MS Drivers

Screening Assessment

Revised Manual

2017

NB Lincoln & KA Radford

University of Nottingham

Introduction

The Multiple Sclerosis Drivers Screening Assessment (MSDSA) was developed as part of a research programme on assessing fitness to drive in people with neurological conditions (Radford,2000). In the development, people with who were being assessed at a regional mobility centre were given a battery of cognitive tests and tested on the road by a professional driving instructor. Discriminant function analysis was used to identify those tests that best predicted driving performance on the road (Radford, 2000). It was found that predictions could be improved if different tests were used according to the neurological condition. A battery of tests was identified for predicting fitness to drive in people with multiple sclerosis (MS) (Lincoln & Radford, 2008). These tests were compiled together as the MS Drivers Screening Assessment (MSDSA).

The MSDSA was designed to be used as a screening tool for identifying cognitive problems, which may affect a person's fitness to drive. The MSDSA is usually administered to people with MS who are currently driving but showing decline in cognitive abilities. It was designed to identify those who needed on road assessment. It should be used to inform the decision-making process, in conjunction with assessment of motor abilities and visual functions.

Test Administration

The tests are administered in a quiet room with the client seated at a table. If possible, the assessor sits at 90 degrees to the client. Tests are administered in the order given and if possible should all be administered in a single session. In the validation studies the SDSA was always administered in one session. However if the test has to be administered over two sessions, for reasons other than fatigue or poor concentration, the results are still likely to be valid. If the patient requires two sessions because of fatigue or poor concentration, their driving will probably also be affected by these factors. It would not be sensible to give patients with fatigue and concentration problems rests between MSDSA tasks, as this would artificially raise their level of performance and not reflect the fatigue and concentration difficulties.

No feedback about performance is given until the end of the session. People are encouraged to persevere by giving non–specific feedback, such as 'that's fine'. The testing session can be introduced with an explanation that the tasks have been found to indicate whether people who have MS are likely to encounter problems when driving. For example:

"*Some people have problems with concentration and reasoning as a result of multiple sclerosis. These may affect their ability to drive a car. Some of the tasks will be easy and some more difficult. We wish to identify whether you have any problems as a result of your MS, which may affect your ability to drive a car."*

For each test standard instructions are provided. These may be repeated once if the client seems not to understand or has difficulty remembering what he/she is required to do. No additional information may be given. If the client asks for further instructions a phrase such as *"I am not able to give you any more information"* or *"Do what you think is right"* should be used. The instructions were intentionally kept short so that minimal language comprehension would be required. In all the validation studies the instructions used have been those provided in the manual. Any deviation from these may affect the scores obtained and therefore the predictive validity of the test. Gestures are used to supplement the verbal instructions. These are intended to help those with communication problems, but should be used for all clients.

Two tests are part of the Stroke Drivers Screening Assessment (SDSA) (Lincoln, Radford and Nouri, 2016) and two tests are from the Adult memory and Information processing Battery (AMIPB) (Coughlan and Hollows, 1985).

SDSA Dot Cancellation

Equipment

Photocopy of SDSA Dot cancellation master, pen and timer. A felt pen is easy for clients to use and easier to mark than a pencil or biro.

Method

Place the photocopied dot cancellation sheet on the table centrally in front of the client. Explain the test as follows:
"*You will see that there are groups of dots arranged in rows. Some of the groups have 3 dots, some 4 and some 5 dots* (indicate examples on the practice row). *I want you to cross out every group of 4 dots*."

"I want you to complete the first row as a practice."

If the client is unsure what to do cross out the first set of 4 dots as an example and then ask the client to continue with the practice row. Check the practice row. If the client makes any errors point them out, by saying for example *"you have missed a set of 4 dots here"* or *"you have crossed out a group of 3 dots but the task is to cross out all the groups of 4 dots".*

Then say
"The task is timed but it is more important to be accurate than fast. Start when you are ready".
Start the timer as soon as the client starts to attempt the task.

If the client seems to have forgotten the instructions or requests a repetition, the instructions can be repeated once using the same wording as given at the beginning of the task. After that no further explanation should be given.

Time Limit

15 minutes.

If the client has not completed the task after 15 minutes has elapsed, indicate that the task is complete by a phrase such as

"That's fine, you have done enough now and can stop".

If the client continues beyond the time limit, despite being asked to stop working, note the point reached at the time limit and mark on the score sheet afterwards. However it is reasonable to allow a client to finish the task if very close to the end but to record the point reached at the 15-minute time limit and score as if the client had been stopped at that point.

It may be necessary to stop the paper slipping while the client is writing. A sheet of non-slip mat can be used. Also, a wide pen or a sponge cuff on the pen may be helpful.

Score

Record the following on the Summary Score Sheet

The time taken to complete the task (except the practice row) in seconds. If the client did not complete the task in the time limit, the time taken is recorded as 900 seconds.

