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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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Abstract

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.

Keywords

Distracted driving; Executive function; Older drivers; Adolescent drivers

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, Hallett, & Gordon, 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

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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 & 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, Hanowski, and Klauer (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, Eiser, & Harris, 2004).

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, Hill, Rybar, and Styer (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 & Drew, 2004), and less on the frequency of these behaviors in this age demographic (for a review see Koppel, Charlton, & Fildes, 2009). While we know these behaviors are less frequent than younger cohorts in years past (Pickrell

& 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 & Rosselli, 2007). These higher order processes are associated with development of the prefrontal cortex (Diamond, 2002) and susceptible to aging (Zelazo, Craik, & Booth, 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, Karlsson, & Marklund, 2009; Ross et al., 2015) and age-related decline has been associated with on-road driving errors (Anstey & Wood, 2011; Tabibi, Borzabadi, Stavrinos, & Mashhadi, 2015), crash risk (Daigneault, Joly, & Frigon, 2002; Koppel et al., 2009), and decline in driving skill (Stelmach & Nahom, 1992) for older adults, little research has investigated the relation of EF with engagement in distracted driving behavior.

Sanbonmatsu, Strayer, Medeiros-Ward, and Watson (2013) found that lower executive control, measured by the Operation Span task (Turner & Engle, 1989; Unsworth, Heitz, Schrock, & Engle, 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, Russo, and Wirth (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 & 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, Isquith, & Gioia, 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, Johansen, Ulleberg, Lundqvist, & Schanke, 2015; Rike, Ulleberg, Schultheis, Lundqvist, & Schanke, 2014) and with adolescent drivers (Pope, Ross, & Stavrinos, in press). 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, Roth, Kenworthy, & Gioia, 2014; McAuley, Chen, Goos, Schachar, & Crosbie, 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, Budge, & Clarke, 2003). Additional participant characteristics are provided in Table 1. Of the 59 participants, 25.4% ($n = 15$) had reported a MVC in the past three years. When assessing MVCs across age groups, older adults reported the highest percentage at 32.0% ($n = 8$), followed by young adults at 30.8% ($n = 4$), and middle-aged adults at 14.3% ($n = 3$). Lastly, the entire sample reported having a cell phone with young adults receiving their first cell phone at the average age of 12.69 ($SD = 0.33$), middle-aged adults at the average age of 27.17 ($SD = 1.96$), and at the average age of 53.16 ($SD = 2.14$) for older adults.

2.2. Procedure

A university IRB approved all procedures, and written consent was obtained for all participants. Participants completed all questionnaires in the lab and were monetarily reimbursed for their participation.

2.3. Measures

2.3.1. Demographics—A standard self-report questionnaire was given to all participants to collect pertinent demographic information such as age, gender, and ethnicity.

2.3.2. The Behavior Rating Inventory of Executive Function (BRIEF) (Roth et al., 2005)—Difficulty with executive function was assessed over 75 questions in a pencil and paper format. The questionnaire was normed for individuals 18 – 90 years old. Questions refer to real-world behavioral disruptions that have occurred over the past month using a three-point scale: never (1), sometimes (2), and often (3). BRIEF questions capture difficulty in different executive function domains such as “I rush through things” to reflect the domain of inhibition. The BRIEF was comprised of 1) the Behavioral Regulation Index (BRI), which was further divided into four subscales: inhibit, shift, emotional control, and self-monitor, and 2) the Metacognitive Index (MI), was further divided into five subscales: initiate, working memory, plan/organize, task monitor, and organization of materials. The two composite scores (BRI and MI) were summed together to yield the Global Executive Composite (GEC) score, which provided an overall global score of executive functioning. Reliability was assessed using Cronbach’s alpha with the total global executive composite score (GEC) (α = 0.97) and composite scores, BRI (α = 0.94) and MRI (α = 0.94) having excellent reliability. Because MI and BRI were highly correlated (r = 0.83), GEC was used to assess executive function.

