CEDR Transnational Road Research Programme

Call 2016 Safety

Funded by Belgium-Flanders, Ireland,
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ADVERTS Assessing Distraction of Vehicle drivers in Europe from Roadside Technology-based Signage.

Roadside advertising and road safety

what do we know, what do we do?

Executive Summary

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Executive Summary

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Table of contents

ADVERTS: minimising distraction from roadside billboards

Roadside advertising and in particular digital billboards seem to be becoming more and more prevalent, and can be an important source of income for road authorities. However, roadside advertising can present a safety risk through distraction of passing motorists, since just a short moment of inattention in traffic can have serious consequences.

The ADVERTS project aims to provide recommendations for road authorities on how to minimise negative safety effects of roadside billboards. The project has completed a review of the scientific literature on billboards and distraction; this review focused on summarising the evidence around distraction, and on identifying knowledge gaps. A summary of regulations and guidelines currently in use (mainly in CEDR member countries) was also prepared.

Within ADVERTS we distinguish between three types of billboards:

- Traditional static billboards
  Billboards with a poster continuously displaying the same advertisement. A new advertisement has to be put up manually. These billboards can be illuminated.

- Static digital billboards
  Billboards with a light emitting screen displaying static advertisements, i.e. without moving images. Advertisements can be digitally replaced by another advertisement after it has been displayed for a set period of time.

- Video billboards
  Billboards with a light emitting screen displaying moving advertisements, i.e. showing videos or animations. Advertisements can be digitally replaced by another advertisement after it has been displayed for some a set period of time.

This document

In this executive summary we summarise the main findings of the literature review and current practices. Further details, the scientific justification and references to specific studies are available in the following separate research reports, downloadable at https://www.cedr-adverts.eu/en/deliverables-publications:

- Vlakveld, W. & Helman, S. (2018) The safety effects of (digital) roadside advertising: an overview of the literature. D1.1a of the CEDR-commissioned ADVERTS project.
- Boets, S., Vandemeulebroek, F., Daniels, S. (2018) Roadside advertising: an inventory of current practices and future trends. D1.1b of the CEDR-commissioned ADVERTS project.
- Boets, S., Vandemeulebroek, F., Daniels, S., Helman, S., Weekley, J., Vlakveld, W., Van Schagen, I. (2018) Roadside advertising: knowledge gaps and research strategies. D1.1c of the CEDR-commissioned ADVERTS project.

The next stage of the ADVERTS' project will produce a document with recommendations and guidelines for minimising distraction from roadside advertising.

1 Do roadside billboards lead to more accidents?

The findings relating to the question of whether roadside billboards lead to more accidents are not straightforward. Only five studies were identified that specifically focused on the effects of billboards on accidents, two of which were scientifically robust. One found an increase in accidents[1], the other did not[2]. Both studies looked at static digital billboards.

It must be noted that it is very difficult to assess the effect of billboards on accidents in a scientifically robust way. Accidents are rare events. Hence, a very long observation period is required before there are sufficient data for robust statistical analyses. During this long period there can be many other developments that affect the number of accidents, for example changes in traffic volumes or speeds. Consequently, a very robust research design (including multiple locations, data on a number of variables and the application of appropriate analysis techniques) is needed to be able to exclude the possibility that other external factors played a role in any changes in accidents seen during the study period.

For this reason, and because it is obviously preferable to have motorists looking at the road when driving, the inconclusive nature of the evidence base on billboards and accidents should not be taken as an indication that they are safe.

2 Do billboards affect driving behaviour?

In order to assess the effect of billboards on road safety it is also possible to look at their influence on various aspects of behaviour. There is a large literature on this, with most studies focusing on car drivers. The majority of studies use a driving simulator, although a few studies have been undertaken in real traffic with an instrumented vehicle. The results indicate that, overall, drivers tend to behave less safely in the neighbourhood of billboards.

Specifically, when billboards are present, drivers:

- more often tend to drift out of their lane,
- drive closer to vehicles in front,
- respond later when the vehicle in front suddenly brakes,
- more often overlook road signs, and
- more often forget to use their direction indicator.

Speed behaviour appears not to be affected.

1. Gitelman, v., Zaidel, D. & Doveh, E. (2012, 29-31 August). Influence of billboards on driving behavior and road safety. Paper presented at the 18th International Conference on Traffic and Transport Psychology ICTTP, Groningen, The Netherlands.
2. Izadpanah, P., Omrani, R., Koo, S. & Hadayeghi, A. (2014). Effect of Static Electronic Advertising Signs on Road Safety: An Experimental Case Study. Journal of Orthopaedic Trauma, 28 (Supplement 1), S33-S36.

