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Mechanisms behind distracted driving behavior: The role of age and executive function in the engagement of distracted driving

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Performing secondary tasks, such as texting while driving, is associated with an increased risk of motor vehicle collisions (MVCs). While cognitive processes, such as executive function, are involved in driving, little is known about the relationship between executive control and willingness to engage in distracted driving. This study investigated the relationship between age, behavioral manifestations of executive function, and self-reported distracted driving behaviors. Executive difficulty (assessed with the BRIEF-A) as well as demographics (age and gender) was considered as possible predictors of engagement in distracted driving behaviors. Fifty-nine young, middle, and older adults self-reported executive difficulty and weekly engagement in distracted driving behaviors. Results revealed that while partially accounted for by age, global executive difficulty was uniquely related to engagement in distracted driving behaviors. Older age was associated with fewer weekly self-reported distracted driving behaviors while higher self-reported executive difficulty was associated with more frequent weekly engagement in distracted behavior. No significant differences were found between young and middle-aged adults on distracted driving behaviors. Findings conclude that distracted driving is a ubiquitous phenomenon evident in drivers of all ages. Possible mechanisms underlying distracted driving behavior could potentially be related to deficits in executive function.

1. Introduction

Distracted driving is a pervasive public health concern and a major source of injury and death for motorists in the United States across the lifespan (National Highway Traffic Safety Administration [NHTSA], 2015). Distracted driving is defined as completing a secondary task that diverts or captures attention away from the task of driving (Regan et al., 2011). Distraction is further categorized into three main types: visual (a distractor that involves removing the driver's eyes off the road), manual (a distractor that involves removing the driver's hands off of the wheel), and cognitive (a distractor that involves taking the driver's mind or cognitive resources off of the immediate task of driving; (NHTSA, 2015).

In 2014, on a typical day during daylight hours, it is estimated that 7.82% of US drivers are using a cell-phone (hand-held or hands-free) while driving (Pickrell and KC, 2015), which is a number assumed to under-represent the actual level of behavioral engagement with cell-phones while driving. While distracted driving is prevalent, previous research has shown that engagement in distracted driving behaviors puts drivers at a higher risk of having a motor vehicle collision (MVC) or near MVC (Klauer et al., 2014). Klauer et al. (2014) found that novice drivers (M_{age} = 16.4) were 8 times more likely to have a MVC or near-crash while dialing a cell-phone, while experienced drivers were more than 2 times more likely. Although much attention has been placed on technological distractions while driving, specifically focusing on cell phone usage, distractors can also be non-technological, as shown by Dingus et al. (2011). In particular, this naturalistic driving study revealed that distracting behaviors such as eating or reaching for objects in the vehicle while driving were associated with a 1.6 and 8.8 increased odds of having a MVC or near-crash, respectively. Furthermore, video coded driving observations revealed that drivers performed these behaviors frequently while driving, with up to 21% of seventy age-diverse participants engaging in some form of non-mobile distracting behavior during a span of three hours (Stutts et al., 2005). Interestingly, research supports the finding that drivers possibly view behaviors such as eating or reaching, as not being as distracting or dangerous as engaging with cell-phones or technology (White et al., 2004).

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The majority of distracted driving research has focused on adolescents or young drivers due to the higher proportion of MVCs compared to the rest of the US population and the higher prevalence of technology use in this demographic. NHTSA (2012) reported that young drivers had the highest level of MVCs and near crashes due to phone involvement. While distracted driving seems to be ubiquitous with young drivers, less research has focused on the prevalence of these behaviors in other age demographics, i.e. middle-aged and older adults. Engelberg et al. (2015) collected self-reported distracted driving behavior among middle-adults and found that out of 715 adults ranging between the ages of 30–64, 56% spent at least some point of their time driving using a handheld device, with 66% texting while waiting at red lights. Notably, age was a significant predictor of distracted driving, in that older age was predictive of lower engagement in distracted driving behaviors. Similarly, Parr et al. (2016) found the same relation between age and engagement in cellular distraction while driving, with adolescents reporting more engagement with using the phone and texting while driving than older adults, but no difference between age groups for having a cell phone conversation while driving. These studies conclude that distracted driving is a phenomenon not only seen with young drivers, but also in older and more experienced drivers, just not as frequently.

In the realm of older adults (ages 65 and older), most research assessing distracted driving behaviors has elaborated on the detrimental effects of secondary task engagement on attention and cognitive load (see Strayer and Drew, 2004), and less on the frequency of these behaviors in this age demographic (for a review see Koppel et al., 2009). While we know these behaviors are less frequent than younger cohorts in years past (Pickrell and Ye, 2013), older adults have reported more positive and accepting attitudes towards technology (Mitzner et al., 2010). Moreover, the proportion of baby boomers driving is larger than previous cohorts with more drivers relying on private cars as the major form of mobility and transportation in the community (Koppel et al., 2009). This may mean as the pervasiveness and necessity of technology continues to increase in our environment, the safety risks associated with use of such technology may be further compounded for aging baby boomers whose age-related motor and cognitive deficits are more pronounced and common.

