



## Reprint of “Driving avoidance by older adults: Is it always self-regulation?”<sup>☆</sup>



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### ARTICLE INFO

#### Keywords:

Self-regulatory practices

Mobility

Older drivers

### ABSTRACT

Self-regulation shows promise as a means by which older adults can continue to drive at some level without having to stop altogether. Self-regulation is generally described as the process of modifying or adjusting one's driving patterns by driving less or intentionally avoiding driving situations considered to be challenging, typically in response to an awareness that driving skills have declined. However, most studies asking older adults whether they avoid certain driving situations or have reduced the amount of driving they do under certain circumstances have not delved deeper into the motivations for such avoidance or driving reduction. There are many reasons for modifying driving that have nothing to do with self-regulation, such as no longer needing to take trips at certain times of day because of changes in preferences or lifestyles. The purpose of this study was to examine self-regulatory practices among older adults at multiple levels of driver performance and decision making, taking into account the specific motivations for avoiding particular driving situations or engaging in other driving practices. Study participants completed a computer-based questionnaire on driving self-regulation. Results suggest that self-regulation is a complex process that cannot be defined simply by the reported driving modifications made by drivers. Understanding the motivations for these behaviors is necessary and the study showed that they are varied and differ considerably across driving situations. Reasons for driving avoidance or other practices were often more closely related to lifestyle or preferences than to self-regulation. Based on these findings, three distinct groups were identified with regard to whether and for what reasons participants modified their driving.

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### 1. Introduction

The aging of the population in many countries around the world has led to increasing research attention on how best to extend the period over which older adults can safely drive. A number of factors have contributed to this research interest. As people age, many will experience declines in visual, cognitive, or psychomotor skills as a result of medical conditions that become more prevalent with age or the medications used to treat those conditions (Eby et al., 2009; Molnar et al., 2007). At the same time, there is

considerable variation in the extent to which individuals experience these declines and their effects on safe driving (Eby et al., 1998; European Road Safety Observatory, 2006). Older adults, like most people, prefer driving as their means of maintaining mobility and consider driving to be essential to independence and quality of life (Dickerson et al., 2007; Whelan et al., 2006). Having to give up driving has been associated with a number of adverse consequences, including loss of independence, mobility, and freedom (Adler and Rottunda, 2006; Bauer et al., 2003), increased social isolation (Liddle et al., 2004; Ragland et al., 2004), increased symptoms of depression (Fonda et al., 2001; Marottoli et al., 1997; Ragland et al., 2005); and more general accelerated health declines (Edwards et al., 2009).

Self-regulation shows promise as a means by which older adults can continue to drive at some level without having to stop altogether, although the evidence for reduced crash risk is still inconclusive (e.g., see Molnar and Eby, 2008; Unsworth et al., 2007). Self-regulation is generally described as the process of modifying or adjusting one's driving patterns by driving less or

DOI of original article: <http://dx.doi.org/10.1016/j.aap.2013.04.010>.

<sup>☆</sup> This article is a reprint of a previously published article. For citation purposes, please use the original publication details: Accident Analysis and Prevention 57 (2013) 96–104.

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intentionally avoiding driving situations considered to be challenging (e.g., Baldock et al., 2006; Ball et al., 1998; D'Ambrosio et al., 2008; Molnar and Eby, 2008; Stalvey and Owsley, 2000). In particular, many researchers view self-regulation as a strategy to compensate specifically for declining health or loss of functional abilities that can compromise driving (e.g., Hakamies-Blomqvist and Wahlström, 1998; Sullivan et al., 2011). For example, older adults' self-regulatory practices have been described as: "...compensation for age-related declines in abilities by reducing their annual mileage as well as regulating when and where they drive" (Dobbs and Dobbs, 2001, p. 101); making "...adjustments in their driving behaviour that adequately match changing cognitive, sensory, and motor capabilities" (Charlton et al., 2006, p. 363); and as a process requiring "...an awareness of physical, cognitive, and sensory limitations" (Sargent-Cox et al., 2011, p. 898).

