IMPROVING THE SAFETY OF SCHOOL TRAVEL VIA BUS WARNING SIGNAGE IN ABERDEENSHIRE, SCOTLAND

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1. INTRODUCTION

Following the tragedies involving two pupils being fatally injured on Aberdeenshire's roads after alighting school buses in 2008, Aberdeenshire Council has progressed a number of trials that seek to improve the safety of school transport services, including a trial of new school bus signage. This paper describes the detail of the trial and presents the results from the evaluation undertaken on the new signage. Consideration is also given to some more general lessons that have been learned in taking forward this body of work on what is understandingly a very emotive topic with a high level of public and media interest.

2. BACKGROUND

2.1 Context

In September 2008, two school pupils were fatally injured on Aberdeenshire roads in separate incidents after alighting school buses. In the immediate aftermath of the tragedies, the topic of school transport safety became the focus of significant political, public and media interest. Following a review of international research in this area, Aberdeenshire Council launched a number of initiatives to reduce the risk of similar incidents happening again (Aberdeenshire Council 2008). These included the launch of the first UK trial of the SeeMe® interactive school bus stop technology and introduction of the 'Bus Stop!' education pack in Aberdeenshire schools.

In addition, consultations undertaken by the Council with school transport operators revealed various concerns regarding the visibility and interpretation of the existing school bus sign. Visibility concerns related to the view that the sign was not very bright and was often 'lost' in much of the other livery and logos on buses or placed behind tinted glass. Concerns over the interpretation of the sign centred on the view that not all motorists associated the sign's pictorial with school children and, therefore, school transport. Concerns were also raised from other stakeholders in relation to the inappropriate use of the sign ranging from some operators failing to show the sign at all, to some failing to remove the sign when not carrying pupils to and from school. In particular, it was considered that the presence of the school bus sign on all types of buses at all different times e.g. even when not carrying school children, such as on football supporters' coaches during weekends, actually diluted the effectiveness of the sign and leads to motorists failing to take appropriate care when travelling in the vicinity of school buses.

The limited research that exists on school bus signage also served to highlight confusion around its' legislative requirements and appropriate use (Scottish Executive 2007, Thornthwaite 2009). Therefore, to work in partnership with the aforementioned initiatives, the Council, supported by the Scottish Government, undertook a trial of new school bus signage that has sought to address the concerns raised.

2.2 School Bus Sign Legislation

Under the UK Road Vehicles Lighting (Amendment) Regulations 1994, buses and coaches used for journeys to and from school are required to display distinctive retro-reflective yellow school bus signs fitted to the front and rear of the bus (Scottish Executive 2003). Specifically, signs at the front of the vehicle must be at least 250mm x 250mm with the black border of not more than 20mm wide and at the rear of the vehicle at least 400mm x 400mm with a black border of not more than 30mm (Fawcett and Croner 1993). Each has a silhouette of two children in black on a yellow reflective background, as shown in Figure 1.

Figure 1: School Bus Sign

The regulations prescribe the minimum dimensions of the signage and thus larger versions may be used. The regulations also permit buses using the sign to display their hazard warning lights when children are boarding or alighting the vehicle and permit an additional pair of hazard warning lights to be fitted to increase visibility. Additional warning signs are also permissible, such as illuminated signs reading "*School Bus*" or "*Caution: Schoolchildren*" etc. although there are regulations that have to be followed if developing such signage. For example, illuminated signs need to show a steady (i.e. not flashing) light and be red if showing to the rear and white (or in some instances yellow) if showing to the front. It is therefore possible for authorities who outsource school bus contracts to stipulate specific signage conditions over and above the existing minimum requirements if they wish.

The purpose of the school bus sign and hazard warning lights "*is to make other road users aware that when the vehicle is stationary children are likely to be getting on or off the bus and may be crossing the road. Other road users should, therefore, be very cautious when passing a school bus in those circumstances*" (Scottish Government 2003). Arguments follow that the sign should only be displayed when the bus is operating as a school bus,

transporting pupils between their home and school, because its constant display at all times (i.e. when not carrying school pupils) actually dilutes the effectiveness of the sign. However, there is no statutory requirement to remove school bus signs from buses not being used to transport children to and from school, or to use hazard warning lights when the vehicle is stationary and children are boarding or alighting. Instead, it is the local authorities' responsibility to stipulate in their contracts with operators that signs should only be displayed when children are being transported and that hazard warning lights should be used when children are getting on or off vehicles (Scottish Executive, 2003).

