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Individual Difference Factors in Risky Driving among Older Adults

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Abstract

Introduction—Motor-vehicle crashes kill roughly 4,500 American adults over the age of 75 annually. Among younger adults, one behavioral factor consistently linked to risky driving is personality, but this predictor has been overshadowed by research on cognitive, perceptual, and motor processes among older drivers.

Method—In this study, a sample of 101 licensed drivers, all age 75 and over, were recruited to complete self-report measures on personality, temperament, and driving history. Participants also completed a virtual environment (VE) course designed to assess risk-taking driving behavior. State records of motor-vehicle crashes were collected.

Results—Results suggest both a sensation-seeking personality and an undercontrolled temperament are related to risky driving among older adults. Sensation-seeking was particularly related to history of violations and tickets, while temperamental control was more broadly related to a number of risky driving measures. Methodological and crash prevention issues are discussed.

Keywords

risky driving; personality; older adults; virtual environments

Introduction

Motor-vehicle crashes kill almost 45,000 Americans annually, including over 4,500 adults over the age of 75 (National Center for Injury Prevention and Control [NCIPC], 2005). Efforts to reduce the rate of motor-vehicle fatalities over the past several decades have been moderately

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successful, largely due to the increased use of seat belts and to improvements in vehicle, traffic, and road engineering. Despite this, motor-vehicle crashes remain the leading cause of unintentional injury among Americans and researchers continue to uncover a number of behavioral factors that, along with environmental factors, play a substantial role in causing motor-vehicle crashes.

One behavioral factor consistently linked to risky driving among younger and middle-aged adults is personality (Arthur, Barrett, & Alexander, 1991; Beirness, 1993; Dahlen, Martin, Ragan, & Kuhlman, 2005; Fine, 1963; Jonah, 1997; Oltedal & Rundmo, 2006; Schwebel, Severson, Ball, & Rizzo, 2006; Tillmann & Hobbs, 1949). Studies vary widely in their methodology, constructs of interest, and study populations, but several consistent findings emerge. First, drivers who are impulsive – that is, those who respond quickly to stimuli, and without thought – are more likely to drive in risky manners (e.g., Arthur & Doverspike, 2001; Beirness, 1993; Dahlen et al., 2005; Schwebel et al., 2006). Second, drivers who are high in sensation seeking – those who enjoy risky, exciting, sensational, and novel activities – are more likely to drive in risky manners (Burns & Wilde, 1995; Iversen & Rundmo, 2002; Jonah, 1997; Jonah, Thiessen, & Au-Yeung, 2001; Trimpop & Kirkcaldy, 1997).

To date, the literature on safety among older drivers has focused primarily on other risk factors – cognitive, perceptual, and motor factors – that decline in aging populations (e.g., Anstey, Wood, Lord, & Walker, 2005; Ball et al., 2006; Goode et al., 1998; Owsley et al., 1998; Owsley, McGwin, & Ball, 1997). This is sensible – as adults age, their cognitive, perceptual, and motor processes deteriorate and change in ways that may influence safe driving. However, given the links between personality and driving safety among younger populations, it is surprising that the literature has paid little attention to those links among older drivers, particularly since individuals' personality apparently changes as they develop in late adulthood (Helson, Jones, & Kwan, 2002; Maiden, Peterson, Caya, & Hayslip, 2003; Martin, Long, & Poon, 2002; Small, Hertzog, Hultsch, & Dixon, 2003; Zuckerman, 2007).

The present investigation was designed, therefore, to study the role of personality in dangerous driving behavior among older adults. Existing research on the topic is limited and yields mixed results. Two reports found no correlation between personality variables and risky driving in older adults (Garrity & Demick, 2001; Strahan, Mercier, Mercier, & O'Boyle, 1997), but a third (Owsley, McGwin, & McNeal, 2003) found otherwise. Owsley and colleagues administered the Eysenck Impulsiveness, Venturesomeness, and Empathy (IVE) Questionnaire (Eysenck & Eysenck, 1978) and a self-report driving behavior instrument to 305 older drivers (mean age = 71.8 years). Results suggested that both high impulsivity and low venturesomeness predicted self-reported driving errors; high impulsivity also predicted self-reported driving violations; and none of the three personality traits predicted crash involvement. Our present hypothesis, therefore, was rather straightforward. We predicted that high sensation-seeking and low temperamental control – traits shown to relate to younger drivers' risk-taking (Beirness, 1993; Dahlen et al., 2005; Jonah, 1997; Schwebel et al., 2006) – would similarly be related to crashes and reckless driving among older adults.

