Cognitive Screening for Fitness to drive in people with dementia

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Overview

- Which cognitive tests to use in assessing fitness to drive?

  – Nottingham Assessment for Drivers with Dementia

  – The Dementia Drivers Screening Assessment

  – The Rookwood Assessment Battery

Background

- There is currently no universal, standardised way to assess fitness to drive.

- The most ecologically valid method is **on road assessment** but road assessments for everybody are expensive, time consuming and demand may outweigh capacity

- Therefore, we need screening methods that allow us to identify who needs a road assessment.

- Lack of consistency in research methods used to determine the degree of cognitive impairment which should preclude driving and

- Differences in assessment practices between countries (Nys and Raeymakers, 2013, Alzheimer Europe, 2014)

- Lack of research on which to base recommendations and of consensus (Martin AJ, Marottoli R, O'Neill D, 2013)

Research

- **Reger et al (2004)**. 27 studies, 12 used on-road driving to assess driving ability. Meta-analysis - **Effect sizes significant but small for** the relation between on-road driving and **all neuropsychological tests**.

- **Molnar et al (2006)** 16 studies (six used on-road driving). M**arked inconsistencies between studies** – some tests showed positive associations with driving, others did not. **Few provided cut-off scores for making clinical decisions.**

- **Hird et al (2016)** systematic review and meta-analysis in AD and MCI; 32 studies. **Executive function, attention, visuospatial function and global cognition were significant predictors of driving performance**. TMT and Maze test best single predictors but **inconsistencies across studies**. Driving ability of MCI and AD related to the degree of cognitive impairment.

- **Bennet et al (2016)** 28 studies investigating relationship between cognitive function and driving. **Inconsistency. Scores on individual tests did not predict driver safety. Composite batteries predict driver performance**

Cognitive screening for fitness to drive

Purpose of screening
- To identify who needs further assessment at a specialist driving assessment centre
- To introduce some form of screening into procedures where currently none exists
- To inform more comprehensive assessment

- So that;
- decisions are based on criteria related to driving competence
  - Increased objectivity
  - Reduce family burden

- Safe drivers enjoy the privileges of driving a car
- Unsafe drivers are identified (prior to accidents)

Development of The Dementia Drivers Screening Assessment

The assessment of fitness to drive in people with dementia

Nadina B. Lincoln[1]*, Kate A. Radford[1], Elizabeth Lee[2] and Alice C. Reay[2]

[1]University of Nottingham, UK
[2]Walton...

- To determine whether cognitive tests are predictive of fitness to drive in people with dementia in order to identify people who needs referral to a specialist driving assessment centre

Method

Participants

- Dementia (42, Median age 73.5, Mean 45.7 yrs driving exp)
- Healthy elderly (33, Median age 67, Mean 45.1 yrs driving exp)
 - Volunteers over age 60 years with no known memory problems

Completed

- battery of cognitive tests
- on road driving assessment on Nottingham Neurological Driving Assessment instructor blind to results of cognitive assessment

