Canadian Journal on Aging / La Revue canadienne du vieillissement

www.cambridge.org/cjg

Personality Is Associated with Driving Avoidance in the Canadian Longitudinal Study on Aging (CLSA)

Arne Stinchcombe[1], Shawna Hopper[2], Nicole G. Hammond[3], Bruce Weaver[4] and Michel Bédard[4,5]

[1]School of Psychology, University of Ottawa, Ottawa, ON, Canada, [2]Department of Gerontology, Simon Fraser University, Vancouver, BC, Canada, [3]School of Epidemiology and Public Health, University of Ottawa, Ottawa, ON, Canada, [4]Centre for Research on Safe Driving, Lakehead University, Thunder Bay, ON, Canada and [5]Centre for Applied Health Research, St. Joseph's Care Group, Thunder Bay, ON, Canada

Article

Cite this article: Stinchcombe A, Hopper S, Hammond NG, Weaver B, & Bédard M. (2023). Personality Is Associated with Driving Avoidance in the Canadian Longitudinal Study on Aging (CLSA). *Canadian Journal on Aging / La Revue canadienne du vieillissement* **42**(3), 446–454.
https://doi.org/10.1017/S0714980823000065

Received: 16 September 2021
Accepted: 13 July 2022

Mots-clés:
vieillissement; conducteurs âgés; arrêt de conduite; évitement de la conduite; personnalité; ELCV

Keywords:
aging; older drivers; driving cessation; driving avoidance; personality; CLSA

Corresponding author:
La correspondance et les demandes de tirés-à-part doivent être adressées à : / Correspondence and requests for offprints should be sent to: Arne Stinchcombe, School of Psychology, Faculty of Social Sciences, University of Ottawa, 136 Jean-Jacques Lussier, Vanier Hall Ottawa, ON, K1N 6N5 (astinchc@uottawa.ca).

Résumé

À mesure que les individus vieillissent et prennent conscience des changements dans leurs capacités de conduite, ils sont plus susceptibles d'autoréguler leur conduite en évitant certaines situations de conduite (par exemple, la conduite de nuit, la circulation aux heures de pointe, etc.). Dans cet article, nous avons cherché à examiner les corrélats de l'évitement situationnel de la conduite avec un accent particulier sur les rôles des traits de personnalité, du genre et de la cognition au sein d'un grand échantillon d'adultes âgés provenant de l'Étude longitudinale canadienne sur le vieillissement (ÉLCV). Nos résultats montrent que les femmes plus âgées ont tendance à déclarer plus d'évitement de conduire et que les traits de personnalité, en particulier l'extraversion, la stabilité émotionnelle et l'ouverture à l'expérience, peuvent réduire l'évitement de conduire. Une association négative a été trouvée entre la cognition et l'évitement de la conduite, de sorte que les personnes ayant une cognition plus élevée ont déclaré moins d'évitement de la conduite.

Abstract

As individuals age and become aware of changes in their driving capabilities, they are more likely to self-regulate their driving by avoiding certain driving situations (i.e., night driving, rush hour traffic, etc.). In this paper, we sought to examine the correlates of situational driving avoidance with a particular emphasis on the roles of personality traits, gender, and cognition within a large sample of mid-life and older adults from the Canadian Longitudinal Study on Aging (CLSA). Our findings show that women of older ages tend to report more driving avoidance and that personality traits, specifically extraversion, emotional stability, and openness to experience, may reduce driving avoidance. A negative association was also found between cognition and driving avoidance, such that individuals with higher cognition reported less driving avoidance.

Introduction

As most North American neighbourhoods are designed for personal automobiles as the primary mode of transportation, driving remains an important activity for older adults' physical, psychological, and social needs (Turcotte, 2012). Many older adults have been driving for more than 60 years, making driving a part of their identity and relating the ability to drive to a sense of freedom and independence (Stinchcombe, Hopper, Mullen, & Bédard, 2021). Although linked to overall health and well-being, driving is also associated with risk of injury and mortality as it is a complex task that requires a combination of physical abilities, cognitive functioning, visual acuity, and processing speed to perform safely (Ang, Jennifer, Chen, & Lee, 2019). Changes in health and cognition may make certain aspects of driving more difficult and impact older adults' ability to drive safely (Huang, Luster, Karagol, Park, & Pitts, 2020).

Worldwide, many countries are experiencing aging population resulting in a growing number of older drivers, with adults over age 65 making up the fastest growing segment of the licensed population. In 2009, 75 per cent of Canadian adults over age 65 reported that they were still driving (Turcotte, 2012). Driving cessation is associated with many negative outcomes, including poor health, depression, decreased social engagement, as well as increased institutionalization and mortality risk (Chihuri et al., 2016). A study by Feng and Meuleners (2020) found that 92 per cent of individuals planning to cease driving have concerns about driving cessation, but that most older adults do not make any lifestyle changes to prepare for a time when they may no longer drive.

Evidence suggests that some individuals begin to avoid certain driving situations as they age. Based on the self-regulatory theory, as older adults become self-aware of changes in their driving behaviour, they are more likely to avoid situations to reduce risk (e.g., night driving, rush hour traffic) (Stalvey, Owsley, Stalvey, & Owsley, 2000). Rudman, Friedland, Chipman, and Sciortino's (2006) Model of Driving Self-Regulation details that self-regulation depends on interpersonal factors (i.e., family and physician feedback), intrapersonal factors (i.e., self-perceived changes in abilities, symbolic importance of driving), and environmental factors (i.e., environmental hazards, social norms, alternative transport). When older drivers' comfort levels are reduced to an unacceptable level, despite their self-regulation, they may then make the decision to cease driving.

Common self-regulation behaviours include reducing driving frequency and distance, avoiding driving at night and in poor weather, and avoiding busy intersections (Ang et al., 2019). Self-regulation of driving may be due to several reasons. Increasing age is associated with greater driving regulation and poorer driving confidence. This association may be explained as older adults report poorer general health, including poorer vision, as well as decreased cognitive and physical abilities necessary for safe driving (Conlon, Rahaley, & Davis, 2017). Along with objective health status, perceived health symptoms have been found to be associated with avoiding challenging driving situations (Tuokko et al., 2016). Many studies have concluded that perceived health is as important as objective health when deciding to restrict driving in older age (Ang et al., 2019). Furthermore, women have been found to reduce their driving distance (Charlton et al., 2019), to be more likely to self-restrict (St. Louis et al., 2020), and to consider driving cessation earlier when compared to men (Ang et al., 2019). Other commonly reported reasons of self-regulation include psychological changes such as depression and safety concern, social influences, environmental factors, and driving history (Ang et al., 2019).