2.3.3. Distracted Driving Behavior Questionnaire—This 10-item questionnaire assessed self-reported distracted driving behaviors on a weekly basis and was adapted from a larger, more comprehensive lab-developed driving questionnaire (Welburn, Garner, Schwartz, & Stavrinos, 2010). The distracted driving behaviors questionnaire evaluated the frequency of 10 distracted driving behaviors over a weekly basis: 1) drinking a cold beverage, 2) eating, 3) talking/singing while no other passengers are present, 4) reaching without taking your eyes off the road, 5) driving lost in thought, 6) talking on a “hands-held” cell phone, 7) talking on a “hands-free” cell phone, 8) using a GPS navigation system, 9) sending a text message on a cell phone, and 10) receiving a text message on a cell phone. Participants were instructed to report “how often do you (days/week)” engage in each distracted driving behavior listed above. Participants responded with a whole number between 0 and 7 for each behavior. Distracted driving behaviors were standardized and summed across behaviors to yield a distracted driving behavior composite score.

Reliability of distracted driving behaviors in the total sample was then assessed. Looking at the 10 distracted driving behaviors reported from the distracted driving behavior questionnaire, reliability was borderline acceptable (Cronbach’s α = 0.70) (Meyers, Gamst, & Guarino, 2013). However, results showed that removing questions concerning hands-free cellphone and GPS use via an if-item deleted analysis provided by SPSS, improved the internal consistency of distracted driving behaviors composite score to acceptable (Cronbach's α = 0.76) by detecting variables with low relation to the overall construct of distracted driving. Further investigation into these two variables revealed most of the sample (69.5%) reported no engagement in these behaviors, possibly resulting in low relation due to lack of variation. Therefore, these two distracted driving behaviors were dropped and the resulting composite based on the remaining 8 distracted driving behaviors was used in the analyses.

2.4. Data Analysis Plan

2.4.1. Preliminary Analyses—Means and standard deviations were calculated for all participant demographics and measures for the overall sample (n = 59) and also stratified by age group (i.e., young adult, middle adult, older adult). Correlations were performed to assess interrelatedness among predictors and outcome variables. A univariate one-way analysis of variance was conducted to investigate possible age differences with distracted driving behaviors, driving experience, and executive difficulty. Post-hoc tests were applied using the Bonferonni method.

2.4.2. Regression Analyses—A hierarchical linear regression was then used to test the unique effect of GEC over and above the effects of age and gender on the number of weekly distracted driving behaviors (See Table 3). All models were assessed for meeting the assumption of linear regression to assure no substantial violations in linear trends, homoscedasticity, or multicollinearity. The ratio of the indirect to the total direct effect was used as an index of relative strength that executive function difficulties accounted for the effect of age on distracted driving behaviors using the Baron and Kenny model of mediation (Baron & Kenny, 1986). Furthermore, bootstrapping with 5000 resamples was used to test the mediating effects of executive function difficulties (see Figure 1) by calculating bias-corrected confidence intervals (Preacher & Hayes, 2008). This analysis has greater power to determine a significant or non-significant mediation while correcting for sample bias, which is particularly useful in studies with small sample sizes. All analyses were conducted in SPSS 22.0 with significance was denoted for p values less than an alpha level of .05.

3. Results

3.1. Preliminary Analyses

Table 1 includes demographic characteristics and executive function variables of the total sample as well as for each age group. In the overall sample, participants were predominately Caucasian (59.3%) and African American (32.2%) and women (59.3%). Regarding measures of executive difficulty, the mean GEC was 109.37 (SD = 23.16), consisting of an average MI of 58.92 (SD = 11.65) and BRI of 44.84 (SD = 7.86). A one-way ANOVA revealed a significant difference among age groups on distracted driving behaviors (F(2,56) = 23.75, p < 0.001). Post-hoc tests indicated that young (M = 4.55, SD = 4.29) and middle-aged adults (M = 1.55, SD = 4.11) engaged in more distracted driving behaviors than older adults (M = −3.66, SD = 2.98). When assessing driving experience, measured as months since full licensure, there was no significant difference between genders (t(57) = 0.911, p = 0.366). A significant difference between age groups on driving experience was found (F

(2,56) = 297.71, $p < 0.001$). A post-hoc test revealed that older drivers had the most driving experience (649.96 months) when compared to middle age drivers (307.95 months) who both had more experience than younger drivers (34.08 months). No significant difference was found between age groups for executive difficulty ($F(2, 56) = 2.38$, $p = 0.102$).