The number of groups of 4 dots not crossed out (errors). This score is not included in the predictive equation.

The number of groups of 3 and 5 dots cancelled in error (false positives).

An item is scored if a pencil/pen mark goes through some point of the group of dots. So for example if the client just marks one dot in a group of 4, this would count as having crossed out the group. Similarly if a client scribbles across the pages, all those groups crossed through by chance would count in the score even though the client was not performing the task of crossing out groups of dots.

It may be useful to create a scoring template by photocopying the master sheet on to a transparent acetate sheet and marking the correct answers. A version of this is available on our website.

SDSA Road Sign Recognition

Equipment

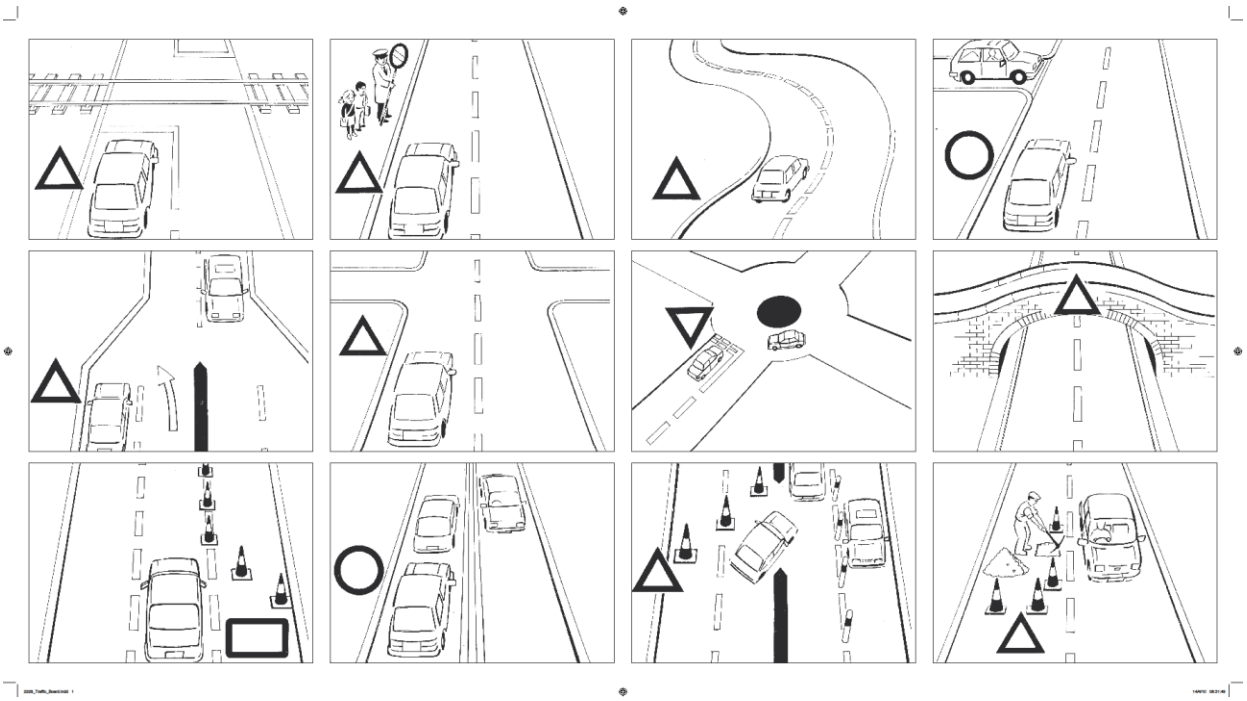
SDSA Road situations board, road situation practice card, road sign cards and timer.

If the road situations board will not lie flat, bend and flex the board several times so that it will.

Method

Place the road situation grid in front of the client as shown in Fig 3. Place the practice road situation (broken traffic lights) card to one side of the grid. The order of presentation of the road sign recognition cards was not standardised in the original validation and therefore has not been specified. Spread the road signs below the road situation grid.

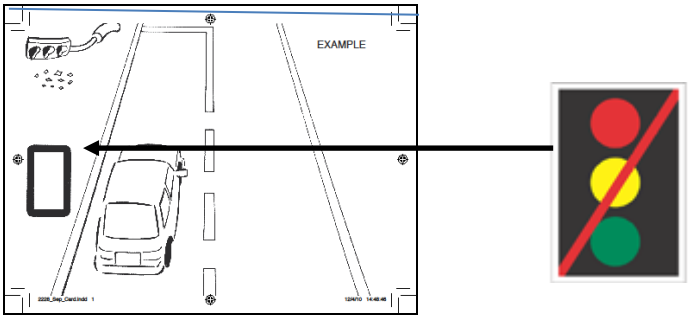
Fig 3 Road Sign Recognition Layout



Explain the test as follows:

"I would like you to put each road sign on the picture of the road situation which it matches best. This card shows a broken traffic light (point to the example road situation card*). The sign which best matches this situation is the one indicating a traffic light out of action* (pick out the broken traffic light road sign). *So this sign*

(broken traffic light) *goes with this picture.* (Place the broken traffic light road sign on the example card and move to one side). *Now you do the rest."* Put the example card with the example sign on top of it to one side.