Cognitive Tests

- Stroke Drivers Screening Assessment (SDSA)
- Mini Mental State Examination
- Salford Objective Recognition Test
- Stroop Colour Word Test (Victoria version: Strauss et al, 2006)
- BADS Key Search and Rule Shift
- TEA elevator counting & telephone search
- VOSP Incomplete Letters and Cube Analysis
- AMIPB Information Processing
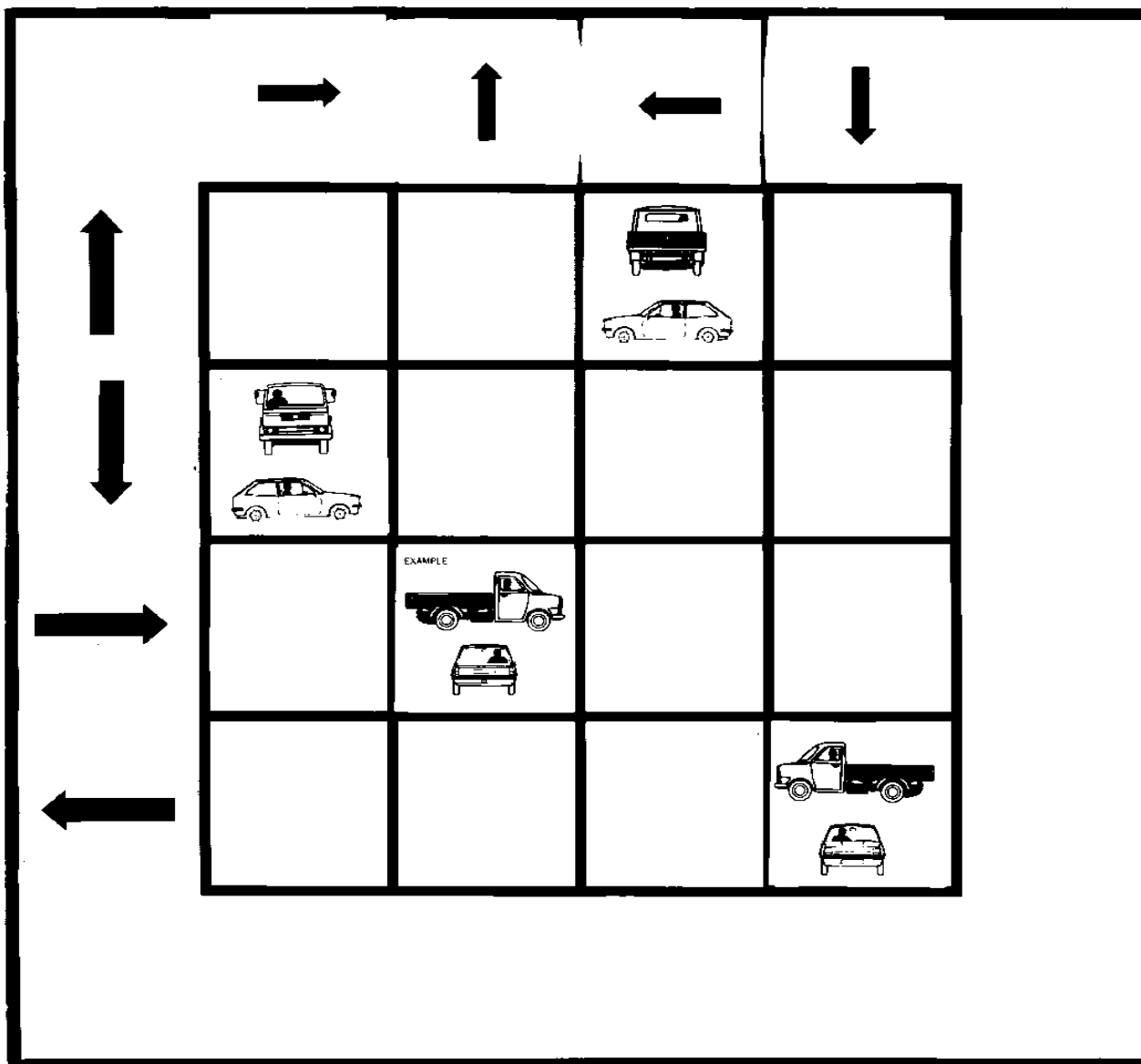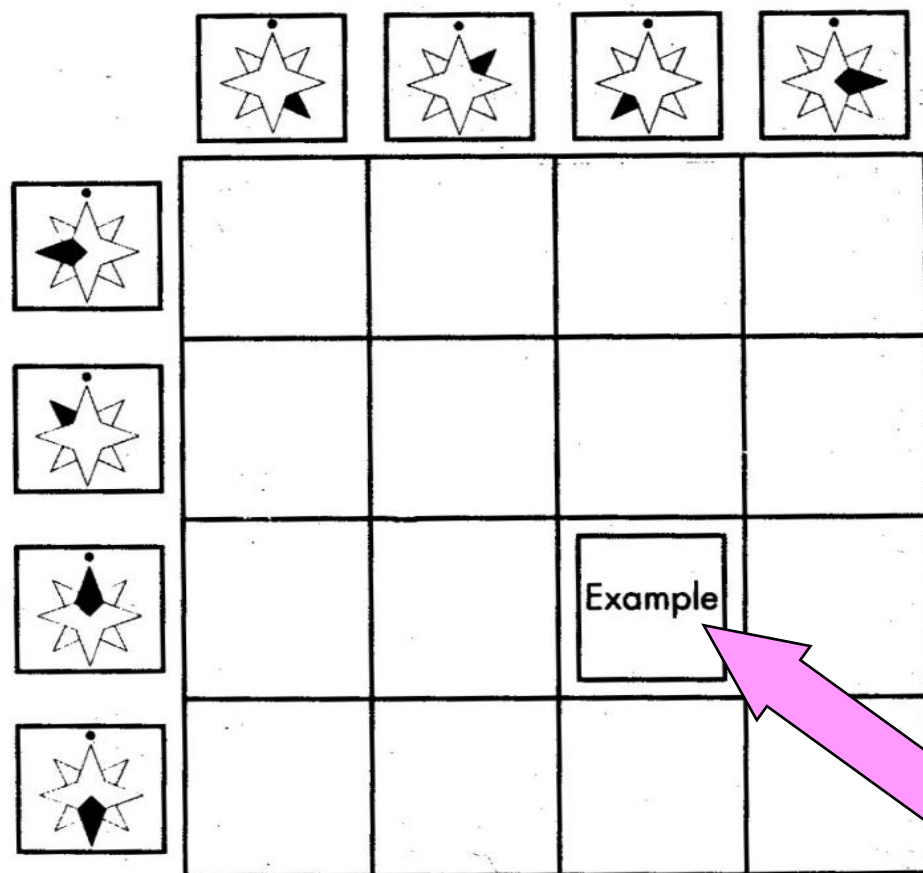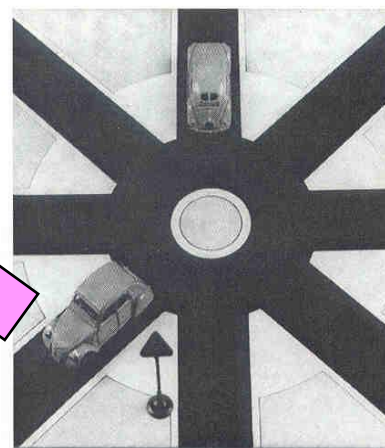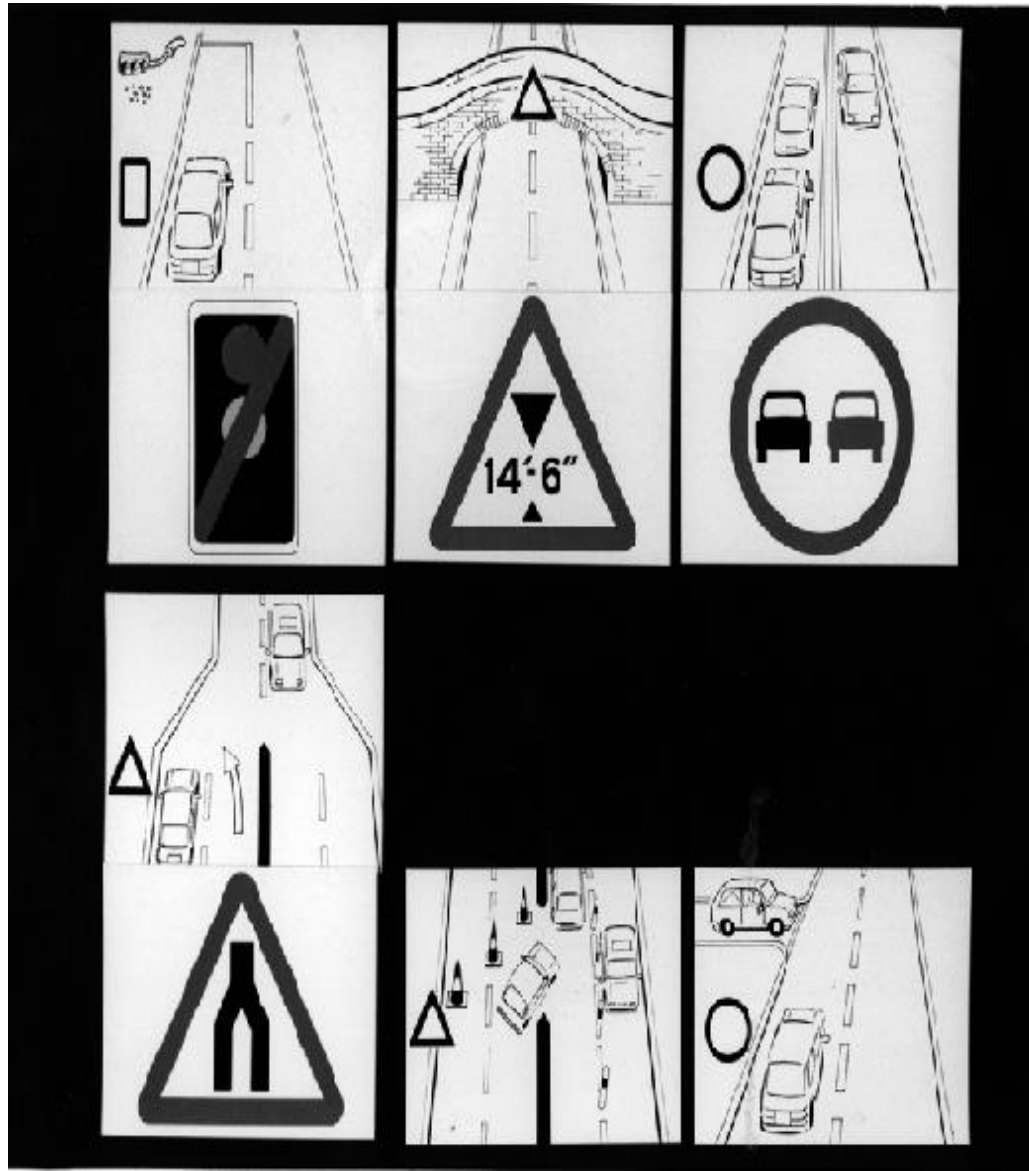- Balloons Test