Subjective cognitive difficulties have also been found to be associated with driving self-regulation (Conlon et al., 2017), as older adults may restrict their driving to compensate for declines in cognitive function and avoid potential collisions (Vance et al., 2006). Similarly, many older adults categorized as having low cognitive functioning have been found to restrict their driving to short distances (Freund & Szinovacz, 2002). On the other hand, Kowalski et al. (2012) found that cognitive impairment was related to driving status but not driving restriction or reduction, whereas Rapoport et al. (2013) found no association between cognitive functioning and driving behaviours.

One less studied determinant of driving avoidance is an individual's personality traits. The Five Factor Model (FFM) of personality categorizes personality into five domains: extraversion (outgoing, energetic, assertive), conscientiousness (responsible, organized, reliable), agreeableness (cooperative, considerate, sympathetic), openness (imaginative, adventurous, curious), and neuroticism (anxious, unstable, lacking in confidence) (McCrae & John, 1992). Evidence suggests that personality is related to driving outcomes across the lifespan, specifically predicting risky behaviours in young adults. A study by Monteiro et al. (2018) found that individuals high in neuroticism show higher levels of anger and aggressive behaviours while driving, resulting in riskier driving behaviours. Similarly, evidence shows that a high level of extraversion is associated with decreased driving performance (Adrian, Postal, Moessinger, Rascle, & Charles, 2011), with increased crashes, traffic violations, and risky behaviours (Clarke & Robertson, 2005; Riendeau, Stinchcombe, Weaver, & Bédard, 2018). In contrast, high conscientiousness has been associated with less risky driving in mid-age drivers (Riendeau et al., 2018).

Given the relationship between driving and personality, it is important to understand the relationship between driving behaviours and personality in older adulthood. To date, limited research has focused on the relationship between personality traits and driving habits within older populations. A recent study by Sawula et al. (2017) found that in a sample of older drivers (72–92 years), extraversion was associated with an increased tendency to drive in challenging situations, after controlling for covariates. Similarly, it has been found that individuals with high extraversion were more likely to rate their driving abilities greater than those with low extraversion, prompting driving in riskier circumstances (McPeek, Nichols, Classen, & Breiner, 2011). Although self-regulation is commonly believed to be an ideal step in the transition towards driving cessation, a study by Schulz et al. (2020) concluded that self-reported driving avoidance is an independent indicator of reduced on-road driving skills. This suggests that driving avoidance may not be an optimal strategy for safe driving in older adulthood.

The purpose of this paper is to examine determinants of situational driving avoidance, with a particular emphasis on the roles of personality traits, gender, and cognition within a large sample of mid-life and older adults from the Canadian Longitudinal Study on Aging (CLSA). It is important to better understand the correlates of driving avoidance among aging adults to best support continued mobility and safe driving for an aging population. It was anticipated that women would avoid more situations than men, and that participants with lower cognition scores would also report greater driving avoidance. In terms of personality characteristics, it was anticipated that extraversion would be associated with less driving avoidance.

Method

Sample

The CLSA is a longitudinal study of health and aging (Raina et al., 2009; Raina et al., 2019). At baseline (2015), community-dwelling older adults (45–85 years) were recruited (n > 50,000). Data collection is ongoing. Post-baseline, data are collected at every three-year interval, which will continue until participant death or the year 2033 (Raina et al., 2019). CLSA participants can be differentiated based on their study cohort: the tracking or comprehensive cohort. Data for the tracking cohort (n = 21,241) were collected via less-resource intensive means: trained interviews conducted 60-minute telephone-based interviews using a computer-assisted telephone interview (CATI) system. In contrast, comprehensive cohort participants (n = 30,097) consented to multiple data collection methods (telephone and in-person assessments). The latter required participants to live within 25–50 kilometers of a national data collection site (n = 11) (Raina et al., 2019). As part of the in-person visits, standardized neuropsychological assessment measures (detailed below), other clinical (e.g., fitness), and biological (e.g., urine) measures were collected (Raina et al., 2019). The in-person assessments included both an in-home visit (90 minutes), where trained interviewers administered a series of questionnaire modules, and in-person visit to their local data collection site for more in-depth measurements (2.5 hours). Participants could refuse the biological sample portion of the data collection site visit and still participate in the CLSA (Raina et al., 2019). Additionally, tracking and comprehensive participants were administered a short (30-minute) Maintaining Contact Questionnaire following their baseline assessment; however, the content differed by cohort

https://doi.org/10.1017/S0714980823000065 Published online by Cambridge University Press

(see www.clsa-elcv.ca/doc/540). The survey materials administered to the two cohorts are a mix of shared (e.g., demographics, general health) and non-shared questionnaire modules (e.g., personality traits) (Raina, Wolfson, & Kirkland, 2008), the combination of which allows for joint or independent analysis of the two cohorts (Raina et al., 2019). For a breakdown of the tracking and comprehensive cohort questionnaire modules, please see Tables 6.1 and 6.2 of the CLSA protocol, respectively (Raina et al., 2008).

The CLSA protocol (Raina et al., 2008) details the recruitment methodology, but in brief, the Canadian Community Health Survey – Healthy Aging Component (CCHS-HA) defined the eligibility criteria for selecting participants into the CLSA and was one of three recruitment strategies (Raina et al., 2008). In addition, random digit dialing (RDD) (landline telephones) and provincial health care registration databases were employed to supplement recruitment and meet the targeted sample size (Raina et al., 2008). The comprehensive cohort was recruited solely via RDD and health care registries (Raina et al., 2008). Given that the CCHS sampling frame defined the inclusion criteria of the CLSA, it also outlined the CLSA's exclusion criteria. In accord with Statistics Canada recruitment methodologies, the following is a list of persons or groups of persons not eligible for CLSA participation: Canadian persons living in the territories or select remote regions, persons living on First Nations reserves and settlements, full-time members of the Canadian Armed Forces, incarcerated persons, and institutionalized persons, including long-term care residents, at baseline (Raina et al., 2008). All participants provided written informed consent (Raina et al., 2009). The Lakehead University Research Ethics Board (REB #1466056) approved these analyses.