3 Do drivers self-regulate when they look at billboards?

There are indications[3] that drivers are more inclined to look at irrelevant information and objects alongside the road when the driving task is easy than when it is more demanding. Hence, drivers seem to self-regulate themselves at least to some extent when they let their eyes wander away from the road. However, a traffic situation can change in a split second, suddenly requiring full attention and fast responses. In these circumstances looking at billboards could easily have detrimental effects on road safety.

4 Which billboard features are relevant for distraction?

Not all billboards are equally distracting. We distinguish four billboard features that, based on formal theory about looking behaviour, affect the amount of attention people pay to them. The theoretical framework used to understand these features was the SEEV-model[4]:

Salience:	Billboards that are salient, e.g., because they are large, have bright colours and use moving images, attract more attention than less salient (small, static, uncoloured) billboards.
Effort:	Billboards that require effort to see and read because they are located father away from the forward roadway (drivers need to turn their head to see them) and/or have small print, attract less attention than billboards that are located close to the forward roadway and/or have large print.
Expectancy:	Billboards at locations where drivers expect to find relevant information for performing their driving task, e.g. direction signs near intersections or motorway exits, receive more attention than billboards at locations where no traffic-relevant information is expected.
Value:	Billboards providing information that drivers value receive more attention than 'neutral' billboards, e.g., a restaurant advert when the driver is hungry, or a message that elicits a positive or negative emotion).

3. 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.

4. Wickens, C. D., Helleberg, J., Goh, J., & Horrey, W. J. (2001). *Pilot task management: testing an attentional expected value model of visual scanning*. Technical Report ARL-01-14/NASA-01-7. https://pdfs.semanticscholar.org/31b2/24a9e54431faf52cec4a257b44252e7339a3.pdf

5 What is known about the effects of billboard features?

5.1 Salience

The salience of the billboard is determined by many factors. A few of them have been studied empirically. The main conclusions are as follows[5]:

- Drivers look longest at billboards with moving images such as videos or animations and these have the most detrimental effect on driving performance. This effect is strongest for young drivers.
- The larger the billboard, the longer it takes drivers to start braking when the traffic situation becomes dangerous.
- Drivers do not seem to look more or longer at illuminated billboards in the dark (high contrast) than in daylight (low contrast).
- Many billboards have sequential static messages. Drivers look more and longer at the billboard when there is a switch from one message to another.

Related to salience is luminance. Luminance refers to the amount of light that passes through, is emitted or reflected from a particular area. Digital billboards generally have high levels of luminance. This increases their salience and, consequently, affects distraction. Moreover, high levels of luminance can cause glare, in particular in night time conditions. Susceptibility for glare increases with age.

5.2 Effort

- Empirical studies on aspects of the feature 'Effort' indicate the following: Drivers look less often at billboards if they have to turn their head than if they are located in their 'normal' forward viewing direction.
- Drivers look less often at billboards if the traffic situation is complex.

However, if drivers do look,

- they look longer at billboards that are not in the forward viewing angle.
- the interference with the driving task increases with increasing amounts of text or pictures and smaller letters or images.
- the interference of the billboards with the driving task is larger in complex traffic situations than in relative simple traffic situations.

5.3 Expectations

There was just one empirical study that looked at the effect of expectations. In this study, billboards were placed near urban intersections with road signs and traffic lights. In the situation with billboards, drivers less often looked at the road signs, compared to the situation without billboards. This is most likely to be explained by the fact that, at intersections, drivers

[5] Detailed information about the studies are available in an ADVERTS report by Vlakveld, W. & Helman, S. (2018) *The safety effects of (digital) roadside advertising: an overview of the literature*.

expect to find relevant traffic information, they actively look for that, but instead their eye catches a billboard. While looking at that, they are not looking at relevant traffic signs.

5.4 Values

Research on the feature Values is very limited. Regarding the content of the billboard message, there are indications that pictures or text that evoke a negative emotion can have a negative effect on driving performance.

