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Road signage comprehension and overload: the role of driving style and need for closure

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Abstract

This study looks at the provision of information via traffic signs and its relation with driving styles, need for closure and socio-economic characteristics of road users. A web-based questionnaire allowed collecting information about traffic signs and road surface markings in 12 traffic locations that were presented in two variations: (i) in the first 6 cases, a first configuration contained information that led to ambiguity about the manoeuvres that were legal and a second configuration added traffic signs to eliminate the ambiguity; (ii) in the second 6 cases, a first configuration presented the road environment without signs and a second configuration added traffic signs to verify information redundancy. Respondents indicated for each location which manoeuvres they deemed legal and how many conflicts they estimated without traffic signs, and safety perception and comfort level improved with the traffic signs. Moreover, respondents reported their socio-economic characteristics and filled two questionnaires about need for closure and driving styles. Completed questionnaires from 753 participants from Hungary with expertise in transport and traffic were analysed via statistical and factor analysis, and results reveal that: (i) road users are heterogeneous in their perception and processing of information, as the number of manoeuvres correctly identified as legal relates to their socio-economic characteristics; (ii) the perception of improvements after the provision of information relates also to the road uses' socio-economic characteristics and their driving style and need for closure; (iii) different amounts of information are sufficient for different road users not to feel uncertain regarding manoeuvres being legal at a certain traffic location.

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1. Introduction

As traffic conflicts are a major cause of serious and fatal injuries, and 90% of them are attributed to behavioural causes, it is essential to approach their analysis with an anthropocentric approach. This study looks at the provision of information via traffic signs and its relation with driving styles and cognitive approaches in order to understand whether a safe minimum information level exists for drivers and what this level relates to.

Existing research on traffic signs and surface markings has focused on their effect as stand-alone items rather than parts of a complex system with the road users and the road environment. Although countries have largely agreed on the basics of shape, layout, colour schemes and marking configurations (UNECE, 1968), road agencies around the world have applied different rules that vary in particular on the maximum amount of traffic signs allowed on a pole

(e.g., one for New Zealand, two for the United Kingdom, three for Hungary). Researchers have looked into the traffic signs and markings to investigate the effect of ergonomic principles (Ben-Bassat and Shinar, 2006; Ng and Chan, 2008), background colour (Liu et al., 2010), and symbol and text mixture (Shinar and Vogelzang, 2013). Moreover, researchers have looked at the provision of information to analyse the effect of amount (Liu, 2005; Lai, 2011; Shalloe et al., 2014), multiple message configuration (Castro et al., 2008), and placement (Borowsky et al., 2008; Liu and Lu, 2013; Zhao et al., 2014), as well as their comprehensibility as a function of road users' characteristics (Al-Madani and Al-Janahi, 2002a, 2002b; Ng and Chan, 2007). Lastly, researchers have looked at the potential for distraction when traffic signs are alongside commercial advertisements (Young et al., 2009; Bendak and Al-Saleh, 2010; Edquist et al., 2011) or contain commercial content (Metz and Kruger, 2013).

This study concentrates in particular on the amount of information that plays a crucial role in the traffic context. Existing research demonstrates that too much information may be a problem, as the efficiency cognition of drivers has been shown to decrease with an increase in the amount of information provided (Liu, 2005; Liu et al., 2011), and the provision of traffic signs along a route has been proven not informative as drivers read only 25% of the signage while driving (Costa et al., 2014). These findings are not surprising when thinking about the working memory theory (Baddeley and Hitch, 1986) about the existence of a central executive mechanism in the human mind that can only distribute attention as a limited resource, that has lead the US Department of Transportation to mention that too much information in the traffic environment might lead to complete disregard of all the traffic signs (FHWA, 2009). Existing research shows also that too little information may be a problem, as the less information is provided, the more drivers rely on their own knowledge of traffic laws as well as their judgment. Ambiguous scenarios create uncertainty that may lead to undesirable coping mechanisms from distractedness to aggression (Gwyther et al., 2014).

As the amount of information plays a crucial role, this study looks at the relationship between road user, road environment and traffic signs from an anthropocentric perspective. The assumption is that road users process information in a heterogeneous manner because of different characteristics, as shown by existing research focusing on the Need for Closure cognitively (Webster and Kruglanski, 1994) that can be linked to the way people process information (Kossowska et al., 2013), recall information accurately (Dijksterhus et al., 1996) or deal with uncertainty by utilizing coping mechanisms (Czernatowitz-Kukuczka et al., 2014).

This study looks at how road users process road signs and the road environment by proposing a web-based questionnaire where the participants were required to answer questions about traffic signs and road surface markings in 12 traffic locations that were presented in two variations: (i) in the first 6 cases, a first configuration contained information that led to ambiguity about the manoeuvres that were allowed and a second configuration added information to eliminate the ambiguity; (ii) in the second 6 cases, a first configuration presented the road environment without signs and a second configuration introduced traffic signs that led to verify whether redundancy existed. For each location, respondents not only indicated which manoeuvres they deemed legal, but also how they perceived safety, how they perceived the setting comfortable, and how the second configuration helped in improved the perceived safety. Moreover, the questionnaire collected information about driving styles via the Multidimensional Driver Style Inventory (MDSI, Taubman – Ben-Ari et al., 2004) and need for cognitive closure via the Need for Closure Scale (NFCS, Webster and Kruglanski, 1994).

2. Methods

2.1 Survey design and administration

The survey design relied on three hypotheses: (i) road users are heterogeneous in terms of perceiving and processing information, which affects their decision making and comfort level while driving; (ii) the perception of safety by road users is correlated with the amount of information in the road environment; (iii) a different amount of information for each road user is sufficient not to feel uncertain regarding manoeuvres being legal at a certain traffic location.

The locations for the survey were selected according to two criteria: (i) the first 6 cases needed ambiguity regarding the layout and the geometry so that additional traffic signs would remove the uncertainty about the legal manoeuvres; (ii) the second 6 cases needed an environment where the traffic signs were providing information that appeared quite obvious from the layout and the geometry. The locations were selected from Google Street view (please refer to the examples in Figure 1 and 2), and were digitally corrected to eliminate image rendering issues. Two variants for each location were then created: for the first 6 locations, the location did not contain information and was open to ambiguity