Outcome

Driving avoidance

Participants were asked: *If possible, do you try to avoid any of these driving situations?* The response options included:

- On and off ramps
- Traffic circles
- Four-way stops without traffic signals
- Unfamiliar routes
- Heavy traffic in town
- Heavy traffic or rush hour on multi-lane or divided highways/expressways
- Heavy traffic or rush hour on single-lane or undivided highways/expressways
- Making left-hand turns with traffic lights
- Making left-hand turns with no traffic lights or stop signs
- Travelling next to large trucks
- Crossing or entering busy streets without traffic signals
- Yielding to traffic at yield signs
- Driving in heavy rain or snow
- Driving at dawn or dusk
- Driving at night

For each participant, the total number of situations avoided was summed and ranged from 0–15, with higher scores indicating greater driving avoidance.

Covariates

Demographic variables

Demographic variables included in the analysis were chronological age (continuous), education, household income, gender, retirement status, and whether participants lived in a rural or urban area. Respondents' educational attainment was classified as "less than secondary school" (referent), "secondary school graduation," "some post-secondary," and "post-secondary graduation." Participants were asked to report their household income: *What is your best estimate of the total household income received by all household members, from all sources, before taxes and deductions, in the past 12 months?* Responses were categorized as "< $20,000" (referent), "$20,000–49,999," "$50,000–99,999," "$100,000–149,999," and "≥ $150,000."

Health variables

Self-reported health was captured by asking participants: *In general, would you say your health is excellent, very good, good, fair, or poor?* Participants were asked about their sensory function; they self-reported the quality of their hearing and vision on a five-point scale from "poor" to "excellent." Specifically, participants were asked: *Is your hearing, using a hearing aid if you use one…* and, *Is your eyesight, using glasses or corrective lens if you use them….* For both sensory health characteristics, responses were collapsed to represent the presence (poor/fair) or absence (good/very good/excellent) of low hearing and vision, respectively. The number of symptoms of depression over the past week was quantified using the short form of the Centre for Epidemiologic Studies – Depression Scale (CESD-10) (Andresen, Malmgren, Carter, & Patrick, 1994). Items on the scale are summed to generate a score with a range of 0–30, with higher scores indicating greater symptoms. The CESD-10 shows good psychometric properties, including high test-retest reliability ($r = 0.71$) (Andresen et al., 1994).

Cognition

We computed an overall cognitive function variable based on the three measures of cognition administered to the Comprehensive cohort as part of their in-home assessment: the Rey Auditory Verbal Learning Test (RAVLT) (Rey, 1964), the Mental Alternation Test (MAT) (Jones, 1993), and the Animal Naming Fluency Test (AFT) (Read, 1987). The RAVLT is a 15-item word learning test that assesses learning and retention (memory). Scores for the (first) immediate and delayed recall trials represent the total number of correct responses for each trial, respectively, and have a possible range of 0–15.

Both the MAT and AFT were administered to obtain a baseline assessment of participants' executive function. The MAT requires participants to alternate between numbers 1–26 and the letters of the alphabet (i.e., 1-A-2-B-3-C, etc.). The total number of correct scores on the MAT ranges from 0–52, with higher scores indicative of better mental flexibility and processing speed (Tuokko et al., 2020). In contrast, the AFT assesses verbal category fluency, with participants asked to name as many animals as possible within 60 seconds (Tuokko, Griffith, Simard, & Taler, 2017). Two AFT scoring algorithms were developed for purposes of the CLSA (Tuokko et al., 2017), with the more lenient of the two methods used here. Like the MAT, the AFT produces a total score that ranges from 0–52, with higher scores indicative of better executive function.

For purposes of this study, we computed an overall indicator of cognitive function composed of memory (RAVLT) and executive function (MAT and AFT). The measure of cognitive function was computed in a stepwise fashion:

1. Raw (individual) test scores were standardized to obtain z-scores.

https://doi.org/10.1017/S0714980823000065 Published online by Cambridge University Press

2. We summed the respective measures for memory (immediate + delayed recall trials) and executive function (MAT + AFT).
3. We combined the memory and executive function measures (memory + executive function).

We standardized the raw test scores by the participants' language of administration for each test (French, English, or Bilingual) (Oremus et al., 2019). Standardized scores were then combined to derive an overall z-score for each measure. More information on the administration and performance of the cognitive measures within the Comprehensive cohort is available elsewhere (Tuokko et al., 2020).

Primary Predictor

Personality

The Ten-Item Personality Inventory (TIPI) was used to measure participants' personality (Gosling, Rentfrow, & Swann, 2003). The TIPI includes questions that represent each of the FFM domains to provide a measure of each of the five personality traits on a scale from 1 to 10. For neuroticism, the TIPI provides a measure of its contrast dimension, emotional stability; higher scores indicate greater emotional stability. The TIPI has been found to have adequate convergent validity (mean $r = 0.77$) and test-retest reliability (mean $r = 0.72$) (Gosling et al., 2003).

Analysis

Analyses were conducted in Stata/SE 15.1 (StataCorp LLC, College Station, TX). For categorical variables, frequencies (n) and percentages (%) are reported; for quantitative variables, means (M) and standard deviations (SD) are reported. Given the evidence that the outcome variable (driving avoidance) was overdispersed, a multiple negative binomial regression analysis was conducted (UCLA: Statistical Consulting Group, 2021). As a first step, we examined the crude (i.e., bivariate) relationships between the covariates and personality traits (primary predictor) with driving avoidance (outcome). Next, we entered personality traits and the covariates as a single block into a multivariable regression model treating driving avoidance as the outcome variable. Given the existing evidence showing differences in driving avoidance by age, gender, and cognitive function, we also entered an age × gender × cognition three-way interaction and all lower-order (two-way) interactions. If the higher-order (three-way) interaction was not statistically significant, the lower-order interactions were visualized if statistically significant ($p < .05$).

Analytic Sample

Participants in the comprehensive cohort (only) completed personality measures as part of their Maintaining Contact Questionnaire (Raina et al., 2008). Thus, our analytic sample was defined by participation in the comprehensive cohort ($n = 30{,}097$) and the initial CLSA maintaining contact questionnaire for the comprehensive cohort ($n = 28{,}789$). Further, given our focus on driving avoidance, participants were included if they reported holding a valid driver's license and driving more than once a month ($n = 25{,}120$). In terms of missingness, most variables showed less than 2 per cent missing, apart from income (6.1%) and total cognition (7%). The cognition variable was a composite of several cognitive tasks that were audio recorded and later scored (Tuokko et al., 2020). Due to poor sound quality, some recordings were unable to be scored. After removal of missingness, the analytic sample consisted of $n = 20{,}998$. Alpha was set to $\alpha = .05$ (two-tailed).

