Från:	helen.asman@trafikverket.se
Till:	Fredrik Holmér
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Hej

Svar på begäran om yttrande gällande TRV 2019/50685, Remiss gällande riktlinje för skyltning, Täby kommun, Stockholms län.

Trafikverkets yttrande bifogas.

Vänliga hälsningar

Trafikverket

Handläggare:

Åsman Helen, PLsts
helen.asman@trafikverket.se

Trafikverket
http://www.trafikverket.se
telefon: 0771-921 921
trafikverket@trafikverket.se

Datum: 2019-05-09

REMISSVAR

Trafikverket
Ärendemottagningen
Box 810
781 28 Borlänge

Besöksadress: Solna Strandväg 98
171 54 Solna
Telefon: 0771-921 921
Texttelefon: 0243-750 90
trafikverket@trafikverket.se

www.trafikverket.se

Helen Åsman
Enhet PLstsa
Direkt: 010-123 14 42
helen.asman@trafikverket.se

Ärendenummer:
TRV 2019/50685

Ert ärendenummer:
Dnr SBN 2019/93-09

Bygglovenheten
Täby kommun

E-post: fredrik.holmer@taby.se

Kopia:
Diariet

Yttrande angående Täby kommuns interna riktlinje för skyltar

Trafikverket uppskattar möjligheten att få lämna synpunkter på er interna riktlinje för hantering av skyltar. Trafikverket arbetar för närvarande också fram en ny intern riktlinje och handledning för hantering av skyltar där vi kommer skärpa förhållningsättet till reklam som riktar sig till trafikanter. Vi har på senare år sett ett växande problem med allt fler, större och ett allt mer avancerat tekniskt utförande på de reklamskyltar som placeras längs våra större motorleder. All forskning visar att detta innebär risker som är oförenliga med en god trafiksäkerhet, se bilaga.

Trafikverket skulle därför gärna se att ni i er riktlinje i styckena som rör Trafikverkets infrastruktur tillämpar samma förhållningsätt.

Till exempel i stycket om E18 skriver ni .../är oftast olämpligt mot E 18./... Vi skulle gärna se att ni formulerar det så att det framgår att det **alltid** är olämpligt med blinkande, bländande, bildväxlande eller rörliga bilder mot E18, oavsett avstånd till vägen. Även stycket under Övriga vägmiljöer vore det önskvärt om det var formulerat så att det framgår tydligt att det även här, alltid är olämpligt med all form av reklam i komplexa trafikmiljöer; som definieras av att det är hög trafikmängd med periodvisa framkomlighetsproblem, vid på-/avfarter, höga hastigheter, annan vägvisning, kring tunnelmynningar m.m. Det vill säga i princip längs alla de sträckor där det kan vara intressant att placera reklamskyltar som riktar sig till trafikanter på det statliga vägnätet.

Undantag för skyltar mot E18, 264 och 265 mfl kan vara tidsbegränsade byggskyltar om pågående byggen i direkt anslutning till platsen eller fasadskyltar eller liknande som informerar om en verksamhets namn och hör ihop med verksamheten på platsen. Vi vill dock alltid ha även dessa ärenden på remiss.

Takskyltar nämner ni också kan medges i undantagsfall. Här skulle det vara lämpligt om ni även får med att allt som överstiger 20 m över marknivån även ska remitteras till LFV och Försvarsmakten då det kan ha påverkan på luftfarten.

Trafikverket tillämpar i vår riktlinje att höga skyltar, pyloner, master och andra höga anläggningar ska placeras på ett avstånd om minst totalhöjden som avstånd till beläggningskant. För järnväg gäller ytterligare avstånd på 10 m. De tillkommande 10 m som gäller för järnväg kan komma att tillämpas även för väg i samtliga regioner när vår nya riktlinje är fastställd.

I övrigt anser vi att ni fått med de aspekter som berör våra anläggningar och intressen på ett mycket bra sätt.

I Trafikverkets interna arbete med ny riktlinje och handledning för hantering av skyltar som riktar sig till trafikanter på våra vägar, kommer vi arbeta för att i enlighet med Nollvisionen minska alla företeelser som kan orsaka distraktioner hos förarna och därmed minska antalet olyckor. Vi hoppas såklart att kommunerna delar vår syn på trafiksäkerhet och att vi kan samarbeta kring detta på ett enat sätt. I egenskap av ansvarig för trafiksäkerheten på det statliga vägnätet anser vi att vi är sakägare i ärenden som gäller reklam riktad mot trafikanterna på våra vägar oavsett om skyltarna placeras inom 50 m eller bortom 50 m från vägområdet.

Vi hoppas också att tillsynsmyndigheterna får bukt med all den olovlig och olämplig reklam som idag finns i vägmiljöerna, så att dessa befintliga skyltar inte fortsätter att sprida, genom sitt varande, en falsk norm om vad som kan anses vara ”bra” skyltläge.

Slutligen vill vi också bara uppmana er till att skicka alla ärenden till Trafikverket på remiss, hellre yttrar vi oss med ingen erinran än via överklagan av redan fattade beslut i domstol.