Method

Participants

A sample of 101 older adults, all age 75 or over, were recruited from a database of individuals interested in participating in research in the Birmingham, Alabama community (53% male, 47% female; 93% Caucasian, 6% African American, 1% Native American; mean age = 80.02, *SD* = 3.41, range = 75 to 93 years). The sample had modest income (mean income = $46,000) and participants had been licensed drivers for a mean of 60.88 (*SD* = 6.34) years. The study protocol was reviewed and approved by the university's Institutional Review Board.

Protocol

Participants were invited to a laboratory setting for a 60-minute experimental session, provided informed consent to participate in the study, and completed a brief vision screening and demographic form. Participants were then taken to the virtual environment setting, which was situated in a quiet, darkened room. The driving task was run on a Dell Dimension 8300 Series PC with a Logitech MOMO steering wheel and accelerator/brake hardware peripherals. The PC utilized an Nvidia GeForce FX 5200 graphics card and other consumer-level components, and was connected to a 20-inch LCD monitor.

The VE software provided a real-time 3D graphics display of a virtual driving environment consisting of a straight, flat, two-lane road intersected by crossroads at periodic intervals (Rizzo & Severson, 2004; Rizzo, Severson, Cremer, & Price, 2003; Schwebel et al., 2006). Each crossroad was represented by a large gate on both sides of the road. On a randomly determined basis, one of three things happened as participants approached the crossings: the gates remained fully open, the gates closed partway (but still permitted passing through) and then re-opened, or the gates closed entirely and then re-opened.

To create cognitive complexity, attentional distracters, or “mudsplash” events, occurred randomly as participants approached several of the gates. When these events occurred, various animated figures appeared to fly toward the drivers' visual field, catapulting into the “windshield” and therefore creating a potential distraction for drivers making decisions. These distracters were designed to represent real-world driving distracters such as turning vehicles, pedestrians, or animals.

To summarize, study participants drove down a straight virtual road intersected by numerous crossroads. At each crossroad, participants faced a decision about risk: they could cross directly, without slowing, and risk the gate closing upon them; they could decelerate to some degree, hoping to perceive whether the gate would open or close before accelerating again; or they could stop entirely, watching the gate before determining how to proceed. At random intervals, visual distractions appeared during optimal decision-making times. The safest and most time-efficient option in the course was cautious deceleration while approaching gates; continued acceleration or complete stopping represented dangerous choices in real-world driving.

The VE driving task presented an abstract environment designed to assess driver behavior, including risk-taking. It included visual cues to permit veridical assessment of the driving environment (e.g., poles offering 3-dimensional perception; speedometer and odometer) and physical cues to replicate the feeling of a vehicle (e.g., brake and accelerator pedals; steering wheel). It did not attempt to replicate vehicle dynamics or environmental scenarios of actual driving as traditional driving simulators do, although previous work (Schwebel et al., 2006) suggests it correlates well with measures of real-world driving safety.

All participants were monitored from afar as they completed the simulated course (which took about 17 minutes, on average). As described below, several measures of driving behavior were culled from participants' driving in the task. Following completion of the VE course, participants completed several self-report questionnaires, also detailed below.

VE Measures

Five measures were computed based on driving behavior in the VE task. Because outliers created extreme positive skew in the distributions of several measures, scores greater than three standard deviations above or below the mean in each measure were removed from analyses, as listed below. Outliers were removed only from that particular measure; that is, individuals whose scores were outliers on one measure were not removed on other measures in the analyses.