Results

Sample Characteristics

The mean age of participants in the analytic sample was 61.6 years (range 45–86 years). In terms of education, 80.6 per cent of participants reported having completed post-secondary school. Participants had high levels of household income, with over 40 per cent of the sample reporting a household income of at least $100,000. Just over 50 per cent of the sample reported being either partly retired or completely retired, and 91 per cent reported living in an urban environment. Participants had high general health with 64.4 per cent of the sample reporting their self-rated health as at least "very good." With respect to sensory function, 10.7 per cent of the sample reported hearing problems and 5.9 per cent reported vision problems. Participant characteristics are summarized in Table 1.

Participants reported avoiding a mean of 2.6 (SD = 2.7) driving situations (range = 0–15 situations). The most commonly avoided driving situation was avoiding heavy traffic/rush hour in town (43%) followed by driving in heavy rain or snow (41%) and driving at night (30%). Participant response rates for each driving avoidance scenario are summarized in Table 2.

Regression Analysis

The results of simple and multivariable linear regression models treating driving avoidance as the outcome variable are presented in Table 3. Bivariate associations showed that individuals who reported more driving avoidance were older, more likely to be women, partly or completely retired, and living in an urban environment. Participants who reported higher incomes, completion of post-secondary education, and "very good" or better general health tended to avoid fewer driving situations. Participants with a greater number of depression symptoms avoided more situations, whereas participants who exhibited higher total cognition scores avoided fewer situations. In terms of personality traits, all five personality traits were associated with less avoidance among participants in the sample.

After accounting for the covariates in the multivariable model, several of the statistically significant relationships observed in the bivariate models held (see Table 3). Age was statistically significant in the multivariable model (B = .016, SE = .001, $p < .001$); however, it was also implicated in a two-way interaction (described below), tempering its interpretability as a standalone covariate. Higher household income categories were associated with less avoidance in comparison to the lowest income category; participants who reported an annual household income of $100,000 to $149,999 (B = −.137, SE = .045, $p = .003$) or a household income of $150,000 or more (B = −.185, SE = .046, $p < .001$) were less likely to avoid driving situations. Participants who were partly retired (B = .121, SE = .027, $p < .001$) or fully retired (B = .184, SE = .022, $p < .001$) were more likely to avoid driving situations compared to participants who were not retired. Compared to participants living in a rural environment, participants living in an urban environment were more likely to avoid driving situations (B = .079, SE = .026, $p = .003$).

In terms of health, levels of self-rated general health, hearing problems, and cognitive function were no longer associated with driving avoidance after accounting for the other covariates. Vision

https://doi.org/10.1017/S0714980823000065 Published online by Cambridge University Press

Table 1. Participant characteristics (n = 20,998)

Variable		n (%) or M (SD)
Driving avoidance		2.6 (2.7)
Age (years)		61.6 (9.8)
Gender	Woman	10,154 (48.4%)
	Man	10,844 (51.6%)
Education	Less than secondary school graduation	837 (4.0%)
	Secondary school graduation but no post-secondary	1,770 (8.4%)
	Some post-secondary	1,467 (7.0%)
	Post-secondary diploma/degree	16,924 (80.6%)
Total household income	Less than $20,000	651 (3.1%)
	$20,000 or more but less than $50,000	4,052 (19.3%)
	$50,000 or more but less than $100,000	7,640 (36.4%)
	$100,000 or more but less than $150,000	4,541 (21.6%)
	$150,000 or more	4,114 (19.6%)
Retirement status	Not retired	10,232 (48.7%)
	Partly retired	2,399 (11.4%)
	Completely retired	8,367 (39.8%)
Urban/rural	Rural	1,867 (8.9%)
	Urban	19,131 (91.1%)
Self-rated general health	Poor	220 (1.0%)
	Fair	1,303 (6.2%)
	Good	5,949 (28.3%)
	Very good	9,002 (42.9%)
	Excellent	4,524 (21.5%)
Hearing	No hearing problems	18,758 (89.3%)
	Hearing problems	2,240 (10.7%)
Vision	No vision problems	19,763 (94.1%)
	Vision problems	1,235 (5.9%)
Depression symptoms		5.0 (4.4)
Cognition	RAVLT (immediate)	6.0 (1.9)
	RAVLT (delayed)	4.2 (2.1)
	MAT	27.3 (8.4)
	AFT	22.1 (6.3)
Personality	Extraversion	4.4 (1.8)
	Agreeableness	5.9 (1.1)
	Conscientiousness	6.2 (1.1)
	Emotional stability	5.9 (1.3)
	Openness to experience	5.5 (1.4)

Table 2. Participant response rates for avoiding specific driving situations

Driving situation	Per cent avoiding
On/off ramps	3.96
Roundabouts	4.91
Four-way stops without traffic signals	1.21
Unfamiliar routes or detours	12.09
Heavy traffic/rush hour in town	43.08
Heavy traffic/rush hour on multi-lane highways	36.00
Heavy traffic/rush hour on single-lane highways	34.2
Left-hand turns with traffic lights	3.17
Left-hand turns without traffic lights or stop signs	8.08
Travelling next to large trucks	19.99
Crossing or entering busy streets without traffic lights	9.42
Yielding to traffic (at a yield sign)	1.62
Driving in heavy rain/snow	41.27
Driving at dawn/dusk	13.23
Driving at night	30.38

problems (B = .159, SE = .031, p < .001) and depression symptoms (B = .020, SE = .002, p < .001) were associated with greater driving avoidance in the multivariable model.

Three of the five personality traits reached statistical significance in the multivariable analysis. Higher extraversion (B = −.037, SE = .004, p < .001), openness to experience (B = −.024, SE = .005, p < .001), and emotional stability were associated with less driving avoidance (B = −.058, SE = .006, p < .001).

