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# Are drivers' attentional lapses associated with the functioning of the neurocognitive attentional networks and with cognitive failure in everyday life?

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ABSTRACT

Driver distraction and inattention are considered among the major contributing factors in road traffic crashes. One of the most widely used tools to study drivers' attentional lapses and other types of aberrant behaviour is the Driver Behaviour Questionnaire (DBQ). In the present work, further evidence of the feasibility of the DBQ to study driver inattention is provided. The relationships between the DBQ and both a computer-based neurocognitive test on attentional performance (the Attention Network Test for Interactions and Vigilance, ANTI-V) and a self-reported measure of cognitive failure (the Cognitive Failures Questionnaire, CFQ) are analysed. Results show that attentional lapses are negatively associated with vigilance and positively associated with cognitive failure. Other types of aberrant behaviour (driving errors, traffic violations and aggressive behaviours) were not found related to the attentional performance indices (executive control, orienting, phasic alertness or vigilance), with the exception of DBQ-Violations and the executive control score in percentage of errors. In addition, the relationship between the other types of aberrant behaviour with cognitive failure was more moderate (except for DBQ-Errors, which was also highly correlated). Overall, these results are consistent with the idea of DBQ-Lapses being related to driving inattention, and suggest that this subscale could be a useful tool to study vigilance-related driving behaviour. Further evidence with improved versions of the DBQ or alternative questionnaires would be helpful to clarify whether proneness to attentional lapses while driving may be associated with different driving performance measures, such as crashes or near misses.



## 1. Introduction

Driver distraction and inattention are considered among the major contributing factors in road traffic crashes (e.g. Kircher, 2007; Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006; Ranney, 2008) and their negative influence on road safety is expected to further increase in the coming years, due to the proliferation of in-vehicle technologies (Regan, Hallett, & Gordon, 2011; Stutts, Reinfurt, Staplin, & Rodgman, 2001). With the aim of reducing attention-related crashes, road traffic researchers and practitioners would benefit from the synergy of complementary methodologies to analyse the driver

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inattention phenomenon and to evaluate potential countermeasures (see, for example, Kingstone, Smilek, & Eastwood, 2008). These complementary methodologies include, for example, experimental studies using driving simulators (e.g., Lee, McGehee, Brown, & Reyes, 2002; Weaver, Bédard, McAuliffe, & Parkkari, 2009), field studies with naturalistic data (e.g., Klauer et al., 2006; Olson, Hanowski, Hickman, & Bocanegra, 2009) and also self-reported questionnaires (e.g., Ledesma, Montes, Poo, & López-Ramón, 2010; Reason, Manstead, Stradling, Baxter, & Campbell, 1990). For instance, naturalistic observation could be used to comprehensively describe and understand a particular driver inattention situation (e.g., how drivers interact with a GPS navigator and adapt their long-term behaviour using the device). Then, the thorough information gathered might allow the generation of specific predictions (e.g., some compensatory activities might have been observed, which could mitigate the potential risk of the navigator device), and these predictions could be tested in empirical studies using a driving simulator. Furthermore, self-reported questionnaires can be applied to identify or classify particular groups of drivers (e.g., with lower or higher proneness to attentional lapses while driving) and then perform and evaluate customised preventive measures.

One of the most widely used tools to study self-reported aberrant behaviour in drivers is the Driver Behaviour Questionnaire (DBQ; Reason et al., 1990), which usually includes a specific subscale to measure attentional lapses. The current study will provide further evidence to discuss the feasibility of this questionnaire for studying driver inattention, by analysing its relationships with both a computer-based neurocognitive test on attentional performance and self-reported measures of cognitive failure.

### *1.1. Driver aberrant behaviour*

The DBQ (Reason et al., 1990) is a self-reported questionnaire to assess drivers' aberrant behaviour. Originally, the DBQ aimed to distinguish between driving errors and deliberate violations of the traffic rules, supporting the idea that different psychological processes influence these factors. The initial version of the DBQ comprised 50 items about a variety of errors and violations, and the respondents were asked to indicate on a five-point scale how often they committed each type of behaviour while driving. Reason et al. (1990) performed a factor analysis and found support for the expected difference between errors and violations, plus a third factor that included mainly attentional failures (''silly errors'', ''slips and lapses'' or ''lapses''). However, the relevance of this latter factor was questioned in later studies and the corresponding items have not always been considered separately for at least two principal reasons. First, the slip and lapses factor was initially considered as *trivial* (Reason et al., 1990) and failed to be associated with reported crashes (e.g., Parker, Reason, Manstead, & Stradling, 1995). In contrast, later studies have successfully reported significant associations between attentional lapses and crash involvement (for example, among older drivers; Parker, McDonald, Rabbitt, & Sutcliffe, 2000). In particular, a recent study by Ledesma et al. (2010) applied an alternative questionnaire to measure failures of attention while driving (the Attention-Related Driving Errors Scale or ARDES) on a sample of drivers of a wide age range and found that attentional lapses were predictive of self-reported traffic collisions with material damage (after controlling for different sociodemographic and psychological variables, adjusted odds ratio = 7.14, 95% confidence interval = 1.21–42.15). Second, the analysis of the DBQ factor structure and its psychometric properties has not always provided support for the distinction of an independent third factor of attentional lapses (for reviews, see Lajunen, Parker, & Summala, 2004; Özkan, Lajunen, & Summala, 2006). However, according to Özkan et al. (2006), the original three-factor (errors, violations and lapses) or four-factor structures (errors, violations and lapses plus additional items to measure aggressive violations; Lawton, Parker, Manstead, & Stradling, 1997) have been broadly replicated.

Overall, it can be claimed that there is enough evidence for using either a two-factor solution (errors and violations) or a four-factor one (errors, lapses, ordinary violations and aggressive violations). It has been suggested (Lajunen et al., 2004) that, for every-day use, the four subscales might be more informative for road safety practitioners, and this is also true for researchers particularly interested in studying, for example, attentional lapses or aggressive behaviour. Additional evidence supporting the validity of each subscale (for example, by analysing their relationship with other theoretically-related measures) would therefore be helpful to expand the results previously found with factor analysis. Previous research found associations between DBQ-Lapses and some different aspects of attention. For example, Wickens, Toplak, and Wiesenthal (2008) reported that the DBQ-Lapses factor was positively correlated with the Differential Attention Processes Inventory-Extremely Focused Attention (DAPI-EFA; e.g., ''Can you lose yourself in thought so that you are hardly aware of the passage of time?'') and an inattention scale from the Adult Self-Report Scale (ASRS-I; e.g., ''When you have a task that requires a lot of thought, how often do you avoid or delay getting started?''). They also observed that DBQ-Errors was positively correlated with DAPI-EFA and ASRS-I and that DBQ-Violations was positively correlated with the DAPI-EFA and DAPI-Dual Attention Cognitive–Cognitive (DAPI-DACC; e.g., ''Can you read or study easily while at the same time listen easily to a conversation?'').

In the current investigation we aimed to analyse the part played by drivers' neurocognitive attentional system to explain attentional lapses while driving. In consequence, the relationship between the DBQ subscales (specially, the DBQ-Lapses factor), the functioning of the attentional networks (as measured with a computer-based attentional performance test, i.e. the Attention Network Test for Interactions and Vigilance or ANTI-V; Roca, Castro, López-Ramón, & Lupiáñez, 2011; Roca et al., 2012) and cognitive failure in everyday life (as measured with the self-reported questionnaire on cognitive failures, i.e. the Cognitive Failures Questionnaire or CFQ; Broadbent, Cooper, Fitzgerald, & Parkes, 1982) will be analysed.