För Trafikverket region Stockholm

Helen Åsman
Samhällsplanerare

CEDR Transnational Road Research Programme
Call Safety 2016

Funded by Belgium-Flanders, Ireland,
Netherlands, Slovenia, Sweden, United Kingdom

ADVERTS Assessing Distraction of Vehicle drivers in Europe from Roadside Technology-based Signage.

Minimising distraction from roadside advertising

Recommendations for road authorities

Deliverable No: D2.1

Date: 5 February 2019

Partners

SWOV Institute for Road Safety Research, Netherlands

Transport Research Laboratory, United Kingdom

Vias institute, Belgium

CEDR Call 2016: Safety

Funded by Belgium-Flanders, Ireland,
Netherlands, Slovenia, Sweden, United Kingdom

Assessing **D**istraction of **V**ehicle drivers in **E**urope from **R**oadside **T**echnology-based **S**ignage

D2.1
Minimising distraction from roadside advertising
Recommendations for road authorities

Start date of project: September 2017 End date of project: February 2019

Authors:
Jill Weekley & Shaun Helman (TRL)

PEB Project Contact:
Des O'Connor (Transport Infrastructure Ireland)

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1 Introduction

1.1 Background to the ADVERTS project

Roadside advertising and, in particular, digital billboards are becoming more and more prevalent, and can be an important source of economic benefits even for road authorities. However, roadside advertising can present a safety risk through distraction of passing motorists, since inattention in traffic can have serious consequences; for example naturalistic driving data has shown that longer eye glances away from the roadway are associated with greater risk, with glances that last longer than two seconds more than doubling the risk of a crash or near crash (Klauer, Guo, Sudweeks & Dingus, 2010)

From a safety point of view, a complete prohibition of roadside advertising would likely be the optimal solution in many driving situations. However, this would be difficult or even impossible to implement in practice, given the competing demands of the advertising industry and, sometimes, the related economic benefits for road authorities. Hence, it is very important to ensure that any negative safety effects of roadside billboards are at least minimised via appropriate legislation and / or recommendations, and strict permission procedures. It is important that evidence-based knowledge – whether direct or theoretically-based – should guide the decisions on which billboards can be placed and where they can be placed.

The overall aim of the ADVERTS project is to provide evidence-based recommendations for road authorities on how to minimise negative safety effects of roadside billboards. Use of these recommendations should not be considered tacit consent for the presence of billboards at the roadside; they are intended to assist decision makers who may have control over some features of billboards or their location even though they may not have the authority to prohibit altogether.

In line with the Safe Systems Approach, ADVERTS recommendations are based on a human-centred framework that takes the road users[1] and their capabilities and limitations as a starting point, while also addressing the road environment and the organisational context. The project has previously completed a review of the scientific literature on billboards and distraction; that review focused on summarising the evidence on the relationship between roadside billboards and drivers' distraction, and on identifying knowledge gaps. The project also previously reviewed and summarised the regulations and guidelines currently in use (mainly in CEDR member countries). The recommendations presented in this document have been developed based on these two documents – the ADVERTS literature review and the summary of current practices. In this document, references to the literature and to countries reviewed should be understood to refer to this previous work. Both these documents are available on the ADVERTS website at https://www.cedr-adverts.eu/en/deliverables-publications.

[1] The term 'road users' in this context primarily refers to drivers of motor vehicles and cyclists who are travelling on the road. Many of the recommendations may also be applicable to pedestrians. However, the consequences of distracted pedestrians are likely to be less severe.

1.2 This document

In Section 2.1 we outline the ten main recommendations from the ADVERTS project along with their justification. These describe recommended practice for the implementation of roadside advertising and are structured into four categories. Firstly, 'fundamental' recommendations which are always applicable and which tend to sit across more than one category; these are designed to provide road authorities with a basis which is true in all situations and at all times. These recommendations are fundamental since not adhering to them would always be expected to have a negative impact on safety or cause road user confusion (that could in turn lead to safety impacts, or hinder traffic flow).

Next we present the remaining recommendations divided into the categories of 'location-based', 'content-based', and 'physical feature-based'; these recommendations are designed to provide guidance on those elements that should be considered by road authorities on a case by case basis. In most cases, specific thresholds of these elements that are 'acceptable' or 'safe' are not currently possible to define as the evidence is not available, hence we have avoided prescriptive language where possible. Where existing guidance and legislation includes measurable criteria these have been included as illustrative examples, but should not be interpreted as part of the recommendation. It is worth noting that in most existing guidance measurable criteria are rarely specified; this supports the idea that flexibility will remain necessary, whilst building on sound underlying concepts.

In addition to the ten main recommendations, we present a separate set of recommendations in Section 2.2. These are different in nature in that they do not describe recommended practice for the implementation of roadside advertising; instead they provide recommended actions or 'next steps' for road authorities. These recommendations are aimed not at aspects of the billboards themselves but at removing barriers to using the recommended practice and at improving the processes around the approval of billboard installation. These recommendations were developed based on feedback and discussion with stakeholders both in interviews and at a workshop.

The recommendations in this document are focused on minimising distraction caused by billboards –avoiding situations in which drivers are having their attention drawn to billboards at the expense of other information they might need in the driving environment. As such, they are focused on safety considerations only. There are many other critical requirements for the physical design of billboards. These include being constructed from non-perishable materials and being stable in all weather conditions. There are also requirements on location such as not impeding disabled or pedestrian access, and in particular on high-speed roads, not forming a potentially harmful obstacle in themselves. These are not covered in this work.

