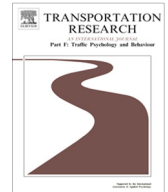




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Do supplementary signs distract the driver?

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ABSTRACT

In 2005, the regulation of signage on German highways was changed and now allows supplementary signs. These signs are installed below direction signs and inform about the services offered on motorway service areas. Being advertisement, the supplementary signs bear the risk to distract drivers looking for directional information. To study the influence of supplementary signs, four experiments ($N = 30$) were conducted. Experiment 1 used the phenomenon of change blindness as an indicator for the allocation of attention. It could be shown that drivers searching for a specific direction direct nearly no attention to the supplementary signs. In experiment 2 and 3, the influence of the supplementary signs on perceptual threshold for directional information and on self-chosen perception times was measured. Neither the perceptual threshold nor perception times freely chosen by the participants were negatively affected by the supplementary signs. The last experiment analyzed the influence of supplementary signs on driver reaction in a critical driving situation in a driving simulator study. Here, supplementary signs had no negative impact on collision rate and reaction time. Based on the results, it is concluded that drivers use effective attentional strategies while searching for directional information. In the experiments no negative effects of the supplementary signs could be found.

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1. Introduction

1.1. Background

Until 2005, highway service areas in Germany were signposted as part of regular direction signs only; no other advertisement was allowed. In 2005, the regulation of signage on German highways was changed. Now, supplementary signs are allowed, which inform about the services offered on motorway service areas. In Germany, the supplementary signs have been installed for direction signs which signpost only motorway service areas, but give no other directions. Besides these simple cases, service areas exist which are signposted via direction signs depicting not only the name of the service area, but also other destinations. Such service areas are either reached by a regular exit or are signposted in a motorway junction. Literature shows that roadside advertisement can lead to distraction and as a consequence can have negative impact on driving safety. Up to now, a direct connection between roadside advertisement and accidents could not be shown; nevertheless, more subtle indicators like reaction time show that a negative impact on driving behavior is possible (Wachtel, 2009). This is especially true for large billboards; research also shows that design and positioning strongly influence the impact of advertisement on driver behavior (e.g. Crundall, Van Loon, & Underwood, 2006; Wallace, 2003). Wallace (2003) concludes that a negative impact of advertisement boards is situation specific and depends on the design of the advertisement.

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The consequences of distraction through the new supplementary signs would be especially pronounced in situations where not only the highway service area but also other directions are signposted together. Here, the supplementary information competes directly with other, maybe more relevant information. As a consequence, installing the supplementary signs for such service areas bears the risk of distracting drivers who search for one of the other depicted directions. It is possible that because of the distracting supplementary information, drivers have more difficulty finding their way. It can be that either drivers take longer to perceive the directional information, or that drivers involuntarily focus on the direction sign for longer than is necessary in order to perceive not only the relevant directional information but also the information given on the supplementary sign. As a consequence, drivers' reactions in critical driving situations could be degraded. Although it has been taken care that the installed supplementary signs are not too distracting (they are rather small and do not contain too much information), the following research was conducted before it was asked for permission to install supplementary signs attached to direction signs signposting more than the highway service area. The aim was to investigate in advance, whether drivers might be distracted through the new signs. This approach is in line with the demand of [Horberry, Regan, and Edquist \(2009\)](#), who state that more emphasis should be placed on advertisers to prove that a roadside advertisement is safe. In our research, the negative effects of the supplementary signs are studied only for drivers who have no interest in the depicted service area, but who are looking for one of the other directions. These are the drivers for whom the new information is obviously irrelevant.

1.2. Attentional strategies

[Färber and Färber \(2006\)](#) studied the perception of signs providing information on traffic congestion on German highways. One type of signs used resembled structurally normal direction signs installed on German highways. Eye movement analysis showed that drivers read the different blocks of information shown for the different directions independently; empty regions and pictograms are normally not fixated on. Furthermore, certain attentional strategies could be identified. For example, drivers often focused on the right block of information; that is information given for the next exit. The utilized strategy can be described as: For destinations not shown for the next exit, continue ahead. These results demonstrate the efficient and task-adapted use of attentional resources in driving. They also fit well with other research on attention in real life tasks. In daily life, attentional strategies are used which allow for the fulfilling of the task at hand most efficiently and effectively (e.g. [Pelz & Canosa, 2001](#); [Yarbus, 1967](#)). Such experimental results can be explained by top-down processes, which influence the orientation of attention ([Henderson, 2003](#); [Land, Mennie, & Rusted, 1999](#)). In the literature top-down controlled orienting of attention is differentiated from stimulus triggered bottom-up processes (e.g. [Hoffmann, 1993](#); [Neisser, 1976](#)). It is believed that a task-adapted balance between both processes is a pre-condition for maintaining driving safety (e.g. [Shinoda, Hayhoe, & Shrivastava, 2001](#); [Wickens, Goh, Helleberg, Horrey, & Talleur, 2003](#)).

Because drivers unfamiliar with the road need to actively search for relevant directional information and the signage used requires reading, little influence of bottom-up processes and peripheral vision is assumed on perceiving directional information. Furthermore, due to the design of the supplementary signs, it is expected that they are not salient and therefore that they do not attract attention automatically through bottom-up processes. Instead, like in other real-life tasks, allocation of attention is expected to be mainly based on top-down attentional strategies.

1.3. Measuring perception of traffic signs

Only little literature dealing with the perception of direction signs in driving is available (e.g. [Dunne & Linfield, 1993](#); [Hall, McDonald, & Rutley, 1991](#)). Instead, research focuses on the perception of warning signs (e.g. [Crundall & Underwood, 2001](#); [Summala & Hietamaki, 1984](#)), the perception of big advertisement boards (e.g. [Crundall et al., 2006](#); [Wallace, 2003](#)) and, in newer publications, the influence of variable message signs on driving safety (e.g. [Dutta, Fisher, & Noyce, 2004](#); [van Houten, Malenfant, Zhao, Ko, & van Houten, 2005](#)). Different approaches for studying perception of traffic signs can be found in the literature ([Martens, 2000](#)).

- Eye movement behavior is recorded as an indicator for attentive processing of e.g. advertisement boards (e.g. [Beijer, Smiley, & Eizenman, 2004](#); [Crundall et al., 2006](#); [Young et al., 2009](#)). It indicates that a certain object has been looked at, but it does not allow concluding that the object also has been consciously perceived. Furthermore, objects can also be perceived through peripheral vision. Therefore, a missing fixation does not necessarily imply that an object has gone unnoticed and a fixation does not provide information about how deep an object has been processed (e.g. [Luoma, 1988](#)). [Martens \(2000\)](#) states that if used for studying the perception of traffic signs, eye movement behavior almost always should be combined with other measures.
- Memory retrieval approaches like the recall or recognition of recently passed traffic signs was used as an indicator for the processing of traffic signs. The main advantage of that approach is that the experimental settings are rather simple and that the used indicators are easy to measure. Many studies using recall or recognition showed surprisingly low memory performance for traffic signs ([Johansson & Rumar, 1966](#); similar studies [Aberg, 1981](#); [Johansson & Backlund, 1970](#); [Milos-ovic & Gajic, 1986](#)). In some studies, it could be shown that memory performance is influenced by the experimental setting ([Luoma, 1993](#)) and the used instructions ([Charleton, 2006](#)). Furthermore, a field study by [Fisher \(1992\)](#), showed no clear relation between memory performance and driving behavior.

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