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Motor vehicle and pedal cycle conspicuity: part 3 - retroreflective and fluorescent materials, validation report.

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Motor Vehicle and Pedal Cycle Conspicuity

Part 3: Retro-reflective and Fluorescent Materials -

Validation Report

Project Number 9/33/13

Undertaken on behalf

The Department of Environment, Transport and the Regions (DETR)

Prepared by

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Claire Quigley

July 1998

Checked by ……..

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1.0 Aim

The aim of these validation trials were to establish whether red retro-reflective markings in the Draft Regulation XA format perform as well as the yellow markings in the same format and to determine if either the yellow or red Draft Regulation XA markings perform significantly better than what is currently on the road.

2.0 Methodology

2.1 Variables

This study was conducted during the hours of darkness at a local test-site. A rig was built to represent the rear of a truck and was fitted with rear lamps and retro-reflectors. Red and yellow retro-reflective material, as defined in the Draft Regulation XA, were assessed in two different forms: in a boxed outline formation and a broken horizontal line, while white retro-reflective material was assessed in just the outline form (see Appendix 1). In addition, the ECE70 marking formats which are currently used on vehicles in the UK were also assessed. These consisted of a retro-reflective yellow rectangle bordered in retro-reflective red and rectangles of retro-reflective yellow and retro-reflective red diagonal stripes (see Appendix 2). To replicate a worst-case scenario, the materials were 'dirtied' using a layer of 'fablon' to cover the retro-reflective material to simulate the effects of accumulated dirt typically found on the rear of a truck which has been estimated to reduce the effect of retro-reflective material by approximately 50 to 70%. In addition, the rear lights on the truck rig were covered with filters to simulate the effects of dirt and the materials were viewed using filtered, dipped beam headlights. Vehicle lights from a road passing behind the test rig added visual noise to the test scene similar to that encountered on the road.

A further aspect to the worst case scenario was to ensure that the materials were viewed under conditions representative of a truck driver opposed to a car driver. Truck drivers view retro-reflective materials over a greater observation angle (this is related to the vertical separation distance between the truck driver's eyes and the headlamps of their vehicle), and so the retro-reflective materials being viewed appear less bright to them than to car drivers. To ensure the participants viewed the materials as a truck driver would, a further rig was built. This located the truck and headlamps at 800mm to the ground and the participants eyes 1280 to 1480 above the headlamps. This viewing rig was positioned 135mm behind the truck rig with the rear markings to be viewed.

2.2 Subjects / Participants

14 male and 10 female participants aged between 20 and 67 took part in the study.

2.3 Procedure

Each participant was positioned the viewing rig platform with their eyes at a height representative of that of a truck driver. The participant's view of the truck rig was restricted by a screen located directly in front of them which consisted of three viewing holes and shutters thus enabling three participants to be tested simultaneously. Each participant was asked to stand behind one of the viewing holes which was obscured by the shutters while they were briefed on what would be required of them. Once informed, the participants were asked to look towards their own viewing hole and stand well clear while the shutter was released by the experimenter. Once released, the shutters provided each participant with a 0.43 second view of the truck rig containing the marking formats. The participants had to make a decision, as quickly as possible, as to whether any truck markings and/or rear lights were present by saying yes or no. On hearing the response the experimenter stopped the timer and recorded the nature of the response and the time taken to give it. To avoid any participants purposely copying the replies of any other participant, each gave their replies to a different experimenter standing next to them. In between each condition, the viewing hole was kept covered by the shutter while the truck rig markings were replaced with the next configuration. A total of forty-eight such presentations were given to each participant, only half of which had some form of marking/light configuration present. The truck absent condition was simulated by turning the truck rig to the side, so no markings were visible. This condition was necessary to give meaning to the 'yes/no' discrimination task required of the participants.

The various presentation conditions viewed by the subjects are given in Table 1.

Table 1: Material/light conditions assessed

Material condition	Number of times viewed
ECE70 rectangle + lights	3
ECE70 diagonal + lights	3
White contour +lights	3
Yellow contour + lights	3
Yellow dashed lines + lights	3
Red contour +lights	3
Red dashed lines + lights	3
Lights only	3
Truck absent	24

3.0 Results

The Table in Appendix 3 shows the raw data collected throughout the trials, including the participants' responses and the times taken to give the responses. In addition, the number of correct detections are also displayed, a correct detection being when a subject said yes when truck markings/lights were present or no when truck markings/lights were absent. The data collected from participants 19,20, 22 and 23 have been omitted from the analysis due to a technical fault in the trials which made the data collected from these participants unreliable.

3.1 Comparison of red and yellow markings in the Draft Regulation XA format

To see whether the red markings performed as well as the yellow markings in the Draft Regulation XA Format, paired two tailed t-tests were carried out to determine if there were any significant differences in the number of correct detections, and the time to make these detections, for red and yellow markings (Tables 2 and 3).

Table 2: Comparison of red and yellow Draft Regulation XA marking formats - number of correct detections

Marking formats	T-Test
Red and yellow full contours	0.33
Red and yellow dashed lines	0.08
Red full contour and yellow dashed lines	No difference

Table 3: Comparison of red and yellow Draft Regulation XA marking formats - detection time

Marking formats	T-Test
Red and yellow full contours	0.33
Red and yellow dashed lines	0.64
Red full contour and yellow dashed lines	0.12

The results reveal that red truck markings are correctly identified as present the same number of times as the equivalent yellow markings and in the same amount of time.