2.3 Literature Review

A background literature review undertaken prior to the development of the Aberdeenshire trial confirmed that while a wide range of school transport safety initiatives operate globally, on the whole, only limited research had been undertaken on school bus signs.

In the UK, research on school transport safety has tended to focus on the effects of safer routes to school, traffic calming, and active travel projects as opposed to school bus safety. UK literature on school bus signage simply serves to confirm that a high level of misunderstanding and confusion exists, both on the part of councils and school bus operators, about the legislative requirements around the display of school bus signs. As Thornthwaite (2009) highlights, the signs are "*widely misused (e.g. wrongly sized signs) or are left in place when it is evident that the vehicle is not being used by children"* and the regulation surrounding the appropriate use of the sign *"...appears to be widely disregarded and inconsistently applied, and it is doubtful today whether there is any benefit or change in driver behaviour around buses as a result*".

At the global level, initiatives include the use of yellow school buses and legislation banning the overtaking of stationary school buses (in the US and Canada), speed limit enforcement around school buses (Australia and New Zealand) and the use of technology and safety assessment tools to improve pupil safety at school transport pick-up and drop-off points (Scandinavia).

There is an emerging body of work on school bus sign conspicuity at the EU level. The EU SafeWay2School Project (http://safeway2school-eu.org/) for example reviewed a wide range of school bus signs from across the world, with an aim to develop a new sign for further development and trial. The review found that graphical representations of 'children', 'running' and 'bus' were common in the majority of the signs, but also identified that representation of the 'children' symbol varied from country to country (Egger 2010). The research concluded by recommending three key factors that would contribute to a more effective school bus sign: [1] an emphasis on danger, [2] clarity of the graphical content of a symbol, and [3] a reduced number of graphical elements.

In Sweden, the Swedish National Road and Transport Research Institute have undertaken research into the effects of school bus signs incorporating flashing lights on motorists' behaviour with one recent study suggesting that the school

bus sign alone does not result in any change to drivers' behaviour, although flashing lights did have a positive effect (Kircher *et al.* 2007). Anund *et al*. (2005) examined road users' behaviour when passing buses at standstill displaying different forms of school bus signs on roads with speed limits of 50km/h and 70km/h respectively. Three different forms of school bus signing were tested: buses without any sign; buses with the existing school transport sign; and buses with the existing school transport sign equipped with blinking lights. Behaviour was measured in terms of motorists' traffic speeds and fixation patterns on buses. The study found that drivers approaching school buses did not lower their speed or when overtaking increase their lateral position to the bus if it is marked only by the existing school transport sign. If however the sign is combined with blinking lights, the drivers will decrease their speed and fixate longer on the bus and more often on it. The study also recommended that future school transport signs should have blinking lights and that the sign should be in another format with another type of icon than at present, which in turn required more research.

3. DEVELOPMENT OF ABERDEENSHIRE'S NEW SIGNS

In summer 2009, Aberdeenshire Council's Road Safety Engineering Unit set about the process of designing a number of new signs in consultation with the UK Department for Transport (DfT).

The signs developed for trial in Aberdeenshire have sought to address the concerns raised by the operators and raise motorists awareness to the presence of school buses and, in turn, the possible presence of pupils boarding and alighting school buses. Key features of the new signage include:

- The use of high visibility reflective materials;
- Inclusion of the words *'School Bus'* to increase understanding and awareness as to the presence of school buses and pupils potentially being picked-up and alighting in the area; and
- Chevrons to increase the visibility of the sign, assist in highlighting the pictogram and *'School Bus'* font, and to make motorists aware that they are approaching a potentially dangerous situation.

Figure 2: Example of the New School Bus Sign (left) and Existing Sign (right)

The manufacture of the signs at larger dimensions was also considered important to increase the signs visibility. As an added benefit, it was felt that the use of larger, more prominent school bus signs could encourage bus operators to remove the sign when their vehicle is not operating as a school bus, particularly if it hides their livery / advertising.

Figure 3: New School Bus Signs in Aberdeenshire (Off/Hidden from Display – left. On Display – right)

At the front of the bus, it was more difficult to increase the dimensions of the sign owing to the lack of useable space to fix the sign to the bus, and a requirement that the sign does not obstruct the drivers view if placed in the windscreen. For this reason, a higher visibility version of the existing sign was the option taken forward for the trial.