To assess interrelation between variables, Pearson correlations were produced between the BRIEF GEC along with age and distracted driving behaviors (see Table 2). Higher scores on the GEC were associated with higher frequency of distracted driving behaviors ($r = 0.52$, $p < 0.001$) and lower age ($r = -0.27$, $p = 0.01$). Spearman's rho showed that gender was not significantly associated with predictor variables or distracted driving behaviors ($p > 0.05$).

3.2. Regression Analyses

A hierarchical linear regression model following the Baron and Kenny (1986) model of mediation was conducted to test the unique effect of executive function on distracted driving behavior over and above age and gender. Bivariate correlations showed no substantial violations in the assumption of linear trends of multicollinearity between continuous predictors ($r = -0.27$). Standardized residual versus predicted plot and Shapiro-Wilk tests did not show any obvious problems in homoscedasticity or the assumption of normality for distracted driving behaviors. All models were assessed for meeting assumptions of linear regression and showed no substantial violations in linear trends, homoscedasticity, or multicollinearity; thus, the models were appropriate for linear regression analysis (ps > .05).

Age was inversely related to the number of distracted driving behaviors ($\beta = -0.65$) and, along with gender, accounted for 43% of the variability in distracted driving behaviors ($p < 0.001$; see Table 3 and Figure 1a.). In order to obtain the indirect effect, the total effect of GEC on distracted driving behavior (after controlling for gender) and the relation between age and GEC was calculated (see Figure1b). Distracted driving behaviors were regressed on GEC and revealed that GEC was a significant predictor ($\beta = 0.52$, $p < 0.001$); higher global executive difficulty was related to reporting more frequent engagement in distracted driving behaviors. GEC was regressed on age after controlling for gender, which also yielded a significant effect ($\beta = -0.29$, $p = 0.043$).

In the second model (see Table 3), distracted driving behaviors were regressed on both GEC and age (while controlling for gender). Age explained 28% of the variance in distracted diving behavior over and above GEC and gender ($R^2_{adjusted} = .26$, $p < 0.001$). Younger age was associated with higher reported distracted driving behaviors ($\beta = -0.56$, $p < 0.001$). However, GEC remained a significant predictor ($\beta = 0.37$, $p < 0.001$). GEC, age, and gender accounted for 54% ($R^2_{adjusted} = 0.53$) of the variance in the number of distracted driving behaviors engaged in weekly (after controlling for gender). The indirect effect was −0.02, computed as the product of the mediated path coefficients of −0.29 and 0.08, while the direct effect was −0.13. Looking at a measure of effect size, the ratio of the indirect effect and the direct effect was approximately 0.18. It thus appears that approximately 18% of the positive effect of age on distracted driving behaviors was partially accounted for by global executive function.

The indirect effect of age between the relationship of GEC and distracted driving behaviors was statistically significant based on bias-corrected bootstrapped confidence intervals (b = 0.03, SE = 0.02, BC 95% CI = 0.001 to 0.063) using the Preacher and Hayes (2008) non-parametric test of mediation macro for SPSS. These findings are in further support of the unique role of GEC in predicting the frequency of self-reported distracted driving behaviors over and above the effect of age.

4. Discussion

Distracted driving is a leading cause of fatality and injury from MVCs and near MVCs in the United States (NHTSA, 2015). Although distracted driving behaviors are routinely assessed and investigated in young drivers, new evidence has shown this phenomenon is also seen in other age demographics, i.e. middle-aged and older adults. The findings of the present study support previous research indicating frequent engagement in distracted driving among young drivers (Klauer et al., 2014) and middle-aged adults (Engelberg et al., 2015) with fewer behaviors seen in older adults (ages 65+) (Pickrell & Ye, 2013). Post-hoc comparisons revealed no significant differences between younger and middle-aged adults in distracted driving behavior engagement, with both engaging in significantly more distracted driving behaviors than older adults. This supports the findings of Engelberg et al. (2015) suggesting the prevalence of distracted driving seen in middle-age adults is high, making distracted driving a pervasive public health concern across age groups. While our sample of older adults engaged less in distracted driving behaviors as compared to other groups, there was still a variable amount of distracted driving behaviors reported. As the baby boomers progress into older adulthood their acceptance and positive affect towards technology and its benefits (Mitzner et al., 2010) may alter the norms and expectations of older adult distracted driving behavior.