Essential to these definitions is the idea that drivers are aware of declines in driving skills and self-regulate their driving so that they can continue driving in some capacity – that is, for safety or related reasons, they reduce their driving overall or avoid certain driving situations that they find challenging such as driving at night, in bad weather, during rush hour traffic, in unfamiliar areas, and on the freeway (e.g., Baldock et al., 2006; Jones et al., 2011; Sullivan et al., 2011). However, most studies asking older adults whether they avoid certain driving situations or have reduced the amount of driving they do under certain circumstances have not delved deeper into the motivations for such avoidance or driving reduction. There are many reasons for avoiding driving situations that have nothing to do with self-regulation, such as no longer needing to take trips at certain times of day because of changes in preferences or lifestyles (see e.g., Ball et al., 1998; Charlton et al., 2006; Myers et al., 2008; Blanchard and Myers, 2010). In addition, recent findings that younger drivers also engage in avoidance behavior (e.g., Naumann et al., 2011) support the contention that driving avoidance is not always related to declining abilities associated with aging.

Overall, studies have yielded mixed results with regard to the extent and type of self-regulation that occurs among older adults, and considerable knowledge gaps remain about the self-regulation process and the individual, social, and environmental factors that influence it. The lack of conclusive results in this area is due in large measure to considerable differences across studies in terms of how self-regulation is conceptualized and measured, the characteristics of study participants such as age, gender, and functional status, and the extent to and way in which studies have included measures that seem to influence the adoption of self-regulatory practices such as insight into functional declines and confidence in driving ability. Most studies have also limited their measures to a relatively narrow set of driving situations without taking into account broader choices and decisions that influence driving behaviors.

The research on self-regulation is now at a point where a deeper understanding of the issue is needed. While there is general agreement that at least some older drivers are aware of their functional declines and make concomitant adjustments in their driving (see Molnar and Eby, 2008 for a review of this literature), important questions remain about the extent to which and the conditions under which older adults do self-regulate or otherwise modify their driving. There is a need for a more comprehensive approach to understanding self-regulation by older drivers that encompasses not only the extent to which older adults drive less or avoid specific driving situations, but also the broader choices they make in compensating for functional declines such as the types of vehicles they buy, the vehicle design features they choose, and even where they choose to live. Importantly, an approach is needed to uncover the reasons people have for avoiding particular situations or otherwise reducing their driving so that avoidance due to self-regulation can be disentangled from avoidance due to other reasons such as lifestyle or preferences.

## 2. Study background

The purpose of this study was to examine self-regulatory practices among older adults, taking into account the specific motivations for why people modify their driving by avoiding certain situations or engaging in other practices. The study is part of a larger program of research investigating: the nature and extent of self-regulation by older drivers at multiple levels of driver performance and decision making; how self-regulation is influenced by various individual, social, and environmental factors; and how self-reports of self-regulatory practices compare with objective data on driving patterns and behaviors. The research is being undertaken by the University of Michigan Transportation Research Institute (UMTRI) and Monash University Accident Research Centre (MUARC), as part of the latter's Ozcandrive study which includes older drivers in both Australia and New Zealand. The Ozcandrive project is a partnership with the Canadian Driving Research Initiative for Vehicular Safety in the Elderly (Candrive) project, an interdisciplinary, health-focused research program dedicated to improving the safety of older drivers (see <http://www.candrive.ca/>). The Candrive/Ozcandrive project is the first study to follow a large group of older drivers over several years to collect comprehensive data on health, functioning, and driving. A major focus of the study is to document the natural driving life course of older drivers, including the transition from driving to non-driving, using self-reported and objectively derived driving and clinical data.