Interactions

The results of the three-way interaction between age, gender, and cognition did not reach statistical significance. However, a statistically significant lower-order interaction between age and gender was observed, suggesting that the relationship between chronological age and driving avoidance depends on gender (B = −.004, SE = .002, p = .016). Figure 1 shows the predicted values of driving avoidance (y-axis) at five-year increments in chronological age by gender. For both men and women, as age increases, so does the number of driving situations avoided. At all age increments, women avoid more situations than men; the magnitude of the difference between men and women increases with age such that the biggest difference between men and women in driving avoidance is at age 85 years (i.e., the maximum age of the sample).

Discussion

Driving avoidance is an important outcome because of its relationship to future driving cessation and potential health outcomes (Edwards, Lunsman, Perkins, Rebok, & Roth, 2009). In this study, we examined the correlates of driving avoidance in a sample of adults ages 45–85 years, with a particular emphasis on the roles of personality traits, gender, and cognition. Our study yielded several noteworthy findings.

https://doi.org/10.1017/S0714980823000065 Published online by Cambridge University Press

Table 3. Results of simple and multiple regression models treating driving avoidance as the outcome

		Simple		Model 1	
Variable		*B* (SE)	*p*	*B* (SE)	*p*
Age (years)		.020	<.001	.016	<.001
Gender	Woman (referent)				
	Man	−.249	<.001	.018	.868
Education	Less than secondary school graduation (referent)				
	Secondary school graduation but no post-secondary	−.234	<.001	−.074	.102
	Some post-secondary	−.159	.001	.031	.508
	Post-secondary diploma/degree	−.189	<.001	.099	.011
Total household income	Less than $20,000 (referent)				
	$20,000 or more but less than $50,000	−.070	.124	−.039	.380
	$50,000 or more but less than $100,000	−.206	<.001	−.058	.180
	$100,000 or more but less than $150,000	−.412	<.001	−.137	.003
	$150,000 or more	−.550	<.001	−.185	<.001
Retirement status	Not retired (referent)				
	Partly retired	.207	<.001	.121	<.001
	Completely retired	.424	<.001	.184	<.001
Urban/rural	Rural (referent)				
	Urban	.112	<.001	.079	.003
Self-rated general health	Poor (referent)				
	Fair	.059	.468	.150	.051
	Good	−.057	.453	.137	.061
	Very good	−.149	.049	.119	.107
	Excellent	−.275	<.001	.064	.394
Hearing	No hearing problems (referent)				
	Hearing problems	.118	<.001	.018	.462
Vision	No vision problems (referent)				
	Vision problems	.267	<.001	.159	<.001
Depression symptoms		.036	<.001	.021	<.001
Cognition (total)		−.033	<.001	.034	.155
Personality	Extraversion	−.058	<.001	−.037	<.001
	Agreeableness	−.022	.001	−.004	0.560
	Conscientiousness	−.049	<.001	−.007	0.364
	Emotional stability	−.101	<.001	−.058	<.001
	Openness to experience	−.070	<.001	−.025	<.001
Age × cognition		–	–	−.001	.166
Gender × age		–	–	−.004	.016
Gender × cognition		–	–	−.031	.356
Age × gender × cognition		–	–	.000	.464
Model fit			$\chi^2(29) = 1946.24$, p <.001 Pseudo $R^2 = 0.021$		

First, consistent with previous work in this field, our crude analyses showed that women reported greater driving avoidance than men (Barrett, Gumber, & Douglas, 2018; Choi, Adams, & Kahana, 2013) and that older age was associated with more avoidance (Stalvey et al., 2000). In the multivariable model, however, our findings showed that the relationship between gender and driving avoidance depends on age such that the gender difference in driving avoidance increases among older age groups. In their qualitative review of the literature on driving reduction and driving cessation, Ang et al. (2019) highlighted the gendered nature of

https://doi.org/10.1017/S0714980823000065 Published online by Cambridge University Press

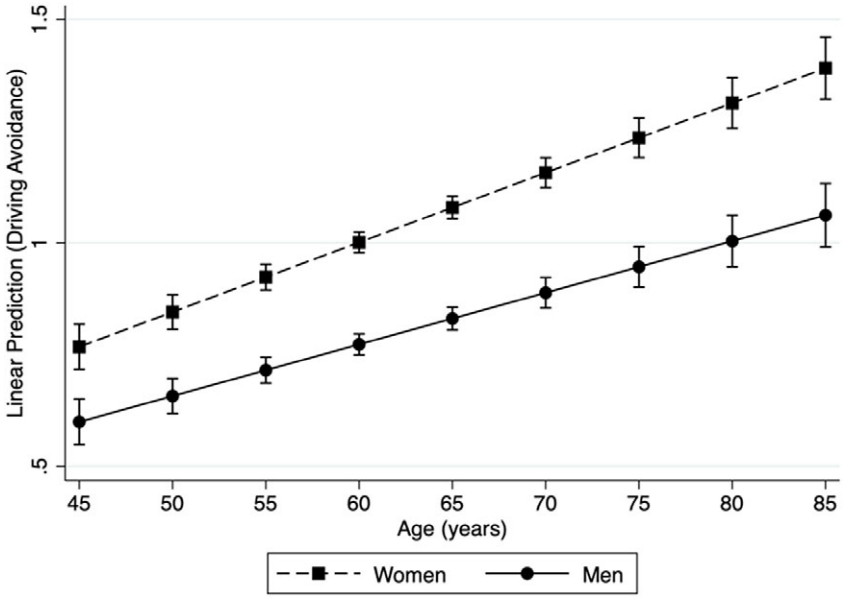

Figure 1. Visualized interaction between age and gender.

driving, noting that women are more willing than men to reduce and cease driving. When considered through the Model of Driving Self-Regulation, it is reasonable to surmise that intrapersonal factors that often accompany aging, such as perceived changes in abilities, may amplify gender differences in driving avoidance. Additionally, the stronger association between gender and driving avoidance in older age groups may be related to cohort differences such that older women in the sample may have historically driven less than men and therefore may be less comfortable driving when compared to younger women in the sample (Hakamies-Blomqvist & Siren, 2003; Molnar et al., 2018).

Second, with respect to cognitive function, the crude analysis showed a negative association between cognition and driving avoidance such that participants with higher cognition were less likely to report avoiding driving situations. The addition of multiple potential covariates, however, attenuated this finding in the multivariable model, and cognition was no longer significantly associated with driving avoidance. The lack of association after adjustment may be related to the relatively young sample in the baseline wave of the CLSA and the fact that participants had to be free from cognitive impairment to be enrolled in the study.