SDSA Dot cancellation
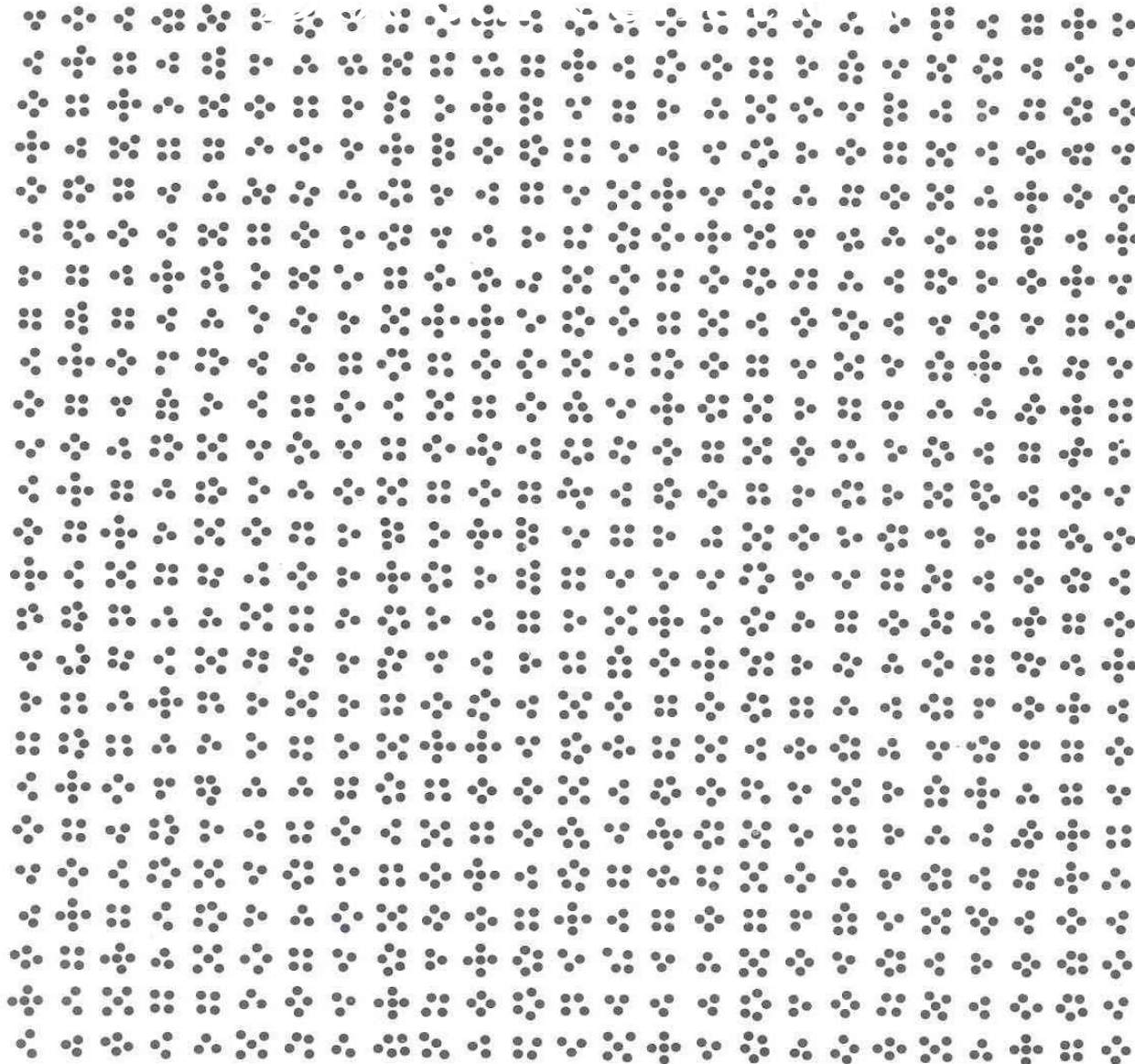
Square Matrices Compass Cards