2 Recommendations

2.1 Recommended practice for implementation of roadside advertising

Categorisation: Fundamental, Location, Content, Physical design

1. Billboards which can be confused with road signs (e.g. size, shape, colour, content or a combination of these) should never be allowed.
Road signs (for example direction signs, signs giving orders such as speed limits and 'no entry', and warning signs such as 'give way') are an essential part of providing relevant information to motorists, to facilitate the smooth and safe operation of traffic. Billboards resembling such signs could easily cause drivers to become confused, leading to potential negative impacts on traffic flow and safety.

Despite there being no formal studies on this particular issue in the applied literature, there is clear theoretical evidence on which the recommendation can be made. Put simply, searching for information (much of it on signs) while driving is a visual search task. A fundamental finding in the study of visual search is that, in general, the more similar background 'distractor' objects are to 'target' objects, the more difficult it is to detect the targets (Estes, 1972). Thus, having billboards ('distractor' objects in this context) that are perceptually similar to road signs ('target' objects in this context) is undesirable as it would be expected to slow down the acquisition of relevant information and to increase the amount of information missed by drivers. In some circumstances, it may even provide incorrect information for example if a motorist were to interpret something written on a billboard as relevant to their navigation.

One of the two key concepts found in all legislation and guidance reviewed was that billboards or advertisements must not confuse road users or distract them such that it may cause a hazard. Whilst this is discussed in more depth for Recommendation 3, it is clear that billboards resembling road signs are a specific and obvious example that contravenes this guiding concept. Most countries reviewed also explicitly state, in terms of colour, size and shape and content, that billboards which could be confused with road signs are prohibited – whether or not they are deliberately designed to be misleading. Such a requirement should be mandatory in all guidance or legislation.

Some countries do include specific guidance targeted at preventing unintentional confusion with road signs, for example, in Flanders, red and / or green digital billboards are not allowed within 75m of traffic lights. This example is also targeted at issues relating to visual clutter and driver workload which are addressed in subsequent recommendations.

2. Billboards should never be located in such a way as to obstruct or hinder road users' view of road signs, traffic signals, or any road infrastructure (including the road) critical to their understanding of the road system.

If a billboard obstructs some infrastructure which provides critical information to a road user, this effectively distracts them from the information they require and could have a safety or network performance impact. This may be through physical obstruction of the road user's view or through more indirect mechanisms, such as the lighting of a billboard causing a road sign to be silhouetted or difficult to read.

There are no known studies directly addressing this issue, nor is there any need for a theoretical basis to this recommendation. Instead, it is a rare valid case in which a reliance on common sense is possible; assuming that we have a desire to have drivers detect and understand information on road signs, then having billboards which block this information is clearly undesirable. It can, of course, be argued that obstruction of some information by a billboard is not strictly the same as a billboard causing a distraction from that information, but if we think of the behavioural outcome (misallocation of attention) we can see that the two are, in fact, covered under the same theoretical framework.

This was the second of the two key concepts that was found repeatedly in all legislation and guidance that was reviewed; some merely stating that visibility of signs, signals, equipment or the road itself must not be impaired or reduced, others specifying that particular attention must be paid to sightlines at junctions, bends or other intersections. These, or similar, requirements have an obvious direct link to safety and as such should be mandatory in all guidance or legislation.

3. Billboards should be avoided in complex driving situations such as intersections and motorway exits or entrances.

In certain situations and locations, a higher level of attention and concentration is required in order to drive safely; a driver must be ready to respond and make decisions quickly and the consequences of being distracted at these locations are more severe. Examples are intersections and motorway exits or entrances. Adding to the mental demands on the driver at these points should be avoided.

Similarly, billboards should be avoided in situations where there are already many signs (or existing billboards) as this can create a complex situation and cause driver confusion.

The theoretical basis for this recommendation is twofold. First, complexity in the driving situation will demand greater attention from the driver (Fuller, 2005) and thus adding billboards into these contexts will potentially draw attention when it is required for the driving task. Second, we can again refer to basic findings in the literature on visual search (see e.g. Treisman & Gelade, 1980). So long as search is not for a simple feature likely to 'pop out' (see also Recommendation 1) the larger the set of distractor items in the display being searched, the longer it takes to find a target item. Although the precise link between this basic psychology finding and the similar task in driving has not been established in full, it seems sensible to be careful and avoid adding complexity to an already complex situation where possible.

Visual clutter is the state where there are excessive items present in someone's field of view, potentially leading to degradation in the performance of a task. Experts argue that because visual clutter may deteriorate driving performance, billboards and especially static digital billboards or video billboards should not be placed near complex road and traffic situations where drivers have to concentrate even more on the driving task and to take decisions such as near intersections (e.g. Wallace, 2003, Edquist, 2008).