Third, given existing evidence showing a relationship between personality traits and driving behaviours among older adults, five personality traits were entered into the model, treating driving avoidance as the outcome. Consistent with existing research (Sawula et al., 2017), the results showed that extraversion was negatively associated with driving avoidance such that individuals who were more extroverted were less likely to report avoiding driving situations. This finding follows other work showing that extraversion is associated with risky and dangerous driving: collisions, traffic violations, and driving under the influence of alcohol (Clarke & Robertson, 2005; Fine, 1963; Kirkcaldy & Furnham, 2000; Lajunen, 2001; Renner & Anderle, 2000; Smith & Kirkham, 1981). Extroverts may be less likely to avoid certain driving situations that could lead to bodily harm and may be less likely to cease driving even when safety becomes compromised. Openness to experiences was also negatively associated with driving avoidance, and while the body of literature linking openness to experience and driving is less robust, some evidence points to a relationship with at-fault crashes (Arthur & Graziano, 1996). Finally, we did observe a negative association between emotional stability and driving avoidance such that individuals who reported more emotional stability reported less avoidance. This aligns with existing work showing a relationship between anxious driving styles and driving avoidance (Gwyther & Holland, 2012).

While the focus of our study was on gender, cognition, and personality traits, the results did yield other interesting findings. Participants living in rural environments were less likely to avoid driving situations. It is possible that, within rural areas, the driving environment is less complex and that participants may not encounter challenging driving situations such as heavy traffic or rush hour on multi-lane highways, leading to lower avoidance scores in this study. Another explanation may be that rural-dwelling older adults have a greater reliance on driving a personal automobile as alternative transportation options are limited and there is reduced walkability to services (e.g., pharmacies, doctor's offices, and supermarkets) (Hansen, Newbold, Scott, Vrkljan, & Grenier, 2020). Additionally, individuals who reported low vision function also reported greater driving avoidance. Other work has highlighted the salience of vision problems in driving performance, its relationship to driving avoidance, and its contribution to driving cessation (Ragland, Satariano, & MacLeod, 2004).

Strengths of this work include a large population-based sample, which allowed for the inclusion of numerous relevant covariates. In addition, cognitive function was captured objectively and included measures of memory and executive function. The 40-year age range allowed us to capture the driving behaviours of a wide age group, enhancing the generalizability of this work. An important limitation is the reliance on self-report driving as an outcome measure. Similarly, the cross-sectional study design precludes our understanding of whether driving avoidance temporally preceded our predictors (e.g., retirement, depression symptoms). Further, participants were required to drive more than once per month for inclusion in the present study. Due to the cross-sectional design, we were unable to examine whether driving avoidance led to driving cessation or whether driving avoidance is a precursor to reductions

https://doi.org/10.1017/S0714980823000065 Published online by Cambridge University Press

in driving frequency. Follow-up data will allow us to examine the temporal relationships between driving avoidance and driving cessation. It is unclear whether driving avoidance reported here reflects changes in objective driving safety. Participants were not required to take part in an on-road driving test as part of the CLSA.

Conclusions

Driving remains a primary means of mobility for older adults. For some, driving avoidance may be indicative of changes in driving safety, whereas for others it may lead to unnecessary restricting in community mobility. Understanding the factors that contribute to driving avoidance is an important component of promoting community mobility for an aging population. Supporting the safety and mobility of older drivers is multifaceted, involving driver optimization through training initiatives, evidence-based driver assessment, and facilitating adaptation during the driving cessation process. Our findings show that women of older ages tend to report more driving avoidance and that personality traits, notably extraversion, emotional stability, and openness to experience, may also play a role in determining driving avoidance. These correlates can assist researchers and practitioners to identify who is avoiding and tailor supports appropriately.

Acknowledgement. The opinions expressed in this manuscript are the authors´ own and do not reflect the views of the Canadian Longitudinal Study on Aging (CLSA).

Funding. This research was made possible using the data/biospecimens collected by the Canadian Longitudinal Study on Aging (CLSA). Funding for the CLSA is provided by the Government of Canada through the Canadian Institutes of Health Research (CIHR) under grant reference: LSA 97743 and the Canada Foundation for Innovation. This research has been conducted using the CLSA data set Baseline Tracking Dataset version 3.2, Baseline Comprehensive Dataset version 3.1, under Application Number 170323. The CLSA is led by Drs. Parminder Raina, Christina Wolfson, and Susan Kirkland. Data are available from the Canadian Longitudinal Study on Aging (www.clsa-elcv.ca) for researchers who meet the criteria for access to de-identified CLSA data. This research used data from the CLSA supported in part by the Ontario Ministry of Transportation. This project was funded through a CIHR Catalyst grant (373190) awarded to Dr. Michel Bédard. Ms. Shawna Hopper holds a doctoral scholarship from the Social Sciences and Humanities Research Council of Canada. Ms. Nicole G. Hammond is funded by the Frederick Banting and Charles Best Canada Graduate Scholarship Doctoral Awards (CGS-D) program. Dr. Arne Stinchcombe holds a New Investigator award from the Alzheimer's Society of Canada Research Program.

References

Adrian, J., Postal, V., Moessinger, M., Rascle, N., & Charles, A. (2011). Personality traits and executive functions related to on-road driving performance among older drivers. *Accident Analysis & Prevention*, **43**(5), 1652–1659. https://doi.org/10.1016/j.aap.2011.03.023

Andresen, E. M., Malmgren, J. A., Carter, W. B., & Patrick, D. L. (1994). Screening for depression in well older adults: Evaluation of a short form of the CES-D (Center for Epidemiologic Studies Depression Scale). *American Journal of Preventive Medicine*, **10**(2), 77–84.

Ang, B. H., Jennifer, O., Chen, W. S., & Lee, S. W. H. (2019). Factors and challenges of driving reduction and cessation: A systematic review and meta-synthesis of qualitative studies on self-regulation. *Journal of Safety Research*, **69**, 101–108. https://doi.org/10.1016/j.jsr.2019.03.007

Arthur, W. J., & Graziano, W. G. (1996). The five-factor model, conscientiousness, and driving accident involvement. *Journal of Personality*, **64**(3), 593–618.

