a patient has an upper limb deficit that impacts their ability to use touch screen technology, they may use a stylus or the Administrator-Assisted Method may be used.

Patients With Reduced Literacy or English Language Skills

The touch screen DSDA was validated with patients who attended school to year 7 or higher. The touch screen DSDA is easier to administer to patients who have reduced English language skills, reduced literacy, or a medical condition impacting communication (e.g., aphasia) as compared to the computer version. The test has not, however, been validated for these groups. Results may be used qualitatively but should be interpreted with caution.

If you indicate that the patient does not speak English at home, the following notation appears on the clinical report: “Drivesafe DriveAware has been standardised for people who speak English as a first language. If English is not spoken at home the test results may be used qualitatively, but should be interpreted with caution”.

Patients Diagnosed With a Psychiatric Condition

DSDA was developed to determine a patient’s ability to manage the cognitive aspects of driving. Psychiatric conditions may impact cognitive functioning, however, often the primarily difficulty with driving is due to disturbances of emotion, behaviour, and perception. If you indicate that a patient has an identified psychiatric condition, the following statement appears on the report: “DriveSafe DriveAware has not been standardised for drivers with psychiatric conditions. The purpose of the test is to predict cognitive capacity for driving. Results may be used qualitatively, but should be interpreted with caution”.

Learner Drivers

All learner or beginner drivers who have a medical condition that may affect their driving need to undergo an occupational therapy driving assessment if there is concern regarding their fitness to drive. The DSDA test is not valid as a standardised test for this group as prior driving experience is assumed and the test was validated with experienced drivers.
Chapter 2.
General Administration Guidelines

Administration Methods

The touch screen DSDA can be self-administered or practitioner-administered. The touch screen development phase revealed that 9 out of 10 senior adults (ages 65 to 93) were able to successfully self-administer the application. There will always be a small number of individuals who cannot self-administer the test due to a medical condition or difficulty with the technology. The Administrator-Assisted Method (described on page 23) was developed for use with these such individuals. It is recommended that patients who are unable to complete the DSDA touch screen version either independently or via the Administrator-Assisted Method, be referred to a driving clinic for further assessment of fitness to drive.

Rapport / Approach

The goal is to administer the test in as non-threatening a way as possible so the patient can give his or her best effort. Use your clinical experience and common sense to determine the most effective way of establishing rapport. A confident, friendly, and relaxed approach can elicit cooperation and ease uncertainty or anxiety about testing.

Instructions

Administer the test in a professional and unhurried manner, following the instructions given. This manual includes standard phrases that must be used when prompting is required. The standard phrases appear in bolded, red type. These are the only words that should be used. The test includes audio and written instructions to enable self-administration.

Rest Periods / Breaks

If the patient requests a break during testing, allow the break after the patient has completed a subtest and not in the middle of a subtest. Stopping testing in the middle of a subtest may impact test validity. The device only saves data upon completion of a subtest. Data is not be saved if a subtest is aborted part way through.

Subtests can be completed on different days or with breaks in between. Subtests can be administered by different practitioners. Because the administration time is short, it is unlikely that breaks will be required.

Discontinuing Testing

If the patient is using the self-assessment method and struggling, allow him or her time to repeat items and practice. If the patient continues to struggle, switch to the Administrator-Assisted Method. If the patient continues to struggle with the test to the point that the results may not be valid, discontinue testing. The test can be discontinued at any time by tapping the top left corner of the screen twice. Enter the PIN number to exit the test.

If the patient is unable to complete the test independently or with the Administrator-Assisted Method, refer him or her to a driver assessment service to determine fitness to drive.
Frequency of Testing (Test-Retest Reliability)

Test–retest reliability has not been examined for the touch-screen version of DSDA, however, a test–retest reliability study was conducted for the computer version of the test (O’Donnell, 2013). Retesting was undertaken at 6 week and 12 month intervals for patients diagnosed with an unruptured aneurysm. The computer version was found to be test–retest reliable at both time intervals (results being prepared for publication). There is no clinical reason to expect a difference in test-retest reliability between the two digital delivery methods, however, this is an area for future research.

Use Caution in Applying the Results

Suitably qualified clinicians are expected to use DSDA as a decision support tool in conjunction with their clinical judgment and other clinical indicators when assessing a patient’s capacity to resume or continue driving.

Prior to advising a return to driving, the general practitioner or driver trained occupational therapist must ensure the patient’s vision is legal for driving according to the national medical guidelines Assessing Fitness to Drive (2012). These guidelines apply to both Australia and New Zealand and are available online at: https://www.onlinepublications.austroads.com.au/items/AP-GS6-13. The general practitioner must also ensure the patient does not have a medical condition that is contraindicated for driving (e.g., seizures; blackouts; some heart conditions). Medical clearance is required for driving for patients who have some long term medical conditions. These notifiable conditions are outlined in Assessing Fitness to Drive guidelines.

Assessing Fitness to Drive indicates that a practical driving assessment may be required for some people to determine fitness to drive (Austroads, 2012). Referral to a driving assessment service is advised when;

- Results of DSDA place the patient in the category ‘requires further testing,’ and the patient wishes to continue to drive.
- Results of DSDA place the patient in the category ‘unlikely to pass an on-road driving assessment,’ but the patient still wishes to drive.
- The patient has long-term physical deficits that may impact their ability to operate car controls (e.g., amputations, paralysis, and incoordination). Vehicle modifications are likely to be required.
- Information supplementary to the clinical assessment is required for borderline cases where fitness to drive is not clear.

Occupational therapists conducting driving assessments must be ‘driver trained’. This means they must have completed postgraduate training in driver assessment and rehabilitation and have a registration number allocated by the training institution.

Australian driver-trained occupational therapists can be contacted via the relevant state Occupational Therapy Association (OT Australia) website: http://www.otaus.com.au.

Setting Up the Testing Environment

Room Set Up

Administer the touch screen DSDA in a quiet room that is free from distractions and interruptions (e.g., an office or clinical treatment room). If the test must be administered in a busy area due to lack of space (e.g., patient waiting area), have the patient use the headphones and seat them as privately as possible (e.g., behind a screen or in a separate area). You should administer the test without family or friends present. If this is not possible, instruct any person accompanying the patient to sit silently and avoid inadvertently helping or distracting the patient.

Table / Chair Set Up

Seat the patient comfortably in an upright chair at a table or desk. Do not place the tablet on the patient’s lap. Make sure the desk is free of other materials to minimise distractions. Position the patient away from windows or lights that may cause glare on the tablet screen. Close window coverings or turn off lights if the patient prefers it.

