Assessment of route and destination displays on public service vehicles: final report

Assessment of route and destination displays on PSVs

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Final report

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GLOSSARY

Character height – For the purpose of this study character height refers to the vertical distance from the top of an upper case capital letter to the baseline on which it sits. For example:

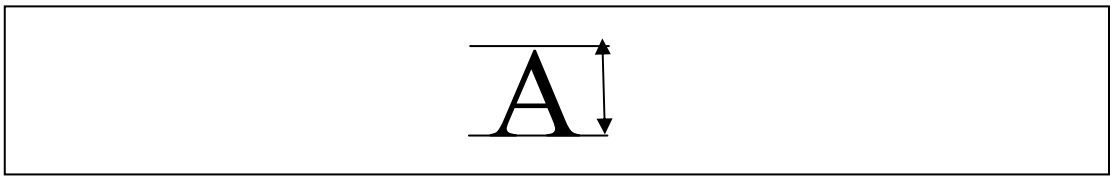

Figure 1.

Character width/stroke width – Is the width of the line that forms the letter.

Colour contrast - Refers to the relative differentiation of colours within the visual field. According to the Munsell colour System, colour is defined in terms of:

- Hue – This relates to the dominant wavelength by which different colours are distinguished ranging from red to yellow to green to blue.
- Chroma – This relates to the strength of hue relative to the brightness of an object that is white or highly transmitting.
- Lightness – This relates to the brightness of the colour relative to an object with a reflectance of unity.

Dynamic or dynamically – In this report refers to displays viewed while the bus is in motion.

Flip dot – Also known as reflective Disk Matrix Displays. These displays consist of a matrix of circular, square or rectangular elements that are reflective on one side and matt black on the other. An electromagnetic current rotates the elements to display either the black or reflective side, with the reflective elements forming to create

the letters and therefore the message. The most common colour of the reflective side is yellow. A flip dot display is a power driven display which can be programmed with many different configurations of flip dots to form different route displays. The driver can electronically select the required route for display.

LED – Refers to signs created out of a matrix of Light Emitting Diodes (LEDs) that are turned on or off to form letters and therefore display the intended message. An LED display is an power driven display which can be programmed with many different configurations to form different route displays. The driver can electronically select the required route for display

Luminance contrast - Luminance is the technical term for the intensity of light per unit area of its source. Luminance contrast is a measure of the relative luminance between two parts of the visual field.

Printed – Refers to Printed display technologies, in which the solid painted letters have been printed onto the display background. Conventionally a series of displays were printed onto a continuous sheet that was put onto a roller that was turned until the required destination appeared in the display aperture. More recent methods for conveying printed text have included boards attached to a rotating drum that is turned until the correct board is sited within the display aperture.

Raised descenders – Refers to descending letter such as y, g, p, q, j that have been raised such that the descending part of the letter no longer hangs under the written line. Figure A shows three raised descenders (g x2 and y x1). All the letters in the word do not go under the written line.

Figure 2

Static or Statically - In this report refers to displays viewed on a bus while the bus is stationary.

Title case – Refers to text that is printed in lower case with an initial upper-case character as required.

Tiresais –Is a design of typeface that was originally designed in response to a need for improving the text for television subtitling. It is a sans serif font. The primary aim of the Tiresais typeface is to provide characters that are easy to distinguish from each other, and to create fonts that display clearly on screen generation technologies. The design of the typeface was carried out with special reference to the difficulties experienced by people with visual impairments.

Executive summary

1.0 Main findings

The aim of the research was to investigate the practicality, reliability and quality of information shown on displays taking into consideration legibility, quantity of information, the use of intermediate place names and the requirements of people with low vision. A number of aspects were investigated within the research and the findings and recommendations are summarised below.

1.1. Identification as a bus

Discussions with visually impaired groups indicated that there could be difficulties identifying the approaching vehicle as a bus due to the vehicle colour, the livery used, etc. Further research to address this is recommended.

1.2. Identification of the route information

Discussions with visually impaired groups also indicated that there could be difficulties 'locating' the route information on the front of the bus due to the 'clutter' of advertising. Further research to address this is recommended.