Red full contours were not detected any quicker or more often than the yellow dashed lines.

If the mean reaction times are converted into metres per second at 70mph, the quickest marking format to react is the yellow full contour at 8.40m. The full red contour incurs an additional 0.43m, the yellow dashed lines an additional 1.34m and the red dashed lines an additional 1.67m (Table 4).

Table 4: Implications of marking format for stopping distances

Marking format	Mean Reaction time (secs)	Speed		
		30mph	50mph	70mph
		Distance travelled in metres		
Red contour	0.43	3.79	6.31	8.83
Yellow contour	0.40	3.60	6.00	8.40
Red dashed lines	0.48	4.32	7.19	10.07
Yellow dashed lines	0.47	4.17	6.96	9.74

3.2 Comparison of yellow Draft Regulation XA and ECE70 marking formats

To identify whether the yellow markings outlined in the Draft Regulations XA perform significantly better than the markings which are currently used on the road, paired, two-tailed t-tests were conducted for number of detections and detection times (Table 5 & 6).

Table 5: Comparison of Draft Regulation XA yellow and current marking formats - number of correct detections

Marking formats	T-Test comparison	
	Full contour	Dashed lines
Rectangle	1.00	0.33
Diagonal	1.00	0.33
Lights only	0.43	0.19

Table 6: Comparison of Draft Regulation XA and current marking formats - detection times

Marking formats	T-Test comparison	
	Full contour	Dashed lines
Rectangle	0.20	0.55
Diagonal	0.09	0.27
Lights only	0.06	0.93

If the Draft Regulation XA full contour and dashed lines marking formats are applied in yellow, the truck is correctly identified as present the same number of times and in the same amount of time as the ECE70 rectangle and diagonal markings and the lights only condition.

If the mean reaction times are converted into metres per second at 70mph, the marking format to produce the quickest reaction is the yellow full contour at 8.40m. The ECE70 diagonal incurs an additional 0.84m, the ECE70 rectangle 0.87m, the lights only 1.29m and the yellow dashed lines an additional 1.34m (Table 7).

Table 7: Implications of marking format for stopping distances

Marking format	Mean Reaction time (secs)	Speed		
		30mph	50mph	70mph
		Distance travelled in metres		
Yellow contour	0.40	3.60	6.00	8.40
Yellow dashed lines	0.47	4.17	6.96	9.74
Rectangle	0.45	3.97	6.62	9.27
Diagonal	0.44	3.96	6.60	9.24
Lights only	0.47	4.15	6.92	9.69

3.3 Comparison of red Draft Regulation XA and ECE70 marking formats

The same analysis was carried out to compare the Draft Regulation XA markings in red with the road markings currently in use (Table 8 and 9).

Table 8: Comparison of Draft Regulation XA and current marking formats - number of correct detections

Marking formats	T-Test comparison	
	Full contour	Dashed lines
Rectangle	0.33	0.33
Diagonal	0.33	0.33
Lights only	0.19	1.00

Table 9: Comparison of Draft Regulation XA and current marking formats - detection times

Marking formats	T-Test comparison	
	Full contour	Dashed lines
Rectangle	0.44	0.21
Diagonal	0.45	0.18
Lights only	0.18	0.53

When applied in red, the Draft Regulation XA full contour and dashed lines marking formats on the truck are correctly identified as present the same number of times and in the same amount of time as the ECE70 rectangle and diagonal markings and the lights only condition.

If the mean reaction times are converted into metres per second at 70mph, the marking format to produce the quickest reaction is the red full contour at 8.83m. The ECE70 diagonal incurs an additional 0.41m, the ECE70 rectangle 0.44m, the lights only 0.86m and the red dashed lines an additional 1.24m (Table 10).

Table 10 Implications of marking format for stopping distances

Marking format	Reaction time (secs)	Speed		
		30mph	50mph	70mph
		Distance travelled in metres		
Red contour	0.43	3.79	6.31	8.83
Red dashed lines	0.48	4.32	7.19	10.07
Rectangle	0.45	3.97	6.62	9.27
Diagonal	0.44	3.96	6.60	9.24
Lights only	0.47	4.15	6.92	9.69

4.0 Conclusions

Comparison of Draft Regulation XA marking formats applied in red opposed to yellow

The draft Regulation XA marking applied in red perform as well as those applied in yellow in terms of the number of times a vehicle is detected and the time taken to make those detections.

Comparison of Draft Regulation XA red and yellow marking formats with ECE70 rectangle and diagonal marking formats and the lights only conditions.

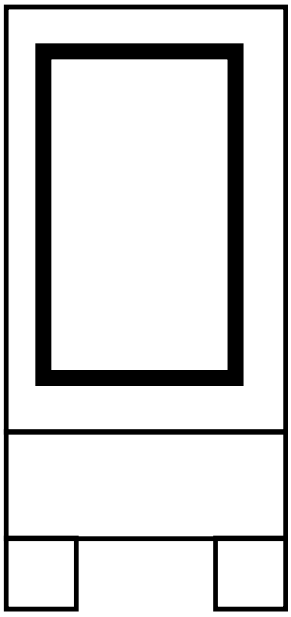
The Draft Regulations XA formats applied in red or yellow do not perform any better than the ECE70 rectangle and diagonal formats and the lights only condition.