- Seat the patient on an upright chair at a table.
- Place the stand on the table, directly in front of the patient (in their midline) at a 20-degree angle.
- Place the tablet on the stand and make sure the patient can reach it comfortably, without allowing the patient’s hand to rest on the screen. This will trigger unwanted responses.
- Adjust the brightness of the tablet image to full to ensure there is no glare on the screen and there is adequate contrast in the image.
- The volume of the tablet should be turned to full.

Note: It is acceptable to turn down volume or brightness of the tablet if requested by the patient for his or her comfort. The patient may adjust the proximity of the stand for comfort.

The goal of the tablet set-up is to ensure that the patient has the best view of the screen for his or her focal length, with good image contrast for the time of day and light in the room.

Use of Headphones and Stylus

Offer the patient the opportunity to use the headphones if they have difficulty hearing or a stylus if they have difficulty responding during the familiarisation process. The decision to use these aids is up to the patient.

Administrator’s Position

Sit beside (rather than opposite) the patient on a separate chair during the set up and practice stage. Sit on the patient’s non-dominant side so that you can easily access the tablet without touching the patient, in case you need to provide assistance.

DriveSafe

The DriveSafe subtest is self-administered with instructions presented in written and audio form. DriveSafe consists of 10 images of a 4-way intersection (an example intersection image is presented in Figure 1.). 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 object presented, the patient is prompted to recall 3 pieces of information:

1. Type of object (e.g., car, pedestrian, couple walking together, truck, or bicycle)
2. Object location
3. Direction of movement
After the objects disappear, the patient is prompted with “touch the screen to show your responses”. When the patient touches the screen, a yellow location point appears with an object menu attached (see Figure 2.). The patient selects one of the five possible object icons to indicate the type of object previously observed.

Figure 1. Example DriveSafe Intersection Image

Figure 2. Object Location Point with Object Type Menu
After the patient selects the object type, an arrow appears (see Figure 3.). The patient must drag the arrow in the direction the object was travelling.

![Object direction icon](image)

**Figure 3.** Object direction icon

**DriveAware**

The DriveAware subtest consists of seven questions. The patient rates his or her perceived performance on the DriveSafe subtest in two self-administered questions (see Figure 4.). Self-administered questions are presented via written and audio instructions.

![How well did you remember the location of people and vehicles?](image)

**Figure 4.** Example DriveAware question
The remaining five DriveAware questions are part of an interview that a general practitioner or health professional conducts at the conclusion of the test. The administrator reads aloud four questions to the patient and enters the responses via the touch screen. 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.

Results of the DriveSafe and DriveAware subtests are used to classify drivers in three categories: likely to fail an on-road assessment, requires further testing, and likely to pass an on-road assessment. For more information on scoring and categorisation, see Chapter 4.

**Intersection Rules (Optional)**

Intersection Rules is an optional, self-administered subtest with instructions presented in written and audio format. The Administrator-Assisted Method could also be used if required. If the healthcare professional selects it for inclusion, the subtest automatically begins after the two DriveAware self-administered questions, but before the remaining five questions included in the brief interview.

The Intersection Rules subtest presents eight intersections with two to four vehicles in each intersection (see Figure 5.). Four intersections have road sign symbols. For each intersection, the patient is prompted with the phrase “tap the vehicles in order”. The patient touches the screen to indicate the order in which vehicles in the intersection should proceed, according to the road markings and symbols presented.

![Example Intersection Rules item](image)

*Figure 5. Example Intersection Rules item*
Chapter 3.
Administering DSDA

Preparing the Tablet for Testing

The DSDA home screen is shown in Figure 6. The home screen has three columns. Use the left column to search patient records by name, status, or date of testing. Touch ‘Patient set-up’ to set up a new test. The number of report usages available is shown at the bottom of this left column.

The centre column lists records from newest to oldest and colour codes records based on status. Red indicates the test is ready to start or resume. Yellow indicates the test has been completed, but the report has not yet been created. Green indicates the test has been completed and the report created. The right column lists all records for patients previously tested. You can retrieve old records from this column or by using the search fields in the left column.

Set up the patient record and test prior to the patient’s appointment. This process takes 1–2 minutes and ensures that the test is ready when the patient arrives for the assessment. Select ‘Patient set-up’ to start a new test for either a new patient or to re-test a previous patient (see Figure 7.).
Figure 7. DSDA Patient Set-Up Screen

The administrator must enter the patient details, then select ‘Save’ or ‘Start Test’ as preferred. Select ‘Start Test’ to begin testing. Select ‘Save’ to return to the home page.

Consent Forms

Prior to beginning the test, either you OR the patient must provide consent. The patient consent form provides a brief summary of the test purpose and content, explains where the information is being sent, and states that the participant may withdraw consent at any time until testing has been completed and results calculated. The patient must select ‘yes’ in response to “I have read and agree to the conditions”. Alternatively you can consent on behalf of the patient by selecting ‘yes’ to “I have given the patient a verbal explanation of the DSDA test, its procedures and risks and I believe that the patient has understood that explanation”.

Administering the Demo and Practice Sections

Use the following procedure for the demonstration and practice sections, for both administration methods.

Test Start

Once consent has been given, the test start screen appears (see Figure 8.).

![DSDA Patient Start Screen](image)

*Figure 8. DSDA Patient Start Screen*

The patient touches ‘Start’ when ready to begin. Allow the patient to self-administer the test, following the prompts. The patient is taken through audio and vision checks to ensure the volume is appropriate and the screen is the correct brightness. When the checks are complete, the patient is presented with the DSDA demonstration introduction screen, which describes the basic premise of the test via audio and written instructions (see Figure 9.).
The patient begins the demonstration by touching ‘View demo’. **Remain in the room until the patient successfully completes the demonstration and practice items.** This enables you to:

1. provide assistance if needed; and
2. decide whether or not the Administrator-Assisted Method is required.

**Demo Section**

The demonstration section consists of one item to teach the patient the test functions (tap, arrow swivel, object menu and undo). Watch the patient complete the demonstration item (with the red car driving forwards).

- If the patient struggles to move the arrow, say: **touch the arrowhead and move your finger to show which way the car was driving.** You may also demonstrate this, but allow the patient to try it first.

**Repeating the Demo Section**

The patient can repeat the demonstration item **only once** by selecting ‘Repeat demo’. Have the patient repeat the item if he or she is having significant difficulty and you think it may help.
The patient moves from the demonstration to the practice section by selecting ‘Start practice’ (see Figure 10.).

![Figure 10. DSDA Practice Start Screen](image)

**Practice Section**

The practice section of DriveSafe consists of three items. The purpose of the practice section is to teach the patient the basic premise of the test. The items provide various levels of assistance as required via error messages and additional instructions.

The patient must complete each of the three practice items correctly before the test allows them to proceed. The patient can have a maximum of four attempts per item. If the patient fails to answer correctly on the fourth attempt, they receive a message instructing them to see their administrator for help. The development and research phase of the test revealed no improvement in performance beyond four attempts and/or the patient became too frustrated to succeed beyond this point.