1.3. Location of display within vehicle

It is recommended that displays are located as close as possible to the display window aperture in the body of the vehicle since recessed displays reduce reading angularity.

1.4. Amount of information

The route number was considered to be the most important type of information contained within the front display, followed by the final destination and then the intermediates. It was also found that the addition of one intermediate place name significantly increases the reading time above that for the route number and final destination. Due to this and their relative reduced importance, it is recommended that intermediates be only used where they do not detract from the optimum provision of the route number and final destination information.

1.5. Layout of display

Where preferences were expressed, the majority were for the route number to be to the right-hand side of the display and for the final destination to be below the route number.

1.6. Display technology

No single display technology performed better than the others under all the viewing conditions.

When corrected for character height, LED displays could be read statically at significantly greater distances. (This was statistically significant for sighted participants by daytime only).

When the printed white on black and flip-dot displays were assessed dynamically under day and night conditions (it was not possible to assess the printed yellow on black and LED display's dynamically due to drivers of these vehicles being unavailable during the trials), it was found that their reading distances were significantly less than for reading the static displays, the exception being the flip-dot display under night-time conditions where no difference was found.

The printed yellow on black display could be read at significantly wider forward viewing angles by sighted participants by daytime and night-time than the flip dot displays. The printed white on black display could also be read at significantly greater viewing angles over the flip-dot display but only in night time conditions.

Preferences were expressed for printed displays; the flip-dot and LED displays were considered to be less readable when viewed close-to due to a lack of clarity.

It is recommended that the clarity of the flip-dot and LED displays be improved when viewed close up and that the viewing angularity of the LED displays be increased. However the level of increase for these aspects, which is 'good enough', is not known.

1.7. Display colour

Within the laboratory trials, the white text on a black background was read significantly quicker than fluorescent yellow text on a black background by visually impaired participants only. However, subjectively no preference was found between yellow text on a black background and black text on a yellow background. Within the field trials, the fluorescent yellow text could be read at greater viewing angles than the white text. It is recommended that displays be used in which the text has a high colour contrast with the background, such as white or fluorescent yellow in conjunction with black.

1.8. Font size

Based on the visually impaired participants in the laboratory and field trials it is not possible to increase text to a sufficient size to make the displays readable at 40m (broadly the minimum PSV stopping distance). Even relatively modest readability benefits to this group would necessitate increases in character height that are beyond the limits of current display and vehicle design. Given the relative importance of the route number, it is recommended that priority be given to maximising the height of this within the display followed by the height of the final destination.

Given that the reading of the front display of an approaching vehicle at a distance of 40m requires a font size that far exceeds the current designs of vehicle and displays, consideration regarding close viewing distances should be

made. Information presented in the Sign Design Guide (2001) regarding character height versus reading distance suggests that a character height of 120mm will enable partially sighted people with visual acuity levels greater than 3/60 to read the information at a distance of 2m. Therefore current character heights of 125mm and 200mm, for final destination and route number respectively, are sufficient to enable some visually impaired passengers to read the displays when viewed close to at 2m, i.e. when a bus has stopped at a bus stop. This means that the affects of reading angularity at such close distances is therefore an important aspect (Refer to 1.3).

1.9. Typeface

Previous research, as well as investigations within this project, indicate that readability is improved if sans serif and bold characters with a square-like formation are used. It is also recommended that text with raised descenders is not used.

1.10. Ageing of displays

Due to difficulties in defining an aged system and knowing its relevance to the real world, the ageing of displays was assessed within the laboratory trials by considering the effect of accumulating dirt on contrast. It was concluded that the readability of higher contrast displays would not be degraded as quickly by dirt as lower contrast displays and it is therefore recommended that displays with a high luminance contrast be used.

1.11. Passenger perceptions

Relative importance of displays

The front display was found to be significantly more important to the use of the bus by both groups of participants and the side display was found to be more important to visually impaired participants than the sighted participants.

Display element

The route number was found to be significantly more important to the use of the bus by both groups of participants.

Glare and reflections

Glare and reflections were reported as unfavourable aspects of current displays. It is recommended that future display designs address these issues.

Improvements

For all groups larger numbers was the most frequently cited method of improving bus displays. In addition visually impaired participants favoured improved clarity, while the sighted participants were more concerned with the type of information provided.