Anecdotal evidence suggested the outliers were a result of attentional distraction (that is, looking away from the computer monitor or stopping to stretch one's arms) rather than genuine driving behavior.

Bumping Curb (3 outliers removed)—Number of times the participant steered into the curb on either side of the road, through the full course. The simulated road was five times the width of the vehicle, so bumping curbs required substantial off-center steering.

Hitting Closed Gates (4 outliers removed)—Number of closed or half-open gates “hit” by the participant's vehicle. Such errors would have resulted in a crash in real-world driving.

Distance to Closed Gates (1 outlier removed)—The average distance between the vehicle and the gate when the vehicle stops, as measured for all closed gates. Negative numbers could be achieved if the vehicle stopped after passing through and hitting a closed gate. When vehicles stopped and started and then stopped again, the final stop was used for measurement. This variable was designed to assess judgment of appropriate stopping distances (e.g., at stoplights).

Slowing at Open Gates (2 outliers removed)—The number of times the participant slowed significantly (defined as the driver's speed dropping below 2 meters/second) before passing through an open gate. Such behaviors would be dangerous in real-world driving.

Time to Complete Course (1 outlier removed)—Average time in which participants completed the full course of 75 gates.

Due to a variety of reasons including fatigue, boredom, and simulator sickness, 10 participants refused to complete the full virtual reality course. Statistical comparisons of participants who failed to complete the simulator course compared to those who did complete it revealed no differences on any demographic, personality, or driving history variables.

Self-Report Measures

Immediately following the VE task, participants completed three self-report questionnaires, described below in the order of completion. The questionnaires were chosen based on their strong psychometric properties and previous use in similar research (Schwebel et al., 2006).

The short version of the *Driving Behavior Questionnaire* (DBQ; Parker, Reason, Manstead, & Stradling, 1995; Reason, Manstead, & Stradling, 1990) is a 24-item inventory that yields three broad factors of self-reported driving behavior: violations, errors, and lapses. The British-developed questionnaire was altered slightly to make it appropriate for North American drivers (e.g., questions about right turns were changed to be about left turns; British terminology such as “zebra crossing” was changed to comparable American terms such as “crosswalks”). Test-retest and internal reliability of the DBQ are adequate, as is predictive validity of the three factors (Parker et al., 1995; internal consistency in the current sample was Cronbach's alpha = .59, .80, and .72 for violations, errors, and lapses, respectively).

The short form of the *Adult Temperament Questionnaire* (ATQ; Derryberry & Rothbart, 1984, 1988; Evans & Rothbart, 2006) is a 77-item measure yielding scores on 19 scales that fall into four broad factors – Extraversion, Negative Affect, Effortful Control, and Orienting Sensitivity. The ATQ is known to have good internal validity and convergent validity with other measures of temperament and personality (Derryberry & Rothbart, 1988; Evans & Rothbart, 2006; Rothbart, Ahadi, & Evans, 2000), although internal consistency on the subscales administered to the current study's sample was mediocre (range from .34 to .64).

For this study, we administered four scales of particular interest to risky driving: the inhibitory control, activation control, attentional control, and high intensity scales. Activation control is designed to assess capacity to perform an action despite a tendency to avoid it (7 items). Attentional control is designed to assess capacity to focus and shift attention as desired and dictated by external stimuli (5 items). Inhibitory control is designed to assess capacity to suppress approach tendencies when appropriate (6 items). Finally, high intensity pleasure is designed to assess pleasure related to high stimulus intensity, rate, complexity, novelty, and incongruity (7 items).

The *Sensation-Seeking Scale – Form V* (SSS-V; Zuckerman, Kolin, Price, & Zoob, 1964; Zuckerman, 1994) is a 40-item measure yielding a single overall score of sensation-seeking as well as four sub-traits. The SSS-V has good internal consistency and convergent validity with related constructs (Zuckerman, 1994). The overall score (Cronbach's alpha = .75 in this sample) plus the thrill and adventure seeking (alpha = .47), experience seeking (alpha = .53), disinhibition (alpha = .50), and boredom susceptibility (alpha = .40) subscales were used in this study.