Barrett, A. E., Gumber, C., & Douglas, R. (2018). Explaining gender differences in self-regulated driving: What roles do health limitations and driving alternatives play? *Ageing & Society*, **38**(10), 2122–2145. https://doi.org/10.1017/S0144686X17000538

Charlton, J. L., Koppel, S., D'Elia, A., Hua, P., St. Louis, R., Darzins, P., *et al.* (2019). Changes in driving patterns of older Australians: Findings from the Candrive/Ozcandrive cohort study. *Safety Science*, **119**, 219–226. https://doi.org/10.1016/j.ssci.2018.11.008

Chihuri, S., Mielenz, T. J., DiMaggio, C. J., Betz, M. E., DiGuiseppi, C., Jones, V. C., *et al.* (2016). Driving cessation and health outcomes in older adults. *Journal of the American Geriatrics Society*, **64**(2), 332–341. https://doi.org/10.1111/jgs.13931

Choi, M., Adams, K. B., & Kahana, E. (2013). Self-regulatory driving behaviors: gender and transportation support effects. *Journal of Women & Aging*, **25**(2), 104–118. https://doi.org/10.1080/08952841.2012.720212

Clarke, S., & Robertson, I. T. (2005). A meta-analytic review of the big five personality factors and accident involvement in occupational and non-occupational settings. *Journal of Occupational and Organizational Psychology*, **78**(3), 355–376. https://doi.org/10.1348/096317905X26183

Conlon, E. G., Rahaley, N., & Davis, J. (2017). The influence of age-related health difficulties and attitudes toward driving on driving self-regulation in the baby boomer and older adult generations. *Accident Analysis & Prevention*, **102**, 12–22. https://doi.org/10.1016/j.aap.2017.02.010

Edwards, J. D., Lunsman, M., Perkins, M., Rebok, G. W., & Roth, D. L. (2009). Driving cessation and health trajectories in older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*, **64A**(12), 1290–1295. https://doi.org/10.1093/gerona/glp114

Feng, Y. R., & Meuleners, L. (2020). Planning for driving cessation in older drivers. *Transportation Research Part F: Traffic Psychology and Behaviour*, **72**, 62–70. https://doi.org/10.1016/j.trf.2020.05.005

Fine, B. J. (1963). Introversion-extraversion and motor vehicle driver behavior. *Perceptual and Motor Skills*, **16**(1), 95–100. https://doi.org/10.2466/pms.1963.16.1.95

Freund, B., & Szinovacz, M. (2002). Effects of cognition on driving involvement among the oldest old: Variations by gender and alternative transportation opportunities. *The Gerontologist*, **42**(5), 621–633. https://doi.org/10.1093/geront/42.5.621

Gosling, S. D., Rentfrow, P. J., & Swann, W. B. (2003). A very brief measure of the big-five personality domains. *Journal of Research in Personality*, **37**(6), 504–528. https://doi.org/10.1016/S0092-6566(03)00046-1

Gwyther, H., & Holland, C. (2012). The effect of age, gender and attitudes on self-regulation in driving. *Accident Analysis & Prevention*, **45**, 19–28. https://doi.org/10.1016/j.aap.2011.11.022

Hakamies-Blomqvist, L., & Siren, A. (2003). Deconstructing a gender difference: Driving cessation and personal driving history of older women. *Journal of Safety Research*, **34**(4), 383–388. https://doi.org/10.1016/j.jsr.2003.09.008

Hansen, S., Newbold, K. B., Scott, D. M., Vrkljan, B., & Grenier, A. (2020). To drive or not to drive: Driving cessation amongst older adults in rural and small towns in Canada. *Journal of Transport Geography*, **86**, 102773. https://doi.org/10.1016/j.jtrangeo.2020.102773

Huang, G., Luster, M., Karagol, I., Park, J. W., & Pitts, B. J. (2020). Self-perception of driving abilities in older age: A systematic review. *Transportation Research Part F: Traffic Psychology and Behaviour*, **74**, 307–321. https://doi.org/10.1016/j.trf.2020.08.020

Jones, B. N. (1993). A new bedside test of cognition for patients with HIV infection. *Annals of Internal Medicine*, **119**(10), 1001. https://doi.org/10.7326/0003-4819-119-10-199311150-00006

Kirkcaldy, B., & Furnham, A. (2000). Positive affectivity, psychological well-being, accident- and traffic-deaths and suicide: An international comparison. *Studia Psychologica*, **42**(1–2), 97–104.

Kowalski, K., Love, J., Tuokko, H., MacDonald, S., Hultsch, D., & Strauss, E. (2012). The influence of cognitive impairment with no dementia on driving restriction and cessation in older adults. *Accident Analysis & Prevention*, **49**, 308–315. https://doi.org/10.1016/j.aap.2011.11.011

Lajunen, T. (2001). Personality and accident liability: Are extraversion, neuroticism and psychoticism related to traffic and occupational fatalities? *Personality & Individual Differences*, **13**(8), 1365–1373.

McCrae, R. R., & John, O. P. (1992). An introduction to the five-factor model and its applications. *Journal of Personality*, **60**(2), 175–215. https://doi.org/10.1111/j.1467-6494.1992.tb00970.x

McPeek, R., Nichols, A. L., Classen, S., & Breiner, J. (2011). Bias in older adults' driving self-assessments: The role of personality. *Transportation Research Part F: Traffic Psychology and Behaviour*, **14**(6), 579–590. https://doi.org/10.1016/j.trf.2011.06.001

Molnar, L. J., Eby, D. W., Vivoda, J. M., Bogard, S. E., Zakraksek, J. S., St Louis, R. M., *et al.* (2018). The effects of demographics, functioning, and perceptions on the relationship between self-reported and objective measures of driving exposure and patterns among older adults. *Transportation Research. Part F, Traffic Psychology and Behaviour*, **54**, 367–377. https://doi.org/10.1016/j.trf.2018.02.026

Monteiro, R. P., Coelho, G. L. de H., Hanel, P. H. P., Pimentel, C. E., & Gouveia, V. V. (2018). Personality, dangerous driving, and involvement in accidents: Testing a contextual mediated model. *Transportation Research Part F: Traffic Psychology and Behaviour*, **58**, 106–114. https://doi.org/10.1016/j.trf.2018.06.009

Oremus, M., Konnert, C., Law, J., Maxwell, C. J., O'Connell, M. E., & Tyas, S. L. (2019). Social support and cognitive function in middle- and older-aged adults: Descriptive analysis of CLSA tracking data. *European Journal of Public Health*, **29**(6), 1084–1089. https://doi.org/10.1093/eurpub/ckz047

Ragland, D. R., Satariano, W. A., & MacLeod, K. E. (2004). Reasons given by older people for limitation or avoidance of driving. *The Gerontologist*, **44**(2), 237–244. https://doi.org/10.1093/geront/44.2.237

Raina, P., Wolfson, C., & Kirkland, S. (2008). *Canadian longitudinal study on aging (CLSA): Protocol Version 3.0.* Canadian Longitudinal Study on Aging (CLSA). Retrieved 17 July 2022 from https://www.clsa-elcv.ca/researchers#content399.