*Repeating the Practice Section*

The patient may repeat the practice section only once if you judge this as beneficial in facilitating independence. Repeated practice beyond this was not found to be beneficial in the development and research phase of the test.
If a Patient has Difficulty and Does Not Improve With Practice

If a patient has significant difficulty with the test and does not improve with practice, consider what you observed during the practice section of DriveSafe and ask yourself:

Was the patient able to complete at least one practice item without assistance (i.e., indicate object location, type and direction of movement without help)?

If the answer is 'no' then use the Administrator-Assisted Method outlined on page 23. Figure 11. represents the Administration Method Decision Tree.

---

DriveSafe Practice Section:

Can the patient independently indicate

1. object location;
2. object type; and
3. direction of movement.

(all 3) for a least one practice intersection?

---

*The patient may repeat the practice section only once

---

Figure 11. Administration Method Decision Tree
DSDA Self-Administered Method

DriveSafe

After the patient has successfully completed the demonstration and practice sections, the DriveSafe start test screen appears (see Figure 12.). The patient should select ‘Start test’ when he or she is ready to begin (see Figure 12.).

Figure 12. DriveSafe Start Test Screen

No further prompting or assistance may be given. At this point, the administrator may leave the room but should be available if the patient calls for help. If the patient asks for assistance, you can only say:

**Sorry, I cannot provide assistance during the test. Just do your best.**

You cannot physically assist with test functions, provide verbal prompts, or provide feedback on performance if the patient is self-administering the test.
DriveAware

DriveAware—Self-Administered Questions

The patient completes the two self-administered DriveAware questions according to written and audio instructions. The patient can only choose one response. Do not provide any prompting or assistance during the questions. If the patient asks for help, say:

**Sorry, I cannot provide assistance during the test. Just touch the response that seems most correct to you.**

DriveAware—Clinician Interview

The remaining five DriveAware questions comprise an interview that you are to conduct the same way for all patients. Conduct the interview in a private area, such as a treatment room or office. You and the patient should be comfortably seated. You must read the questions verbatim and touch the response that is most like the one the patient gives. Following are two examples of how to enter responses for questions in the DriveAware interview.

Example 1 - DriveAware Question 6 (see Figure 13.).

![Figure 13. DriveAware Question 6.](image)
Table 1. presents examples of responses to DriveAware Question 6.

**Table 1. Examples of responses to DriveAware Question 6.**

<table>
<thead>
<tr>
<th>Example of Patient Responses</th>
<th>Example of Clinical Contexts</th>
<th>Appropriate Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>“I don’t know”</td>
<td>Has been diagnosed with dementia. Diagnosis discussed with patient in the past.</td>
<td>A–Does not report primary reason</td>
</tr>
<tr>
<td>“My GP just told me to come.”</td>
<td>Referred due to memory loss. Family concerned about forgetfulness.</td>
<td>A–Does no report primary reason</td>
</tr>
<tr>
<td>“Doctor can you please fill out my license form to say I am OK to drive”</td>
<td>License authority has posted the patient a medical form to be completed by their doctor due to their age (75).</td>
<td>C–Reports primary reason</td>
</tr>
<tr>
<td>“I agreed to be involved in a research project”</td>
<td>Test being administered as part of a research project</td>
<td>C–Reports primary reason</td>
</tr>
<tr>
<td>“I’m just getting old”</td>
<td>Had a stroke and recent hospital admission</td>
<td>A–Does no report primary reason</td>
</tr>
<tr>
<td>“I don’t know. My family are worried about my memory but I’m OK”</td>
<td>Diagnosis of dementia has been discussed with patient in previous appointments</td>
<td>B–Indicates partial awareness</td>
</tr>
<tr>
<td>“I have had a brain injury so people are worried this might affect my driving. I think I’m OK.”</td>
<td>Has had a brain injury. There is uncertainty regarding whether this will affect driving safety.</td>
<td>C–Reports primary reason</td>
</tr>
<tr>
<td>“I’ve had a stroke”</td>
<td>Had a stroke last month but has largely recovered.</td>
<td>C–Reports primary reason</td>
</tr>
<tr>
<td>“I don’t know – I have no problems with my driving. I have been driving for 60 years”</td>
<td>Told practice nurse earlier he had hit a pole in a car park so his daughter had suggested seeing the doctor.</td>
<td>B–Indicates partial awareness</td>
</tr>
</tbody>
</table>
Example 2 - DriveAware Question 7 (see Figure 14.).

For DriveAware Question 7, select A, B or C depending on your judgment for this patient (see Figure 14.). **Base your decision on the clinical information you have available** (e.g., medical diagnosis, vision report, medical test results, referral information) and other information reported by family, caregivers or the patient (e.g., difficulty with daily activities, reduced mobility, recent collisions, report of reduced frustration tolerance).

**Intersection Rules (Optional)**

The Intersection Rules subtest is an optional subtest. When the administrator first sets up the patient, they will be required to indicate whether this subtest should be included for each individual.

The administrator does not need to be present during the Intersection Rules subtest. If the patient calls for help, assistance can be provided only for the practice item. This may include demonstration of how to number vehicles or select ‘undo’. The administrator may repeat instructions but only as written (e.g., **You need to number all of the vehicles**). The patient can repeat the practice item as many times as they like (if at all). If the patient asks for help deciding right of way, say:

**Sorry, I cannot provide assistance during the test. Just do your best.**
DSDA Administrator-Assisted Method

Sit at the table next to the patient on the patient’s non-dominant side. This position enables you to take over test functions without touching the patient. The patient should have an unimpeded view of the tablet.

- The tablet should be muted so that there is no sound.
- The administrator enters or selects test functions (e.g., selection of ‘start’ and ‘next’, and indication of DriveSafe responses).
- The patient may continue to enter responses as long as it does not disrupt the flow of the test. Use your clinical judgment to decide.

DriveSafe

Starting the Test

Begin testing with the DriveSafe start test screen (see Figure 15.). Clearly state the following instructions to the patient:

You will see images of an intersection. Try to remember

1. which objects you saw,
2. where they were located, and
3. which way they were going.
Are you ready to start?

Select ‘Start test’ when the patient is ready to begin. You may repeat the instructions verbatim as many times as required. Do not use any additional words.

Figure 15. DriveSafe Start Test Screen
**During Countdown**

During the countdown, say: **Get ready to look.**

**After Objects Disappear**

When the objects have disappeared, say: **Tell me what you saw.**

If the patient says “There is nothing there” or does not understand the test requirements, say: **Try to remember the objects you saw before they disappeared. Tell me what you saw.**

You may repeat these words many times as required, but do not use any additional words.