The previous study concerning marking conspicuity (as measured by visibility and image) indicated that full contour markings were likely to be more conspicuous than the ECE70 formats. However, this finding was not replicated in this study. This may in part be due to the detection nature of this assessment since the participants were highly cued to detect any form of reflected light. The format of the reflected light may therefore have been less of a determining factor in the results than for the visibility and image trials where the amount of material displayed (which is related to format) is likely to have been a critical factor. The findings of this study are likely to be more relevant to alert drivers who will be quick to respond to any cue. Fatigued drivers may need more powerful cues to make them aware of other vehicles and so stronger and brighter images such as the full and partial contour formats are likely to be more effective.

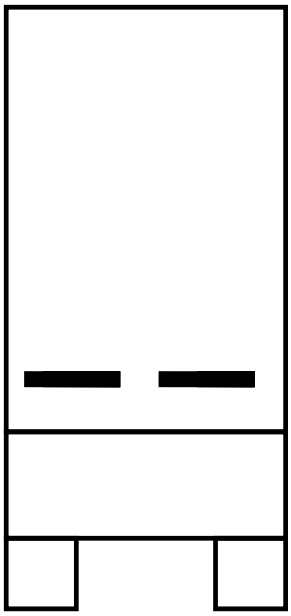
Appendices

Appendix 1

Marking formats defined by Draft Regulation XA



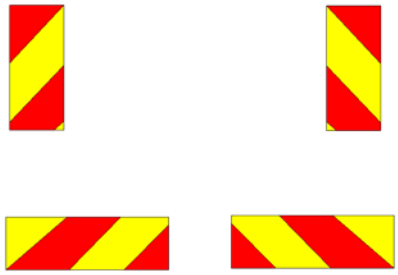
Full contour format



Dashed lines format

Appendix 2

ECE70 Marking Formats



Class 3

Class 4

= Retro-reflective red

= Retro-reflective yellow

Appendix 3

Raw Data

Appendix 3

		Subject 1			Subject 2			Subject 3			Subject 4			Subject 5		
	Condition	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time
1	None	N	1	0.32	N	1	1.23	Y	0	0.81	N	1	0.88	N	1	0.88
2	None	N	1	1.56	N	1	0.63	N	1	0.46	N	1	0.48	N	1	0.95
3	None	N	1	0.61	N	1	0.62	N	1	0.69	N	1	0.59	N	1	0.98
4	None	N	1	1.13	N	1	1.27	N	1	0.69	N	1	0.61	N	1	0.64
5	None	N	1	1.09	N	1	1.16	N	1	1.07	N	1	0.72	N	1	0.59
6	None	N	1	1.01	N	1	0.86	N	1	0.73	N	1	0.69	N	1	0.87
7	None	N	1	0.82	N	1	0.63	N	1	0.7	N	1	0.9	N	1	0.78
8	None	N	1	1.05	N	1	0.74	N	1	0.7	N	1	0.59	N	1	0.91
9	None	N	1	0.49	N	1	0.77	N	1	0.71	N	1	0.22	N	1	0.92
10	None	N	1	0.4	N	1	0.81	N	1	0.71	N	1	0.19	N	1	0.63
11	None	N	1	0.98	N	1	0.79	N	1	0.89	N	1	0.9	N	1	0.66
12	None	N	1	0.93	N	1	1.98	N	1	0.44	N	1	0.47	N	1	0.81
13	None	N	1	0.96	N	1	0.56	Y	0	0.79	N	1	0.67	N	1	0.45
14	None	N	1	0.91	N	1	0.57	N	1	0.7	N	1	0.49	N	1	0.62