When assessing distracted driving behaviors, more is known about the behaviors in an environmental context and less behind the mechanisms of this dangerous behavior (Sanbonmatsu et al., 2013). Using the BRIEF-A, executive difficulty was assessed and used along with age and gender as possible predictors of engagement in distracted driving behaviors. Findings indicated that while age was a significant predictor, the relationship was partially mediated by global executive difficulty. Furthermore global executive difficulty was uniquely related to the frequency to engage in distracted driving behaviors across the lifespan. Global executive difficulty together with gender accounted for 28% of the variance in distracted driving behavior and accounted for 18% of the effect of age. Older age was associated with fewer self-reported distracted driving behaviors while more executive difficulty was associated with more engagement in distraction. One unexpected finding was a negative relation between age and executive difficulty, with younger age reporting more executive difficulty. This finding contradicts a prominent body of literature suggesting executive declines are more apparent in older age than in middle-age and younger adults, particularly when measured by performance-based tasks of executive functioning (Jurado & Rosselli, 2007; Zelazo et al., 2004). Findings on normal cognitive aging deficits vary, with studies showing mixed findings due to methodological problems such as study design, biased-sample selection, and aging-related diseases such as mild cognitive impairment (MCI) and dementia confounding results (Harada, Love, & Triebel, 2013). Previous literature supports the idea that certain domains of executive functioning, e.g. inhibition, declines substantially compared to younger adults after the age of 70 (Harada et al., 2013; Lezak, Howieson, & Loring, 2004).

Our results revealed that executive control plays an important role in the engagement in distracted driving behavior. Specifically, individuals who reported more executive difficulty engaged in more distracted driving behaviors. This aligns with findings from Sanbonmatsu et al. (2013) suggesting that individuals with less executive control are more likely to multi-task and engage in secondary driving behavior. These findings possibly suggest that individuals with deficits in executive function are more prone to engaging in distracted driving behaviors due to the inability to properly inhibit or regulate their behavior. Because these findings are both based on self-report, more experimentally controlled studies are needed to further investigate the relationship.

The present study has a few limitations that leave room for further investigation. Distracted driving behaviors and executive difficulty were solely based on self-report. While both questionnaires were designed to assess self-report, observable and experimental data is needed for comparison. Naturalistic driving data along with performance-based executive function tasks are needed to assess reliability of these findings. Further research is also needed to assess longitudinal change with these self-reported measures, as cross-sectional analyses are more commonplace, but limit the conclusions that may be drawn. Although, the BRIEF-A shows little statistical association with performance-based measures (Ritter, Perrig, Steinlin, & Everts, 2014) further investigation into the relationship between the two types of executive function is needed in the context of driving. It could be the case that the BRIEF-A captured variance not explained by traditional performance-based measures and may be tapping into “hot cognition” that is not always captured with “cool cognition” in-lab performance-based measures (see Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Prencipe et al., 2011) as the BRIEF has shown association with negative driving outcomes (Pope et al., in press; Rike et al., 2015; Rike et al., 2014). We also did not measure impulsivity, a trait associated with distracted driving and executive deficit or self-regulation, a compensation strategy involving awareness of cognitive and motor deficits frequently seen in older drivers that factor into a driver’s willingness to engage in certain driving behaviors (Lerner, Singer, & Huey, 2008). Previous literature has shown that impulsivity is related to the need to text while driving (Hayashi et al., 2015) and the engagement of multitasking, including using a cell phone while driving (Sanbonmatsu et al., 2013). Further investigation is needed to assess the relationship between impulsivity, self-regulation, executive function, and distracted driving behavior.