To fully understand willingness to engage in distracted driving, investigating possible underlying mechanisms behind this behavior is imperative. What individual difference factors relate to the engagement in secondary behaviors behind the wheel? Executive function refers to a broad set of cognitive processes that manage and control complex behavior such as problem solving and prospective thinking (Jurado and Rosselli, 2007). These higher order processes are associated with development of the prefrontal cortex (Diamond, 2002) and susceptible to aging (Zelazo et al., 2004), with full maturity reached in late adolescence and evident heterogeneous age-related decline present in mid-to-late life, dependent on the cognitive domain of interest (Salthouse, 2009). Although decrements in certain domains of executive function, e.g. working memory and inhibition, have been associated with negative simulated driving outcomes for young adults (Mäntylä et al., 2009; Ross et al., 2015) and age-related decline has been associated with on-road driving errors (Anstey and Wood, 2011; Tabibi et al., 2015), crash risk (Daigneault et al., 2002), and decline in driving skill (Stelmach and Nahom, 1992) for older adults, little research has investigated the relation of EF with engagement in distracted driving behavior.

Sanbonmatsu et al. (2013) found that lower executive control, measured by the Operation Span task (Turner and Engle, 1989; Unsworth et al., 2005), was related to higher impulsivity and better perception of multi-tasking, which was highly related with using a cell phone while driving. Interestingly, individuals who reported being better multi-taskers performed worse on the executive control task, reported more impulsivity and sensation seeking, and reported higher engagement in multi-tasking. Although impulsivity and sensation seeking were not the focus of the study, it has been shown that these two processes have a complex relationship with executive function development (Romer et al., 2011). Hayashi et al. (2015) found that texting while driving was related to impulsivity indicating that individuals who frequently texted while driving chose smaller, immediate rewards over larger, delayed rewards compared to controls on a delay-discounting task. This alludes to the intricate relationship between executive function, impulsivity, and driving behavior that warrants further investigation.

Although the primary means for assessing executive function in previous work has been through performance-based tasks that measure a specific cognitive function or domain (Jurado and Rosselli, 2007), executive function can also be assessed through real-world behavioral manifestations. The Behavior Rating Inventory of Executive Function- Adult Version (BRIEF-A) (Roth et al., 2005) assesses behavioral disruptions spanning nine domains of executive function (inhibit, shift, emotional control, self-monitor, initiate, working memory, plan/organize, task monitor, and organization of materials) over the past month. Previous research has shown the BRIEF to be related to negative driving outcomes in individuals after brain injury (Rike et al., 2015, 2014) and with adolescent drivers (Pope et al., 2016). To our knowledge no other study has assessed the BRIEF in relation to engagement in distracted driving. Previous evidence has shown that the BRIEF may be assessing different behaviors to environmental demands that performance-based measures fail to capture possibly explaining its lack of relation with lab-based executive function outcomes (Isquith et al., 2014; McAuley et al., 2010).

The main aim of this study was to investigate the relationship between executive difficulty and the frequency of distracted driving behaviors cross-sectionally in young adults, middle-age adults, and older adults. Given the relationship between executive control and driving, we hypothesized that increases in self-reported behavioral executive disruptions would be predictive of weekly-distracted driving engagement. Also, because distracted driving behavior is prevalent in younger individuals, age was investigated as a variable of interest, with distracted driving behaviors hypothesized to be less frequent in older age and the most frequent in young adults. We hypothesized that executive difficulty would be a significant predictor after controlling for age effects due the aforementioned relationships between executive control and distracted driving behaviors (Sanbonmatsu et al., 2013). In addition, we predicted that the effects of age on distracted driving behavior would be partially mediated by executive difficulty.

2. Materials and method

2.1. Participants

Thirteen young adults (19.10 to 19.96 years; M_{age} = 19.69, SD = 0.28), twenty-one middle age adults (36.16 to 53.97 years; M_{age} = 43.93, SD = 5.75), and twenty-five older adults (65.00 to 91.47 years; M_{age} = 71.66, SD = 7.02) were recruited for a total sample size of 59 participants. All participants were recruited from a large university in the Southeast through IRB approved community flyers and the university clinical trial reporter. Inclusion criteria included having a valid driver's license, being a current driver, operationally defined as someone who had driven in the last 12 months and would drive that day if he or she needed to, and for older adults, a passing score on the TICS-M, a telephone administered assessment of cognitive status (de Jager et al., 2003). Additional participant characteristics are provided in Table 1. Of the 59 participants, 25.4%