15	None	N	1	0.99	N	1	0.71	N	1	0.71	N	1	0.49	N	1	0.54
16	None	N	1	0.81	N	1	0.73	N	1	0.78	N	1	0.21	N	1	0.57
17	None	N	1	0.88	N	1	0.49	N	1	0.59	N	1	0.26	N	1	0.57
18	None	N	1	0.64	N	1	0.66	N	1	0.7	N	1	0.3	N	1	0.56
19	None	N	1	0.65	N	1	0.67	N	1	0.66	N	1	0.31	N	1	0.66
20	None	N	1	0.59	N	1	0.86	N	1	0.7	N	1	0.38	N	1	0.84
21	None	N	1	0.59	N	1	1.68	N	1	0.78	N	1	0.32	N	1	0.9
22	None	N	1	0.49	N	1	0.88	N	1	0.77	N	1	0.4	N	1	0.66
23	None	N	1	0.63	N	1	0.65	N	1	0.66	N	1	0.31	N	1	0.61
24	None	N	1	0.41	N	1	0.82	N	1	0.66	N	1	0.28	N	1	0.74
25	Lights only	Y	1	0.39	Y	1	1.09	Y	1	0.45	Y	1	0.5	Y	1	0.62
26	Lights only	Y	1	0.91	Y	1	1.07	Y	1	0.59	Y	1	0.49	Y	1	0.5
27	Lights only	Y	1	1.07	Y	1	0.64	Y	1	0.66	Y	1	0.4	Y	1	0.76
28	Block + lights	Y	1	0.71	Y	1	0.47	Y	1	0.56	Y	1	0.25	Y	1	0.96
29	Block + lights	Y	1	0.63	Y	1	0.77	Y	1	0.61	Y	1	0.46	Y	1	0.91
30	Block + lights	Y	1	0.52	Y	1	0.88	Y	1	0.77	Y	1	0.34	Y	1	0.92
31	Diagonal + lights	Y	1	1.03	Y	1	0.75	Y	1	0.73	Y	1	0.63	Y	1	0.65
32	Diagonal + lights	Y	1	0.91	Y	1	1.03	Y	1	0.72	Y	1	0.4	Y	1	0.61
33	Diagonal + lights	Y	1	0.53	Y	1	0.65	Y	1	0.64	Y	1	0.37	Y	1	0.7
34	White outline +lights	Y	1	0.43	Y	1	1.06	Y	1	0.61	Y	1	0.38	Y	1	0.48
35	White outline +lights	Y	1	0.7	Y	1	0.96	Y	1	0.49	Y	1	0.22	Y	1	0.76
36	White outline +lights	N	0	0.59	Y	1	0.57	Y	1	0.65	Y	1	0.32	Y	1	0.62
37	Yellow outline + lights	Y	1	1.26	Y	1	0.69	Y	1	0.51	Y	1	0.69	Y	1	0.66
38	Yellow outline + lights	Y	1	0.49	Y	1	0.83	Y	1	0.55	Y	1	0.22	Y	1	0.63
39	Yellow outline + lights	Y	1	0.63	Y	1	0.5	Y	1	0.77	Y	1	0.54	Y	1	0.65
40	Yellow dashed lines + lights	Y	1	1.14	Y	1	1.33	Y	1	0.54	Y	1	0.58	Y	1	0.56
41	Yellow dashed lines + lights	Y	1	1.41	Y	1	0.7	Y	1	0.62	Y	1	0.37	Y	1	0.97
42	Yellow dashed lines + lights	Y	1	0.67	Y	1	0.64	Y	1	0.63	Y	1	0.4	Y	1	0.66
43	Red outline +lights	Y	1	0.9	Y	1	0.41	Y	1	0.56	Y	1	0.29	Y	1	0.56
44	Red outline +lights	Y	1	0.71	Y	1	0.58	Y	1	0.63	Y	1	0.29	Y	1	0.66
45	Red outline +lights	Y	1	0.82	Y	1	0.65	Y	1	0.58	Y	1	0.34	Y	1	0.83
46	Red dashed lines + lights	Y	1	0.33	Y	1	0.84	Y	1	0.45	Y	1	0.74	Y	1	1.62
47	Red dashed lines + lights	Y	1	0.84	N	0	1.08	Y	1	0.62	Y	1	0.25	Y	1	0.62
48	Red dashed lines + lights	Y	1	0.69	Y	1	0.69	Y	1	0.58	Y	1	0.38	Y	1	0.58