State Driving Records

Driving records from the past 5 years were collected on all study participants from state authorities, as matched by drivers license numbers, birthdates, and names. Records included all crashes within the state that participants were involved in requiring police assistance. Two coders independently reviewed the records, recording the number of crashes and the number of crashes for which the participant was deemed at fault. Inter-coder agreement was 100% for counting crashes and 98% for rating fault; disagreements on ratings of fault were resolved through discussion.

Vision Screening

Far visual acuity was measured using the ETDS Chart with a Good-Lite model 600A light box. Distance vision was tested binocularly at a distance of 10 feet. Participants read the letters from left to right on nine lines that become progressively smaller by the line. Each line was worth a total of 10 points, and scores could range from 0 (if no letters were correctly identified, approximately equivalent to a Snellen score of 20/125) to 90 (if all letters were correctly identified, approximately equivalent to a Snellen score of 20/16).

Results

Analyses were divided into four steps: (a) examination of descriptive statistics, including age and gender effects; (b) consideration of the validity of the VE measures; (c) correlations between individual difference factors and risky driving measures; and (d) stepwise regression analysis predicting risky driving using independent individual difference factors and then interactions between them.

Descriptive Analyses

Table 1 presents descriptive data for all measures of interest.

To assess for effects of age and driving experience on the other variables, correlations were computed between age and all risky driving and individual difference variables, and between years of driving experience and all risky driving and individual difference variables. Several statistically significant correlations emerged. Age was correlated to vision (r (99) = -.25, $p < .05$) and ATQ high intensity pleasure (r (99) = .20, $p < .05$). Years of driving experience was correlated to SSS-V thrill and adventure seeking (r (97) = .23, $p < .05$) and slowing in front of open gates (r (86) = .26, $p < .05$). Not surprisingly, years of driving experience was also highly correlated to age (r (98) = .65, $p < .01$).

To assess for gender effects, independent samples *t*-tests were conducted comparing men and women on the primary variables of interest. Several significant effects emerged, with men (M = 2.85, SD = 3.00) reporting more tickets than women (M = 1.52, SD = 2.15), t (97) = 2.50, $p < .05$; men scoring higher on the SSS-V thrill and adventure seeking (M = 3.04, SD = 2.43) and SSS-V disinhibition (M = 1.31, SD = 1.42) subscales than women (M = 1.91, SD = 2.18 and M = 0.72, SD = 1.02, respectively), t (97) = 2.41, $p < .05$ for thrill and adventure seeking and t (97) = 2.33, $p < .05$ for disinhibition; and men reporting more years of driving experience (M = 63.09, SD = 3.96) than women (M = 58.38, SD = 8.06), t (98) = 3.78, $p < .01$.

Although we conducted multiple comparisons without controlling for Type I error risk, given the trend in the findings we decided to take the more conservative approach and control for gender, age, and years of driving experience in all primary analyses.

Validity of the VE Measures

To replicate previous findings that the VE measures have good construct validity (Schwebel et al., 2006), we correlated the five virtual environment measures with the self-report measures of tickets and crashes, the DBQ measures, and the state motor-vehicle crash records. Two VE measures correlated with crashes where the participant was judged at fault in the state motor-vehicle records, bumping the curbs (r (86) = .24, $p < .05$) and slowing significantly before open gates (r (86) = .23, $p < .05$). There was also a significant correlation between participants' stopping distance from gates and self-reported driving errors on the DBQ (r (88) = -.25, $p < .05$). These findings combined with previous work suggest behavior in the virtual environment offers a reasonable parallel to real-world driving.

Correlations between Individual Difference Factors and Risky Driving

Table 2 shows a correlation matrix between the individual difference measures of interest and the VE risky driving measures, with gender, age, and years of driving experience partialed in all correlations. As shown, a number of significant correlations emerged. Self-reported traffic tickets were related to higher levels of sensation-seeking and lower levels of activation control. Surprisingly, self-reported motor-vehicle crashes were most closely related to lower levels of thrill and adventure seeking.