6 What do we not know?

There are many aspects that are theoretically relevant for the road safety effects of billboards, but have not yet been studied empirically. These have been grouped as follows:

- Effect of non-digital, static digital and video billboards directly on accident rate – existing studies are inconclusive and most study designs are weak with many confounding factors.
- Criteria for optimal design, placement and operation of roadside billboards, e.g. the best method for the transition between messages and the effects of messages that might elicit dangerous actions (e.g. 'dial now and win ….'), and the potential threat of hacking billboards.
- Role of driver characteristics, e.g. the impact of driver age or trip motive, and the impact of driver state on the distracting effect of billboards.

For many design and placement features we do know the direction of the relationship with safety, but we do not know exact thresholds or the magnitude of effects. For example, we do not know the best size of a billboard, or the best size of the letters to minimise distraction, or when colours might be too bright, or when a message might be too emotional.

Finally, we know that glances greater than two seconds in length away are highly undesirable from a safety perspective and should be prevented[6]. However, we do not know exactly how looking behaviour relates to the outcomes desired by those who operate billboards (e.g. brand awareness). So, it might be interesting to identify ways of advertising that promote greater brand awareness without requiring longer gazes.

For a complete overview of the most important knowledge gaps and potential research options to fill these gaps we refer to a separate ADVERTS report[7].

[6] 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.

[7] Boets, S. et al. (2018a) *Roadside advertising: knowledge gaps and research strategies*.

7 How do road authorities currently deal with roadside advertising

An inventory among road authorities in CEDR member countries[8] showed that almost all countries have legislation covering roadside billboards. A majority of countries complement this with guidelines or recommendations. The level of detail of the legislation and guidelines varies from very general and mainly conceptual to very extensive and detailed.

In addition the permission procedures vary per country; generally, for billboards along the main road network:

- Road authorities have to give permission if the billboard is located within a certain zone alongside the road and on public land.
- Road authorities do not have to give permission if the billboard is located outside this zone or on private land.

For a billboard alongside minor roads, road authorities are generally not involved in permission procedures.

Overall, it can be concluded that

- Permission procedures are quite varied between countries and also within countries.
- Permission criteria are not always transparent and appeal procedures either do not exist or are not very effective.
- Conflicts of interest might appear when authorities are responsible for permissions, but at the same time receive financial benefits from roadside billboards.

8 What do legislation and recommendations include?

Regulations and guidelines relate to placement criteria and design criteria. They generally include more placement criteria than design criteria. All countries put restrictions on the placement of billboards in relation to the road environment (longitudinal and lateral) for different road types. A majority of the countries set restrictions on information presentation (size, use of colours) and content of roadside billboards. Also a majority of countries explicitly consider luminance in their regulations and/or guidelines.

In most countries legislation and recommendations not only deal with traditional and digital static billboards, but also with video billboards, although not always explicitly. Legislation and recommendations for video billboards generally include the restrictions on the use of moving images, and the use of flashing lights, as well as exposure times.

8. A total of 26 CEDR countries were approached; information was received from 18 countries. See for details about the approach and the results Boets et al. (2018b) *Roadside advertising: an inventory of current practices and future trends*.

Placement criteria include:

- longitudinal placement: where alongside the road,
- lateral distance: distance from the carriageway edge,
- vertical placement: height of the billboard,
- viewing angle: the angle of the billboard in relation to the driving direction, and
- road environment: complexity of the road situation.

Design criteria include:

- use of moving images, flashing lights, etc.,
- time of exposure to a message and transition time between messages,
- information presentation, e.g. size of billboard, amount of information, font size, colours,
- content and sequence of messages, and
- luminance / illumination, potentially causing glare.

9 What can we do?

From a safety point of view, a complete prohibition of roadside advertising would be the optimal solution in most driving situations. However, this would probably be difficult or even impossible to implement in practice, given the competing demands of the advertising industry and, often, the related economic benefits for road authorities. Hence, it is very important to ensure that the negative safety effects of roadside billboards are at least minimised via appropriate legislation and / or recommendations, and strict permission procedures.

These recommendations need to be clear, concise and not open to interpretation. Where possible, evidence-based quantifications – otherwise theoretically-based directions – should guide the decisions on which billboards can be placed and where they can be placed.

The next stage of the ADVERTS' project will produce a document with such recommendations for roadside advertising, as well as their scientific justification. These will be made available in spring 2019 on https://www.cedr-adverts.eu.

In addition, it is important that the most significant research gaps are addressed through targeted studies. In particular, a greater understanding of how various behavioural impacts actually map onto safety outcomes is required. This includes looking behaviour, and how good a proxy this is for safety outcomes, as well as for brand awareness from adverts.