To develop options for fitting the signs to the vehicles, site meetings were held with the operators involved in the trial. At these meetings, the operators were provided with variations of the sign and suggestions offered as to how they could affix the signs to their vehicles. As far as possible, operators were encouraged to fit the signage to the outside of the buses, with hinged, bolted-on options recommended such that the signs could be folded away when not in use as a school bus. Anti-loose fasteners were also examined, as were sticker options on those vehicles which were only ever used as school buses. Regrettably however, it was accepted that for some buses, owing to their physical dimensions, the only suitable position for the sign was in the window.

4. EVALUATION

4.1 Details of the Trial

The new signage was unveiled at Meldrum Academy on 5 November 2009 with the trial running until summer 2010, allowing the signage to be assessed in a range of daylight and weather conditions.

Meldrum Academy, based in Oldmeldrum, Aberdeenshire, was selected for the trial as it has the largest proportion of pupils travelling by school bus in Aberdeenshire. A mix of operators also provides school bus services to the

Academy, which was advantageous in that the new signage could be piloted on a range of vehicle types. Nineteen school bus services operate to Meldrum Academy, with the new signage provided to each of the operators for the trial.

Figure 4: New School Bus Signs Launch, November 2009

4.2 Purpose / Research Objective

The key purpose of the evaluation was to investigate whether the new school bus signs being trialled in Aberdeenshire were more effective than the existing signs, in school transport safety terms, through increasing motorists' awareness to school buses and, in turn, the possible presence of pupils.

Specifically, this study sought to examine if the new signage addressed concerns in relation to the existing signage and increased motorists' awareness levels to school buses in terms of their ability to better understand what the new school bus sign meant, and their views on its visibility. Research also established that many of the school transport safety initiatives implemented across the world have sought to improve pupil safety through reducing the speed of motorists in the vicinity of school buses and school zones. Findings in this regard have therefore also been taken into account in evaluating the effectiveness of the new school bus signage.

4.3 Methodology

To investigate whether the new trial school bus signs are more effective than the existing signs, in terms of improving school transport safety, through increasing motorists' awareness to school buses and, in turn, the possible presence of school pupils, a robust evaluation programme was developed including:

- A Survey of Drivers;
- Driver Behaviour Observations; and
- Survey of Bus Drivers.

The ***Driver Survey*** was based on the use of 'before' and 'after' questions using photos of the existing and trial signs, designed to investigate with motorists the extent to which they understood the meaning of the signs and their views on each signs' effectiveness. The questionnaire was made available online and promoted through press releases, Twitter, and adverts in the local press and on the Council's website.

The ***Driver Behaviour Observational Study*** was based on the approach adopted in the Anund *et al*. study (2005) and involved a controlled assessment to examine whether the new signage encouraged motorists to reduce their speed when passing school buses. Speed surveys were set up in the vicinity of a lay-by on the B9001; a 60mph road used by commuters travelling from the Rothienorman area of Aberdeenshire to Inverurie and Aberdeen City. Three types of bus were positioned in the lay-by: a school bus displaying no signage; a school bus displaying the existing signage; and a school bus displaying the new Aberdeenshire trial signage. The study was undertaken on three consecutive days in February 2010 and the bus was present at the site on each of these days during the peak AM, afternoon control, and peak PM periods. To assess the impacts of the signs on motorists' behaviour, analysis was undertaken of the speed data collected from speed radar devices set up in the vicinity of the school bus lay-by.

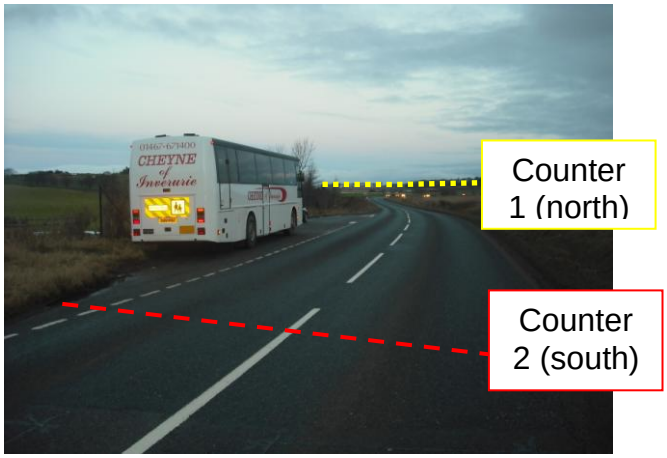

Figure 5: Location of Speed Traffic Counters as part of the Driver Behaviour Observational Study

The ***Bus Drivers Questionnaire*** was developed following discussions of 'before' and 'after' scenarios with the bus drivers involved in the Meldrum Academy trial. Specifically, drivers were asked what (if any) problems they experienced on the school run, in relation to other motorists. This was followed by questions asking if they had noticed any positive change in how motorists drove in the vicinity of their bus following the introduction of the new signs, and what type of changes they had noticed.