The DBQ report of violations was most closely related to high levels of sensation-seeking, and to thrill and adventure seeking in particular. DBQ errors were related to all four temperament measures: lower activation control, attentional control, inhibitory control, and higher high intensity pleasure. The DBQ lapses measure was strongly related to low attentional control, and was also related to low activation control.

Correlations between individual differences and state driving records were not as strong, perhaps because the crash measures have poor variance. Finally, the virtual environment measures were most closely related to temperament. Hitting closed gates was related to lower activation control and the distance participants stopped before gates was related to higher activation control. Excessive slowing near open gates was related to lower attentional control.

Stepwise Regression Analysis Predicting Risky Driving

The final analytic step was to construct stepwise linear regression equations to predict risky driving behaviors. In each analysis, gender, age, years of driving experience, and vision were entered in the first step. Temperament and personality measures were entered in a second step.

Because of the number of measures used in this study, the principle of aggregation was invoked for the regression equations. Aggregation of multiple measures of the same construct offers greater specificity in the assessment of a construct and is recommended to achieve greater predictive power in regression equations and other models (Epstein, 1983; Rushton, Brainerd, & Pressley, 1983).

Sensation-seeking was aggregated by using only the total score, which is an aggregate of all items in the instrument. For temperament, we chose to aggregate all four measures into a single score of control. Although high intensity pleasure falls into a different factor in the original ATQ instrument, the four constructs hung together well in a factor analysis with this sample and had a strong average intercorrelation ($r = .31$) and Cronbach's alpha ($\alpha = .63$); this decision was also informed by the fact that high intensity pleasure correlated quite strongly with the activation control ($r\ (99) = -.61$, $p < .01$) and inhibitory control ($r\ (99) = -.41$, $p < .01$) measures.

Aggregation of the dependent risky driving measures was informed by a combination of principal components analysis, theory, and previous research (Schwebel et al., 2006). We created three aggregates: crash history, simulator driving speed, and simulator reckless driving. The crash history aggregate consisted of three measures, all standardized and then averaged: crash history in the state records, history of at-fault crashes in the state records, and self-reported crashes ($M = 0.00$, $SD = 0.80$; average intercorrelation = .47). The simulator driving speed aggregate was comprised of two standardized and averaged measures: time in course and slowing excessively at open gates ($M = -0.01$, $SD = 0.88$; $r = .53$). Finally, the simulator reckless driving aggregate was comprised of three standardized and averaged measures: hitting closed gates, bumping curbs, and distance to closed gates ($M = 0.02$, $SD = 0.75$; $r = .53$; average intercorrelation = .28).

Following aggregation, four stepwise linear regression models were constructed (see Tables 3 and 4). Table 3 illustrates results from two regressions, one predicting the crashes aggregate and the other predicting self-reported tickets. The overall model predicting crashes was not statistically significant and no individual predictors of interest emerged. The model predicting tickets was statistically significant ($F\ (6, 91) = 3.18$, $p < .01$) in the second step. The strongest predictor of tickets was high sensation seeking (*beta* = .24).

In Table 4, two regressions predicting risky driving in the virtual environment are shown. The model predicting risky driving speed was not significant. The model predicting reckless driving was significant on the second step ($F\ (6, 82) = 2.25$, $p < .05$). Two variables were significant predictors of reckless driving on the second step, male gender (*beta* = -.23) and lower temperamental control (*beta* = -.23).

Discussion

Among this sample of older drivers, personality was a modest but consistent correlate with risky driving behavior. Sensation-seeking seemed to be most strongly related to violations and tickets, while temperamental control was more broadly related to a number of risky driving measures. These results held after controlling for the effects of gender, age, and years of driving experience.

One complication in the study of personality traits that might predict risky driving is the conceptualization of what is encompassed in risky driving behavior. Driving is not really a single activity, but rather the concatenation of several different cognitive, perceptual, motor, and other processes. Particular personality traits might influence some but not all of those processes, and therefore might influence some aspects of risky driving, but not all.