Road Sign Recognition Test

Nottingham Neurological Driving Assessment

- Starting Precautions
- Moving off
- Observation at Side Junctions
- Observations to rear
- Use of Signals
- Positioning on Road
- Cornering
- Braking Accelerating
- Overtaking
- Driving in Traffic Lanes
- Passing Static Vehicles
- Merging with Traffic Stream
- Anticipation of Pedestrian Behaviour
- Anticipation of Beh. of others
- Use of Speed
- Obedience of Road Signs
- Emergency stop
- Reversing
- Parking
- Turning Right
- Following too close

- **Classified**
  - **Definitely Safe**
  - **Probably Safe**
  - **Probably Unsafe**
  - **Definitely Unsafe**

Driving Assessor blind to the results of the cognitive assessment

Safe vs. Unsafe Drivers with Dementia

- No significant difference on individual cognitive tests
  - Except TEA telephone search p<0.008
  - Trend on Road Sign Recognition p=0.07
- Combination of tests?

$\rightarrow$ discriminant function analysis

Discriminant function analysis

	Predicted Group	
	Fail	Pass
Fail	9	1
Pass	2	25
Accuracy 92%, PPV 82%, Sensitivity 90%		

Misclassification

- Positioning problems on the road
  - Not detected by cognitive test battery
- Professional drivers
  - Performed better than predicted from cognitive testing

Validation Study

RESEARCH ARTICLE

International Journal of **Geriatric Psychiatry**

A prospective study of cognitive tests to predict performance on a standardised road test in people with dementia

Nadina B. Lincoln[1], Jenny L. Taylor[1], Kristina Vella[1], Walter P. Bouman[2] and Kathryn A. Radford[1]

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Objective: Previous work by Lincoln and colleagues produced a cognitive test battery for predicting safety to drive in people with dementia. The aim was to check the accuracy of this battery and assess whether it could be improved by shortening it, including additional cognitive tests, and a measure of previous driving.

Methods: Participants with dementia, who were driving, were recruited. They were assessed on cognitive tests including measures of concentration, executive function, visuospatial perception, verbal recognition memory, and speed of information processing. Patients were then assessed on the Nottingham Neurological Driving Assessment (NNDA) by an approved driving instructor (ADI), blind to cognitive test results.

Results: Seventy-five patients were recruited and completed the cognitive tests. Of these, 65 were assessed on the road. These participants were aged 59–88 (mean = 75.2, SD = 6.8) and 49 were men. Time driving varied from 19 to 73 years (mean = 52.5, SD = 10.0). Thirteen participants were unsafe and 52 safe to drive. Using a cut-off of > 0 to indicate safety to drive, the original predictive equations correctly classified 48 (76.2%) of 63 participants with complete data. Logistic regression including additional tests
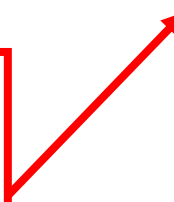
Was the old equation predictive?

- Yes: 76.2% correctly classified

Predicted group membership (cognitive tests)

		Unsafe	Safe
Road	Pass	**5**	**40**
Assessment	Fail	**8**	10

These individuals are actually unsafe, but would have been missed by the equation

Overall predictive ability for safe drivers

- Sensitivity 8/18 = 44.4%

- Specificity 40/45 = 88.8%

- PPV for unsafe drivers 62%

- If they score as 'safe' they probably are safe, if they 'fail' they need a road test.

- ROC curves: cut off 0.224 – increased accuracy

Who did the equation misclassify?

a) Actually **safe**, but predicted to be **unsafe** (n=10)

- 6 were 'probably safe', not 'definitely safe' therefore borderline?
- 2 had advanced driving experience: overlearned driving skills? Less susceptible to decline?

b) Actually **unsafe**, but predicted to be **safe** (n=4)

- 1 Rated as "probably unsafe": possibly borderline and similar to "probably safe" in daily driving
- 1 Only driving for 19 years: skills more susceptible to decline?
- 1 Often drove an automatic car (whilst in Hungary) but tested in manual which drives in UK
- 1 Taking anti-depressants and hypnotics, both proven to hinder driving

Practical Application

Diagnosed with dementia/licence for review

Cognitive Screening Assessment

Score more than 0.224

Score less than 0.224

Continue driving

Referred for on-road assessment at Regional Mobility Centre

What is the NADD?