Begin timing. Score the responses when the client indicates he/she has finished.

If the client seems to have forgotten the instructions or requests a repetition, the instructions can be repeated once using the same wording as given at the beginning of the task. After that no further explanation should be given.

Time limit

3 minutes

If the client has not completed the task after 3 minutes have elapsed, stop the client using a phrase such as *"That's fine, you have done enough now and can stop".*

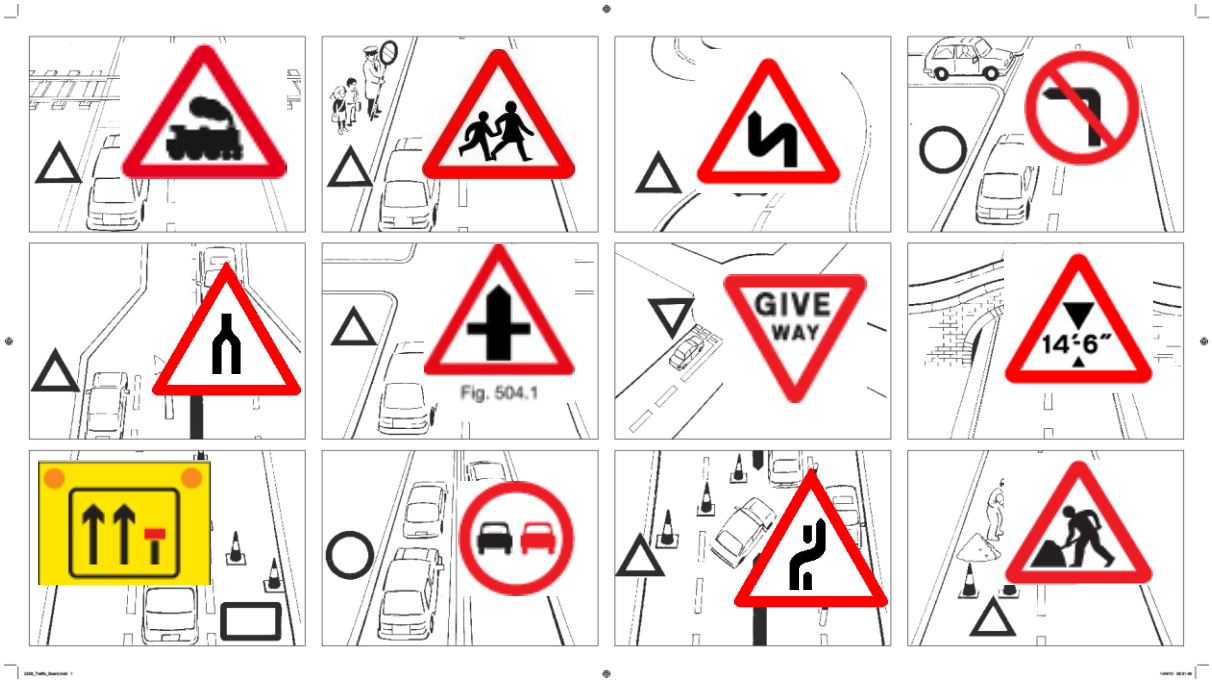
If the client continues beyond the time limit, despite being asked to stop working, note the score obtained at the time limit.

Score

One point for each sign correctly matched. The example is not included in the score. If the client puts several cards in a pile, score only the top card on the pile. Maximum score 12 points.

The correct answers are shown in Figure 4.

Fig 4. Road Sign Recognition Test Correct Signs



Transfer the score to the Summary Score Sheet

AMIPB Task B

Equipment

Copy of AMIPB test sheet with demonstration items and motor speed task. Copy of AMIPB information processing B task.

Method

The client is required to work through a list of items. Each item comprises a four-digit number, a hyphen and a five-digit number e.g. 4127-71624. The five-digit number contains all the digits of the four-digit number plus a new digit. The client is required to cancel out the new digit in each item. A test of the client's motor speed is also included.

a) Information Processing

Show the client the demonstration items. Explain and demonstrate using the first five items that the client is required to strike out (with a single dash or stroke) the new digit in the number on the right of the hyphen. Allow the client to practice on the second five items and check that he/she has grasped the task.

Present the client with the test sheet and say:

'Now I would like you to work through these, striking out the new number each time. Work down the page and go as fast as you can until I tell you to stop. I'll give you a few minutes. Off you go.'