Some direct studies have shown that there appears to be some kind of self-regulation – i.e. when the road and traffic situation is complex drivers tend to concentrate more on the driving task and tend to look less often at billboards (Young, Stephens, Logan & Lenné, 2017; Marciano & Yeshurun, 2012). Despite this, it is best to avoid increasing the risk; other studies indicate that billboards affect decision making in complex road situations (Edquist, Horberry, Hosking & Johnston, 2011), increase response times (Milloy & Caird, 2011) and affect drivers' observation of other road signs (Smiley et al., 2005).

As discussed in Recommendation 1, all guidance and legislation reviewed emphasises the need to not confuse or distract drivers such that it causes a hazard. This is difficult to objectively assess and hence most existing guidance aims at minimising driver workload and driver confusion. One approach used is to prohibit any advertisements in complex locations – such as intersections. Many countries do not provide measurable criteria for these restrictions; some provide criteria that vary according to road type or speed at the location.

Where guidance or legislation provides these specific distances and requirements, these tend to be related to two elements – the minimum distance between two billboards or advertisements (along the roadside) and the minimum distance between a billboard / advertisement and various traffic signs, signals or road infrastructure.

A typical example is that billboards should not be placed within 50m of junctions, crossings or safety-critical signs on urban roads (e.g. in Malta and Luxembourg, amongst others). Italy in particular uses a high level of detail, providing different minimum distances before and after safety-critical signs, before and after other signs, and before tunnels, intersections and bends. The minimum distance between billboards varies from 25m on low-speed urban roads in Italy to 3km on motorways in Cyprus.

The sparsity and variety of such criteria demonstrate the difficulty of defining specific requirements that are broadly applicable; guidance will always need the flexibility to consider individual circumstances whilst bearing in mind a general understanding of the concepts of workload and distraction.

4. Advertisements with moving images and animations should not be used.
Movement draws attention. There is no clear evidence to define an amount of movement that is 'acceptably safe' and therefore it is recommended that road authorities prohibit all moving images on billboards.

There are limited direct studies on this issue, due to the relative novelty of the technology; however when video billboards were included in the studies, these billboards had the most deteriorating effect on gaze behaviour and driving performance, especially for young drivers (Chattington, Reed, Basacik, Flint & Parkes, 2009).

From a theoretical standpoint, movement is one basic feature of stimuli that seems to draw attention (Franconeri & Simon, 2003) as is abrupt visual onset (Yantis & Jonides, 1984). Both of these are undesirable for road safety and transport system efficiency. The precise impact of the amount of movement on gaze behaviour in this context is a gap in research; there is currently an absence of clear evidence on thresholds that might be deemed acceptable. Research on the specifics (such as how much movement is needed to draw attention) might in the future help to inform the debate. The safest assumption at this stage is therefore that moving images should not be used.

This is supported by existing practice in all countries considered; all guidance included the requirement that there should be no moving images, no moving text, no 'dynamic' advertisements, no video and / or no animation; for some this was only explicitly stated for high-speed roads, but in most it was a universal restriction.

5. Billboards should never display content that encourages drivers to look for information or to perform some action which is not relevant to driving.
The content of an advertisement may encourage attention to be drawn away from the driving task in different ways, all of which may cause a hazard. Examples would be content that may encourage a visual search for non-driving information, such as looking out for a subsequent billboard with further information, or referring to subsequent advertisements on the same billboard. Content encouraging actions such as 'call now' telephone numbers are another example. These are all undesirable as they may encourage drivers to modify their behaviour in order to be able to view the subsequent information or perform the action.

There were no studies in the literature review which addressed this issue directly. The theoretical basis to underpin this recommendation is twofold. First, any content which draws attention to subsequent content on the same billboard (for example over phased transitions) or on subsequent billboards is by definition designed to extend the length of time it is looked at, or to encourage drivers to look for information which is not relevant to driving. Dingus et al. (2016) showed that when drivers look for an extended period of time at an external object, crash risk increases. Longer glances away from the roadway (especially greater than two seconds) raise the risk of a crash (Klauer et al., 2010), so this is clearly undesirable. Second, content which encourages visual search behaviour unrelated to the driving task should also be avoided. EinhÃ, Rutishauser and Koch (2008) note that the goal of the observer in visual search tasks can override stimulus-driven saliency effects (i.e. the basic features of a stimulus like brightness which might otherwise draw attention) in some conditions; in practice this might mean a driver seeking information (due to a previous billboard) could miss a road hazard, even if it were relatively obvious in terms of its visibility.

While additional research may be required to further refine the effects of different durations of glances away from the road, or of types of items that are being searched for, we argue that any sequential links in billboard content, or information which encourages driver attention to be allocated to other subsequent non-driving-related content, should be avoided.

Similarly, we argue that any content that encourages drivers to undertake an action that is not related to driving should be avoided. Performing an action may not only take attention from the driving task; it may also have a physical impact on the driving task, for example, taking a hand off the wheel, which presents an unacceptable safety risk.

In existing practice, the issue of subsequent information on the same billboard is rarely explicitly addressed; where it is mentioned – in Flanders, Sweden, Malta and Norway – it is universally prohibited. All countries reviewed have criteria related to the content of advertisements, many of which implicitly or explicitly address the issue of how it might encourage drivers to allocate their attention after seeing it. Some specific examples are: no content that has real-time interaction with the road user (Flanders), no inciting to an action that distracts the driver from the driving task (Netherlands), no phone numbers or web addresses (Sweden, Norway), no content that encourages making abrupt driving stops or directly draws attention away from traffic (e.g. instructions to brake, or direction arrows) (Norway).