**Entering Responses in DriveSafe**

**Your role during DriveSafe is simply to provide assistance with response entry.** No prompting should be given to elicit information. For example, the administrator is not permitted to say “which way was the car going?” or “where did you see the car?”

Enter responses exactly as the patient has stated them. Pointing and gestures are accepted to indicate responses (e.g., direction of movement).

Keep in mind the three categories of information that need to be recalled when entering patient responses (name of object, object location, and direction of movement). If the patient says “there was a car over there”, enter only the object type (car) and object location (as indicated by the patient) and, not the direction of movement. Table 2 provides examples of interpreted patient responses.

You may allow the patient to touch the tablet if you judge this as effective (e.g., the patient enters the location and object type, and you enter the direction of movement). Ask the patient to locate the object as specifically as possible by say: **Is this what you mean?** No other prompting or instruction is allowed. If the patient says “no”, delete the response and re-enter it as indicated.

If the patient accidentally triggers unwanted or additional responses (e.g., as the result of a tremor), simply delete the responses. When using the Administrator-Assisted Method, the administrator responds to all pop-ups and messages such as, **Are you sure you have completed this screen?** and **Do you want to delete this response?** The goal is to facilitate a smooth testing flow and limit disruptions.

Patients with significant cognitive deficits may attempt to tell the administrator their responses while objects are still displayed on the screen. In this case, say: **Wait until the objects are gone.** When they have disappeared, say: **Now tell me what you saw.**
Table 2. Example responses with corresponding response entry

<table>
<thead>
<tr>
<th>Patient Response</th>
<th>Response Entry</th>
</tr>
</thead>
</table>
| “I saw something here (pointing but not touching screen) but I can’t remember what it was.” | **Location:** Administrator touches location point indicated by patient but first asks: “Is this what you mean?”  
**Object:** No entry (leave menu on screen)  
**Direction of Movement:** No entry |
| “I saw two people over here (touching screen).”                                  | **Location:** Location point entered by patient  
**Object:** Administrator selects couple icon  
**Direction of Movement:** No entry |
| “I saw a thing here on the road but I can’t remember if it was a car or a truck. I’m not sure.” | **Location:** Administrator touches location point indicated by patient but first asks: “Is this what you mean?”  
**Object:** No entry  
**Direction of Movement:** No entry |
| “I saw a person over here” (pointing to pole on left footpath but not touching screen). | **Location:** Administrator touches location point indicated by patient but first asks: “Is this what you mean?”  
**Object:** Administrator selects person icon  
**Direction of Movement:** No entry |
| “There were two people here” (pointing to right footpath). “They were walking this way” (gesturing left) “and a bike over here” (touching screen) “coming this way” (gesturing toward self). | **Location 1:** Administrator touches location point indicated by patient but first asks: “Is this what you mean?”  
**Object 1:** Administrator selects 2 person icon  
**Direction of Movement 1:** Administrator moves arrow to approximately 270°.  
**Location 2:** Entered by patient  
**Object 2:** Administrator selects bike icon  
**Direction of Movement 2:** Administrator moves arrow to approximately 180°. |

When the patient is ready to move to the next image, ask: Are you ready to move on? If the patient says yes, select Continue.

**DriveAware**

**DriveAware—Two Self-Administered Questions**

Read the questions exactly as written and ask the patient to respond. Allow the patient to see the screen and read the text, but do not allow the patient to touch the screen. You must enter the responses for the patient (this is to avoid incorrect responses inadvertently being selected as responses cannot be changed). If the patient asks for help, say: Sorry, I cannot provide assistance during the test. Just tell me the response that seems most correct to you.

**DriveAware—Clinician Interview**

The remaining five DriveAware questions are conducted in the same way for all patients, whether the test has been self-administered or administrator-assisted. This procedure is described on page 19.
Intersection Rules (Optional)

The Intersection Rules subtest runs if you opted to include it in the set up stage.

Practice Item

You must read the instructions exactly as written (see Figure 16.). Mute the sound for this part of the test. Select ‘View practice’ when the patient is ready.

When the practice intersection appears, ask: Which car goes first? The patient may touch the desired car him- or herself, or you may touch the car on his or her behalf. Next, ask: Which car goes second? Again, the patient may touch the desired car or you may touch it on his or her behalf. Allow the patient to touch cars only if it does not disrupt the flow of testing. If the response is incorrect, read the error messages verbatim and then select Continue or Try again. The practice item can be completed as many times as you think it is necessary.

When the patient is ready to start the test, read the instructions on the Intersection Rules start test screen (see Figure 17.) verbatim and then select ‘Start test’.
**Test Items**

Follow the same procedure for selecting vehicles as you did with the practice items.

Ask: **Which car goes first?**

Enter the response (or allow the patient to touch the desired vehicle). Do this for all remaining vehicles (e.g., **Which car goes second? Which car goes third? Which car goes fourth?**).
Chapter 4.
Scoring and Reporting

Scoring

The touch screen DSDA automatically scores all test items and records all subtest timings. These are presented in a clinical report and patient letter at the conclusion of the test (see Reporting).

DriveSafe Scoring

The DriveSafe subtest consists of 10 intersections, with a total of 28 objects presented. All possible independent and combined variable options were examined throughout the development and research phase. Results indicated that the variables most predictive of driving performance were object type, object location, and direction of movement, scored as independent variables. As a result, these variables were selected as the basis for the DriveSafe subtest scoring.

Each correctly recalled piece of information (object type, location and direction of movement) in the DriveSafe subtest receives one point. The maximum score for 28 objects is 84. The total number of objects missed, the total number of details missed (location and directions), and the number of additional objects the patient indicates (that were not actually present) are also recorded. Time taken to complete the test is automatically recorded.

The total DriveSafe subtest score (maximum 84) is used to categorise patients three ways (see Figure 21.). A score of 57 or below indicates the patient is likely to fail an on-road assessment. A score of 72 or above indicates the patient is likely to pass an on-road assessment. A score of 58 to 71 indicates further assessment is required to determine fitness to drive. The patient’s DriveAware results are then applied to this scoring categorisation.

DriveAware Scoring

The DriveAware subtest consists of 6 items. 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 ratings. 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. A score of 10 or below indicates impaired awareness of abilities related to driving and a high score of 13 or above indicates awareness of abilities related to driving. A score of 11 or 12 indicates further assessment is needed.

Final categorisation in DriveAware depends on the DriveSafe subtest outcome. Both DriveSafe and DriveAware scores are combined to further classify patient ability and awareness into the three categories: Pass, Fail, and Further Testing. 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 (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. The DSDA scoring system and decision flowchart is illustrated below (see Figure 18.).
Patient Categorisation

DriveSafe DriveAware subtest scores are used to identify patients who are likely to fail an on-road driving assessment, those who are likely to pass an on-road assessment, and those who require further testing to determine fitness to drive. The cut scores and categorisation flow chart for both subtests are indicated in Figure 18.