Allow four minutes. Note the time if the client completes all 105 items in under four minutes and prorate the score for four minutes.

b) Motor Speed

Show the client the motor speed test sheet. Say:
'This is a test of speed. I'd like you to strike out each of these figures as quickly as you can. (Demonstrate on the items provided).Work down the page and go as fast as you can until I tell you to stop. I'll only give you a few seconds. Off you go'.

Allow 20 seconds. If the client appear to slacken, remind him/her to go as fast as possible.

AMIPB

INFORMATION PROCESSING B FORM 1

NAME ______________________ DATE ______________

AGE ________ DOB ______________________ REF. NO. ______________

Demonstration

3 1 - 1 3 9

2 7 5 - 5 8 7 2

5 2 1 6 - 6 1 4 2 5

3 7 9 9 - 5 9 7 3 9

2 6 9 5 - 1 2 5 6 9

1 4 4 8 - 8 4 0 4 1

5 0 2 7 - 2 0 7 3 5

6 9 8 1 - 4 8 1 6 9

7 2 1 6 - 2 6 1 7 8

Demonstration

1 1

1 1

1 1

1 1

1 1

	Score	%ile range
Task B Total	______	______
Errors %	______	______
Speed	______	______
Adjusted	______	______

Motor Speed

11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11
11	11	11

5184 - 13485
2910 - 71092
8024 - 24089
7514 - 76145
5672 - 27356

5238 - 84325
6022 - 20962
4953 - 84953
6597 - 75689
4818 - 18845

5619 - 91625
8723 - 30872
6556 - 64565
1912 - 29113
7024 - 70842

2941 - 17429
2824 - 82124
1309 - 93081
9467 - 57496
5436 - 73546

4157 - 57140
2581 - 86251
8043 - 40893
2218 - 21248
2709 - 74290

9127 - 21794
8352 - 53298
1034 - 30541
5243 - 64253
8979 - 68979

1768 - 67841
4923 - 63942
4594 - 44597
2156 - 51326
3182 - 27831

6316 - 56631
5748 - 38475
1246 - 12964
4926 - 26941
3295 - 59362

6317 - 71643
5418 - 25481
9037 - 70329
4521 - 15642
6459 - 84695

4691 - 96415
3832 - 38213
2527 - 57282
1496 - 16549
9134 - 45193

4005 - 50240
3967 - 72396
1081 - 98011
9261 - 21968
4513 - 37514

3078 - 87430
2972 - 72219
6180 - 67081
1245 - 15342
4126 - 21647

6012 - 20861
9063 - 62390
6572 - 75261
8489 - 88049
3817 - 21783

2716 - 91672
8407 - 83047
9165 - 65192
4756 - 84765
9039 - 36909

5982 - 90852
4176 - 67413
1289 - 92815
6134 - 41763
3519 - 61935

3556 - 52563
8719 - 97148
2478 - 74286
4539 - 95346
7952 - 82795

4683 - 38624
3157 - 47135
7256 - 65270
1964 - 14695
4875 - 45978

1028 - 85021
4695 - 74659
7138 - 83417
5029 - 92560
5814 - 49851

3864 - 46893
6379 - 93867
4920 - 30429
4713 - 13745
9474 - 49417

6719 - 92716
9421 - 12394
1082 - 80162
9354 - 54319
1759 - 13795

7069 - 90762
3518 - 51843
4276 - 36724
7129 - 20917
4518 - 84152

Scores

The scores recorded are:

1. The number of items attempted (Total)
2. The number of items cancelled on the motor speed task (Speed)
3. The cognitive speed score is the number of information processing items that would have been attempted in four minutes if motor speed was not involved. This is labelled Task B Adjusted.

The derivation of the adjusted scores is as follows:

Assuming a constant rate on the speed task it takes 20/speed to cancel one item
The time spent cancelling items on the Information Processing task is therefore (20/Speed) x Total

The amount of time in cognitive processing on the speed of information task in 4 minutes is 4 x 60 - ((20/Speed) x Total)

The number of items processed per second is therefore

Total / (4 x 60 - ((20/Speed) x Total))

In 4 minutes:

$$\frac{\text{Total} \times 4 \times 60}{4 \times 60 - \frac{20 \times \text{Total}}{\text{Speed}}}$$

Therefore the equation for calculating Task B Adjusted is:

$$\frac{12 \times \text{Total} \times \text{Speed}}{(12 \times \text{Speed}) - \text{Total}}$$

Transfer the Adjusted score to the summary sheet.

Alternatively, the tables below can be used to obtain the adjusted score.