6. Any advertisement on a billboard should be concise, legible and simple to understand.
The more information there is on a billboard, the more difficult it is to read (because, for example, of font size or style) or the more complex it is to understand, the longer drivers will require to read it. This means they will look away from the road for longer if interested in the billboard; the longer drivers spend looking away from the road the less safe a situation is.

There are some relevant simulation studies that support this recommendation – these showed that the more text that was displayed on a billboard the more the lateral control of a vehicle deteriorated when drivers tried to read it (Schieber, Limrick, McCall & Beck, 2014) and that billboards with only a few words in large font size deteriorate the performance of a tracking task (resembling steering) the least (Marciano & Setter, 2017).

The theoretical basis here is also simple; the more information there is on a billboard (or the more difficult it is to read for whatever reason), the longer it will take people to read it, and the longer their eyes are off the road the less safe the situation is. Work from naturalistic driving suggests that glances away from the road of greater than 2 seconds are particularly dangerous (Klauer et al., 2010) although in many driving situations this threshold may be too high.

Most countries have some variation of this concept as part of the guidance, although almost none provide any specific, or quantifiable, criteria. The exception is Norway that requires simple fonts, good contrast between text and background and no more than eight words, symbols, images or numbers.

7. Billboards which switch between adverts can be allowed, but the duration of display should be maximised so that the number of transitions is minimised.
One aspect of digital billboards that is useful for advertising is the ability to allow multiple adverts to be displayed in turn on the same billboard. It is known that the moment where one advert changes to another is more distracting than the adverts themselves, and therefore the display time of each advert should be as long as possible so that the number of transitions will be minimised.

Both in simulator studies and in field studies it was found that at the moment a switch of advertisements occurs, they attract the most visual attention. More drivers tend to look at

these billboards at those moments and when they look, they look for longer (see Belyusar, Reimer, Mehler & Coughlin, 2016; Mollu, Comu, Brijs, Pirdavani & Brijs, 2018). The less drivers experience a switch of the advertisement when they approach, the less drivers will be distracted due to these transitions. One paper which has been published since the literature review in the ADVERTS project is that of Mollu et al. (2018), who showed in a driving simulator study that shorter display times (and therefore more transitions) resulted in more glances to a billboard, and significantly higher mental workload ratings. The theoretical basis for this recommendation is the same as that for Recommendation 4 – movement and change are more likely to draw attention.

Transitions themselves can be made in a variety of ways and at a range of different speeds – for example, the first advert could be 'faded' slowly out to be replaced by the next, or it could be an instantaneous transition. However it is not at all clear from the evidence whether longer or shorter transitions are more distracting or if there are methods which are preferable in terms of minimising distraction. Mollu et al. (2018) found that drivers approached a pedestrian crossing at a slightly higher speed with shorter transitions but, by itself, this is not sufficient to resolve the issue. It is therefore not possible to provide any recommendation on how the transitions should be made. The evidence base does however state that the moment of transition is more distracting than the (static) adverts either side. This implies that the longer the display time of an advertisement on a static digital billboard, the better this is for road safety.

Most countries specify some requirement on display (or exposure) time, but the variability of these measurements suggests that the basis for the values chosen is not robust. The shortest time seen in guidance is a minimum display time of 6 seconds in Luxembourg; Finland and Flanders specify a minimum of 30 seconds. In Norway the minimum is 24 hours, a restriction that arguably is equivalent to outright prohibition.

For other countries, the restriction depends on the speed limit of the road. Both Malta and Sweden provide formulae which require that display time should be longer than the time taken for a vehicle to pass at the posted speed limit (this also therefore depends on the road environment and the legibility distance of the billboard).

8. Billboards which dazzle road users, or which are excessively bright or reflective should never be allowed.
Driving is predominantly a visual task. Dazzle is, by definition, temporary blindness, and therefore is clearly undesirable. Brighter things also draw more attention, so even in the absence of dazzle, consideration should be given to whether billboards are more likely to draw attention in the scene than other, more task-relevant information or even reduce the visibility of other road signs due to excessive relative brightness. The acceptable level of brightness of a billboard will vary depending on the road lighting, the weather and the time of day.

Whilst there are no direct studies in the literature, the theoretical basis supporting the need to avoid dazzle is self-evident. The need to avoid lighting and reflectivity that is greater in level than that on existing road signs in the driving scene is based on the fact that, in human vision research, brightness is an agreed low-level vision feature that influences visual search from a 'bottom up' perspective (see e.g. Itti & Koch, 2000); put simply, brightness is one stimulus

feature that draws attention, and it therefore makes sense to avoid having the objects in a scene which are less important for safety and information purposes being brighter than those that are.

Many countries specify explicitly that billboards should not be dazzling, blinding or cause glare for road users, and acknowledge that illumination should not be distracting and lead to potentially unsafe driving conditions.

Most include some kind of guidance for illumination related to the surrounding environment: some requiring billboards only to be less luminous than road signs – in order not to reduce their effectiveness; some requiring the luminance and brightness to be lower than ambient light more broadly, with the capability of automatic adjustments when necessary. Some relate specifically to the other lighting present – prohibiting any illumination of billboards in absence of other road lighting.