Raina, P., Wolfson, C., Kirkland, S., Griffith, L. E., Balion, C., Cossette, B., et al. (2019). Cohort profile: The canadian longitudinal study on aging (CLSA). *International Journal of Epidemiology*, **48**(6), 1752–1753j. https://doi.org/10.1093/ije/dyz173

Raina, P., Wolfson, C., Kirkland, S. A., Griffith, L. E., Oremus, M., Patterson, C., *et al.* (2009). The canadian longitudinal study on aging (CLSA). *Canadian Journal on Aging/La Revue Canadienne Du Vieillissement*, **28**(3), 221–229. https://doi.org/10.1017/S0714980809990055

Rapoport, M. J., Naglie, G., Weegar, K., Myers, A., Cameron, D., Crizzle, A., *et al.* (2013). The relationship between cognitive performance, perceptions of driving comfort and abilities, and self-reported driving restrictions among healthy older drivers. *Accident Analysis & Prevention*, **61**, 288–295. https://doi.org/10.1016/j.aap.2013.03.030

Read, D. (1987). Neuropsychological assessment of memory in the elderly. *Canadian Journal of Psychology*, **41**(2), 158–174.

Renner, W., & Anderle, F. G. (2000). Venturesomeness and extraversion as correlates of juvenile drivers' traffic violations. *Accident; Analysis and Prevention*, **32**(5), 673–678.

Rey, A. (1964). *L'examen clinique en psychologie*. Presses Universitaire de France, Paris, France.

Riendeau, J., Stinchcombe, A., Weaver, B., & Bédard, M. (2018). Personality factors are associated with simulated driving outcomes across the driving lifespan. *Transportation Research Part F: Traffic Psychology and Behaviour*, **54**, 171–187. https://doi.org/10.1016/j.trf.2018.01.022

Rudman, D. L., Friedland, J., Chipman, M., & Sciortino, P. (2006). Holding on and letting go: The perspectives of pre-seniors and seniors on driving self-regulation in later life. *Canadian Journal on Aging/La Revue Canadienne Du Vieillissement*, **25**(1), 65–76. https://doi.org/10.1353/cja.2006.0031

Sawula, E., Mullen, N., Stinchcombe, A., Weaver, B., Tuokko, H., Naglie, G., *et al.* (2017). Associations between personality and self-reported driving restriction in the Candrive II study of older drivers. *Transportation Research Part F: Traffic Psychology and Behaviour*, **50**, 89–99. https://doi.org/10.1016/j.trf.2017.06.012

Schulz, P., Beblo, T., Spannhorst, S., Labudda, K., Wagner, T., Bertke, V., Boedeker, S., Driessen, M., Kreisel, S. H., & Toepper, M. (2020). Avoidance behavior is an independent indicator of poorer on-road driving skills in older adults. *The Journals of Gerontology: Series B*, **75**(10), 2152–2161. https://doi.org/10.1093/geronb/gbz063

Smith, D. I., & Kirkham, R. W. (1981). Relationship between some personality characteristics and driving record. *British Journal of Social Psychology*, **20**(4), 229–231. https://doi.org/10.1111/j.2044-8309.1981.tb00491.x.

St. Louis, R. M., Koppel, S., Molnar, L. J., Di Stefano, M., Darzins, P., Bédard, M., Mullen, N., Myers, A., Marshall, S., & Charlton, J. L. (2020). The relationship between psychological resilience and older adults' self-reported driving comfort, abilities, and restrictions. *Journal of Transport & Health*, **17**, 100864. https://doi.org/10.1016/j.jth.2020.100864

Stalvey, B. T., Owsley, C., Stalvey, B. T., & Owsley, C. (2000). Self-perceptions and current practices of high-risk older drivers: Implications for driver safety interventions. *Journal of Health Psychology*, **5**(4), 441–456. https://doi.org/10.1177/135910530000500404

Stinchcombe, A., Hopper, S., Mullen, N., & Bédard, M. (2021). Canadian older adults' perceptions of transitioning from driver to non-driver. *Occupational Therapy in Health Care*, 1–21. https://doi.org/10.1080/07380577.2021.1936338

Tuokko, H., Griffith, L. E., Simard, M., & Taler, V. (2017). Cognitive measures in the Canadian longitudinal study on aging. *The Clinical Neuropsychologist*, **31**(1), 233–250. https://doi.org/10.1080/13854046.2016.1254279

Tuokko, H., Griffith, L. E., Simard, M., Taler, V., O'Connell, M. E., Voll, S., *et al.* (2020). The Canadian longitudinal study on aging as a platform for exploring cognition in an aging population. *The Clinical Neuropsychologist*, **34**(1), 174–203. https://doi.org/10.1080/13854046.2018.1551575

Tuokko, H., Sukhawathanakul, P., Walzak, L., Jouk, A., Myers, A., Marshall, S., *et al.* (2016). Attitudes: Mediators of the relation between health and driving in older adults. *Canadian Journal on Aging / La Revue Canadienne Du Vieillissement*, **35**(1), 44–58.

Turcotte, M. (2012). *Profile of seniors' transportation habits.* Statistics Canada. Retrieved 18 May 2022 from https://www150.statcan.gc.ca/n1/en/pub/11-008-x/2012001/article/11619-eng.pdf?st=oVfdAg95.

UCLA: Statistical Consulting Group. (2021). *Poisson Regression.* Retrieved 15 July 2022 from https://stats.idre.ucla.edu/stata/dae/poisson-regression/.

Vance, D. E., Roenker, D. L., Cissell, G. M., Edwards, J. D., Wadley, V. G., & Ball, K. K. (2006). Predictors of driving exposure and avoidance in a field study of older drivers from the state of Maryland. *Accident Analysis & Prevention*, **38**(4), 823–831. https://doi.org/10.1016/j.aap.2006.02.008