Finally, our design was cross-sectional. While cross-sectional designs are advantageous when looking at age and cohort differences, there is always the chance of inflation in differences between age groups in comparison to longitudinal designs (e.g. cohort differences; (Rönnlund & Nilsson, 2006). Cross-sectional design along with screening for cognitive dysfunction, using the TICS-M, could also have contributed to the unexpected relation between age and executive difficulty. Previous literature, while complex, has shown a notable decline in executive functioning as we age. Our findings align with the BRIEF raw scores with a slight decrease in behavioral disruptions with age (Roth et al., 2005). Though the relation is in the opposite direction than performance-based measures, the groups did not statistically differ in reported difficulty. Because of the aforementioned reasons such as cross-sectional design, lack of variation in the GEC scores, and lack of longitudinal data on self-reported cognitive ability the unexpected age effect may be an artifact that warrants further investigation. While longitudinal design would have been preferred, this study aimed to assess the differences in distracted driving behavior between age groups - a topic about which little is known. It could be the case that individuals who are prone to distracted driving or are unable to inhibit or regulate effectively show distracted driving behaviors across the lifespan and do not deter with age.

This study was among the first to take a developmental approach to distracted driving behaviors by assessing the engagement of these behaviors in the context of executive deficit. While it is necessary to learn how to motivate compliance with distracted driving legislation, it is also important to understand why this behavior is so ubiquitous and pervasive in our society. If individuals continue to perform these behaviors as they age they could potentially encounter the negative effects of distracted driving in combination with age-associated deficits in driving such as motor and attention decline (Laughton et al., 2003; Verhaeghen & Cerella, 2002). More research is needed to see if these behaviors are stable with driving experience and if attitudes or behavior can be modified to improve public health.

5. Conclusions

While it is well established that young adults are frequent distracted drivers putting them at higher risks for negative driving outcomes such as MVCs, this study presented empirical evidence that distracted driving is a phenomenon seen across ages. Furthermore the findings revealed that middle-aged adults engaged in distracted driving behaviors just as frequently as young adults. As expected older adults engaged the least in distracted driving behaviors, but as a group were still engaging in about 8 distracted driving behaviors on average weekly. Interestingly, executive difficulty was related to the frequency to engage in distracted driving, even after taking age into account. Like other studies, this study is not free of limitations but is among the first to assess distracted driving and cognitive difficulty from a developmental standpoint. Future work might consider further studies into the mechanisms behind the need to multitask while driving and how these attitudes and behaviors change as we age giving needed information that may translate into findings needed for further law and legislation changes regarding distracted driving.

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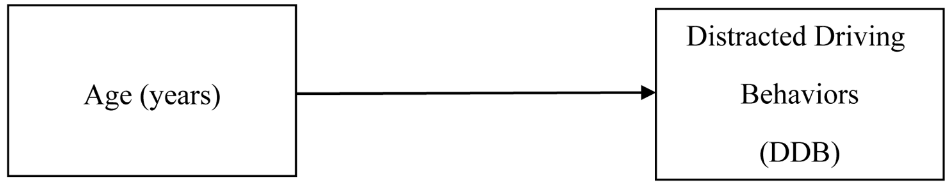
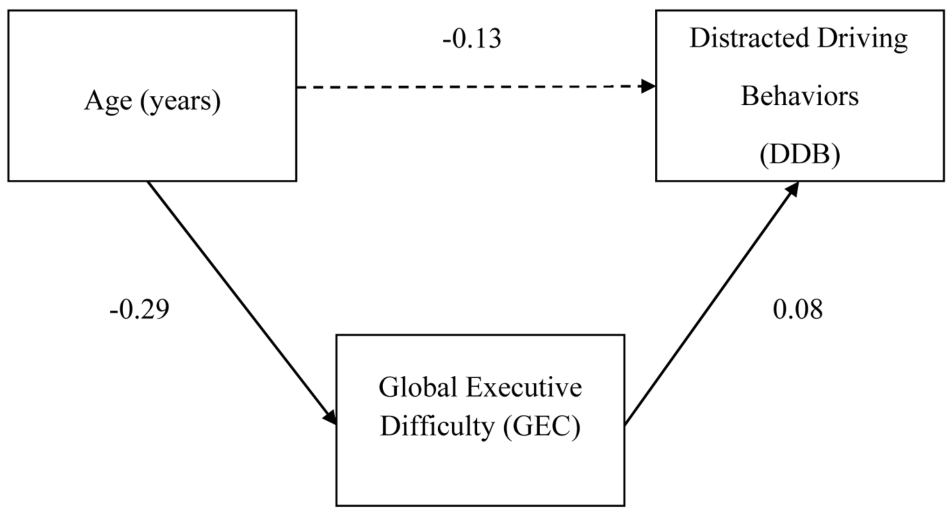