![Figure 18. DriveSafe DriveAware classification flow chart](image)

Intersection Rules Scoring (Optional)

The Intersection Rules subtest consists of 8 items. One point is awarded per item only when all vehicles are placed in the correct order of right of way. This results in a maximum score of 8. Time taken to complete the test is recorded.

Intersection Rules was initially investigated in the context of DriveAware in the statistical analysis during the development and research phase. Results indicated the subtest was not useful as a predictor of driving performance and was not correlated with performance on the DriveSafe subtest, the DriveAware subtest, or with the on-road assessment outcome. Intersection Rules was therefore altered to be an optional subtest. Patient performance on this subtest does not contribute to DriveSafe or DriveAware scoring. The subtest is retained primarily for driver trained occupational therapists to use as a brief screen of knowledge regarding right of way at intersections and for the qualitative information provided (e.g., ability to plan responses and follow instructions). This subtest may still be useful for other clinicians including general practitioners and can be selected for inclusion at the patient set-up stage.
Reporting

When the patient has completed DriveSafe DriveAware, you can generate the report. You can have the report emailed to yourself or print it directly from the tablet. The report consists of three sections:

3. Patient Letter

You may generate only the Summary Report or both clinical reports if additional information is required (e.g., the patient wants evidence of why they fell into a particular category). The Patient Letter provides a brief summary of performance and the implications of this performance for the patient. A sample Clinical Report (Summary and Extended) and Patient Letter is provided on page 37. A 9-square, colour-coded graphic provides a quick visual representation of performance in both the Summary Report and the Patient Letter.

Clinical Report: Summary Report

The Summary Report is a brief, one-page summary of performance that includes demographic information and any notes that were entered. The Summary Report includes the following information (see Figure 19.):

- Demographic information
- DSQA diagram illustrating test results
- Total scores for the DriveSafe DriveAware subtests and the Intersection Rules subtest (if completed)
- Outcome category (likely to pass on-road, likely to fail on-road, requires further testing)
- Recommendation
- Notes entered by the administrator into the open notes fields

Clinical Report: Extended Report

The Extended Report provides more detail on performance. The Extended Report includes the following information (see Figures 20. and 21.):

- Summary of the number of objects missed and details missed in the DriveSafe subtest
- Additional objects indicated (that were not present) in the DriveSafe subtest
- DriveAware score in relation to cutoff scores
- Performance on the Intersection Rules subtest (if completed)—simple intersections compared to complex intersections
- Time taken to complete DriveSafe and Intersection Rules (if included)
- Categorisation diagram illustrating cutoff scores and categorisation process
- Caution notices if the test flags that the person speaks English as a second language or has a psychiatric condition.

Patient Letter

The Patient Letter includes the following information (see Figure 22.):

- Purpose of the test
- Total score on the DriveSafe subtest as well as indication of the number of objects and details missed
- Total score on the DriveAware subtest
- Total score on the Intersection Rules subtest (if completed)
- Outcome category (likely to pass on-road, likely to fail on-road, requires further testing)
- DSQA diagram illustrating test results
- Recommendation
DriveSafe DriveAware - Summary Report

Name
Ruth Allan

DOB / Age
03 Aug 1945 - 69 years

Gender
Female

MRN
417

Assessment Date
03 Mar 2015

Test Administrator
Beth Cheal

Diagnosis
Parkinson's disease

DriveSafe
78 / 84

DriveAware
11

Intersection Rules
7 / 8

Outcome*
Likely to pass an on-road assessment

*Please consult manual for interpretation of category.

Recommendation
Results indicate the patient is likely to pass an occupational therapy on-road assessment and is likely to be able to manage the cognitive aspects of driving. Please consider this recommendation in the context of your clinical judgement.

Figure 19. Example Summary Report
DriveSafe Drive Aware - Extended Report

Name: Ruth Allan
MRN: 417

1. DriveSafe (Objects & Directions)
DriveSafe determines awareness of the driving environment.

Table 1: Missed information

<table>
<thead>
<tr>
<th>Information</th>
<th>No. Missed / Incorrect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objects</td>
<td>1/28</td>
</tr>
<tr>
<td>Details (Location / Direction)</td>
<td>5/56</td>
</tr>
</tbody>
</table>

Total score: 78/84
Additional objects: 0
Time taken to complete test: 4 minutes and 6 seconds

Research indicates the median time taken to complete DriveSafe for people who pass an occupational therapy on-road assessment is 4 minutes and 46 seconds, and for people who fail the assessment, 6 minutes and 49 seconds.

2. Intersection Rules
Right of way is determined for 8 intersections.

Table 2: Performance based on intersection complexity

<table>
<thead>
<tr>
<th>Intersection No.</th>
<th>Road Signs</th>
<th>No. of Vehicles in Image</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3, 4, 7</td>
<td>Without road signs</td>
<td>2</td>
<td>4/4</td>
</tr>
<tr>
<td>2, 5, 6, 8</td>
<td>With road signs</td>
<td>3-4</td>
<td>3/4</td>
</tr>
</tbody>
</table>

Total score: 7/8
Time taken to complete test: 0 minutes and 33 seconds

Research indicates the median time taken to complete Intersection Rules for people who pass an occupational therapy on-road assessment is 2 minutes and 38 seconds, and for people who fail the assessment, 3 minutes and 49 seconds.
DriveSafe DriveAware - Extended Report

Name          MRN
Ruth Allan    417

3. DriveAware

DriveAware determines awareness of own abilities related to driving.

Score 11

A score of 10 or below indicates impaired awareness.
A score of 11 or 12 indicates further assessment is needed.
A score of 13 or above indicates intact awareness.

Figure 1. DriveSafe DriveAware Categorisation Cut-off Scores

Figure 21. Example Extended Report—Page 2
DriveSafe DriveAware - Patient Letter

Name
Ruth Allan

MRN
417

The purpose of this test is to determine a driver’s awareness of the driving environment and their own abilities related to driving. Results are used to indicate if further assessment of ability to manage the cognitive aspects of driving (thinking skills) is required.

Your results were:

<table>
<thead>
<tr>
<th>DriveSafe</th>
<th>DriveAware</th>
<th>Intersection Rules</th>
</tr>
</thead>
<tbody>
<tr>
<td>78/84</td>
<td>11</td>
<td>7/8</td>
</tr>
</tbody>
</table>

Missed 1 object and 5 details (location/direction).

A score of 10 and under indicates reduced awareness of abilities related to driving.

These results place you in the category:

**Likely to pass an on-road assessment**

Your results indicate you are likely to pass an occupational therapy on-road assessment (provided you do not have any physical impairment that may affect your driving ability).

Note: If you have a medical condition that can affect physical capacity to drive, you may be required to undergo an occupational therapy driving assessment even if you fall into the ‘green’ section on this graph.