- The Nottingham Assessment for Drivers with Dementia is a shortened version of the Dementia Drivers Screening Assessment (Lincoln et al, 2006)

The Nottingham Assessment for drivers with dementia (NADD)

Research

A shortened version of the Dementia Drivers' Screening Assessment

Nadina Lincoln, Kate Radford

Introduction: Cognitive tests are used to inform recommendations about the safety of people with dementia to continue driving. The Dementia Drivers' Screening Assessment (DDSA) is a neuropsychological battery designed to assist in this process. However, it is lengthy to administer and requires materials from various test batteries.

Aims: The primary aim of this study was to develop a shortened version of the DDSA for individuals with dementia.

Methods: Data on participants with dementia from two studies were analysed. These participants were all drivers with dementia who were identified by community mental health teams and psychiatrists. Each participant was assessed on the DDSA and also assessed on-road by an 'approved driving instructor' using the Nottingham Neurological Driving Assessment.

Results: This study analysed 102 participants, who had a mean age of 74.0 (SD=7.7) years and of whom 80 (78%) were men. Twenty three drivers were judged to be unsafe and 79 safe. The agreement between the short version and on-road assessment was 79%. The assessment was better at detecting safe drivers than unsafe drivers.

Conclusion: The findings suggested that the shortened DDSA is suitable for participants who are unable or do not wish to undergo lengthier assessment.

Method

- Anonymised data from two previous studies (2006, 2010)
- 102 drivers (mean 74.0 (SD 7.7, range 52-88 years))
- diagnosed with dementia by treating clinician, no other medical diagnosis (e.g. stroke) that could affect driving
  - driven in the last 5 years, valid drivers licence
  - living within 100 mile radius of recruitment centre
- Cognitive Assessments - same battery of tests
- Tested on road using Nottingham Neurological Driving Assessment (Lincoln et al, 2012)
- Discriminant analysis

Results

		On-road Assessment		
		Fail	Pass	
Nottingham Assessment for Drivers with Dementia	**Fail**	7	5	**79 % agreement** **Sensitivity for fail 30%** **Specificity 94%** **Positive predictive value 58%** **Negative predictive value 82%**
	Pass	16	74	
		23	79	

SORT Test

AMIPB-IA-A

STROOP Test

STROKE DRIVER
- screening assessment -

NADD

Conclusions

- Cognitive tests discriminated between participants with dementia and those without
- MMSE alone not predictive of on road driving
- A predictive equation was developed, which correctly classified 92% of drivers with dementia
- Further validated and correctly classified 76.2%
- Shortened (NADD) correctly classified 79% but is better at predicting safe drivers
- Cut-off values (using ROC curves) could not be identified for individual tests, with sufficient accuracy to be used to predict safety to drive
- NADD is suitable for patients unable or unwilling to undergo lengthier assessment (takes 1/3 time) but better at detecting safe drivers than unsafe drivers so refer those who fail for on road evaluation

Rookwood Driving Battery
McKenna, 2009

Rookwood Driving Battery (RDB)

12 tests of visual perception, executive and praxis skills

- Developed in the context of a specialist driving assessment centre.

- People (n= 543) with a range of neurological conditions, including dementia (n= 53), assessed on a battery of cognitive tests.

- Performance on tests compared with the overall decision by the centre on participants' fitness to drive.

Cut-off scores for predicting people who are unsafe to drive.

For the sample as whole, a cut-off of >10 recommended
For people over 70 years a cut-off of > 6.

(McKenna, Jefferies, Dobson, & Frude,2004; McKenna & Bell, 2007)

- **Shape perception and visuospatial abilities**: Visual Object and Space Perception (VOSP; Warrington & James, 1991) Incomplete Letters, Position Discrimination and Cube Analysis subtests.

- **Divided Attention:** Letter Cancellation, in which participants are required to cancel Es and Fs in an array of letters with a distractor task (threes)

- **Abstract thinking**: Weigl Sorting Task (Goldstein & Scheerer, 1941)

- **Executive function**: Behavioural Assessment of the Dysexecutive Syndrome (Wilson et al, 1996): Key Search, Action Programme and the Rule Shift Cards.

- **Praxis:** Copying hand movements, Gestures and Use of Objects subtests, involving the miming the use of an object, and copying gestures and hand-movements.

- **Rule-bound praxis:** Tapping and Sequencing.

- **Ability to follow instructions:** Modified Token Test (Coughlan & Warrington, 1978), a shortened version with eight instructions

Strengths

- Available to purchase as a test battery, administration and scoring procedures are straightforward
- Therapists already familiar with some of the tests
- Good for use in driving centres as data generated on that population
- Using cut of of > 6 positive predictive value 78%, ability to detect unsafe drivers (sensitivity) was 66% and safe drivers (specificity) 73%.

Limitations

- In the validation sample only 10% participants with dementia.
- Overall decision about safety to drive informed by the results of the cognitive test (not an independent judgement).
- Using cut of of >10 ability to detect unsafe drivers only 54%.
- ? How representative are the findings for patients in memory clinics?

How do the NADD and the Rookwood compare?