## 3. Research framework

As described in Molnar et al. (2009), self-regulation can occur at three levels of driver performance and decision making: tactical, strategic, and life-goal. The tactical and strategic levels come from Michon's hierarchical model for driving skills and control (Michon, 1979, 1985), while the life-goal level (a term coined by Eby et al., 2009) builds on work by Keskinen and others on young drivers (e.g., Keskinen, 1996, 2007; Keskinen et al., 2004; Laapotti and Keskinen, 2004). Strategic self-regulation has to do largely with pre-trip decisions about the circumstances under which to drive or not to drive (e.g., avoiding night driving or other situations considered challenging, reducing driving overall). Tactical self-regulation has to do with actual maneuvers made in traffic in response to conditions in the driving environment (e.g., reducing distractions while driving such as chatting with passengers, leaving more distance between one's car and the car ahead). Life-goal self-regulation has to do with drivers' broader decisions in life that affect driving such as where to live in relation to the destinations one frequents or what kind of car to drive, with safety often being an important consideration in the vehicle purchase decision (Eby and Molnar, 2012). It should be noted that Michon's (1985) operational level is not included in this conceptualization of self-regulation because it has to do with driving behaviors and decisions that are largely automated and not generally amenable to self-regulation.

## 4. Methods

The study used a subset of data from the Candrive/Ozcandrive prospective study of older drivers discussed earlier. Specifically, participants in the Australian cohort of the Ozcandrive sample (i.e., those Ozcandrive participants recruited from the greater Melbourne area in Victoria, Australia) completed a computer-based questionnaire on driving self-regulation about 4 months after being recruited into the study. The questionnaire included detailed items on various avoidance behaviors as well as items on the motivations for engaging in these behaviors. Participants completed the questionnaire in addition to their regular obligations as participants

in Candrive/Oz Candrive. Full detail on the Candrive/Oz Candrive study protocols can be found in [Marshall et al. \(in press\)](#). Of special interest for this study are the protocols related to participant recruitment summarized briefly below.

#### 4.1. Participant recruitment

Study participants were primarily recruited through community and city newspapers, newsletters, posters, and presentations to various senior-related associations. Potential participants who expressed interest in the study were contacted via telephone by a research assistant from Oz Candrive and screened for eligibility and study commitment. The overall aim was to recruit older, active drivers who would potentially be able to participate in the study for up to 5 years. Recruitment for the Australian site began in June 2010 and closed in June 2011.

Inclusion criteria for Oz Candrive included: having a general class driver license and having been actively driving for at least 1 year; being age 75 or older; driving at least 4 times per week; having agreed to undergo an annual physical and cognitive assessment and be contacted at least quarterly for vehicle data pickup and interview; residing in the local region of the study city for at least 10 months a year; being followed actively by a family physician; intending to continue driving for the next 5 years; fluent in English; consenting to release driving information from licensing authority; access to a vehicle of model year 2002 or newer; and driving one vehicle for at least 70% of the time. Exclusion criteria included: planned move out of the region; medical contraindication to driving within the previous 6 months (according to the Austroads guide); and diagnosis of progressive conditions that could affect driving (e.g., Alzheimer's disease, macular degeneration).

#### 4.2. Questionnaire development and testing

The computer-based self-regulation instrument, termed the Advanced Driving Decisions and Patterns of Travel (ADDAPT) questionnaire, was initially developed at UMTRI. Full detail on development and testing of the questionnaire can be found in [Molnar et al. \(2009\)](#); a brief summary is presented here. Development of ADDAPT was based on review of the literature and consultation with experts. The instrument addressed the following topics: current driving patterns and changes over time; alternative transportation options; general health and functioning; abilities for safe driving; self-regulatory driving practices at the life-goal, strategic, and tactical levels; life-goal preferences and activities; feelings of driving comfort and safety; ability to self-regulate; and participant socio-demographic characteristics. ADDAPT was designed to take about 30–45 min to complete. It was pilot tested with a sample of 132 adults age 70 and older residing in Michigan, USA, comprised of both older adults recruited from the general population and older adults recruited from specialty geriatric clinics at the University of Michigan with losses in vision, psycho-motor skills, or cognition. Based on pilot results and advice from the Australian authors, ADDAPT was revised and tailored to Australasian older drivers.

#### 4.3. Measures

At the life-goal level, respondents were asked about three lifestyle-related changes they might have made during the past year that could impact driving. First, they were asked if they had moved to a new location and if so, whether the move was influenced by wanting to be closer to the places they normally drove to, wanting more options for getting around, or other reasons related to driving or mobility. Second, they were asked if they had

purchased a different vehicle, and if so, whether their decision was influenced by not feeling comfortable driving their previous car, not feeling safe driving their previous car, or other reasons related to driving. Finally, they were asked if they had started a regular exercise program or fitness regime, and if so what their reasons were.