1.12. Practicality of system operation

LED and flip dot displays, opposed to the roller blind printed displays, enable vehicles to be used more flexibly across routes

thereby permitting operators to be more responsive to market demands. They can also be programmed in house to accommodate new or amended routes unlike the traditional printed displays that have to be manufactured by external specialists.

1.13. Ease of setting

The roller blind printed displays have to be individually adjusted which can be time-consuming as well as a driver safety and vehicle security risk since the driver may have to leave the cab. Also drivers may need to apply high forces if the mechanisms have deteriorated. Using LED and flip dot displays, the driver can change all displays simultaneously at the push of a button without leaving the cab.

1.14. Reliability of equipment

The more recent models of electronic displays (i.e. LED and flip dot displays) are considered to have good reliability and are relatively maintenance free with some manufacturers offering a lifetime guarantee. By comparison the manually wound displays require regular maintenance to ensure reliable working.

1.15. Reliability of information displayed

The reliability of the information displayed by flip-dot and LED displays is affected by poor character definition. In addition, flip-dots can stick and fade whilst the LED bulbs can fail and suffer

impeded visibility in bright light. The reliability of the information displayed by traditional, manually wound printed displays is reduced by display mis-alignment, the intrusion of backlighting and the potential for greater dirt ingress into the non-sealed units causing degradation of the text.

2.0 Recommendations

2.1. Identification as a bus

Whilst vehicle colour and size were the most frequently mentioned methods for identifying a bus, the lack of standardised colouring due to deregulation and the ongoing amendments to corporate liveries as well as the confusability of buses with other large vehicles, meant that this was not a reliable strategy for use by the visually impaired passengers. This suggests that the use of a unique identifying feature that can be applied across all PSVs should be considered e.g. a broad fluorescent yellow horizontal band across the front of the bus.

2.2. Identification of the route information

It is recommended that advertising and graphics be removed from the areas of the display and replaced with a format which will not detract form the route information and preferably enhance it e.g. locating the display within the broad fluorescent horizontal yellow band described in 2.1 above.

2.3. Location of display within vehicle

It is recommended that the displays are located immediately behind the display window aperture.

2.4. Amount of information

The route number was considered to be the most important type of information contained within the front display, followed by the final destination and then the intermediates. It was also found the addition of one or more intermediates significantly increased the reading time of the display above that required for reading just the route number and final destination. It is therefore recommended that intermediates only be used where they do not detract from the optimum provision of the route number and final destination information. Refer to 2.8.

2.5. Layout of display

Where preferences were expressed it was for the route number to be to the right of the display and for the final destination to be displayed below the route number.

However it was noted by the experimenters that for deeply recessed displays, the right-hand side of the display might be obscured from the view of passengers standing on the kerbside at the front of the bus.

2.6. Display technology

It is recommended that the clarity of the flip-dot and LED displays be improved when viewed close up and that the viewing angularity of the LED displays be increased. However the level of increase for these aspects that is ‘good enough’ is not known.

2.7. Colour

It is recommended that displays be used in which the text has a high colour contrast with the background.

2.8. Font size

It is recommended that priority be given to making the height of the route number be as large as possible followed by the character height of the final destination.

2.9. Typeface

It is recommended that bold, broad character typeface that employs conventional dropped descenders (opposed to raised descenders) be used.

2.10. Ageing of displays

It is recommended that displays with a high luminance contrast be used.

2.11. Variation in day and night time lighting conditions

This variable was taken into account in the assessment conditions and is reported within the other findings.

2.12. Displays lit and unlit

Through discussions with operators the displays are always operated lit both daytime and night-time.

2.13. Passenger perceptions

Relative importance of displays

There would appear to be merit to having displays to the front, side and rear and their continued use is recommended.

Display readability

Based on the visually impaired participants used within this research, there is a need to improve display readability. Means for achieving this are given within this recommendations section.

Display element

The route number is the key element in display use. Aspects to improve its readability should be prioritised.

Favourable features of display design

Large, clear, bold high contrast text should be used.

Unfavourable features of display design

Glare, reflection and the misalignment of information should be addressed by the display design.

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