We found, for instance, that a higher level of attentional control – the capacity to focus and shift attention as desired and dictated by external stimuli – was related to a reduced tendency toward one dangerous behavior in the virtual environment, excessive slowing at open gates. Attentional control was not related to other dangerous behaviors in the virtual environment. Excessive slowing can be highly hazardous in real-world driving, but it surely is not the only dangerous behavior a driver can do. A different dangerous behavior – such as bumping obstacles (hitting closed gates in our virtual environment) – was related to low levels of activation control but not to attentional control. In other words, different personality traits likely predict different types of dangerous driving behaviors, and future research might build off our results to parse out the particular traits that are linked to particular dangers.

Relatedly, personality might play a different role at different developmental stages. Risk-taking youth are clearly at increased risk for crashes; a large empirical literature supports this assertion (Arthur et al., 1991; Beirness, 1993; Dahlen et al., 2005; Jonah, 1997; Oltedal & Rundmo, 2006; Schwebel et al., 2006). In older age, however, when risk-taking and sensation-seeking behaviors decline (Zuckerman, 2007), a risk-taking personality might offer some advantage to driving safety. When entering a freeway on-ramp, for example, safe drivers are willing to take some risk by accelerating into traffic. Unsafe drivers may hesitate, slow down, and place themselves at risk by traveling much slower than other traffic. Stated differently, future research should consider the possibility that personality relates nonlinearly to unsafe driving, particularly when considered over broad phases of human development (Oltedal & Rundmo, 2006).

Methodological Issues

One methodological issue that arose in this experiment is whether the VE provides a reasonable surrogate for real-world driving. Although a sizable literature supports the validity of automobile simulators (Freund, Gravenstein, Ferris, & Shaheen, 2002; Lee, Cameron, & Lee, 2003), our simulator was designed to address specific components of driver behavior (i.e., risk-taking, distraction, and decision-making processes) at relatively low cost. It presented an abstract and not-fully-immersive environment. Previous research found that behavior in this virtual environment matched real-world driving history among a sample of undergraduate students (Schwebel et al., 2006). In the present study, some behaviors in the virtual environment correlated with self-reported and state-reported driving history, but others did not. The low variance of self- and state-reported crashes likely contributed to some non-findings, but we might also conclude that driving in this virtual environment represents some aspects of real-world driving and concede that no analogue measure ever perfectly represents real-world behavior.

A related concern is the fact that nearly 10% of the sample failed to complete the virtual reality course, in some cases because of simulator sickness. Post-hoc exploration of drop-outs failed to yield definitive evidence of why the high drop-out rate occurred, particularly since it contradicted previous research with younger participants using the same simulator and reporting very low levels of simulator sickness (Schwebel et al., 2006). One possible explanation for the high drop-out rate among this sample is the fact that the study was conducted in the summer, when it is uncomfortably hot and humid in Alabama. Although the room where the simulator was situated had air-conditioning, it was somewhat warm. Physiological symptoms of simulator sickness are exaggerated in hot, humid environments (Harm, 2002; Mollenhauer, 2004) – and this may be particularly so in older individuals. Other possible explanations include the relative lack of experience engaging in simulator-style video games among a sample of older adults; side effects of medications individuals in the sample may have been taking; or other unidentified peculiarities of this sample.

A third methodological issue this study raised is that of accurately measuring temperament and personality among older adults. Although measuring such traits through self-report is considered by many the "gold-standard," personality and temperament traits are comprised of somewhat ambiguous constructs that are challenging to measure (John & Benet-Martínez, 2000). Furthermore, almost all measures are normed with younger samples, and it is known that developmental aspects of aging influence the demonstration and exhibition of personality traits among older adults (Zuckerman, 2007). These factors may also explain the poor internal consistency of some of the constructs with our sample.

Finally, there may have been influences on the data from external factors we did not assess. Experience with computers or video games was not measured, for instance, and may have contributed to behavior in the simulated environment. We also did not request information concerning participants' driving habits or history; participants who drove more miles, in busier places, or on more complex routes, might have responded differently in the simulated environment and other measures than less experienced drivers.