Some countries do specify absolute maximum luminance, although it is not clear what these values are based on and there is significant variability. In the Netherlands the maximum is 500 cd/m^2 in rural areas and increases to 1000 cd/m^2 in town centres; in Italy the maximum is 150 cd/m^2.

9. Billboards with flashing, intermittent, modulating or moving lights or moving parts should never be allowed.
Lights which are moving in some way, or appear to be moving, grab more attention than stationary lights and therefore represent an unacceptable level of distraction. This is also true for billboards with moving parts. It must also be ensured that, on malfunction, billboards do not attract attention through movement (for example through intermittent flashing of a broken bulb).

There are no direct studies in the literature that address this issue, however the same theoretical basis for Recommendations 4 and 7 applies for this recommendation; movement and sudden changes have been shown to draw visual attention. The extent to which modulation of lighting draws attention is less well known, but it seems likely that there may be some impact, and therefore these features should be avoided. In addition, flashing lights can be confused with safety-critical traffic signs and signals and therefore may be hazardous or confusing, as discussed in Recommendation 1.

Not all countries' guidance addresses flashing or moving lights directly; however the existing practice discussed in relation to moving images in the content (Recommendation 4) and brightness of billboards (Recommendation 8) should also be considered relevant here, and support this recommendation. Those countries where flashing lights are mentioned explicitly in the guidance prohibit their use outright.

10. Very large billboards, where the size itself will draw attention, should be avoided.
Although an absolute size is difficult to define, very large billboards are more likely to grab attention than smaller ones, through their dominance in the scene and their tendency to be perceived as rapidly approaching and 'looming' in the observer's vision. The extent to which looming is a problem will depend on how much of the visual scene the billboards take up. In short, very large billboards which are close to the driver are likely to draw attention just due to their physical size.

There is limited direct evidence for this recommendation; only one study was found in which the size of the billboard was an independent variable (Zalesinska, 2018); in this study, the larger the static digital billboard was, the longer it took drivers to start to brake when an acute hazard suddenly materialized at the moment billboard was in sight.

A theoretical basis for this recommendation is provided by the literature on attention and how it is attracted. Franconeri and Simon (2003) showed that looming stimuli (i.e. stimuli rapidly expanding in the observer's vision) attract attention. Larger objects loom more than smaller objects at the same distance and speed from the observer (all other things being equal – see Delucia, 1991). They are also more likely to block other information in the environment that might be required by drivers (see Recommendation 2). Therefore, it is recommended that their use be avoided.

Looking at existing practice, it is explicitly included as a requirement in the guidance for Norway and Northern Ireland that billboards should not be distracting because of the size. Most other countries do not comment on dimensions of billboards at all (other than in relation to avoiding sizes and shapes that resemble traffic signs). A few – Flanders, Cyprus, Italy, Finland – do specify a maximum size but this varies from $5m^2$ to $40m^2$ and also depends on location relative to the road.

2.2 Recommended actions for road authorities

In this section we present a number of recommended actions for road authorities to address the potential issue of driver distraction caused by roadside advertising.

1. **Road authorities should use the billboard recommendations described in Section 2.1 as a basis for their own guidance or legislation. Examples of existing practice are provided in the accompanying text to illustrate how these recommendations can be implemented in practice.**

   The aim of this recommended action is to minimise the negative safety impacts of driver distraction caused by roadside billboards as far as is possible in practice. As previously discussed, from a road safety standpoint the optimal solution would be a complete prohibition of roadside advertising, however it is understood that the road authority does not have sole jurisdiction over this issue. The extent to which road authorities can implement the billboard recommendations depends on the responsibilities and level of authority that the road authority has in the approval process.

2. **Road authorities should consider implementing the billboard recommendations described in Section 2.1 in relation to their own use of signing infrastructure when displaying non-functional content.**

   The aim of this action is ensure that the safety issue caused by roadside advertising is not also caused by a road authority's own signing infrastructure. Most of the messaging displayed by road authorities on their networks is critical to traffic safety or driver information and as such, attracting the drivers' attention is the key objective. However sometimes signing infrastructure is repurposed for non-functional content, for example variable message signs displaying general road safety messages or tourist information. In these cases, road authorities should ensure that the signs do not cause an unnecessary distraction to drivers.

3. **Road authorities should raise awareness of the need for their sign-off to be a mandatory stage in the approval process for installation of any billboard that is visible from the road network.**

   The aim of this action is to ensure that the impact on road safety is always considered before any roadside billboard is installed. The action depends on the existing situation in the country in question. In some countries, road authority sign-off may already be mandatory and therefore no action is necessary. In most however, road authorities have only limited (or no) involvement in the approvals process and even when present, it is often only advisory with no power to change the outcome. In that case, road authorities need to raise awareness of the impact on road safety with the organisation(s) that control the approvals procedure.