Tables for calculation of adjusted score

TASK A TOTAL / TASK B TOTAL

	TOTAL								
	4	8	12	16	20	24	28	32	36
Speed									
4	4	10	16	24	34	48	67	96	144
8	4	9	14	19	25	32	40	48	58
12	4	8	13	18	23	29	35	41	48
16	4	8	13	17	22	27	33	38	44
20	4	8	13	17	22	27	32	37	42
24	4	8	13	17	21	26	31	36	41
28	4	8	12	17	21	26	31	35	40
32	4	8	12	17	21	26	30	35	40
36	4	8	12	17	21	25	30	35	39
40	4	8	12	17	21	25	30	34	39
44	4	8	12	17	21	25	30	34	39
48	4	8	12	16	21	25	29	34	38
52	4	8	12	16	21	25	29	34	38
56	4	8	12	16	21	25	29	34	38
60	4	8	12	16	21	25	29	33	38
64	4	8	12	16	21	25	29	33	38
68	4	8	12	16	21	25	29	33	38
72	4	8	12	16	20	25	29	33	38
76	4	8	12	16	20	25	29	33	37
80	4	8	12	16	20	25	29	33	37
84	4	8	12	16	20	25	29	33	37
88	4	8	12	16	20	25	29	33	37
92	4	8	12	16	20	25	29	33	37
96	4	8	12	16	20	25	29	33	37
100	4	8	12	16	20	24	29	33	37
104	4	8	12	16	20	24	29	33	27
108	4	8	12	16	20	24	29	33	37
112	4	8	12	16	20	24	29	33	37
116	4	8	12	16	20	24	29	33	37
120	4	8	12	16	20	24	29	33	37

Tables for calculation of adjusted score contd.

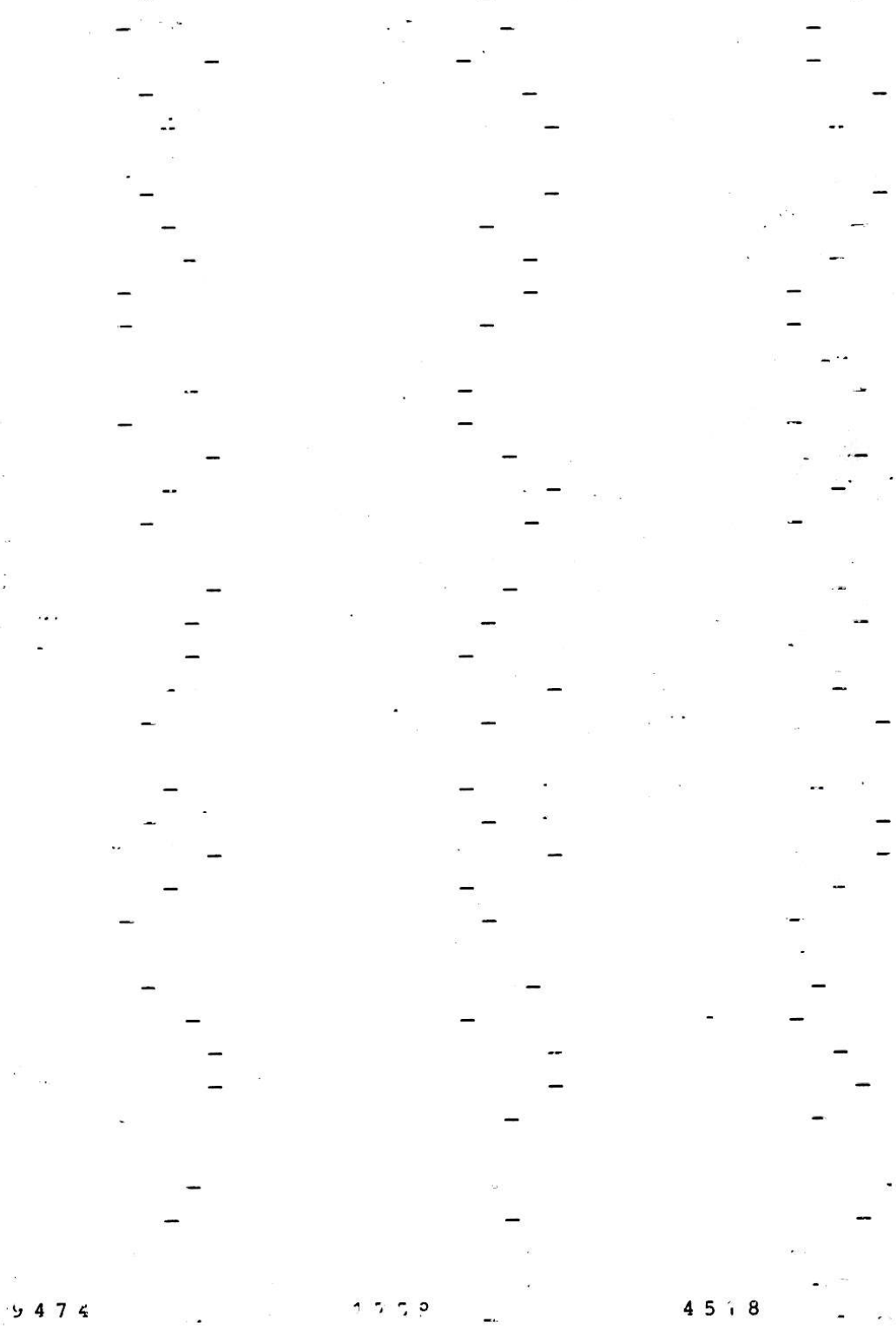
	TOTAL									
	44	48	52	56	60	64	68	72	76	80
Speed										
4										
8	81	96	113	134	160					
12	63	72	81	92	103	115	129	144	161	
16	57	64	71	79	87	96	105	115	126	137
20	54	60	66	73	80	87	95	103	111	120
24	52	58	63	70	76	82	89	96	103	111
28	51	56	62	67	73	79	85	92	98	105
32	50	55	60	66	71	77	83	89	95	101
36	49	54	59	64	70	75	81	86	92	98
40	48	53	58	63	69	74	79	85	90	96
44	48	53	58	63	68	73	78	83	89	94
48	48	52	57	62	67	72	77	82	88	93
52	47	52	57	62	66	71	76	81	87	92
56	47	52	56	61	66	71	76	81	86	91
60	47	51	56	61	65	70	75	80	85	90
64	47	51	56	60	65	70	75	79	84	89
68	46	51	56	60	65	69	74	79	84	89
72	46	51	55	60	64	69	74	79	83	88
76	46	51	55	60	64	69	73	78	83	88
80	46	51	55	59	64	69	73	78	83	87
84	46	50	55	59	64	68	73	78	82	87
88	46	50	55	59	64	68	73	77	82	87
92	46	50	55	59	63	68	72	77	82	86
96	46	50	54	59	63	68	72	77	81	86
100	46	50	54	59	63	68	72	77	81.	86
104	46	50	54	59	63	67	72	76	81	85
108	46	50	54	59	63	67	72	76	81	85
112	45	50	54	58	63	67	72	76	81	85
116	45	50	54	58	63	67	72	76	80	85
120	45	50	54	58	63	67	72	76	80	85