If you would like more information about DriveSafe DriveAware please visit the following website:

Disclaimer

The recommendations above were based on information provided by you, clinical information, performance on the day of the assessment, and results of research. The results of this test are for clinical and diagnostic purposes only, and are intended for use with a licensed clinical practitioner. The results should not be relied upon as an indicator of being collision-free (or otherwise).

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Chapter 5.
Test Development and Research

Background

Responsibility for determining fitness to drive typically falls to the primary healthcare physician (referred to as 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 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, which is usually borne by the driver. 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 (Kay, Bundy, & Clemson, 2009a).

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. Computer administration of the 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 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.

Precursor Tests—VRST and DSDA Computer Version

The precursor test for DriveSafe DriveAware was the Visual Recognition Slide Test (VRST), developed by Becky Zropf, an occupational therapist who established driver assessment and rehabilitation training for occupational therapists at the University of Sydney in 1989. Driver-trained occupational therapists in several Australian jurisdictions used VRST for many years as part of a clinical assessment of fitness to drive (Kay, Bundy, & Clemson, 2008). VRST is conceptually different from other driver screening tests currently being used, in that it assesses global awareness of the driving environment rather than the component visual processing and cognitive skills (Kay, Bundy, & Clemson, 2008).

Dr. Kay examined the psychometric properties of VRST in 2007 via a large retrospective study (N = 838). The VRST was found to have sound psychometric properties and was a promising screening test with a specified cutoff score (Kay, Bundy, & Clemson, 2008). The test yielded sensitivity and specificity of 81% and 89% respectively. VRST was updated, shortened and renamed DriveSafe, in light of these results.

The research also identified the importance of awareness of driving ability for safe driving. In the absence of suitable measures of driving awareness at the time, Dr. Kay developed the Driving Awareness Questionnaire (DriveAware). DriveAware was found to have good construct validity; however, more items were needed to assess the least aware drivers (Kay, Bundy, & Clemson, 2009b). The test was subsequently modified to include more items, improving its psychometric properties.
The construct validity and internal reliability of DriveSafe and DriveAware were re-examined following modification, in a study of 115 drivers with cognitive impairment using Rasch modelling (Kay, Bundy, & Clemson, 2009a). Results indicated that when DriveSafe and DriveAware are used together, it is possible to separate drivers into unsafe, safe, and further testing categories. Fifty percent of drivers were clearly categorised as either unsafe or safe. The optimal lower cut score identified unsafe drivers with a specificity of 97% and the optimal upper cut score identified safe drivers with a sensitivity of 93% (Kay, Bundy, & Clemson, 2009a).

In 2009, Pearson Clinical Assessment published the computer version of DriveSafe DriveAware (DSDA). Pearson converted DSDA to touchscreen in 2015.

**DSDA Conversion to Touch Screen**

Conversion to touch screen technology provided opportunity for a number of key simplifications to be made to the test to suit the new delivery mode (tablet) and testing context.

Market research was conducted by Pearson prior to development of the touch screen version; a representative sample of 250 general practitioners across Australia was surveyed to determine how they would use a touch screen version of DSDA in medical practice. Most general practitioners reported they would prefer the practice nurse to set up and monitor the self-administered sections of the test; then the general practitioner would conduct the brief interview and provide test results to the patient. Further details on setup and administration can be found in Chapter 3.

**DriveSafe**

The computer version of the DriveSafe subtest relies on the clinician’s interpretation of the patient’s verbal responses. The touch screen test is able to capture more information in the one response. For instance, the required response inputs of ‘object location’ and ‘side of screen’ (required in the computer version of the test), could be collapsed in the touch screen version, as touching the tablet screen provided both types of information within the one response. Furthermore, images from the previous version of the DriveSafe subtest were updated to facilitate international adaptation of the test. A four-way intersection replaced the roundabout image. With the exception of this change, new images replicated the computer version as closely as possible. Suitable boundaries for the 28 location zones and 28 direction ranges were set by comparing responses from 30 study participants with a sample of participants with no impairments (N=30).

**DriveAware**

Five out of seven DriveAware subtest questions were retained from the computer version of the test, some with minor word changes where words were no longer applicable (e.g., ‘slide test’ was adjusted to ‘test’). Two questions were dropped from the subtest because they related to items that could not be measured in the new testing context (i.e., anxiety about the assessment process and difficulty with memory). One recommendation from Dr. Kay’s research was that additional items be included in DriveAware. The ability of the touch screen version to capture precise information regarding performance, allowed the addition of 3 new DriveAware questions relating to patient performance on the DriveSafe and Intersection Rules subtests. As discussed statistical analysis indicated the two items related to performance in Intersection Rules were not successful and therefore these were dropped. The version of the DriveAware subtest used in the research included 8 items and the final published version includes 6 items (see Table 3.).
Table 3. Final DriveAware Questions

<table>
<thead>
<tr>
<th>Item Order</th>
<th>DriveAware Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>How well did you remember the location of people and vehicles? (discrepancy score calculated according to actual performance in DriveSafe subtest)</td>
</tr>
<tr>
<td>2</td>
<td>How well do you remember the direction of travel? (discrepancy score calculated according to actual performance in DriveSafe subtest)</td>
</tr>
<tr>
<td>3</td>
<td>Do you have any concerns about your driving ability? (discrepancy score calculated according to clinician rating)</td>
</tr>
<tr>
<td>4</td>
<td>How often do you get surprised by vehicles / pedestrians appearing out of nowhere? (discrepancy score calculated according to actual performance in DriveSafe)</td>
</tr>
<tr>
<td>5</td>
<td>Why have you been asked to complete DriveSafe DriveAware? (discrepancy score calculated according to actual reason for completing DSDA)</td>
</tr>
<tr>
<td>6</td>
<td>How well do you think you did in the test? (discrepancy score calculated according to actual performance in DriveSafe)</td>
</tr>
</tbody>
</table>

Intersection Rules

The computer version of the Intersection Rules subtest consisted of 8 items. Two items were dropped due to differences in road rules between Australia and New Zealand. These items were replaced with 3 new intersections, with the same number of vehicles and level of complexity as the removed items. Following statistical analysis, one of the new intersections was dropped to shorten the test and return it to the original 8 items. An additional item was included in the research in case there was an unforeseen problem with one of the items.

Research Aim

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.
Quality Assurance Procedures

Ethics Approval

The University of Sydney Human Research Ethics Committee provided approval for this study. Two of the research sites were public hospitals and therefore required further ethical approval via the National Ethics Application Form (NEAF). St Vincent’s Hospital Sydney Human Research Ethics Committee provided ethical approval for the two hospital sites.