4. **Road authorities (and other organisations) should raise awareness of the need for a European standard on the safe installation of static and digital billboards at the roadside.**

   Regulation will ultimately be required for full implementation of any recommendations aimed at roadside billboards. This will first require the formation of a working group of experts to develop a technical specification on which the standard can be based. Legislation from the European Commission is then needed to make the technical specification mandatory in all European Union countries. Sometimes the Commission will pass legislation that calls for the development of the technical specification; this can be useful in facilitating the process. The aim of this action is to specify the role of road authorities in calling for a European standard and in initiating this process.

5. **Road authorities should request that the maintenance of billboards be incorporated into the current revision of Directive 2008/96/EC on road infrastructure safety management (European Commission, 2008); this would be implemented by inclusion of billboards in the roadside infrastructure to be included in road safety inspections.**

   Directive 2008/96/EC is currently in the process of revision and therefore represents an opportunity for relatively easily including the issue of billboards in legislation, requiring only the addition of billboards to the list of infrastructure that must be inspected with relation to their impact on safety. The aim of this action is to take advantage of the opportunity to address at least some of the issues associated with roadside billboards. Road authorities should request this change through the most appropriate mechanism.

6. **Road authorities should undertake (or raise awareness of the need for) regular maintenance of billboard hardware and software to ensure that malfunctions do not cause distraction.**

   This action, although related to Directive 2008/96/EC, can potentially be considered and implemented separately. As previously discussed, maintenance of billboards is unlikely to fall under the control of the road authority, however where possible the road authority should raise awareness of the issue and / or include this issue in any requirements that are to be imposed upon the owners of these billboards. Often the billboard owners are not the same as the advertising companies that produce the content, and may need to be approached differently.

7. **Road authorities should incorporate billboards into existing roadside inspection procedures to gather information on existing billboard infrastructure.**

   Again although this action would be fulfilled by the recommendation related to Directive 2008/96/EC above, it can also be implemented separately and by the road authority. There are currently limited data available on the number and locations of billboards that are visible from the road network in most countries. Road authorities should include auditing of any visible billboards in their existing inspection procedures; unlike full safety inspection or maintenance this is possible without cooperation from billboard owners, land owners or

advertising companies. The aim of this action is to allow road authorities to quantify the extent of the problem and provide evidence for the importance of this issue.

8. **Road authorities should actively engage with the advertising industry in order to ensure safety is taken into account. This should include education about good practice, which will expedite the safety approval process.**

   This action is aimed at tackling the issue of roadside advertising at the source. Road authorities should engage with advertising companies and, as far as possible, educate them as to the elements of adverts and billboards that present unacceptable safety risks to drivers. Depending on the role of the road authority in the approval process, this may be particularly attractive to advertising companies as it may help them to expedite the process of gaining safety approval. It is likely also to minimise any liability issues they may encounter if distraction-related collisions occur.

9. **Road authorities should support further research aimed at filling the knowledge gaps identified.**

   The aim of this action is to progress towards answers to the outstanding questions that have been identified. If a road authority can commission research directly, this action is relatively simple. If funding is not available, road authorities should engage with potential funding streams to raise awareness of the importance of this issue and the relative lack of research addressing it. An example would be through engagement with advertising companies as in the previous action – it is conceivable that an advertising company would be willing to fund research into certain topics that may be of value to them, for example how we can achieve brand awareness at the same time as minimising distraction rather than compromising both aims.

3 Final remarks

The purpose of the ADVERTS project is to provide evidence-based recommendations for road authorities on how to minimise the negative safety effects of roadside billboards, with a specific focus on digital billboards.

A review of the scientific literature relating directly to the issue of billboards was undertaken and the findings available at the project website (https://www.cedr-adverts.eu/en/deliverables-publications). In addition, for the development of these recommendations, relevant scientific theory was considered. The purpose of these reviews was to underpin the recommendations with the best available understanding of the science of distraction when driving. Finally, current regulations and guidelines (mainly in CEDR member countries) were reviewed to provide examples of implementation, especially as examples of the recommendations made (also available at the project website).

The outcomes of the project are ten recommendations regarding the actual implementation of roadside advertising, and nine recommended 'next steps' for road authorities that should help to remove barriers to using the recommended practice.

Given the potential for injury that can result from even momentary distraction of those controlling motorised vehicles travelling at speed (especially when around vulnerable road users) it might come as a surprise that a large number of research gaps were also identified, especially around features that digital billboards enable, such as animation. In the absence of clear evidence quantifying the extent to which different billboard features distract road users, a conservative approach (erring on the side of caution) has been adopted in the recommendations given. It seems likely however that pressure from advertising companies will continue, as they seek to open new market possibilities for their clients, so one important question for the road safety community is simply "How should advertisers be engaged in the process?"

The narrative between advertisers and the road safety community around this topic is anecdotally adversarial; this is partly because the basic market offering from advertisers using roadside billboards (that they will draw the attention of passing road users) is completely at odds with the preferred outcome for road safety (that passing road users have their attention on the road). One possible answer to the question of how to engage advertisers is that the findings from this project be used as a starting point for a discussion around finding outcomes that are beneficial to advertisers without compromising road safety outcomes. As the potential locations for digital content also move away from just roadside advertising, and potentially into individual vehicles through their connectivity with intelligent infrastructure, the need for this conversation will be even more pressing. It is our hope that the ADVERTS project, in addition to delivering recommendations for implementation and next steps right now, becomes a catalyst for such a conversation.