At the strategic level, driving avoidance behavior was measured by a series of yes/no questions asking respondents if they tried to avoid various driving situations including driving at night, in bad weather, on busy roads, in unfamiliar areas, alone, at night in bad weather, during rush hour traffic, or on the freeway, as well as making right turns across oncoming traffic at intersections without right hand turn arrows and reversing. Respondents were also asked if they planned their route ahead of time, made a practice run to become familiar with their route, combined trips into a single outing, or brought passengers along to help navigate, as well as whether they had reduced the amount of driving they did over the past year in any way including driving fewer days or kilometers per week, taking fewer trips per week, or reducing the distance of their trips.

At the tactical level, respondents were asked a series of yes/no questions about trying to avoid various in-vehicle distractions while driving, including chatting with passengers, eating, reading a road map, changing radio stations, talking on a mobile phone, or personal grooming. Respondents were also asked if they tried to leave more room than they used to between their car and the car ahead of them.

Respondents who responded in the affirmative to any of the questions about modifying their driving by avoiding driving situations or engaging in other driving practices at the tactical and strategic levels were asked what their reasons were. The set of reasons presented to respondents included: (1) difficulty seeing during the day or night; (2) difficulty remembering things; (3) difficulty concentrating on more than one thing at a time; (4) reduced strength, flexibility, or general mobility; (5) don't feel comfortable driving in the driving situation/not engaging in that practice; (6) don't feel safe driving in the situation (with safety defined in terms of risk of getting in a crash rather than personal security)/not engaging in that practice; (7) have always tried to avoid the situation/engage in that practice; (8) don't need to avoid the situation/engage in that practice, or (9) other (with the respondent asked to write in the actual reason). Respondents had the option of giving multiple reasons for each reported behavior.

As part of the analysis, a three-level variable was created for each potential driving modification, based on the reasons given for making that modification. Six response options presented to respondents related to what is commonly thought of as self-regulation, as discussed earlier. Two response options were related to what would be considered lifestyle or preferences. Self-regulation was operationalized as any driving avoidance or other practice reported by respondents for which respondents intentionally chose at least one of the first six self-regulatory reasons. Thus, if a respondent reported trying to avoid driving at night because of the single reason that he or she was uncomfortable driving at night, then that was considered avoiding driving at night for self-regulation. At the same time, if a respondent reported trying to avoid driving at night because he or she was uncomfortable driving at night but also because he or she did not need to drive at night or had always tried to avoid driving at night, this was ALSO considered self-regulation. The three levels of each variable included: (1) non-modifiers (those who did not modify their driving); (2) self-regulators (those who modified their driving either by avoiding a particular situation or engaging in a particular practice for reasons related to self-regulation); (3) others (those who modified their driving but not for reasons related to self-regulation).

#### 4.4. Administration of the ADDAPT questionnaire

Prior to administering the questionnaire, approval was received from the Monash University Human Research Ethics Committee. Participants completed the questionnaire approximately 4 months after they began participating in the Ozcandrive study. The questionnaire was self-administered on a computer by study participants during a session in which a member of the research team was present in the room to provide assistance as necessary. Completion of the questionnaire took on average 30–45 min.