Assessor Qualifications and Training

An occupational therapy driving assessment is considered the gold standard for determining fitness to drive as actual driving performance is observed (Kay, Bundy, Clemson, & Jolly, 2008). Therefore, an on-road driving assessment was used as the criterion measure for this study. In Australia, an occupational therapy driving assessment must be conducted by a registered driver-trained occupational therapist. A qualified driving instructor must be present in the vehicle and it is considered best practice for the assessment to be conducted in a dual controlled vehicle. Accordingly, the research sites used in this research were all existing driving clinics where assessments were conducted by appropriately qualified occupational therapists and driving instructors in the course of their usual work.

Training was provided to all research sites via two, one-hour interactive webinars conducted by Dr. Ann-Helen Patomella, Driver Trained Occupational Therapist, Lecturer at the Karolinska Institute in Sweden and author of PDrive, and Beth Cheal, DSDA Project Manager, Driver Trained Occupational Therapist and Driving Instructor. Content was summarised in a manual provided to each site. Training included the standardised administration of DSDA, criteria for the standardised on-road assessment route, the standardised administration of PDrive (the on-road assessment tool used), and how to implement study protocols. After the first webinar, individuals at each site were required to undertake an evaluation of driving performance of an impaired driver using PDrive (presented in a DVD recording). Results were compared in the second webinar to ensure consistent marking.

After the training was completed, all research sites began data collection. In addition to the DSDA assessment and PDrive on-road assessment, occupational therapists were asked to complete a Mini Mental State Examination Version 2 (MMSE-2) (Folstein, Folstein, McHugh & Fanjiang, 2010), for each participant to determine cognitive status. Driving instructors were asked to complete a route evaluation checklist and driving clinics were asked to submit a map of their standardised on-road assessment route as part of the standardisation process. Occupational therapists were asked to rate on-road awareness as ‘intact’, ‘absent’ or ‘partial’ using standard definitions.

Quality Checks Performed

After assessments were completed, Beth Cheal, the DSDA Project Manager, reviewed all data and participant driving reports to ensure participants met the study criteria and that the assessment had been conducted according to the standardised study protocols. This ensured consistent classification of participants based on the definitions of on-road assessment outcomes used in standardisation of the computer version of the test (Kay, Bundy, & Clemson, 2009a):

- **Pass**—Safe and legal driving with no further intervention required
- **Conditional Pass**—Safe and legal driving with restrictions on the license (e.g., kilometer or time of day restrictions)
- **Intervention**—A series of lessons required to improve driving techniques or to learn to use vehicle modifications
- **Fail**—Failure to meet criteria for safe and legal driving or substantial errors and/or driving instructor intervention required for safety

It is critical that driver-trained occupational therapists who use the DSDA as a part of their off-road screen adhere to these definitions of pass, fail, and intervention when taking the patient on-road, to ensure patients are categorised correctly. In particular, if driving-instructor intervention was required for safety (including both verbal and physical intervention), this was not considered a pass for this study regardless of the circumstances.
Statistical Analysis Methods

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, 2014a). 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.

Items or participants with fit statistics outside the acceptable range should be considered for removal from the test. Point measure correlation coefficients should be positive and large enough to show a strong relationship between the item and the construct. Both item fit statistics and point measure correlations are used to verify the unidimensionality of the test (i.e., to ensure items are only included for measuring a single underlying concept.) The unidimensionality of the test was also examined via a principal component analysis with Winsteps Rasch software (Linacre, 2014a). 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).

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). In order to conclude that differences in the measure are due to real differences in the extent to which participants possess the trait and not due to error of measurement, the separation statistic should be 2.00 or greater. The participant reliability index (Cronbach’s alpha equivalent) and the item reliability index should be 0.80 or higher (Linacre, 2014).

Finally, 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

The touch-screen DSDA was administered to a convenience sample of 134 older (60+ years) and cognitively impaired (18 years +) drivers referred to ten driving clinics. For the Rasch analysis, two cases were excluded due to missing DriveAware data (N=132). For the sensitivity and specificity analysis, four cases were excluded because intervention had been recommended only for training in the use of vehicle modifications and another sixteen cases were excluded for not having the classifications Pass or Fail (N=112).

DriveSafe

The Rasch analysis indicates that all DriveSafe subtest items have fit statistics within the acceptable range. The map of items and participants (see Figure 23.) illustrates the spread of participant ability from more competent to less competent in standard deviation units. The range of item difficulty was comparable to the range of participant ability, except for the most competent drivers. This is acceptable as the point of the test is to identify participants as “pass” and not the level of competency within that category. The item-person map demonstrates the test mainly assesses the least competent drivers, which is the group of most concern. The purpose of the test is to identify and classify the “at risk” group of drivers.
Item fit statistics range from .63 to 1.38 (Median = .97), which are in the acceptable range for fit to the model. Item-to-total correlation coefficients are all positive ranging from .44 to .75 (Median = .63), which supports the validity of the DriveSafe subtest. 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%). All the statistics provide strong evidence for the unidimensionality and the construct validity of the DriveSafe subtest.

The DriveSafe subtest initially consisted of 11 items, however, one item was dropped because the analysis suggested this item did not add value to the test. This resulted in a slightly shorter test, which feedback from research sites indicated was favourable. The final version of the DriveSafe subtest therefore consists of 10 items with strong internal consistency of Cronbach Coefficient Alpha (.94).

The analysis indicated the test person separation is high (a model separation of 3.76), with a participant reliability index (Cronbach’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 provide evidence for the internal reliability of the DriveSafe subtest.

The DIF analysis on gender revealed no significant differences in item performance between male and female participants.
Table 23. Map of drivers and items for the DriveSafe subtest (M=mean, S=one standard deviation, T=two standard deviations, F=failed on-road, P=passed on-road, dir=direction, loc=location, ob=object, s=item number)
DriveAware

The initial research version of the DriveAware subtest consisted of 8 items. A discrepancy score was generated between the patient’s performance in the DriveSafe subtest, their self-rated performance and the clinician’s rating (-2 to +2). A 5-point ordinal scale was used to generate a final score for each item. To improve the score interpretability, the scale was further adjusted to a 4-point scale of 0-3: where initial scores -2, -1, 0, 1, 2, were recoded to the respective 3, 3, 2, 1, 0 new scores. The final scale of 0–3 removes the negative values and results in a lower score that represents lower awareness and a higher score that represents greater awareness. (In the computer version of the test a higher score represents lower awareness, which may be counter intuitive; thus the scale was reversed).

Two of the initial DriveAware items related to awareness of performance on the Intersection Rules subtest. Item analysis revealed that these items did not perform the same way as others. This, coupled with the optional nature of the Intersection Rules subtest, resulted in the decision to remove the two items from the DriveAware subtest. The total maximum score of the final DriveAware subtest is 17, as five of the six items have a maximum score of 3 and one item has a maximum score of 2.