Implications for Prevention

Intervention strategies to improve safe driving among older drivers tend to focus on screening for physical, visual, or cognitive impairments, and then intervening through enhancements in the vehicle itself, medically, or through a training program. For example, visual deficits that are improved through vision correction or cataract removal have been found to result in reduced crash risk (Owsley et al., 2002). Cognitive training programs, particularly those designed to enhance speed of processing, have demonstrated increased mobility and improved on-the-road driving performance (Ball & Owsley, 2000; Edwards et al., 2002; Roenker, Cissell, Ball, Wadley, & Edwards, 2003).

These are logical and appropriate strategies given the association between these functional abilities and increased crash risk. Our current results suggest, however, that personality and temperament also appear to play some role – albeit a modest one – in the driving safety of older adults, just as in younger adults. Interventionists might also consider targeting first the at-risk drivers (those who are high in sensation-seeking or undercontrolled) no matter what their age, visual, or cognitive status, although this strategy has proven challenging among younger drivers. Another option is development of policies, programs, and marketing strategies that target driving safety in older adults with the recognition that risk-taking behavior may play a role in dangerous driving among older adults, and that reduction of risk-taking while driving could contribute to improved safety on the road.

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Biography

David C. Schwebel, Ph.D., is Associate Professor and Vice Chair in the Department of Psychology at University of Alabama at Birmingham, USA. He earned his B.A. from Yale University in 1994 and his Ph.D. from University of Iowa in 2000. Trained as a child clinical psychologist, he has published widely on psychological aspects of understanding and preventing children's unintentional injuries. His research has been funded by CDC, DOT, and the Woodrow Wilson Foundation.

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Table 1

Descriptive Statistics (*N* = 101)

Variable	**Mean (*SD*)**
Demographics	
Age (years)	80.02 (3.41)
Age Received Driver License	19.08 (5.14)
Gender	53% male
Ethnicity	93% Caucasian
Vision	70.61 (11.61)
Self-Report Driving	
Tickets	2.21 (2.69)
Crashes	2.07 (1.46)
State Driving Records	
Crashes	0.33 (0.65)
At-Fault Crashes	0.15 (0.38)
Virtual Environment: Risky Driving	
Bumping Curb (times)	0.24 (0.74)
Hitting Closed Gates (times)	4.37 (6.40)
Distance to Closed Gates (meters)	11.16 (5.82)
Slowing at Open Gates (times)	6.72 (6.44)
Time to Complete Course (minutes)	17.20 (3.92)
Questionnaires: Risky Driving	
DBQ Errors	0.51 (0.42)
DBQ Lapses	0.93 (0.45)
DBQ Violations	0.54 (0.34)
Sensation-Seeking	
Thrill and Adventure Seeking	2.53 (2.37)
Experience Seeking	2.68 (1.77)
Disinhibition	1.04 (1.27)
Boredom Susceptibility	1.59 (1.41)
Total Score	7.84 (4.44)
Temperament	
High Intensity Pleasure	2.90 (0.98)
Inhibitory Control	4.52 (0.86)
Activation Control	4.95 (0.80)
Attentional Control	4.40 (1.01)

Table 2

Partial Correlation Matrix: Individual Differences and Risky Driving, with Age, Gender, and Years of Experience Partialed (N = 101)