Tables for calculation of adjusted score contd.

	TOTAL									
	84	88	92	96	100	104	108	112	116	120
Speed										
4										
8										1
12										
16	162									
20	129	139	149	160						
24	119	127	135	144	153	163				
28	112	119	127	134	142	151	159	168		
32	108	114	121	128	135	143	150	158	166	
36	104	111	117	123	130	137	144	151	159	166
40	102	108	114	120	126	133	139	146	153	160
44	100	106	111	117	123	130	136	142	149	155
48	98	104	109	115	121	127	133	139	145	152
52	97	102	108	113	119	125	131	137	142	149
56	96	101	107	112	117	123	128	134	140	146
60	95	100	105	111	116	122	127	133	138	144
64	94	99	105	110	115	120	126	131	137	142
68	94	99	104	109	114	119	124	130	135	141
72	93	98	103	108	113	118	123	129	134	139
76	93	97	102	107	112	117	123	128	133	138
80	92	97	102	107	112	117	122	127	132	137
84	92	96	101	106	111	116	121	126	131	136
88	91	96	101	106	110	115	120	125	130	135
92	91	96	100	105	110	115	120	125	130	135
96	91	95	100	105	110	114	119	124	129	134
100	90	95	100	104	109	114	119	124	128	133
104	90	95	99	104	109	113	118	123	128	133
108	90	94	99	104	108	113	118	123	127	132
112	90	94	99	103	108	113	117	122	127	132
116	89	94	99	103	108	112	117	122	127	131
120	89	94	98	103	107	112	117	121	126	131

AMIPB INFORMATION PROCESSING SCORING TEMPLATE TASK B FORM 1

5184 5238 5619



9474 4518

AMIPB Design Learning

Equipment

A design connecting some of the dots in a 4x4 array and five copies of a blank 4x4 array.

Method

Present the client with a pencil and a blank 4x4 response sheet. Say:
'I am going to show you a design which connects up some of these dots. I'll show it to you for 10 seconds. I want you to take a good look at it because when I take it away, I want you to connect up these dots in the same way, from memory'.

Show the design for 10 seconds, holding it over the response sheet to prevent the client from trying to copy it too early. Allow a minimum of 20 seconds and a maximum of 75 seconds for recall. Phrases such as 'any more?' or 'are you sure that is all you remember' may be used if they seem appropriate. Encourage very cautious or hesitant clients to put down whatever they think they may remember.