5. RESULTS

5.1 Driver Survey

The Driver questionnaire was completed by 911 respondents. Without being informed that the survey was in relation to school bus signage (respondents were simply informed they were taking part in a "road safety survey"), respondents were asked a series of questions on whether they had seen the existing and trial school bus signs before, and what they understood the signs to mean. The results revealed that while substantially higher numbers of respondents stated that they had seen the existing school bus sign (71%)

compared to the new school bus sign (38%), a much higher proportion of respondents correctly identified that the new sign meant 'School Bus' (79%) compared to the existing sign, which was correctly identified as meaning such by just over 40% of all respondents. Indeed, the questionnaire results revealed that a high proportion of respondents thought the existing school bus sign actually meant 'Children Crossing' (30%) and 'School Zone' (22%), which adds weight to the belief, first raised by school bus operators, that the general motoring public does not understand what the existing school bus sign means.

The survey results also indicated that 87% of motorists thought that the new trial signs were 'definitely more visible' than the existing signs (11% said it was slightly more visible') while 65% of motorists thought they were 'definitely more understandable' (24% said it was 'slightly more understandable').

Each of the design elements of the new signs were also commented upon favourably and thought to contribute to motorists' increased visibility and understanding of the signs. Specifically, the inclusion of the phrase '*School Bus'* was ranked as 'highly effective' by 69% of respondents and effective by 18%. The use of higher-visibility reflective sign materials was ranked as 'highly effective' by 67% of respondents, and 'effective' by 24%. Finally, the use of the 'red/yellow chevron markings' was ranked as 'highly effective' by 57% of respondents and 'effective' by 30%.

5.2 Driver Behaviour Observation Study

The results obtained from the driver behaviour observations were generally inconclusive. Speed data analysed for Counter 1, at the front of the bus, suggested the new front school bus signs made no impact to motorists' behaviour. This is unsurprising as although the new trial signs use higher-visibility reflective materials the front sign is still relatively small in size, and it is very difficult to increase this owing to regulations surrounding the fitting of signage. The speed data collected for Counter 2, at the rear of the bus, suggested the new rear signage had a minor positive impact in reducing the speeds of passing motorists. For example, speeds reduced by 1mph across the board (when compared against data collected on Day Two when the existing signs were on display), with the only exception being during the afternoon surveys when speeds were found to have decreased by 3mph (5.8%). While it appears that the presence of the new, larger rear signage positively reduced vehicle speeds compared with the data gathered when the existing sign was on display, given the small speed reductions observed (1mph to 3mph), any impact is considered relatively negligible. A number of potential limitations identified with the Motorist Behaviour Surveys, related to the location of the lay-by and positioning of the speed counters, also contribute to this view that the overall results are inconclusive.

5.3 Bus Driver Survey

The Bus Driver questionnaire was completed by 13 drivers operating school bus services carrying the new signage as part of the Meldrum Academy trial. The questionnaire confirmed the wide range of problems that drivers regularly experienced on the school run, with the most common problems relating to "*motorist's overtaking without due care when the school bus is in transit*",

"*dangerous driving around the school bus*" and "*speeding around the school bus*".

It is therefore encouraging that many of the school bus drivers were positive about the signs having the desired impact, suggesting that the new signs have improved perceptions of safety on the school run. For example, 67% of bus drivers stated that they had noticed a positive change in how motorists drove in the vicinity of their bus whilst carrying the new school bus signage, although the low numbers involved in the survey should be acknowledged. The most common change that bus drivers noticed following display of the new signage on their vehicles was a reduction in motorists' overtaking the school bus while it is picking-up/dropping-off pupils (88%). Other positive changes noted by a majority of drivers included 'more careful driving in the vicinity of the school bus' and 'reduced speeding in the vicinity of the school bus' (both noted by 75% of drivers).

100% of drivers agreed that the new signs were more visible and understandable to motorists than the existing ones. The majority of drivers also agreed that, in practical terms, the new signage was easier to take down than the current sign, despite its increased size.

Figure 6: New School Bus Signs in Aberdeenshire

6. FURTHER RECOMMENDATIONS

Through the literature review, and lessons learned in undertaking the trial in Aberdeenshire, a number of further recommendations were identified which may usefully inform further studies in this area.