a) Direct Pathway, $R^2 = 0.43$, $F(1,57) = 42.56$, $p < 0.001$



b) Indirect or Mediated effect = -0.023, 95% Boot CI: -0.056 to -0.002

Figure 1. Mediation with bootstrap analysis adjusted for gender

Mediation model being tested (on the basis of Preacher & Hayes, 2008).

Table 1

Descriptive statistics by age group.

Characteristic	Total Sample (*n* = 59)	Young adult (*n* = 13)		Middle Adult (*n* = 21)		Older Adult (*n* = 25)	
	n (%)	*n*		*n*		*n*	
Race							
Caucasian	35 (59.3%)	8		11		16	
African-American	19 (32.2%)	2		8		9	
Other	5 (8.5%)	3		2		0	
Gender							
Male	24 (40.7%)	8		7		9	
Female	35 (59.3%)	5		14		16	
	M (*SD*)	*M* (*SD*)	Range	*M* (*SD*)	Range	*M* (*SD*)	Range
Age (years)	50.34 (21.29)	19.69 (0.28)	19.10 – 19.96	43.93 (5.75)	36.16 – 53.97	71.66 (7.02)	65.00 – 91.47
GEC	109.37 (23.16)	120.62 (26.44)	70.00 – 157.00	109.10 (24.51)	71.00 – 158.00	103.76 (18.57)	70.00 – 145.00
BRI	47.46 (11.07)	53.39 (13.94)	30.00 – 77.00	46.91 (11.54)	31.00 – 74.00	44.84 (7.86)	30.00 – 61.00
MI	61.91 (13.14)	67.23 (13.58)	40.00 – 83.00	62.19 (14.07)	40.00 – 87.00	58.92 (11.65)	40.00 – 84.00
Distracted Driving Behaviors ⟊	17.92 (12.51)	29.77 (10.47)	11.00 – 51.00	22.00 (10.19)	6.00 – 52.00	8.34 (7.13)	0.00 – 25.00

Note. GEC = Global Executive Composite. BRI = Behavioral Regulation Index. MI = Metacognitive Index. BRIEF scales reflect raw scores. Raw score range for GEC is 70 – 210, for BRI is 30 – 90, and MI is 40 – 120.

⟊ Raw sum of frequencies of distracted driving behaviors reported per week. Standardized scores were used for all analyses.

Table 2

Correlations between measures of executive function, age, and distracted driving behaviors

Measure	*1*	*2*	*3*	*4*	*5*
1. Age	—				
2. GEC	−.27*	—			
3. BRI	−.28*	.95**	—		
4. MI	−.23	.96**	.83**	—	
5. Distracted Driving Behaviors	−.65**	.52**	.47**	.52**	—

Note. GEC = Global Executive Composite. BRI = Behavioral Regulation Index. MI = Metacognitive Index.

* $p < .05$.

** $p < .01$.

Table 3

Linear regressions predicting distracted driving behaviors

Model	Unstandardized Coefficients		Standardized Coefficients					
	b	*SE*	Beta	*t*	*F*	R^2	ΔR^2	*p*
Model 1					20.98	.43		**<.001**
Age	−.15	.02	−.66	−6.45				**<.001**
Gender	.29	1.02	.03	.29				.775
Model 2					23.13	.53	.13	**<.001**
GEC	.08	.02	.37	4.01				**<.001**
Age	−.13	.02	−.56	−5.93				**<.001**
Gender	.27	.91	.03	.30				.767

Note. Bold signifies $p < .05$. *GEC* = Global Executive Composite.