Visual acuity and legal visual requirement to drive a passenger vehicle

AW Kiel, T Butler and A Alwitary

Abstract

Objectives (1) To test the consistency and ease with which number-plates of different component figures can be read under DVLA driving test conditions; (2) to test the relative difficulty of reading corresponding figures on registration plates of white and yellow backgrounds.

Design Prospective study of consecutive eligible clinic patients.

Setting Ophthalmology outpatients.

Subjects 210 individuals with a corrected visual acuity with both eyes open of between 6/9 and 6/12.

Main outcome measures The ability to read three different number-plates under standard DVLA driving-test conditions (ie at 20.5 m in good daylight with glasses if worn) and the ability to read identical number-plates against a white and a yellow background.

Results There is a significant difference between the ease with which three different number-plates can be read depending on their letter and numeral composition, although this did not seem to be significantly affected by whether they were printed on a yellow or white background. Only 92.3% of subjects could read all the number-plates at the legal distance, 96.7% could read at least one number-plate at the legal distance and 3.3% of the test subjects could not read any of the number-plates at 20.5 m.

Conclusions The current test protocol used to obtain a driving licence and, moreover, the test the police will employ to assess visual competence to drive, is highly variable and is unlikely to give consistent repeatable results. The performance of those with equally good visual acuity is unpredictable and is highly dependent on the number-plate they are asked to read. This variability could exclude some who would otherwise pass the test or pass an individual with a visual acuity below accepted standards. The forthcoming changes in the

regulations for design of number-plates is an ideal opportunity to standardise the whole testing procedure for driving visual acuity.

Eye (2003) 17, 579–582. doi:10.1038/sj.eye.6700441

Keywords: legal visual acuity; number plate driving; DVLA test

Introduction

In the United Kingdom, the legal standard of vision for driving is the ability to read a number-plate in good daylight with glasses, if worn, at the legal distance. In practice, this means a number-plate with letters measuring $3^{1/8}$ in (79 mm) in height placed at a distance of 67 ft (20.5 m); however, this is often an arbitrary distance subjectively determined by the examiner.

The purpose of this study is to look at whether the character composition of the number-plate being read and the background colour affect the ease with which they are read.

Subjects and methods

In total, 210 subjects were recruited from consecutive individuals attending for routine appointments at an ophthalmology outpatients. The inclusion criterion was a binocular Snellen visual acuity (ie with both eyes open and spectacle correction if worn) of between 6/9 and 6/12 (ie 6/9–).

These subjects were then asked to read three different number-plates from a distance of 90 ft. If subjects were unable to successfully identify each numeral and letter on the number-plate they were allowed to advance, one foot at a time, until they could correctly see one or more of the plates.

The test was undertaken under standardised conditions being outside, under natural

Ophthalmology Department
Queens Medical Centre
Nottingham, UK

Correspondence:
AW Kiel
Dunedin Hospital
New Zealand
E-mail: willkiel@doctors.org.uk

Received: 16 July 2002
Accepted in revised form:
1 November 2002

Funding: None
Competing interests: None

illumination on a bright sunny day with no shade falling onto the clean number-plate.

Three different number-plates were utilised for the purpose of the study. They were stratified according to level of difficulty dependent on their numerical and alphabetical composition. The selection of characters to be used on each number-plate was based on work by McMonnies.¹ He found that when reading from a visual acuity chart certain letters and numbers were easier to recognise than others and ranked them accordingly. From his rankings we constructed three number-plates. We used letters and numerals deemed easy to recognise to form the easy number-plate (T174ILE), moderately difficult characters for the second plate (P610VOH) and for the difficult number-plate (M528CBY) we incorporated letters and numerals ranked as hardest to identify.

Subjects were then challenged with two identical number-plates (P610VOH), one on a white background and one on a yellow background thus corresponding to front and back number-plates. They again started from a distance of 90 ft and were asked to slowly come forward, a foot at a time, until they could read one of the number-plates correctly. The number-plate background colour was then recorded for the number-plate they could read, or both were recorded if they could read both number-plates simultaneously.

Analysis

In the first part of the study, the three number-plates were ranked in the order in which they were first read and these results were statistically analysed using the Friedman test. This tests the null hypothesis that k -related variables come from the same population.

In the second part, the null hypothesis was proposed that there was no difference between reading a number-plate against a white background when compared to a yellow background. These results were then analysed using the χ^2 test.

Results

The mean age of the participants in the study was 66 years of age (range from 22 to 82 years), 136 (64.8%) were female, and 74 (35.2%) male.

Only 92.3% (194) of the participants could read all the number-plates at the legal distance and 96.7% (203) could read at least one of the three number-plates at the legal distance. The remaining 3.3% (7) could not read any of the number-plates at the legal distance. One of the seven subjects who could not read any number-plates had a visual acuity of 6/9–1.