Among the six items, five have acceptable infit statistics (Infit MnSq) from .67–1.10 and moderate-to-high item–measure correlations from .64 to .82 (Median = .70). One item had the smaller item-measure correlation (r = .54) and the larger infit statistics (Infit MnSq=1.67) but within the acceptable range (Linacre, 2014). The item behaviour may reflect the fact that responses to this question: “Why have you been asked to complete DriveSafe DriveAware?” were less varied than the responses to other questions. Item analysis results support the construct validity of the DriveAware subtest. The principal component analysis yielded a modelled variance (59.3%) that closely matched the empirical variance (59.4%). The percentage of unexplained variance by the first contrast was 11.4% less than the percentage of variance explained by item (16.1%) or by person (46.3%). All statistics show that there is no clear secondary dimension and no excessive amount of misfitting items, indicating the DriveAware subtest measures a unidimensional construct.

Figure 24. is a comparison of the spread of participant awareness (from intact to absent) with subtest item difficulty. The map reveals gaps in that there were no items to measure participant awareness. As expected, this distribution of items confirms that the DriveAware subtest is not a stand-alone test and should be used in conjunction with another test, such as the DriveSafe subtest. The hierarchy of items is conceptually logical and reflects a progression of awareness.

The item separation of 6.87 and score reliability of .98 imply that the sample was able to confirm the item difficulty hierarchy of the test. However, the person separation was lower (1.98) and the reliability was .80, which further confirms that the DriveAware subtest by itself may not be sensitive enough to distinguish between high and low performers.

Among most of the DriveAware subtest items, DIF analysis revealed no statistically significant difference between male and female participants except for Item 1, “How well did you remember the location of people and vehicles?” For this item, female participants had better awareness than males. There might be various causes for this finding, such as gender differences in self-rating of performance. Because the sample was less controlled than in educational and other experimental testing settings, it is not known whether the DIF analysis results are caused by the sample or by the nature of the test. Because the question is important in tapping the patient’s awareness of driving, it was determined that the item should remain in the test.
Table 24. Map of drivers and items for the DriveAware subtest (M=mean, S=one standard deviation, T=two standard deviations, F=failed on-road, P=passed on-road)
Predictive Validity of DriveSafe DriveAware

Among the sample of 112 participants for 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 learn to use modifications or to improve driving performance.

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. However, it is worth noting that positive and negative predictive values are influenced by the prevalence of safe/unsafe drivers in the population that is being tested. If we test in a high prevalence setting, it is more likely that persons who test unsafe truly have unsafe outcome than if the test is performed in a population with low prevalence.

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% as combining both DriveSafe and DriveAware subtest cut scores in the 3-by-3 categorisation figure.

Conclusion

The results of this study present 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.
Appendix A

DSDA Demo and Practice Administration

Procedure

Test Set-Up

- Place tablet on a stand angled to 20 degrees, on a table
- Ensure brightness and volume are set to full (no glare / adequate image contrast)
- Seat patient in an upright chair at the table
- Place the tablet directly in front of the patient (midline and within comfortable reach)
- Offer opportunity to use headphones and/or stylus if difficulties noticed in hearing or touching the screen during the familiarisation process (decision to use is the patient’s).

Demonstration Section

- If the patient struggles to move the arrow say; Touch the arrowhead and move your finger to show which way the car was driving. You may also demonstrate this, but allow the patient to try first.
- ‘Repeat demo’ may be selected only once. Repeat the demonstration only if the patient is having significant difficulty and you think it may be beneficial to repeat the demonstration.

Practice Section

- ‘Practice again’ can be selected only once. Repeat the practice only if you think it may be beneficial in the patient achieving independence.
- If the patient is not able to complete at least 1 of the 3 practice intersections independently (i.e., enter the three pieces of information without assistance), use the Administrator-Assisted Method’ (Appendix B).
Appendix B

DSDA Self-Administered Method

DriveSafe

If the patient asks for assistance only say:

_Sorry, I cannot provide assistance during the test. Just do your best._

Provide no assistance with test functions, verbal prompting, or feedback on performance.

DriveAware—Self-Administered Questions

Provide no prompting or assistance during the two self-administered questions. If the patient asks for help, say:

_Sorry, I cannot provide assistance during the test. Just touch the response that seems most correct to you._

DriveAware—Clinician Interview

Read the first 4 questions verbatim to the patient. Tap the response that is closest to the one provided. Enter your rating for the last question. (This question is not read aloud).

Intersection Rules (Optional Subtest)

If the patient asks for help, you may provide assistance on the practice item, such as demonstrating how to number vehicles or select ‘undo’. You may repeat instructions but only as written (e.g., _you need to number all of the vehicles_). The patient can repeat the practice item as many times as they like. If the patient asks for help only say:

_Sorry, I cannot provide assistance during the test. Just do your best._
Appendix C

DSDA Administrator-Assisted Method

Procedure

- Sit on the patient’s non-dominant side for easy access to the tablet
- Mute tablet sound
- Take over data entry
- Do not prompt for responses and only use words provided in red.
- The patient may continue to enter responses if not counterproductive (administrator to use clinical judgment to decide)
- If unwanted / additional responses are triggered, delete them. Take over responding to all pop-up messages. Aim: Allow a smooth flow and limit disruption.

Verbatim Instructions

DriveSafe

Start-Up

You will see images of an intersection
Try to remember
1. Which objects you saw
2. Where they were located and
3. Which way they were going
Are you ready to start?

During Countdown: Get ready to look
When the objects have disappeared: Tell me what you saw
If additional help needed: Try to remember the objects you saw before they disappeared. Tell me what you saw.
If tries to respond too soon: Wait until the objects are gone.
When gone: Now tell me what you saw.
When finished: Are you ready to move on?

In-Test

Entering Responses

- Enter patient responses exactly as stated (based on the 3 categories – location, object and direction. If a category is excluded by the patient do not enter)
- Pointing / gestures are accepted to indicate location and direction,
- If clarification is needed, ask: Is this what you mean? (adjusting response as required)
DriveAware

Self-Administered Questions

Administrator to read DriveAware questions exactly as written and ask the patient to respond. Allow the patient to see the screen and read the text for the self-administered questions. The patient or the Administrator may tap the selected response. If the patient asks for help, say: Sorry, I cannot provide assistance during the test. Just tell me the response that seems most correct to you.

Clinician Interview

Read the first 4 questions verbatim and tap the response that is closest to the one given. Enter your clinician rating for the last question. This question is not read aloud.

Intersection Rules

Read any instructions or error messages verbatim as written on the screen, with no additional words.

In Intersection Demonstration / Test Items

Ask: Which car goes first? Either the patient or you may tap the selected car (as works best). Continue for remaining vehicles: Which car goes second? Which car goes third? Which car goes fourth?
References