Comparison of assessments of fitness to drive for people with dementia

Kristina Vella[1] and Nadina B. Lincoln[2]

Aim

- to assess concordance between the classifications (pass/fail) of the RDB and DDSA in people with dementia

- to compare any discordant classifications against on-road driving ability

Method

- Pw dementia identified by community mental health teams and psychiatrists.

- Each participant was assessed on the RDB and DDSA in an order determined by random allocation.

- Those with discrepant results also had an on-road assessment.

- Twenty four participants were recruited. The mean age was 74.1 (SD 8.9) years and 18 (75%) were men.

Classification of drivers

		Rookwood Battery			Agreement
		Fail	**Pass**		**Agreement**
		Score >10	Score 0-10		
DDSA	Fail Pass	3 5	1 15		Kappa =.36 P=.05 75% agreement
		Score >6	Score 0-6		
DDSA	Fail Pass	4 11	0 9		Kappa =.21 P=.09 54% agreement
		Score >10	Score 0-10		
NADD	Fail Pass	3 5	0 16		Kappa =.44 P=.009 83% agreement
		Score >6	Score 0-6		
NADD	Fail Pass	3 12	0 9		Kappa =.16 P=.15 50% agreement

Conclusion

- Those who fail the RDB are likely to be unsafe on the road but not all unsafe drivers will be detected and some safe drivers will be precluded.

- The DDSA is better at identifying safe drivers than unsafe drivers. Therefore anyone failing the DDSA should be assessed on the road.

- An RDB cut-off score of >10 = more consistent with the DDSA and NADD

Overall Summary

- Individual cognitive tests useful for identifying problems in specific domains e.g. executive function/ attention that are important for driving but shouldn't be used to make decisions
- In dementia many cognitive domains tend to be affected which complicates assessment of fitness-to-drive - need a battery of tests.
- Unlikely that any one test battery will ever be 100% accurate (80% accuracy is very good!)
- Understanding a test's development and limitations are important for interpreting scores in clinical practice. - Clinical assessment helps to interpret scores
- NADD useful for screening in memory clinics to identify who needs on road assessment
- Rookwood developed using driving assessment centre populations. Lacks sensitivity for detecting unsafe drivers using >10 cut off, further research on >6 cut off needed
- **Cognitive test batteries useful for identifying who needs an on road driving test.**

Thankyou!

Further Information
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NADD Manual
http://www.nottingham.ac.uk/medicine/about/rehabilitationageing/publishedassessments.aspx

Summary

What to do – fulfilling DVLA and Clinical Guidelines

- Ask the driving question
- Identify absolute bars to driving, e.g. epilepsy, visual field loss, hemianopia, poor visual acuity
- Remind the patient of their responsibility to inform the DVLA if their condition is likely to affect their ability to drive safely.
- Screen for cognitive impairments following diagnosis, every 12 months thereafter or when concerns raised.
- Refer for more detailed assessments e.g. vision, cognition and/or on road assessment at a specialist driving assessment centre where appropriate

Screening for Fitness-to-Drive in People with Cognitive Impairment

The University of Nottingham

STROKE

Mild Cognitive Impairment

Dementia

SDSA/NADD
Cognitive Screening for Fitness-to-Drive

PASS

FAIL

If early after diagnosis/stroke

Repeat Assessment
After 3-4 months

FIT-TO-DRIVE
Advise Medical
Practitioner

FAIL

UNFIT-TO-DRIVE
- Advise Medical Practitioner
- Seek further evaluation
- Inform licencing authority

**More detailed assessment (psychological/ medical / visual) and /or
On-Road Assessment at
SPECIALIST DRIVING ASSESSMENT Centre**

Periodic review and repeat assessment
in people with deteriorating conditions

Why screen for fitness to drive?

– To identify who needs further assessment at a specialist driving assessment centre

– To introduce some form of screening into procedures where currently none exists

– To inform more comprehensive assessment

– Moral and legal obligation

– Clinical directive e.g. Guidelines

So that;

– decisions are based on criteria related to driving competence
  • Increased objectivity
  • Reduce family burden

– Safe drivers enjoy the privileges of driving a car

– Unsafe drivers are identified (prior to accident or injury)

Where to obtain the tests

Stroke Drivers Screening Assessment

- The UK version of the assessment is priced at £100, and the US version is available for £150.
- **Email: Professor Nadina Lincoln nadina.lincoln@nottingham.ac.uk**

   REVISED MANUAL:
   http://www.nottingham.ac.uk/medicine/documents/publishedassessments/sdsa-manual-2012-uk.pdf

Trail Making Test

- **Delis-Kaplan Executive Function System™ (D-KEFS™)**

- **University of IOWA**
   - http://www.healthcare.uiowa.edu/igec/tools/cognitive/trailMaking.pdf
   - http://www.nhtsa.gov/people/injury/olddrive/OlderDriversBook/pages/Trail-Making.html
- **Different versions – Caution!**

Finding out more about cognitive tests for use in stroke:

- http://strokengine.ca/assess/module_tmt_psycho-en.html

Useful dementia resources

- **RICA. Older drivers - Driving safely for life**
  - http://www.rica.org.uk/content/older-drivers-driving-safely-life

- **Motability**
  - http://www.motability.co.uk/

- **The older Drivers Forum**
  - https://olderdriversforum.com/

- **Family Conversations with Older Drivers**
- https://www.thehartford.com/resources/mature-market-excellence/family-conversations-with-older-drivers

- **Automobile Association – older drivers**
  - http://www.theaa.com/public_affairs/reports/older-drivers.html

- **Alzheimer's Society Driving and Dementia Factsheet**
https://www.alzheimers.org.uk/site/scripts/download_info.php?fileID=1780