		Subject 6			Subject 7			Subject 8			Subject 9			Subject 10		
	Condition	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time
1	None	N	1	1	N	1	0.62	N	1	1.34	N	1	0.92	N	1	0.51
2	None	N	1	0.74	N	1	0.91	N	1	0.86	N	1	0.95	N	1	0.3
3	None	N	1	0.7	N	1	0.56	N	1	1.04	N	1	0.91	N	1	0.4
4	None	N	1	0.59	N	1	0.99	N	1	0.82	N	1	0.81	N	1	0.45
5	None	N	1	0.64	N	1	0.63	N	1	0.74	N	1	0.74	N	1	0.59
6	None	N	1	0.56	N	1	0.38	N	1	0.76	N	1	0.66	N	1	0.56
7	None	N	1	0.52	N	1	0.25	N	1	0.66	N	1	0.76	N	1	0.41
8	None	N	1	0.57	N	1	0.47	N	1	0.78	N	1	0.77	N	1	0.58
9	None	N	1	0.45	N	1	0.48	N	1	0.91	N	1	0.87	N	1	0.34
10	None	N	1	0.46	N	1	0.56	N	1	0.93	N	1	0.66	N	1	0.41
11	None	N	1	0.61	N	1	0.49	N	1	0.61	N	1	0.66	N	1	0.46
12	None	N	1	0.7	N	1	0.35	N	1	0.91	N	1	0.59	N	1	0.29
13	None	N	1	0.62	N	1	0.58	N	1	0.59	N	1	0.55	N	1	0.56
14	None	N	1	0.5	N	1	0.6	N	1	0.58	N	1	0.69	N	1	0.38
15	None	N	1	0.56	N	1	0.34	N	1	0.64	N	1	0.56	N	1	0.43
16	None	N	1	0.63	N	1	0.2	N	1	0.6	N	1	0.57	N	1	0.57
17	None	N	1	0.68	N	1	0.41	N	1	0.56	N	1	0.53	N	1	0.72
18	None	N	1	0.56	N	1	0.32	N	1	0.83	N	1	0.51	N	1	0.61
19	None	N	1	0.52	N	1	0.45	N	1	0.81	N	1	0.58	N	1	0.59
20	None	N	1	0.39	N	1	0.38	N	1	0.6	N	1	0.6	N	1	0.35
21	None	N	1	0.49	N	1	0.4	N	1	0.61	N	1	0.58	N	1	0.3
22	None	N	1	0.47	N	1	0.49	N	1	0.63	N	1	0.54	N	1	0.41
23	None	N	1	0.57	N	1	0.43	N	1	0.8	N	1	0.6	N	1	0.36
24	None	N	1	0.57	N	1	0.49	N	1	0.69	N	1	0.59	N	1	0.24
25	Lights only	Y	1	0.63	Y	1	0.28	Y	1	0.64	Y	1	0.68	Y	1	0.66
26	Lights only	Y	1	0.48	Y	1	0.42	Y	1	0.56	N	0	0.57	Y	1	0.45
27	Lights only	Y	1	0.64	Y	1	0.41	Y	1	0.66	Y	1	0.59	Y	1	0.52
28	Block + lights	Y	1	0.5	Y	1	0.37	Y	1	0.89	Y	1	0.74	Y	1	0.52
29	Block + lights	Y	1	0.49	Y	1	0.32	Y	1	0.7	Y	1	0.73	Y	1	0.6
30	Block + lights	Y	1	0.41	Y	1	0.21	Y	1	0.72	Y	1	0.79	Y	1	0.63
31	Diagonal + lights	Y	1	0.56	Y	1	0.62	Y	1	0.68	Y	1	0.67	Y	1	0.46
32	Diagonal + lights	Y	1	0.56	Y	1	0.45	Y	1	0.77	Y	1	0.6	Y	1	0.37
33	Diagonal + lights	Y	1	0.51	Y	1	0.36	Y	1	0.77	Y	1	0.53	Y	1	0.56
34	White outline +lights	Y	1	0.43	Y	1	0.47	Y	1	0.62	Y	1	0.71	Y	1	0.5
35	White outline +lights	Y	1	0.49	Y	1	0.27	Y	1	0.54	Y	1	0.58	Y	1	0.69
36	White outline +lights	Y	1	0.49	Y	1	0.47	Y	1	0.66	Y	1	0.58	Y	1	0.51
37	Yellow outline + lights	Y	1	0.5	Y	1	0.28	Y	1	0.56	Y	1	0.9	Y	1	0.24
38	Yellow outline + lights	Y	1	0.49	Y	1	0.45	Y	1	0.61	Y	1	0.65	Y	1	0.58
39	Yellow outline + lights	N	0	0.59	Y	1	0.48	Y	1	0.66	Y	1	0.66	Y	1	0.43
40	Yellow dashed lines + lights	Y	1	0.56	Y	1	0.59	Y	1	0.61	Y	1	0.73	Y	1	0.42
41	Yellow dashed lines + lights	Y	1	0.69	Y	1	0.24	Y	1	0.67	Y	1	0.56	Y	1	0.26
42	Yellow dashed lines + lights	Y	1	0.54	Y	1	0.56	Y	1	0.69	Y	1	0.88	Y	1	0.35
43	Red outline +lights	Y	1	0.49	Y	1	0.38	Y	1	0.57	Y	1	0.79	Y	1	0.4
44	Red outline +lights	Y	1	0.54	Y	1	0.48	Y	1	0.59	Y	1	0.73	Y	1	0.49
45	Red outline +lights	Y	1	0.54	Y	1	0.65	Y	1	0.62	Y	1	0.77	Y	1	0.43
46	Red dashed lines + lights	Y	1	0.56	Y	1	0.57	Y	1	0.72	Y	1	0.61	Y	1	0.41
47	Red dashed lines + lights	Y	1	0.55	Y	1	0.57	Y	1	0.55	N	0	0.93	Y	1	0.4
48	Red dashed lines + lights	N	0	0.58	Y	1	0.37	Y	1	0.89	Y	1	0.63	Y	1	0.47