For the second trial, present the client with a new response sheet and say:
'I'll show you the design again and I would like you to have another go at it'.
Add 'We will probably have a few more/couple more goes at it' now or later if it seems appropriate.
Present the design using the details for the presentation and recall as before.

Continue the procedure to a maximum of five trials or two consecutive correct trials, whichever is the sooner. A trial in which the design is accurately produced but there are intrusion errors also present is not considered correct.

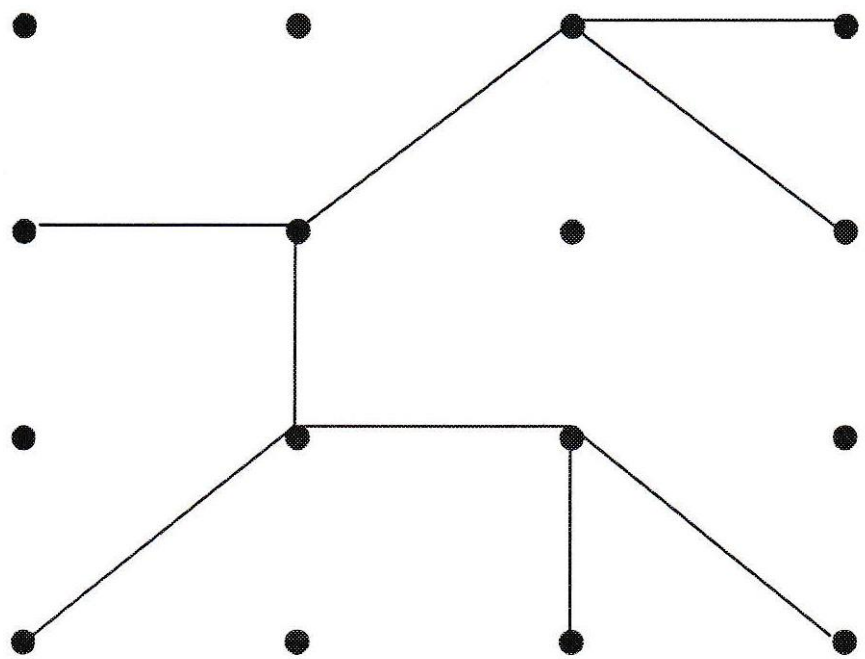
It is permissible to tell the client 'that was close' or 'that wasn't quite right' if it seems appropriate to maintain motivation
If the client reproduces the design correctly before the 5th trial, inform him/her of this and that the ensuing trial is to ensure that he/she can maintain this.

One point is given for each line correctly recalled on each trial.

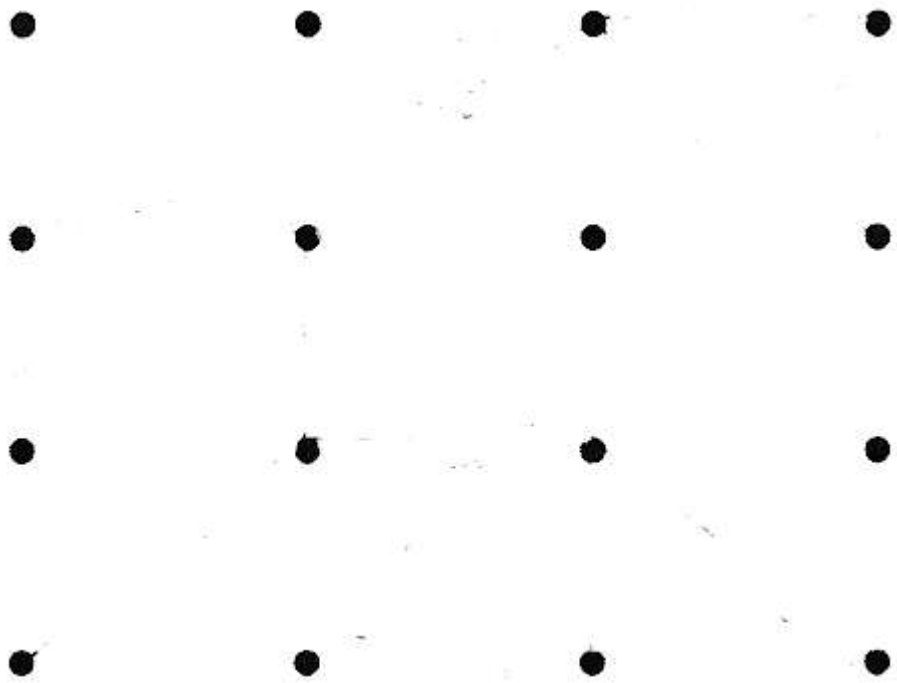
The total number of lines correctly recalled in the first five trials is recorded. Credit is given for trials not administered if the criterion is reached earlier. The maximum score is 45.

Transfer the Total score to the summary sheet.