- **Newcastle Driving and Dementia Pathway**
http://eprint.ncl.ac.uk/file_store/production/205804/832ABB0E-4F77-44C4-83DC-EEF51111929A.pdf
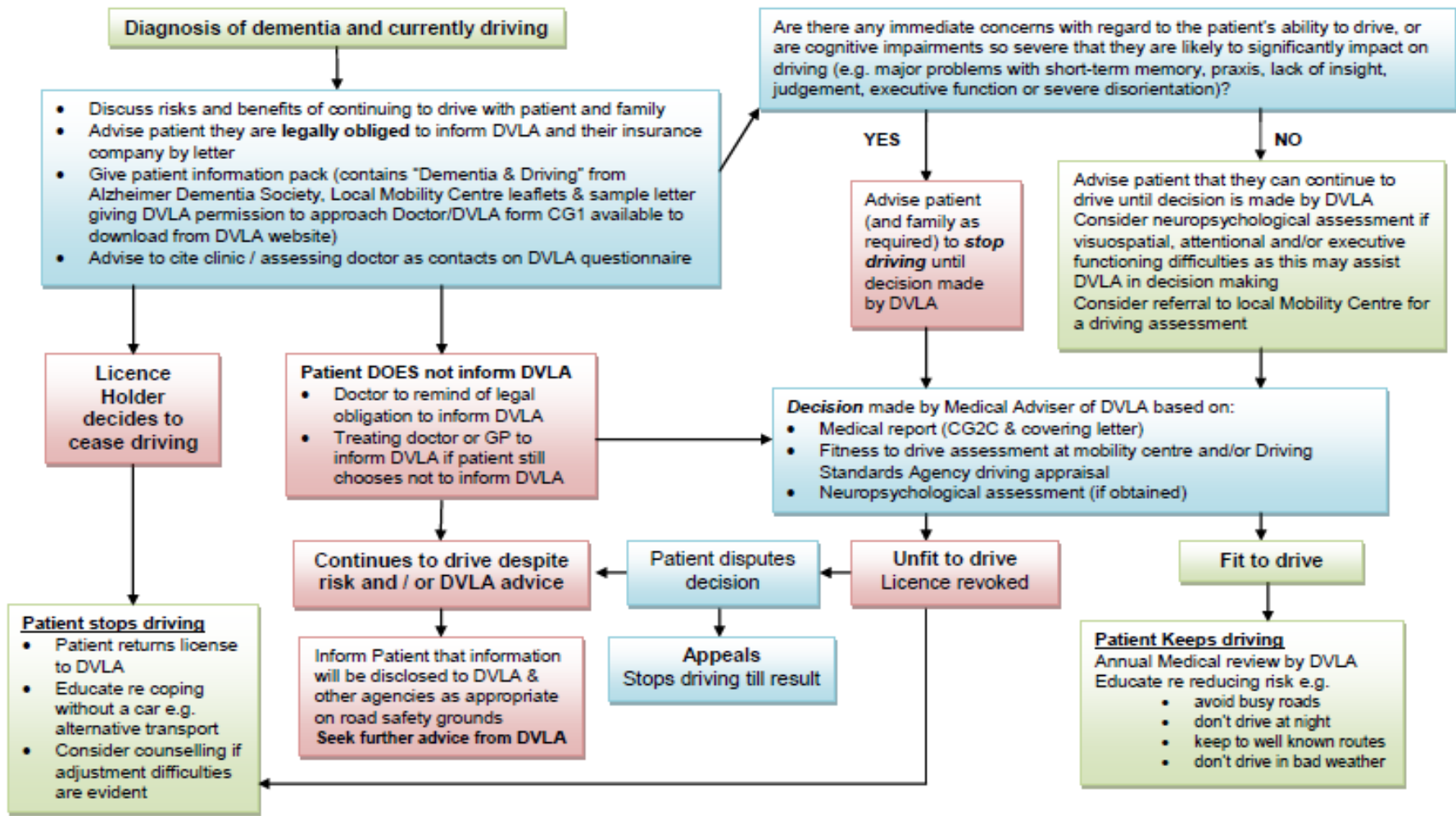
Other Useful resources

- **Confidentiality and a Service User's Fitness to Drive, BAOT/COT Briefings**

- **At a Glance Guide to the Medical aspects of fitness to drive** *www.dft.gov.uk/dvla/medical/**ataglance**.aspx*

- Forum of Regional Mobility Centres
    http://www.mobility-centres.org.uk/find_a_centre/

- **Fitness-to-Drive: Assisting clinical decision making for Occupational Therapists**
    – https://fitnesstodrive.com/

Newcastle Driving and Dementia Pathway

The University of Nottingham

Driving Pathway for Patients with Dementia© 2013 Newcastle University

Document in clinical notes / computerised records:
- Car driving status
- Discussions pre-assessment
- Concerns from patient or family

Diagnosis of dementia and currently driving

- Discuss risks and benefits of continuing to drive with patient and family
- Advise patient they are **legally obliged** to inform DVLA and their insurance company by letter
- Give patient information pack (contains "Dementia & Driving" from Alzheimer Dementia Society, Local Mobility Centre leaflets & sample letter giving DVLA permission to approach Doctor/DVLA form CG1 available to download from DVLA website)
- Advise to cite clinic / assessing doctor as contacts on DVLA questionnaire

Are there any immediate concerns with regard to the patient's ability to drive, or are cognitive impairments so severe that they are likely to significantly impact on driving (e.g. major problems with short-term memory, praxis, lack of insight, judgement, executive function or severe disorientation)?