		Subject 11			Subject 12			Subject 13			Subject 14			Subject 15		
	Condition	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time
1	None	N	1	0.89	N	1	0.93	N	1	0.76	N	1	0.57	N	1	0.81
2	None	N	1	0.81	N	1	0.76	N	1	0.91	N	1	0.67	N	1	1.5
3	None	N	1	0.78	N	1	0.74	N	1	0.79	N	1	0.73	N	1	0.89
4	None	N	1	0.73	N	1	0.8	N	1	0.62	N	1	0.64	N	1	0.99
5	None	N	1	0.75	N	1	0.68	N	1	0.64	N	1	0.57	N	1	0.92
6	None	N	1	0.85	N	1	0.95	N	1	0.72	N	1	0.41	N	1	0.81
7	None	N	1	0.84	N	1	0.77	N	1	0.73	N	1	0.32	N	1	0.8
8	None	N	1	0.77	N	1	0.63	N	1	0.82	N	1	0.49	N	1	0.8
9	None	N	1	0.66	N	1	0.64	N	1	0.49	N	1	0.49	N	1	0.82
10	None	N	1	0.77	N	1	0.66	N	1	0.56	N	1	0.66	N	1	0.81
11	None	N	1	0.69	N	1	0.65	N	1	0.51	N	1	0.56	N	1	0.88
12	None	N	1	0.56	N	1	0.66	N	1	0.56	N	1	0.64	N	1	0.79
13	None	N	1	0.68	N	1	0.6	N	1	0.56	N	1	0.56	N	1	0.84
14	None	N	1	0.62	N	1	0.85	N	1	0.59	N	1	0.68	N	1	1.41
15	None	N	1	0.88	N	1	0.66	N	1	0.67	N	1	0.6	N	1	1.06
16	None	N	1	0.64	N	1	0.7	N	1	0.63	N	1	0.75	N	1	1.58
17	None	N	1	0.63	N	1	0.66	N	1	0.68	N	1	0.7	N	1	0.85
18	None	N	1	0.87	N	1	0.75	N	1	0.51	N	1	0.64	N	1	0.85
19	None	N	1	0.7	N	1	0.61	N	1	0.86	N	1	0.59	N	1	0.84
20	None	N	1	0.85	N	1	0.56	Y	0	0.57	N	1	0.59	N	1	1.63
21	None	N	1	0.76	N	1	0.58	N	1	0.46	N	1	0.64	N	1	1.66
22	None	N	1	0.38	N	1	0.52	N	1	0.52	N	1	0.71	N	1	0.99
23	None	N	1	0.68	N	1	0.59	N	1	0.41	N	1	0.59	N	1	0.81
24	None	N	1	0.66	N	1	0.56	N	1	0.35	N	1	0.58	N	1	0.81
25	Lights only	Y	1	0.72	Y	1	0.84	Y	1	0.61	Y	1	0.96	N	0	3.68
26	Lights only	Y	1	0.82	Y	1	0.73	Y	1	0.44	Y	1	0.43	N	0	1.05
27	Lights only	Y	1	0.45	Y	1	0.62	Y	1	0.52	Y	1	0.52	Y	1	1.16
28	Block + lights	Y	1	0.92	Y	1	0.85	Y	1	0.64	Y	1	0.56	Y	1	1.01
29	Block + lights	Y	1	0.75	Y	1	0.81	Y	1	0.51	Y	1	0.52	Y	1	0.91
30	Block + lights	Y	1	0.82	Y	1	0.65	Y	1	0.42	Y	1	0.62	Y	1	0.84
31	Diagonal + lights	Y	1	0.71	Y	1	0.66	Y	1	0.76	Y	1	0.55	Y	1	1.09
32	Diagonal + lights	Y	1	0.43	Y	1	0.63	Y	1	0.58	Y	1	0.49	Y	1	1.13
33	Diagonal + lights	Y	1	0.48	Y	1	0.52	Y	1	0.61	Y	1	0.45	Y	1	0.92
34	White outline +lights	Y	1	0.52	Y	1	0.59	Y	1	0.48	Y	1	0.8	Y	1	0.9
35	White outline +lights	Y	1	0.53	Y	1	0.56	Y	1	0.65	Y	1	0.36	Y	1	0.69
36	White outline +lights	Y	1	0.56	Y	1	0.58	Y	1	0.5	Y	1	0.51	Y	1	0.77
37	Yellow outline + lights	Y	1	0.57	Y	1	0.55	Y	1	0.81	Y	1	0.53	Y	1	0.75
38	Yellow outline + lights	Y	1	0.91	Y	1	0.54	Y	1	0.77	Y	1	0.49	Y	1	0.79
39	Yellow outline + lights	Y	1	0.53	Y	1	0.45	Y	1	0.61	Y	1	0.46	Y	1	0.98
40	Yellow dashed lines + lights	Y	1	0.6	Y	1	0.81	Y	1	0.68	Y	1	0.51	Y	1	0.7
41	Yellow dashed lines + lights	Y	1	0.61	Y	1	0.7	Y	1	0.48	Y	1	0.54	Y	1	0.98
42	Yellow dashed lines + lights	Y	1	0.56	Y	1	0.64	Y	1	0.85	Y	1	0.66	Y	1	0.98
43	Red outline +lights	Y	1	0.63	Y	1	0.76	Y	1	0.38	Y	1	0.52	Y	1	0.98
44	Red outline +lights	Y	1	0.83	Y	1	0.64	Y	1	0.8	Y	1	0.6	Y	1	1.02
45	Red outline +lights	Y	1	0.89	Y	1	0.55	Y	1	0.63	Y	1	0.48	Y	1	0.76
46	Red dashed lines + lights	Y	1	0.86	Y	1	0.83	Y	1	0.96	Y	1	1.06	Y	1	1.26
47	Red dashed lines + lights	Y	1	0.89	Y	1	0.65	Y	1	0.4	Y	1	0.56	Y	1	0.87
48	Red dashed lines + lights	Y	1	0.48	Y	1	0.56	Y	1	0.5	Y	1	0.56	Y	1	1.03