Design



Response sheet Trial number:



Scoring and Interpretation of the MSDSA

The scores obtained are inserted on the Summary Score Sheet.

Multiply the scores in the predictive equation by the coefficients given on the Summary Score Sheet. Add these together and then subtract the constant. This is performed separately for the 'Pass' equation and the 'Fail' equation.

The Overall Score is the pass equation total – fail equation total.

An excel spreadsheet to calculate scores is available on request from nadina.lincoln@notttingham.ac.uk.

Multiple Sclerosis Driving Screening Assessment
(MSDSA; Lincoln & Radford, 2008)

SCORING SHEET

SDA: Dot Cancellation	[A] Time (secs): _____
	[B] Errors: _____
	[C] False positives: _____
SDA: Road Sign Recognition	[D] _____
AMIPB: Design Learning Total	[E] _____
AMIPB: Task B Adjusted Score	[F] _____

PASS EQUATION		**FAIL EQUATION**	
[A] _____ x 0.057	+	[A] _____ x 0.047	+
[B] _____ x 0.170	+	[B] _____ x 0.163	+
[C] _____ x 0.181	-	[C] _____ x 0.142	-
[D] _____ x 1.337	+	[D] _____ x 0.718	+
[E] _____ x 0.163	+	[E] _____ x 0.319	+
[F] _____ x 0.427	=	[F] _____ x 0.343	=
- 36.9260	=	- 28.595	=
TOTAL: _____		TOTAL: _____	

PASS ☐ FAIL ☐

Higher value indicates likely outcome of driving assessment

The higher value indicates the recommended decision. If the client has a higher value for the pass equation, this indicates the client's cognitive abilities are such that driving is feasible, but physical aspects and vision will need to be checked by a

medical practitioner or through a specialist disabled driving centre. The Forum of Mobility Centres provides a list of specialist driving assessment centres in the UK.

If the client has a higher value for the fail equation then he/she should be advised not to drive. These recommendations have been found to be about 80% accurate. Therefore it may be necessary to take into account other aspects of performance, including the scores on individual tests.

The performance on the individual tests may be compared with scores given in Table 1. It should be noted that there is substantial overlap between the distribution of scores of the Pass and Fail groups on the individual tests and therefore conclusions should not be based on the individual tests on their own.

Table 1. Comparison between Test Scores according to Driving Grades (adapted from Lincoln & Radford ,2008)

Cognitive Test		Pass	Fail	Comparison†
		n= 21	n=13	p
SDSA Dot cancellation time	Med IQR	488 375 – 694	560 442 – 687	.16
SDSA Dot cancellation errors	Med IQR	8 2 – 17	10 3 – 23	.21
SDSA Dot cancellation false positives	Med IQR	0 0 – 0	1 0 – 5	.004**
SDSA Road Sign Recognition	Med IQR	9 5 – 12	6 2 – 7	.005**
AMIPB Design Learning Total	Med IQR	28 22 – 37	33 23 – 39	.22
AMIPB Information Processing B Adjusted score	Med IQR	58.9 38 – 74	39.4[+] 34 – 53	.04*

Key:
Med Median
IQR Interquartile range
'*'= p <.05, '**' = p<.01, '***' = p<.001
† Comparison using Mann-Whitney U test

In the original research to develop the MSDSA the tasks were chosen because of their predictive validity; content validity was not checked. However, the SDSA Dot Cancellation task is primarily a measure of attention. It assesses sustained attention (concentration), selective attention and lateralised attention (unilateral inattention). Radford and Lincoln (2004) evaluated the content validity of the SDSA Road Sign Recognition test and suggested that it measures attention, non-verbal reasoning and spatial abilities. The AMIPB Task B is a measure of speed of information processing and Design Learning assesses visual memory. However, further studies of the content validity are needed.

The purpose of the MSDSA was to screen patients prior to referral to a specialist driving assessment centre. Those who passed the test were then advised they had the cognitive skills needed for driving and might be referred for assessment of physical abilities in relation to driving. Those who failed the MSDSA were advised they were not safe to drive. The MSDSA is a screening assessment and should be used in conjunction with clinical judgement. It is not intended to provide a decision on safety to drive but to provide a recommendation for further action. In most cases the information is passed on to a general practitioner or neurologist to inform their recommendation to the driving authorities. However, it is important to note that the validation of the MSDSA is far more rigorous than for most other assessment methods used in clinical practice to determine fitness to drive.

Feedback on the assessment is always useful and comments should be submitted to Nadina.lincoln@nottingham.ac.uk.

The test materials are available for purchase from the University of Nottingham.
http://www.nottingham.ac.uk/medicine/about/rehabilitationageing/publishedassessments.aspx

References

Lincoln NB Radford KA. Cognitive abilities as predictors of safety to drive in people with multiple sclerosis. Multiple Sclerosis 2008; 14: 123-128.

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.