References

Belyusar, D., Reimer, B., Mehler, B., & Coughlin, J. F. (2016). A field study on the effects of digital billboards on glance behavior during highway driving. *Accident Analysis & Prevention, 88* (Supplement C), 88-96. doi: https://doi.org/10.1016/j.aap.2015.12.014

Chattington, M., Reed, N., Basacik, D., Flint, A., & Parkes, A. (2009). *Investigating driver distraction: The effects of video and static advertising* (PPR 409). TRL, Wokingham, Berkshire, UK

DeLucia, P. R. (1991). Pictorial and motion-based information for depth perception. *Journal of experimental psychology: Human perception and performance*, *17*(3), 738.

Dingus, T. A., Guo, F., Lee, S., Antin, J. F., Perez, M., Buchanan-King, M., & Hankey, J. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. *Proceedings of the National Academy of Sciences.* doi: https://doi.org/10.1073/pnas.1513271113

Edquist, J., Horberry, T., Hosking, S., & Johnston, I. (2011). Effects of advertising billboards during simulated driving. *Applied Ergonomics, 42*(4), 619-626. doi: https://doi.org/10.1016/j.apergo.2010.08.013

Edquist, J. (2008). *The Effects of Visual Clutter on Driving Performance*. (PhD), Monash University, Clayton, Australia. Retrieved from https://www.tml.org/legal_pdf/Billboard-study-article.pdf

EinhÃ, W., Rutishauser, U., & Koch, C. (2008). Task-demands can immediately reverse the effects of sensory-driven saliency in complex visual stimuli. *Journal of vision*, *8*(2), 2-2.

Estes, W. K. (1972). Interactions of signal and background variables in visual processing. *Perception & Psychophysics*, *12*(3), 278-286.

European Commission (2008). *Directive 2008/96/EC of the European Parliament and of the Council of 19 November 2008 on road infrastructure safety management.* http://data.europa.eu/eli/dir/2008/96/oj

Franconeri, S. L., & Simons, D. J. (2003). Moving and looming stimuli capture attention. *Perception & psychophysics*, *65*(7), 999-1010.

Fuller, R. (2005). Towards a general theory of driver behaviour. *Accident Analysis & Prevention*, *37*(3), 461-472.

Itti, L., & Koch, C. (2001). Computational modelling of visual attention*. Nature Reviews Neuroscience*, 2(3), 194-203.

Klauer, S. G., Guo, F., Sudweeks, J., & Dingus, T. A. (2010). *An analysis of driver inattention using a* case-crossover approach on 100-car data (No. HS-811 334).

Marciano, H., & Setter, P. E. (2017). The effect of billboard design specifications on driving: A pilot study. *Accident Analysis & Prevention, 104*(Supplement C), 174-184. doi: https://doi.org/10.1016/j.aap.2017.04.024

Marciano, H., & Yeshurun, Y. (2012). Perceptual load in central and peripheral regions and its effects on driving performance: advertising billboards. *Work, 41*(no. Supplement 1), 3181-3188.

Milloy, S. L., & Caird, J. K. (2011). External driver distraction: The effects of video billboards and wind farms on driving performance. In D. L. Fisher, M. Rizzo, J. K. Caird, & J. D. Lee (Eds.), *Handbook of driving simulation for engineering, medicine, and psychology* (pp. 16-11 - 16-14). Boca Raton, Florida: CRC Press.

Mollu, K., Cornu, J., Brijs, K., Pirdavani, A., & Brijs, T. (2018). Driving simulator study on the influence of digital illuminated billboards near pedestrian crossings. *Transportation Research Part F: Traffic Psychology and Behaviour, 59*, 45-56. doi: https://doi.org/10.1016/j.trf.2018.08.013

Schieber, F., Limrick, K., McCall, R., & Beck, A. (2014). Evaluation of the Visual Demands of Digital Billboards Using a Hybrid Driving Simulator. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting,* 2214-2218.

Smiley, A., Persaud, B., Bahar, G., Mollet, C., Lyon, C., Smahel, T., & Kelman, L. (2005). Traffic safety evaluation of video advertising signs. *Transportation Research Record,* 1937, 105-112.

Treisman, A. M., & Gelade, G. (1980). A feature integration theory of attention. *Cognitive Psychology*, 12, 97-136.

Wallace, B. (2003). *External to vehicle driver distraction* (168/2003). Retrieved from Edinburgh: http://www.gov.scot/Resource/Doc/47133/0029641.pdf

Yantis, S., & Jonides, J. (1984). Abrupt visual onsets and selective attention: evidence from visual search. *Journal of Experimental Psychology: Human perception and performance*, *10*(5), 601.

Young, K. L., Stephens, A. N., Logan, D. B., & Lenné, M. G. (2017). Investigating the impact of static roadside advertising on drivers' situation awareness. *Applied Ergonomics*, 60, 136-145. doi: http://dx.doi.org/10.1016/j.apergo.2016.11.009

Zalesinska, M. (2018). The impact of the luminance, size and location of LED billboards on drivers' visual performance—Laboratory tests. *Accident Analysis & Prevention.* doi: https://doi.org/10.1016/j.aap.2018.02.005