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Exploring associations between self-reported executive functions, impulsive personality traits, driving self-efficacy, and functional abilities in driver behaviour after brain injury

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ABSTRACT

Objective: The assessment of self-awareness and self-efficacy as they relate to driving after stroke and TBI is lacking in the literature where the focus has tended to be on neuropsychological testing of underlying component of cognition in predicting driving outcome. Therefore, this study aims to investigate the associations between self-rating of higher-level functions and post-injury driving behaviour.

Methods: The present one-year follow-up study included twenty-four adults with stroke and ten adults with traumatic brain injury (TBI) deemed suitable for driving after a comprehensive driving evaluation according to Norwegian regulations. In addition, but not part of the decision making, baseline measurements included self-rating of executive functions (Behaviour Rating of Executive Function (BRIEF-A)), impulsive personality traits (UPPS Impulsive Behaviour Scale), driving self-efficacy (Adelaide Driving Self-Efficacy Scale (ADSES)), and functional abilities (Awareness Questionnaire (AQ)). Follow-up measurements twelve months after baseline were collected, the ADSES, AQ, and Swedish Driver Behaviour Questionnaire (Swedish DBQ).

Results: Perceived driving self-efficacy and functional abilities did not change from baseline to follow-up. Baseline perceived executive functions and impulsive personality traits were significantly associated with driving self-efficacy at follow-up. Lower self-efficacy and functional abilities were associated with lower driving mileage and increased use of compensatory driving strategies, whereas lower self-efficacy beliefs were associated with driver mistakes and inattention. Driver violations and inattention were associated with minor accidents.

Conclusion: The present study demonstrates that higher-level functions such as executive functions, impulsive personality traits, driving self-efficacy and functional abilities, influence post-injury accident involvement mediated through proximal driving factors such as driver inattention. Further evidence is warranted to explore self-rating measures compared to performance-based methods as predictors of risky driver behaviour, crashes, and near misses.

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1. Introduction

Driving is a complex task that requires the use of multiple cognitive abilities, such as attention, visual perception, judgment, and executive control, in addition to sensorimotor functions and psychomotor speed (Coleman Bryer, Rapport, & Hanks, 2005; Griffen, Rapport, Bryer, Bieliauskas, & Burt, 2011; Rapport, Bryer, & Hanks, 2008). Higher levels of driver behaviour are influenced by higher-level functions such as self-control, self-evaluation and awareness of personal skills that may enhance accident risk (e.g. impulse control, risky tendencies and planning skills) (Hatakka, Keskinen, Gregersen, Glad, & Hernetkoski, 2002). Survivors of stroke and TBI may present impairments in any of these functions (Marshall et al., 2007; Tamietto et al., 2006). Self-regulation of driver behaviour involves the evaluation of one's own functional abilities and adjustments to driver behaviour accordingly (Baldock, Mathias, McLean, & Berndt, 2006). Little is known about how baseline measures of executive functions and impulsive personality traits interact with perceived post-injury driving self-efficacy and physical, cognitive, and affective/behavioural abilities to affect driver behaviour. Studies are needed that simultaneously explore the higher-level factors within a theoretically based framework related to driving.

1.1. Models of driver behaviour

Theoretical models have described driver behaviour and accident risk (Hatakka et al., 2002; Michon, 1985), including models targeted at brain-injured drivers (Galski, Bruno, & Ehle, 1992). Previous research has found relatively weak associations between personality characteristics (e.g. sensation seeking and aggressive tendencies) and accidents (Elander, West, & French, 1993). Rimmö & Åberg (1999) proposed a mediating model in which aberrant driver behaviours mediate the relationship between sensation seeking and accidents. They posed that sensation seeking had an indirect effect on accident involvement through driving behaviours (i.e. violations and mistakes), although it did not have any direct effects. Sümer (2003) also proposed a contextual mediating model of driving where accident involvement are predicted by a variety of personality and driving behaviours. This is a structured model in which predictors and/or correlates of accident involvement are classified on the basis of their proximal and distal role in accident causation. The distal context consists of general culture factors, socio-demographic factors (e.g. age), personality factors, attitudes and beliefs and cognitive factors, while the proximal context consist of factors which are more closely related to accident tendency. The proximal context includes intrinsic driving style-related elements such as speed choice, traffic errors, violations and overtaking tendency and critical attitudinal/behavioural factors, but also transitory factors such as drinking and driving. Given the distance between accidents and the distal factors and the Poisson distribution of accidents (Elander et al., 1993), the link between distal and proximal factors are expected to be stronger than the association between the proximal context and accident rates. Therefore, Sümer suggests that distal elements either do not predict or poorly predict traffic accidents, but they are expected to have significantly indirect effects.

The above-mentioned model may also be useful in the field of rehabilitation assessing cognitive prerequisites for safe driving, where the predictive power of neuropsychological tests (which may be considered as distal factors) have shown mixed results in predicting accident rates in studies with stroke and TBI participants (Classen et al., 2009; Marshall et al., 2007; Ortoleva, Brugger, Van der Linden, & Walder, 2011; Tamietto et al., 2006). As described in Fig. 1, clinically relevant distal (e.g. cognitive factors, executive functions, impulsive personality traits, driving self-efficacy and perceived functional abilities) and proximal factors (aberrant driver behaviour and driver characteristics such as compensatory driving strategies and driving mileage) in driving after stroke and TBI may fit into the framework of Sümer's model. The higher levels in the hierarchy of driver behaviour involve self-evaluation and awareness of impulse control, planning skills, hazard perception, and the strengths and weaknesses of one's own driving skills (Hatakka et al., 2002). Executive functions, impulsive personality traits and awareness of functional abilities (e.g., cognition and driving capacity) are higher-level functions that may moderate the relationship between neuropsychological functioning and driver behaviour to affect post-injury driving fitness (Griffen et al., 2011; Lundqvist & Alinder, 2007; Stapleton, Connolly, & O'Neill, 2012). The examination of higher-level distal and proximal factors appears pertinent when considering a high-risk activity such as driving in survivors of stroke and TBI in relation to accidents.

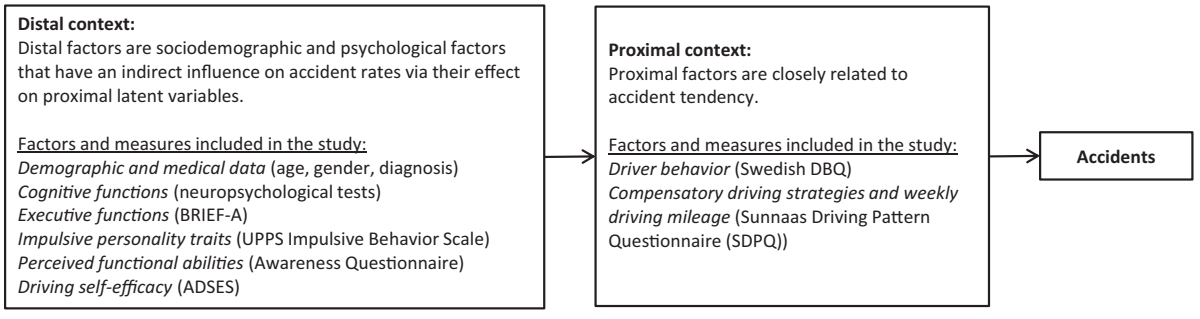

Fig. 1. A clinical adaptation of Sümer's contextual mediated model (Sümer, 2003) of driver behaviour after brain injury.