Firstly, it is considered that it could be interesting for national agencies to experiment with a further sign incorporating flashing lights. Studies in Sweden have recommended that further school transport signs should have blinking lights and be in another format with another type of icon than at present, which in turn required more research (Anund *et al.* 2005). The findings from the Aberdeenshire trial suggest the addition of the phrase "*School Bus*" and some of the other design characteristics could address these recommendations around other "formats". However, it could also be interesting to add flashing lights to investigate what further impact this could have. Indeed, the results from the Drivers Survey revealed high levels of support for flashing school bus signs with significant numbers of respondents

suggesting that *"high intensity flashing LED lights"* should be added to the sign. The literature review highlighted that *"one disadvantage of any permanently displayed sign is drivers, many of whom would pass the same sign regularly without requiring any action in response to it, tend to ignore it or fail to see it... Active signs incorporating flashing lights and/or lit (LED) components which are displayed only when relevant... heighten the visibility of these signs compared with standard (non-flashing) warning signs thereby enhancing driver awareness of risk*" (New Zealand Transport Agency 2002). It should be noted however that there are more stringent regulations around the use of flashing lights on transport signs which would need to be worked through with the DfT. It is also anticipated that the costs of these signs would be substantially more than the Aberdeenshire trial signs. Nonetheless, in light of the strong feedback on this, this is an area that could warrant further consideration.

Secondly, the need for clearer guidance on the appropriate display of school bus signage, and the introduction of legislation that makes it illegal to display the sign when not operating as a school bus – and importantly enforcement of this legislation – is a further recommendation of this study. The research undertaken has confirmed there is a high level of confusion around school bus sign legislation (Scottish Executive 2007, Thornthwaite 2009). As the Scottish Executive (2007) state, "*the legislation, guidance and practice surrounding school transport have grown up through a variety of routes*" meaning "*it is not always readily possible for a lay person to understand and interpret what should be provided and why. The result of this confusion is evident in some of the ill-informed debate which takes place between authorities, parents and the media.*" It continues, "*While some authorities have sought to overcome this confusion by giving information to parents using written material, or face to face at open days, others do not appear to have clear policies in place (for example, on seatbelts and penalties for the inappropriate display of school bus signs) or fail to inform their staff of these policies*".

Thirdly, a point of good practice which should be promoted if any further signage trials are taken forward is the involvement of school bus operators and drivers. The positive feedback and engagement with bus drivers was a particularly encouraging finding of this study, and one which can be attributed not only to the obvious improvements to the school bus signage but also by the process by which the signs were produced; notably the early consultation with school bus operators and the development of a culture of joint-working and shared responsibility.

As a final recommendation, or point for further consideration, while this study has suggested that the school bus signage trialled in Aberdeenshire can potentially contribute to improved pupil safety, a whole range of other measures covering the full spectrum of the "five 'E's" – Education, Engineering, Enforcement, Encouragement and Engagement – are required to more fully address school transport safety issues. Where school transport safety is concerned, Aberdeenshire Council have promoted the message that everyone has a role to play (pupils, parents, schools, bus operators and motorists) and a holistic approach is required to improve the safety of home-

to-school transport services in acknowledgement that there is a whole toolkit of measures that can be called upon. Therefore, going forward, it is recommended that improved school bus signage should be implemented as part of a package of measures covering the "*Five E's*" to increase awareness and reduce speeds and the risk to children around schools and school buses.

Figure 7: Some Examples of other School Safety Projects including (from left to right) Poster from the 'Bus Stop!' Campaign, SeeMe® Trial in Aberdeenshire, and Transport Scotland's School Transport Safety Tookit.

7. CONCLUSION

In conclusion, the results from the study suggest the new school bus signs are more effective than the existing signs in raising motorists' awareness to the presence of school buses and, in turn, the possible presence of pupils.

While research suggests that the use of flashing lights may be worthy of further consideration, taking into account the current financial situation the school bus signs trialled in Aberdeenshire represent an affordable, effective solution to increasing awareness to school buses. In October 2010, Aberdeenshire Council's Transportation & Infrastructure Committee approved the roll-out of the new signage across the region; a process which is currently ongoing.

Nationally (Scottish Government 2009) there is significant interest in the Aberdeenshire school bus sign trial and it is considered there could be the potential for the findings and recommendations from this research to inform future debates concerning school bus signs and potentially the nationwide roll-out of new, improved school bus signage.

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