		Subject 16			Subject 17			Subject 18			Subject 21			Subject 24		
	Condition	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time	Seen?	Correct?	Time
1	None	N	1	0.53	N	1	0.49	N	1	1.01	N	1	2.74	N	1	0.75
2	None	N	1	0.35	N	1	0.55	N	1	1.2	N	1	1	N	1	0.86
3	None	N	1	0.51	N	1	0.59	N	1	0.64	N	1	1.12	N	1	0.68
4	None	N	1	0.5	N	1	0.47	N	1	0.94	N	1	1.02	N	1	0.83
5	None	N	1	0.41	N	1	0.53	N	1	0.67	N	1	0.89	N	1	0.63
6	None	N	1	0.49	N	1	0.4	N	1	0.87	N	1	1	N	1	0.74
7	None	N	1	0.25	N	1	0.45	N	1	0.74	N	1	1.33	N	1	0.66
8	None	Y	0	0.37	N	1	0.7	N	1	0.96	N	1	0.96	N	1	0.75
9	None	N	1	0.45	N	1	0.56	N	1	0.95	N	1	0.88	N	1	0.61
10	None	N	1	0.54	N	1	0.49	N	1	0.89	N	1	0.95	N	1	0.75
11	None	N	1	0.41	N	1	0.44	N	1	0.7	N	1	0.84	N	1	0.58
12	None	N	1	0.52	N	1	0.49	N	1	0.77	N	1	0.95	N	1	0.65
13	None	N	1	0.34	N	1	0.56	N	1	0.83	N	1	1.09	N	1	0.63
14	None	N	1	0.33	N	1	0.51	N	1	0.82	N	1	0.88	N	1	0.67
15	None	N	1	0.36	N	1	0.5	N	1	0.76	N	1	1.11	N	1	0.62
16	None	N	1	0.42	N	1	0.71	N	1	0.63	N	1	0.88	N	1	0.49
17	None	N	1	0.45	N	1	0.63	N	1	0.9	N	1	0.91	N	1	0.62
18	None	N	1	0.37	N	1	0.49	N	1	0.95	N	1	0.83	N	1	0.73
19	None	N	1	0.34	N	1	0.53	N	1	0.72	N	1	0.84	N	1	0.59
20	None	N	1	0.45	N	1	0.49	N	1	0.92	N	1	0.95	N	1	0.49
21	None	N	1	0.34	N	1	0.34	N	1	0.75	N	1	0.85	N	1	0.61
22	None	N	1	0.41	N	1	0.55	N	1	0.72	N	1	0.79	N	1	0.37
23	None	N	1	0.3	N	1	0.53	N	1	0.85	N	1	0.73	N	1	0.59
24	None	N	1	0.34	N	1	0.61	N	1	0.87	N	1	0.77	N	1	0.58
25	Lights only	Y	1	0.5	Y	1	0.56	Y	1	0.87	Y	1	0.98	Y	1	0.7
26	Lights only	Y	1	0.35	Y	1	0.63	Y	1	1.03	Y	1	0.99	Y	1	0.62
27	Lights only	Y	1	0.36	Y	1	0.59	Y	1	0.7	Y	1	0.93	Y	1	0.67
28	Block + lights	N	0	0.37	Y	1	0.57	Y	1	0.73	Y	1	0.95	Y	1	0.66
29	Block + lights	Y	1	0.28	Y	1	0.51	Y	1	0.6	Y	1	0.94	Y	1	0.84
30	Block + lights	Y	1	0.34	Y	1	0.48	Y	1	0.65	Y	1	0.84	Y	1	0.74
31	Diagonal + lights	Y	1	0.29	Y	1	0.52	Y	1	0.82	N	0	3.49	Y	1	0.73
32	Diagonal + lights	Y	1	0.39	Y	1	0.45	Y	1	0.84	Y	1	1.05	Y	1	0.64
33	Diagonal + lights	Y	1	0.33	Y	1	0.49	Y	1	0.68	Y	1	0.9	Y	1	0.63
34	White outline +lights	Y	1	0.46	Y	1	0.47	Y	1	0.75	Y	1	0.84	Y	1	0.67
35	White outline +lights	Y	1	0.41	Y	1	0.39	Y	1	0.98	Y	1	0.77	Y	1	0.53
36	White outline +lights	Y	1	0.52	Y	1	0.5	Y	1	0.86	Y	1	0.72	Y	1	0.54
37	Yellow outline + lights	Y	1	0.39	Y	1	0.32	Y	1	0.84	Y	1	0.8	Y	1	0.67
38	Yellow outline + lights	Y	1	0.43	Y	1	0.56	Y	1	0.74	Y	1	0.69	Y	1	0.63
39	Yellow outline + lights	Y	1	0.4	Y	1	0.49	Y	1	0.61	Y	1	0.64	Y	1	0.57
40	Yellow dashed lines + lights	Y	1	0.36	Y	1	0.49	Y	1	0.79	Y	1	0.83	Y	1	0.78
41	Yellow dashed lines + lights	Y	1	0.38	Y	1	0.58	Y	1	0.74	Y	1	1.02	Y	1	0.67
42	Yellow dashed lines + lights	Y	1	0.42	Y	1	0.45	Y	1	0.83	Y	1	1.15	Y	1	0.63
43	Red outline +lights	Y	1	0.21	Y	1	0.42	Y	1	0.88	Y	1	1.03	Y	1	0.8
44	Red outline +lights	Y	1	0.41	Y	1	0.55	Y	1	0.81	Y	1	0.86	Y	1	0.63
45	Red outline +lights	Y	1	0.28	Y	1	0.54	Y	1	0.82	Y	1	0.76	Y	1	0.63
46	Red dashed lines + lights	Y	1	0.32	Y	1	0.7	Y	1	1.13	Y	1	1.65	Y	1	0.81
47	Red dashed lines + lights	Y	1	0.35	Y	1	0.35	Y	1	0.84	Y	1	1.18	Y	1	0.75
48	Red dashed lines + lights	Y	1	0.35	Y	1	0.53	Y	1	0.71	Y	1	0.9	Y	1	0.51