Table 1 Mean rank of number-plates

<i>Ranks</i>	<i>Mean rank</i>
Easiest number-plate	1.28
Moderate number-plate	1.82
Hardest number-plate	2.90

The number-plate composed of the easiest characters (T174ILE), was read first by 159 individuals (75.7%), followed by the moderate plate (P610VOH), which was read first by 47 individuals (22.4%) and finally six individuals (2.9%) read the hardest number-plate (M528CBY) first.

The order in which the number-plates became legible to the participants was recorded with the first number-plate read (ie at the greatest distance) being assigned a score of 1, the second number-plate read assigned a score of 2, and the last read plate (ie at the shortest distance) assigned a score of 3.

The mean rank for each of the number-plates is shown in the Table 1.

Friedman test revealed a significant difference between legibility of the three plates ($\chi^2 = 287.322$, $df = 2$, $P < 0.001$). This led to the rejection of the Null hypothesis, which stated that the number-plates were of equal legibility.

In the second part of the study, the ease of reading the number-plate against a white background was compared to that of reading it against a yellow background. The results were analysed using a χ^2 ($\chi^2 = 0.476$, $df = 1$, asymp. sig. 0.490).

There was no significant difference between the ease with which a number-plate was read against one background compared to the other. In this case, the Null Hypothesis was accepted.

Discussion

For most adults, the ability to drive a motor vehicle is deemed a necessity for everyday living and an essential part of ones autonomy. Being denied a driving licence on the grounds of poor visual acuity may cause significant lifestyle adjustment and consequent psychological morbidity. In the younger age group, the effects may be amplified by the social stigma associated with inability to drive and the concurrent lack of status among ones peers.

Despite its 'pass-fail' status, a disproportionately small part of the driving test is given to the testing of visual acuity. It is important therefore that the visual acuity test used is quick, simple, and robust. In order to avoid false results, it must also be accurate and repeatable.

The standard of static visual acuity required by ordinary drivers is the ability to read, in good light (with

the aid of glasses or contact lenses, if worn) a registration mark fixed to a motor vehicle and containing letters and figures 79.4 mm ($3^{1/8}$ in high) at a distance of 20.5 m (67 ft). This standardised number-plate test is described in the Motor Vehicles (Driving Licences) Regulations and the Road Traffic Act 1989.

There is no precise critical Snellen chart acuity equivalent to the number-plate standard. Drasdo and Haggerty^{2,3} found that applying a standard of 6/9–2 (6/10) resulted in a mathematical equivalent to this (ie this standard failed the same proportion of people, but not necessarily the same individual). This visual acuity of 6/10 equates to a decimal acuity of 0.6, which is in fact a higher visual acuity than required by the European standard⁴ of 6/12 (decimal 0.5). Although the European standard for monocular drivers is a visual acuity of 6/10 (decimal 0.6) and as the United Kingdom does not discriminate visual acuity for unocular or binocular drivers, it could be said to be in conformity with the directive. Charman⁵ calculated that the number-plate symbol subtended a visual angle of approximately 13.3 min of arc, meaning the nominal binocular visual acuity is actually around 6/15. This is confirmed by simple geometry, (see Figure 1) and is represented by a letter on a theoretical line on the Snellen chart approximately halfway between the lines 6/12 and 6/18.

This level of 6/15 is a lower standard of static visual acuity than specified by the Royal College of Ophthalmologists of approximately 6/10. In our study, of the seven subjects who were unable to read any of the number-plates at 20.5 m, six (85.7%) had a static visual acuity of 6/12. This supports the level of 6/10 chosen by the Royal College of Ophthalmologists for an approximate level of static visual acuity to drive.

The ability to read the number-plate is shown not to be dependent on the background colour when the number-plate is clean.

The lack of standardisation in the number-plate test has frequently been criticised.^{2,3,6,7} There are several potential confounding variables in the test including

illumination, the constituent characters of number-plate, the plate's background and even its cleanliness, which may affect the contrast and visibility of the individual symbols.

Theoretically, in order to pass the standardised test, a visual acuity of approximately 6/15 is required. In our population, all patients had a minimum visual acuity of 6/12 and thus should all have been able to comfortably read each of the number-plates at the legal distance. In our study, 93.2% of patients were able to read all the plates. This was a larger proportion when compared with the study by Currie *et al*,⁸ where only 74% of subjects with visual acuity of 6/9 and only 66% of subjects with a visual acuity of 6/12 were able to read the number-plate. This may be accounted for by their use of an older subject group with a consequent greater degree of cataract formation, poorer contrast sensitivity, and more problems with glare. The number-plates in our study were all in good daylight and clean, thereby aiding visualisation and the subjects were given ample time with which to read them.

