The relations between specific measures of simulated driving ability and functional ability: New insights for assessment and training programs of older drivers

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ABSTRACT

To gain new insights for driving assessment and training, this study had two objectives: (1) to investigate the relations between specific measures of older drivers' driving ability and demographic/functional ability measures, and (2) to verify the explained variance of these relations to determine the strength of these relations. A sample of 55 older drivers (mean age 76 years) completed a set of functional ability tests as well as a driving simulator test. Results indicate that (1) each specific driving measure is related to a specific set of functional abilities, and (2) only a small proportion of the variability observed in the specific driving measures is explained by demographic variables (3–15%) and by functional abilities (7–36%). For driving assessment programs, it will be necessary to assess several functional abilities to cover the complexity of the driving task. Furthermore, an assessment program focusing solely on demographic and/or functional ability measures, will not be successful in discriminating safe from unsafe older drivers. For driving training programs, it will be necessary to focus on the right set of functional abilities given that specific driving measures are related to different functional abilities. Moreover, a training targeting functional abilities might only have marginal effects on driving ability, given the relatively low amount of driving ability variance that is explained by functional abilities.

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1. Introduction

In most industrialized countries, the number of older drivers is increasing. Driving a car is related to autonomy, and important for quality of life and health (Eby, Molnar, & Kartje, 2009). Therefore, driving cessation can significantly impact people's health (Marottoli et al., 1997). Although most older drivers have a lot of driving experience (i.e., more than 50 years) and are less involved in risky driving behavior such as speeding and driving under influence, due to increased frailty older drivers are more susceptible to injury from a traffic accident (Eby et al., 2009). These injuries bring along large social and economic costs, and are a serious challenge to public health (Peden et al., 2004). Altogether, there is a need for a driving assessment instrument that adequately distinguishes between safe and unsafe older drivers. In the last decades, several

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studies have been in search of reliable predictors of older drivers' driving ability. Although unsafe driving increases with chronological age (Anstey & Wood, 2011), age alone, as the mere passage of time, is not an adequate predictor of driving ability (Anstey, Horswill, Wood, & Hatherly, 2012; Barrash et al., 2010). Instead, decline of functional abilities (i.e., cognitive, motor and visual abilities) important for driving does not start at the same age and does not occur to the same degree in each individual (Eby et al., 2009; Fildes, 2008; Langford, 2008). Research investigating the relation between measures of functional abilities and driving ability has shown that several tests are significantly related to driving ability, for example the Useful Field of View (UFOV) test (e.g., Ball et al., 2006; Jongen et al., 2012; Mullen, Chattha, Weaver, & Bédard, 2008). A recent meta-analysis conducted by Vanlaar et al. (2014) indicates that although there is fairly robust evidence suggesting cognitive screening instruments have value in predicting driving ability, there is still no single instrument that can accurately identify an unsafe driver. As noted by Vanlaar et al. (2014), the predictive value of screening instruments for predicting driving ability differs across different ways of measuring driving ability and across screening instruments themselves. Hence, it is crucial to establish the most appropriate method to predict driving ability.