No of Hits (give score out of three)

condition	Sub 1	Sub 2	Sub 3	Sub 4	Sub 5	Sub 6	Sub 7	Sub 8	Sub 9	Sub 10
Lights only	3	3	3	3	3	3	3	3	2	3
Block + lights	3	3	3	3	3	3	3	3	3	3
Diagonal + lights	3	3	3	3	3	3	3	3	3	3
White outline +lights	2	3	3	3	3	3	3	3	3	3
Yellow outline + lights	3	3	3	3	3	2	3	3	3	3
Yellow dashed lines + lights	3	3	3	3	3	3	3	3	3	3
Red outline +lights	3	3	3	3	3	3	3	3	3	3
Red dashed lines + lights	3	2	3	3	3	2	3	3	2	3

No of correct rejections (score out of 24)

None	24	24	22	24	24	24	24	24	24	24

No of Hits (give score out of three)

condition	Sub 11	Sub 12	Sub 13	Sub 14	Sub 15	Sub 16	Sub 17	Sub 18	Sub 21	Sub 24
Lights only	3	3	3	3	1	3	3	3	3	3
Block + lights	3	3	3	3	3	2	3	3	3	3
Diagonal + lights	3	3	3	3	3	3	3	3	2	3
White outline +lights	3	3	3	3	3	3	3	3	3	3
Yellow outline + lights	3	3	3	3	3	3	3	3	3	3
Yellow dashed lines + lights	3	3	3	3	3	3	3	3	3	3
Red outline +lights	3	3	3	3	3	3	3	3	3	3
Red dashed lines + lights	3	3	3	3	3	3	3	3	3	3

No of correct rejections (score out of 24)

None	24	24	23	24	24	23	24	24	24	24

Mean Hit time

condition	Sub 1	Sub 2	Sub 3	Sub 4	Sub 5	Sub 6	Sub 7	Sub 8	Sub 9	Sub 10
Lights only	0.63	0.67	0.39	0.30	0.37	0.40	0.21	0.36	0.40	0.38
Block + lights	0.46	0.45	0.47	0.19	0.67	0.29	0.14	0.51	0.57	0.42
Diagonal + lights	0.66	0.55	0.52	0.31	0.39	0.36	0.32	0.48	0.42	0.30
White outline +lights	0.41	0.60	0.40	0.15	0.36	0.29	0.24	0.35	0.44	0.41
Yellow outline + lights	0.63	0.41	0.43	0.32	0.39	0.32	0.24	0.35	0.56	0.26
Yellow dashed lines + lights	0.91	0.63	0.42	0.29	0.47	0.42	0.30	0.40	0.54	0.18
Red outline +lights	0.65	0.29	0.41	0.15	0.42	0.34	0.34	0.33	0.58	0.28
Red dashed lines + lights	0.46	0.51	0.37	0.30	0.68	0.38	0.34	0.46	0.44	0.25
Mean	0.60	0.51	0.43	0.25	0.47	0.35	0.27	0.40	0.50	0.31

Mean time correct rejection time

None	0.63	0.61	0.52	0.33	0.46	0.41	0.33	0.50	0.50	0.29

Mean Hit time

condition	Sub 11	Sub 12	Sub 13	Sub 14	Sub 15	Sub 16	Sub 17	Sub 18	Sub 21	Sub 24	Mean
Lights only	0.40	0.55	0.36	0.38	0.98	0.24	0.33	0.69	0.79	0.48	0.47
Block + lights	0.57	0.59	0.36	0.31	0.74	0.15	0.26	0.48	0.73	0.57	0.45
Diagonal + lights	0.28	0.42	0.49	0.24	0.87	0.18	0.23	0.60	0.80	0.49	0.44
White outline +lights	0.28	0.40	0.38	0.30	0.61	0.30	0.19	0.68	0.60	0.40	0.39
Yellow outline + lights	0.41	0.33	0.57	0.23	0.66	0.25	0.20	0.55	0.53	0.44	0.40
Yellow dashed lines + lights	0.33	0.54	0.51	0.31	0.71	0.23	0.25	0.61	0.82	0.51	0.47
Red outline +lights	0.52	0.47	0.44	0.27	0.74	0.14	0.24	0.66	0.70	0.51	0.43
Red dashed lines + lights	0.48	0.50	0.46	0.47	0.87	0.18	0.27	0.71	1.06	0.51	0.48
Mean	0.41	0.48	0.45	0.31	0.77	0.21	0.25	0.62	0.75	0.49	

Mean time correct rejection time

None	0.47	0.51	0.46	0.34	0.83	0.25	0.27	0.66	0.83	0.47	0.48