Journal of Transport & Health 9 (2018) 169–179

Contents lists available at ScienceDirect

Journal of Transport & Health

journal homepage: www.elsevier.com/locate/jth

Cognitive ability as a predictor of task demand and self-rated driving performance in post-stroke drivers – Implications for self-regulation

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ARTICLE INFO

Keywords:
Australia
Calibration
Cerebrovascular accident
Cognitive performance
On-road driving
Older drivers

ABSTRACT

Driving is a highly complex task requiring multiple cognitive processes that can be adversely affected post-stroke. It is unclear how much ability post-stroke adults have to self-evaluate their driving performance. Furthermore, the impact of cognitive decline on this evaluation has not been previously investigated. The aim of this study was to investigate the perceived level of task demand involved in driving tasks, and to examine differences between perceived and observed driving performance in post-stroke drivers in comparison to a control group. A further aim of the research was to investigate the influence of cognition on self-rated driving performance. A total of 78 participants (35 post-stroke and 43 controls) were assessed using a series of cognitive tasks and were observed whilst driving. Participants were asked to rate their own driving performance and the task demand involved while driving using the NASA Task Load Index. Between group analyses were conducted to determine differences in the level of self-rated performance and task demand. Further analyses were conducted to investigate whether cognition accounted for differences in task demand or self-rated performance. Overall, the results suggested that the post-stroke drivers exhibited deficits in cognition, but they did not report increased levels of task demand when driving. Post-stroke adults also rated themselves more conservatively than the controls for on-road performance, which was associated with their reduced propensity for risk. The study suggests that cognitive deficits may influence post-stroke drivers to amend their driving behaviour, in order to bring the task demand within a manageable level. Understanding the mechanisms involved in self-rated performance and estimations of task demand can help promote accurate self-regulation practices in post-stroke drivers. Furthermore, measuring calibration may assist practitioners with assessing fitness-to-drive, as well as with tailoring driving rehabilitation.

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https://doi.org/10.1016/j.jth.2018.01.013
Received 22 November 2016; Received in revised form 29 January 2018; Accepted 30 January 2018
Available online 06 March 2018

1. Introduction

Task demand is the amount of cognitive resources and task-directed effort required to complete a given task (Dunn and Williamson, 2012). Perceived task demand (i.e., the self-assessed level of task-directed effort and resources required) is important when driving because it enables the driver to reliably calibrate their competency through matching subjective and objective measures (Heikkilä et al., 1999; Fuller, 2005). It is well established that driving is a highly cognitive and physical task that requires the use of a range of executive and cognitive abilities (Anstey et al., 2005; Groeger, 2000). Following a stroke, survivors often experience a decline in their cognitive abilities (Patel and Birns, 2015). Evidence suggests that some older adults implement compensatory cognitive processes (Andrews and Westerman, 2012) and that drivers alter their environment whilst driving in order to regulate their level of perceived demand (Fuller, 2005). This allows the driver to align task demand with their perceived capabilities (Fuller, 2005), for example, by avoiding high-stress traffic situations as a form of self-regulation (Molnar and Eby, 2008; Hakamies-Blomqvist and Wahlström, 1998). According to the task-capability interface model of Fuller (2005), drivers are able to adjust the difficulty of the driving task (i.e., self-regulate) by, for example, increasing or reducing the vehicle speed or by changing lane. Therefore, safe driving requires adjusting the task demand to the driver's own capabilities and this “calibration” or “self-regulation” activity involves matching the perceived task demand to the perceived capabilities of the driver.

Older drivers have reported higher levels of task demand when completing a driving task (Bunce et al., 2012). Furthermore, older drivers, both with and without neurologically induced cognitive deficits (e.g., a stroke or Parkinson's disease), often lack the ability to realistically evaluate their own driving performance. For example, these drivers have been found to overestimate their driving exposure (Crizzle et al., 2013) and exhibit positive self-bias when reporting on driving ability (Scott et al., 2009). However, the perceived task demand in driving has yet to be investigated in a post-stroke driver group.

Errors in calibration can have a serious effect on safety and mobility (Fuller, 2005). If the calibration between the self- and the observed assessment is at odds and drivers overrate their abilities, then they are considered driving performance over-estimators (Hassan et al., 2015). Those who self-rate lower and perform well are driving performance under-estimators (Hassan et al., 2015). Reduction in driving, due to underestimated driving ability, could mean those who are safe and capable of driving experience a reduced quality of life due to lack of mobility and autonomy (Fristedt et al., 2011). This can have serious consequences for that individual's health status and well-being (Fuller, 2005; Fristedt et al., 2011), particularly as the older population rely heavily on driving as a part of their daily lives (Poole et al., 2008). Those who overestimate their driving capability risk exposing themselves to situations that they are unable to negotiate safely. Therefore, instead of ceasing or amending their driving activities, these individuals continue to use their car despite the greater risk posed to all road users, including themselves (Fuller, 2005; Hassan et al., 2015). As a consequence, relying on self-rated performance as a mechanism for the self-regulation of on-road driving is unreliable. Therefore, gaining an accurate insight into post-stroke drivers’ perceptions of their own calibration capability is important for understanding post-stroke driver behaviour and self-regulation practices.

The impact of declining cognition on driving is well-established (e.g., Anstey et al., 2005). Poor performance in executive function is associated with poorer driving outcomes (Motta et al., 2014), as is impulsive and risk taking behaviour on-road (Cheng and Lee, 2012, Daigneault et al., 2002). However, whether the cognitive deficits associated with post-stroke status affect the ability to adequately calibrate is unclear. The findings from previous research on this topic are conflicted. Specifically, adults diagnosed with a stroke and who continued to drive were found to overestimate their driving capabilities (Heikkilä et al., 1999; Scott et al., 2009). When evaluated by health professionals, these drivers were also found to be more inclined to take risks on the roads (Heikkilä et al., 1999).

Despite these findings, there is some evidence to suggest that post-stroke adults are able to accurately assess their own driving ability. Research has found that the self-rating of some post-stroke adults correlates with the ratings of a nominated proxy, such as a close friend or family member (Stapleton et al., 2012). Research has also found that those with a brain injury are capable of realistic judgements of their own performance (Lundqvist and Alinder, 2007). Therefore, it is possible that post-stroke drivers are conscious of their deficits and will adjust their self-rating and calibration accordingly to avoid risk-taking situations. It is important to understand how much cognition influences the calibration of driving behaviour in post-stroke adults in order to determine how the level of safety will be affected before they return to driving.

There were two primary objectives to this study. The first was to investigate the perceived level of on-road related task demand and self-rated performance in both the post-stroke and control group drivers. The second was to investigate differences in these individuals’ perceived levels of both performance and observed driving performance. A further objective was to investigate the influence of cognition in any perceived driving performance.

2. Method

A comparison group design was used, which involved a group of self-reported post-stroke drivers and an age and gender matched control group.

2.1. Participants

The inclusion criteria for all study participants were as follows:

- all participants held a driving licence valid in Australia;