Driving ability can be assessed in a summarized way (e.g., Stav, Justiss, McCarthy, Mann, & Lanford, 2008) or in a specific way (e.g., Jongen et al., 2012). Possibly, the lack of an instrument that adequately distinguishes between safe and unsafe drivers is the result of the approach that has been used so far to investigate the relation between driving ability and functional abilities, as the majority of studies have used summarized measures of driving ability (Bédard, Weaver, Dãrzin, & Porter, 2008; Jones Ross, Cordazzo, & Scialfa, 2014; Stav et al., 2008; Wood, Anstey, Kerr, Lacherez, & Lord, 2008). A summarized measure of driving ability is an evaluator's overall judgment of driving competence based upon component driving behaviors observed during the execution of a road course (Stav et al., 2008). Hence, specific aspects of driving are incorporated into one overall measure of driving. Often this summarized measure is based on errors and demerit points resulting into a categorical measure, like pass/fail (Bédard et al., 2008). For example, participants 'fail' if they gather too many demerit points or make a serious error. Although the use of summarized measures of driving ability has the advantage of providing a clear view of driving ability status (i.e., pass or fail), it might not be optimal for investigating the relation between driving and functional abilities since driving is a complex, goal-directed task that places high demands on perceptual, cognitive, and motor skills (Groeger, 2000). Therefore, it can be expected that different skills are important for different driving situations. This implies that as part of an assessment, the same test will not be a good predictor of all driving situations and problems. For example, it can be expected that the ability to react fast is more important for a driving situation where one needs to react to a sudden event, while the ability to divide attention is more important for a driving situation where one needs to turn left at an intersection and pay attention to other road users.

In the present study, a different approach was used to investigate the relation between driving ability and functional abilities. As opposed to a summarized measure of driving ability, specific measures of driving ability (e.g., mean driving speed and detection time) were investigated. We had two objectives: our first objective was to investigate the relations between specific measures of driving ability and functional abilities of older drivers; our second objective was to verify the explained variance of these relations to determine the strength of these relations. Altogether, the results of this study may have important implications for both driving assessment and training. As for driving assessment, the current investigation of specific measures of driving ability will illustrate whether different driving situations are dependent on different functional abilities. If so, a driving assessment program should always consider a set of functional abilities. However, only if the variance explained by such a set of functional ability tests is sufficiently high, will a screening instrument consisting of these tests be successful in discriminating safe and unsafe drivers. In addition to insights for future driving assessment programs, this approach provides new insights for future driving training programs that may keep older drivers on the road as safe drivers for as long as possible. Effective training programs are tailored to the individual, targeting those specific abilities that are hampered. This, however, is only possible if that information is available, with driving ability scores at the level of specific driving measures. Summarized measures of driving ability do not provide a detailed view of driving ability: whereas those who pass may still experience problems in some driving situations, those who fail might still be able to drive safely in a number of situations. Therefore, while investigating the relation between functional abilities and driving the inclusion of specific driving measures might allow a more accurate view of driving ability than a summarized driving score (pass/fail) because the latter will not correspond one-on-one with the score on specific driving measures. It has been shown that, even in old age, the human brain is plastic which implies that functional abilities are flexible and can be altered, leading to improvement of those functions (Erickson et al., 2007). Numerous studies have investigated training programs to keep older drivers safe drivers and to postpone or even counteract functional and driving impairment. Various studies have investigated direct types of training of driving ability through for example simulator training (Casutt, Theill, Martin, Keller, & Jäncke, 2014; Lavallière, Laurendeau, Tremblay, Simoneau, & Teasdale, 2009; Romoser & Fisher, 2009) and indirect types of training of driving ability through training of functional abilities, such as motor abilities (Marmeleira, Godinho, & Fernandes, 2009; Sayers & Gibson, 2012) and cognitive abilities (Ball, Edwards, Ross, & McGwin, 2010; Cassavaugh & Kramer, 2009). However, only if the variance explained by functional abilities is sufficiently high, will a training of functional abilities be successful in training driving ability.

Although some studies investigating the relations between specific measures of older drivers' driving and functional ability were already conducted (Aksan, Anderson, Dawson, Uc, & Rizzo, 2015; Anstey & Wood, 2011; Backs, Tuttle, Conley, & Cassavaugh, 2011; Jongen et al., 2012; Mullen et al., 2008; Shanmugaratnam, Kass, & Arruda, 2010; Szlyk, Myers, Zhang, Wetzel, & Shapiro, 2002; Tuttle, Cassavaugh, & Backs, 2009), these mainly focused on measures of cognitive ability. Here, in addition to measures of cognitive ability, measures of visual and motor ability were included. Moreover, since unsafe