A possible explanation for the discrepancy between Snellen visual acuity and the calculated theoretical level of acuity required may be related to the fact that subjects reading a number-plate have a potential choice of 26 letters and 10 numbers (one in 36 or 2.8%) whereas those reading a Snellen chart only have a presumed choice of 26 letters (one in 26 or 3.8%). After a learning period the individual may realise that many letters repeat and the odds can shorten further.

There is also the phenomenon of crowding,⁹ which is often apparent in amblyopic individuals. This is where single letters can be seen at a certain distance; however, when presented with letters on either side, the letter becomes more difficult to read. This difficulty increases the closer the letters are to each other and has also been shown to be effected by which letters are adjacent to the letter under scrutiny. Indeed, certain letters and numbers are inherently easier to read than others.¹

Figure 1 Height of a letter on the number-plate at 20.5 m would subtend the same angle at 6 m if it were 23.24 mm in height.

Although static visual acuity^{10–12} has been shown to correlate to a lesser degree than dynamic visual acuity^{13–15} in relation to the drivers accident record, it seems wise for drivers to have optimal visual acuity when in charge of a passenger vehicle. Periodic retesting would ensure detection of drivers with a potentially hazardous level of visual acuity, as would a reminder of the need to wear an up-to-date pair of glasses when driving. The sending of road fund licence reminders may present an opportunity for such literature to be distributed to all drivers. It would also seem prudent for a standardised vision test to be incorporated as a visual MOT ensuring the drivers, as well as the cars, roadworthiness.

This paper highlights the variability inherent in the current method of testing visual acuity and the lack of standardisation of this assessment in the context of the driving test. With the new registration plates composed of narrower font dimensions and with the revised letter and number distribution offering better conspicuity, the number-plate test has been modified accordingly, with the test distance being reduced to a more memorable 20 m to approximately conform with the previous angle of subtense. It seems sensible at this time to standardise the testing protocol and cooperate with the other European standards.

References

- 1 McMonnies CW. Chart construction and letter legibility/readability. *Ophthalmic Physiol Opt* 1999; **19**(6): 498–506.
- 2 Drasdo N, Haggerty CM. A comparison of the British number-plate and Snellen vision tests for car drivers. Leaflet LF 676. Transport and Road Research Laboratory, Crowthorne, Berkshire, 1977.
- 3 Drasdo N, Haggerty CM. A comparison of the British number-plate and Snellen vision tests for car drivers. *Ophthalmic Physiol Opt* 1981; **1**(1): 39–54.
- 4 EEC (1991) Annex III, Minimum standards of physical and mental fitness for driving a power-driven vehicle. *Off J European Commun* 1991; **L237**: 20–21.
- 5 Charman WN. Vision and driving—a literature review and commentary. *Ophthalmic Physiol Opt* 1997; **17**(5): 371–391.
- 6 Gresset JA, Meyer FM. Risk of accidents among elderly car drivers with visual acuity equal to 6/12 or 6/15 and lack of binocular vision. *Ophthalmic Physiol Opt* 1994; **14**(1): 33–37.
- 7 Taylor JF. Vision and driving. *Ophthalmic Physiol Opt* 1987; **7**(2): 187–189.
- 8 Currie Z, Bhan A, Pepper I. Reliability of Snellen charts for testing visual acuity for driving: prospective study and postal questionnaire. *BMJ* 2000; **321**: 990–992.
- 9 McGraw PV, Winn B, Gray LS, Elliott DB. Improving the reliability of visual acuity measures in young children. *Ophthalmic Physiol Opt* 2000; **20**(3): 173–184.
- 10 Burg A. The relationship between vision test scores and Driving Record: General findings, report 67-24. UCLA Department of Engineering: Los Angeles, 1967.
- 11 Burg A. The relationship between vision test scores and Driving Record: Additional Findings, report 68-27. UCLA Department of Engineering: Los Angeles, 1968.
- 12 Burg A. The relationship between vision test scores and Driving Record: Read before the Symposium on Visibility in Driving Task, College Station, TX, May 13, 1968.
- 13 Burg A. An Investigation of Some Relationships between Dynamic Visual Acuity. Static Visual Acuity and Driving Record, report 64-18. UCLA Department of Engineering: Los Angeles, 1964.
- 14 Burg A. Lateral visual fields as related to age and sex. *J Appl Psychol* 1968; **52**: 10–15.
- 15 Burg A, Hulbert SF. Dynamic visual acuity and other measurements of vision. *Percept Mot Skills* 1959; **9**: 334–337.