	Sensation Seeking Scale					Adult Temperament Questionnaire			
Driving Safety Measure	**TAS**	**ES**	**DIS**	**BS**	**TOT**	**ActCon**	**AttCon**	**InhC**	**HIP**
Self-Report									
Tickets	.12	.26*	.05	.20	.24*	-.25*	-.01	-.10	.21
Crashes	-.28*	.02	-.15	.11	-.14	-.06	-.02	-.07	.08
Driving Behavior Questionnaire									
Violations	.30**	.17	.13	.11	.29*	-.14	-.11	-.13	.17
Errors	-.08	.08	-.12	-.02	-.04	-.30**	-.24*	-.30**	.29*
Lapses	-.06	.04	-.19	-.11	-.10	-.22*	-.47**	-.21	-.01
State Driving Records									
Crashes	-.10	.15	-.08	.19	.04	-.19	.00	-.02	.20
At-Fault Crashes	-.10	.10	.10	.16	.06	-.08	-.04	-.08	.10
Virtual Environment Measures									
Bumping Curb	-.05	-.05	-.03	-.09	-.08	-.17	-.12	-.07	.15
Hitting Closed Gates	-.07	.17	-.01	.11	.06	-.29**	-.16	-.07	.15
Distance to Closed Gates	.09	-.00	.12	.01	.07	.28*	.17	-.00	-.16
Slowing at Open Gates	-.12	.02	.00	-.06	-.07	-.19	-.28*	-.03	.12
Time to Complete Course	-.02	.07	-.03	-.06	-.01	-.19	-.12	-.00	.22

Note. Two-tailed tests. TAS = thrill and adventure seeking; ES = experience seeking; DIS = disinhibition; BS = boredom susceptibility; TOT = total sensation seeking; ActCon = activation control; AttCon = attentional control; InhC = inhibitory control; HIP = high intensity pleasure.

* $p \leq .05$.

** $p \leq .01$.

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Table 3

Stepwise Linear Regression Predicting Crashes and Tickets ($N = 101$)

Variable	Crashes Aggregate B	Crashes Aggregate SE B	Crashes Aggregate β	Tickets B	Tickets SE B	Tickets β
Step 1 – Demographic Variables Added						
Age	-0.03	.03	-.13	-0.14	.11	-.18
Gender (Male = 1, Female = 2)	-0.11	.18	-.07	-1.02	.59	-.19
Years of Driving Experience	0.00	.02	.02	0.07	.06	.18
Vision	-0.00	.01	-.02	-0.03	.02	-.11
Step 2 – Individual Difference Variables Added						
Age	-0.04	.04	-.15	-0.18	.11	-.22
Gender (Male = 1, Female = 2)	-0.11	.18	-.07	-0.87	.57	-.16
Years of Driving Experience	0.00	.02	.03	0.08	.06	.20
Vision	-0.00	.01	-.02	-0.03	.02	-.15
Sensation-Seeking Total	-0.01	.02	-.04	0.15	.06	.24*
Temperamental Control Aggregate	-0.08	.13	-.07	-0.72	.43	-.16

Note. Predicting crashes: R^2 = .02 on Step 1; ΔR^2 = .01 on Step 2. Predicting tickets: R^2 = .09 on Step 1; ΔR^2 = .08 (model $p < .05$) on Step 2.

* $p < .05$.

** $p < .01$.

Table 4

Stepwise Linear Regression Predicting Risky Driving in the Virtual Environment (n = 91)

Variable	Driving Speed Aggregate B	SE B	β	Reckless Driving Aggregate B	SE B	β
Step 1 – Demographic Variables Added						
Age	0.01	.04	.02	0.04	.03	.18
Gender (Male = 1, Female = 2)	0.20	.20	.11	-0.36	.17	-.24*
Years of Driving Experience	0.04	.02	.26	-0.02	.02	-.17
Vision	-0.01	.01	-.07	-0.01	.01	-.12
Step 2 – Individual Difference Variables Added						
Age	-0.00	.04	-.01	0.03	.03	.12
Gender (Male = 1, Female = 2)	0.21	.20	.12	-0.35	.17	-.23*
Years of Driving Experience	0.04	.02	.28	-0.02	.02	-.17
Vision	-0.01	.01	-.08	-0.01	.01	-.14
Sensation-Seeking Total	0.00	.02	.02	-0.02	.02	-.10
Temperamental Control Aggregate	-0.14	.14	-.11	-0.27	.12	-.23*

Note. Predicting driving speed aggregate: R^2 = .07 on Step 1; ΔR^2 = .01 on Step 2. Predicting reckless driving aggregate: R^2 = .08 on Step 1; ΔR^2 = .06 (model $p < .05$) on Step 2.

* $p \leq .05$.

** $p < .01$.