YES

Advise patient (and family as required) to *stop driving* until decision made by DVLA

NO

Advise patient that they can continue to drive until decision is made by DVLA
Consider neuropsychological assessment if visuospatial, attentional and/or executive functioning difficulties as this may assist DVLA in decision making
Consider referral to local Mobility Centre for a driving assessment

Licence Holder decides to cease driving

Patient DOES not inform DVLA
- Doctor to remind of legal obligation to inform DVLA
- Treating doctor or GP to inform DVLA if patient still chooses not to inform DVLA

***Decision** made by Medical Adviser of DVLA based on:*
- Medical report (CG2C & covering letter)
- Fitness to drive assessment at mobility centre and/or Driving Standards Agency driving appraisal
- Neuropsychological assessment (if obtained)

Continues to drive despite risk and / or DVLA advice

Patient disputes decision

Unfit to drive Licence revoked

Fit to drive

Patient stops driving
- Patient returns license to DVLA
- Educate re coping without a car e.g. alternative transport
- Consider counselling if adjustment difficulties are evident

Inform Patient that information will be disclosed to DVLA & other agencies as appropriate on road safety grounds
Seek further advice from DVLA

Appeals
Stops driving till result

Patient Keeps driving
Annual Medical review by DVLA
Educate re reducing risk e.g.
- avoid busy roads
- don't drive at night
- keep to well known routes
- don't drive in bad weather

References to SDSA and NADD development

- Lincoln NB, Fanthome Y. Reliability of the Stroke Drivers Screening Assessment. Clinical Rehabilitation 1994; 8:157-160.
- Lincoln NB, Radford KA, Lee E and Reay AC. The assessment of fitness to drive in people with dementia. International Journal of Geriatric Psychiatry 2006; 21: 1–8.
- Lincoln NB & Radford KA, A shortened version of the Dementia Drivers Screening Assessment, International Journal of Therapy and Rehabilitation, 2014, 21(6), 268-273
- Lincoln NB, Taylor JL, Vella K, Bouman WP & Radford KA. A prospective study of cognitive tests to predict performance on a standardized road test in people with dementia. International Journal of Geriatric Psychiatry. 2009; 25; 489-496.
- Nouri FM Driving after Stroke PhD Thesis University of Nottingham 1991.
- Nouri FM, Lincoln NB. Validation of a cognitive assessment predictive driving performance after stroke. Clinical Rehabilitation. 1992;6:275-281.
- Nouri FM, Lincoln NB. Predicting driving performance after stroke. British Medical Journal 1993; 307:482-483.
- Nouri FM, Tinson D, Lincoln NB. Cognitive ability and driving after stroke. International Disability Studies 1987; 9: 110-115.
- Radford KA Validation of the Stroke Drivers Screening Assessment for patients with an acquired neurological disability (2000) University of Nottingham, PhD Thesis.
- Radford KA, Lincoln NB Concurrent validity of the Stroke Drivers Screening Assessment. Archives of Physical Medicine and Rehabilitation 2004; 85:324–8.

What else might you use?

- Global Screens

- Individual Tests? E.g. Clock drawing or Trail Making Test?

- The Rookwood battery?

Global Screens

Montreal Cognitive Assessment (MOCA)

Esser P, Dent S, Jones C, et al. J Neurol Neurosurg Psychiatry 2016;87:567–568.

135 people with neurological conditions , five groups (Brain injury, dementia, stroke, PD, MS), referred from various settings and assessed on the road.
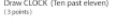
81 passed on road (MOCA 23.8 range 12-30); 54 failed (MOCA 17.4 range 4-28)

Sensitivity 44%, specificity 94% - using ≥26 MOCA = normal

- MOCA <12 accurate (100%) in picking up fails but not specific to picking up passes (16.7%) and

- MOCA >27 not accurate (4.9%) in picking up fails, but specific to picking up passes (100%).

- **More detailed screening on those scoring between 12-27 or refer for on road assessment!**

Individual tests

Clock drawing –In combination with the **Snellgrove Maze Test** *or* **Trail Making Test Part A** and the **Interview to differentiate Ageing and Dementia** (AD-8). 84% accuracy and positive predictive value of 63%

Carr et al J AM GERIATR SOC 59:2112–2117, 2011.
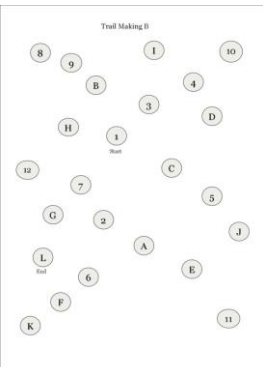
TMT A - Predictive of simulator driving ability using a cut-off score of 5/7 to predict safe driving but this was not supported in relation to on-road driving ability. Freund et al, 2005 J GEN INTERN MED 2005; 20:240–244.

TMT B - A cut off score of <3 minutes is suggested as indicating a safe driver (negative predictive value 88%), but those who score more than 3 minutes should be assessed on the road. The test is better at detecting those who are safe to drive than those who are unsafe.

Roy et al, CANADIAN GERIATRICS JOURNAL, VOLUME 16, ISSUE 3, SEPTEMBER 2013

TMT-A and-B outcomes inaccurate in those whose driving competency has declined to an unsafe level.

Receiver operating characteristic (ROC) curve analysis was used to assess overall 'diagnostic' accuracy of TMT-A and -B for driving competency. Cut points from previous studies/guidelines were used to assess predictive power. Dobbs and Shergill 2013, Age and Ageing 2013; 0: 1–5