## 5. Results

At the time of the study reported here, 246 of the total 257 participants in the Ozcandrive Melbourne area sample had been recruited and their questionnaire data available for inclusion in the analyses. Characteristics of these study participants are summarized in Table 1. The mean age of participants was 79.7 (SD = 3.51, range = 75–94). The majority of participants were male and married. All but three considered themselves to be urban residents. Most participants lived in a residence (i.e., house, flat, or apartment) that they owned and most had lived at that residence for more than 10 years. The majority of households consisted of the participant and at least one other individual. Over 45% of participants reported that someone else in the household also drove and over one-third reported that others were dependent on them to drive. Most reported being retired, although a sizable number were in paid work and nearly two-thirds reported doing volunteer work in the community. Household income and education levels covered a broad range, although two-thirds reported an income of less than \$AUD 50,000 and half had completed at least high school or technical school. Based on census data from the [Australian Bureau of Statistics \(2012\)](#), the sample was younger and more likely to contain men than the age comparable portion of the general population of Victoria. The younger age distribution of the sample makes sense, given that inclusion criteria for the study required participants to be relatively healthy and still driving frequently. While the proportion of men in the sample was considerably larger than that in the general population, this is not the case when actual driving status is taken into account. Pooled results from nine Australian longitudinal studies conducted between 1990 and 2007 indicated that the odds of driving were 5.7 times as likely for men as for women, and that at age 75–79, about 70% of men reported driving, compared to only about 40% of women in the same age group ([Ross et al., 2009a](#)).

#### 5.1. Overall avoidance and other practices/behaviors

Table 2 presents summary information on reported avoidance and other practices/behaviors at the life-goal, strategic, and tactical levels. At the life-goal level, only four respondents (2%) reported having moved to a new location in the past year, 11% reported having purchased a different vehicle, and 28% reported having begun a regular exercise program or fitness regime.

At the strategic level, sizable percentages of participants reported trying to avoid most of the driving situations presented (Table 2). In ascending order, participants were most likely to report trying to avoid driving during rush hour traffic, driving at night in bad weather, driving in bad weather, and driving at night (46%, 44%, 35%, and 22%, respectively). They were least likely to report trying to avoid driving alone (1%). Over two-thirds reported planning their routes ahead of time or combining trips into a single outing. Only 1% reported bringing along a passenger to help them navigate and less than 8% reported making a practice run to become familiar with the route.

**Table 1**  
Sample characteristics.

Characteristic	Number <sup>a</sup>	Percent
Gender		
Male	179	72.8
Female	67	27.2
Marital status		
Married/common law	148	61.7
Separated/divorced	18	7.5
Widowed	60	25.0
Single	14	5.8
Do you consider yourself an urban or rural resident		
Urban	243	98.8
Rural	2	0.8
Other	1	0.4
Housing arrangement		
Owned house, flat, apartment	185	77.1
Rented house, flat, apartment	9	3.8
Family member's house, flat, apartment	3	1.3
Senior/retirement community that provides transportation	29	12.1
Senior/retirement community not providing transportation	11	4.6
Other	3	1.3
Length at present location		
Less than 1 year	5	2.1
1–5 years	35	14.6
6–10 years	29	12.1
More than 10 years	171	71.3
Number of people in the household, including respondent		
1	92	38.3
2	135	56.3
3 or more	13	5.4
Number of drivers in the household, including respondent		
1	131	54.6
2	102	42.5
3 or more	7	2.9
Are you the primary driver - yes	218	90.8
Does anyone in or outside the household depend on you to drive them - yes	85	35.4
Are you retired - yes	229	96.2
Do you currently do any paid work - yes	25	11.7
Do you currently do any volunteer work in the community - yes	154	65.3
Household income (Australian dollars; AUD)		
Less than \$20,000	25	12.2
\$20,000–\$49,999	110	53.7
\$50,000–\$79,999	44	21.5
\$80,000–\$99,999	13	6.3
\$100,000 or more	13	6.3
Education		
Primary school	59	24.0
High school	27	11.0
Trade/technical certificate	37	15.0
Diploma	72	29.3
Degree	37	15.0
Post-graduate	14	5.7

<sup>a</sup> Numbers in each category may not add to 246 due to missing data.

At the tactical level, at least one-quarter or more of all respondents reported trying to avoid in-vehicle distractions with over 90% reporting trying to avoid talking on a mobile phone, personal grooming, or reading a road map (Table 2). Over 40% reported leaving greater distances than they used to between their car and the car ahead of them.

#### 5.2. Motivations for avoidance and other practices/behaviors

As discussed earlier, respondents who reported making changes in the past year at the life-goal level were asked about factors that may have influenced their decision. One of the four respondents who had moved to a new location in the past year reported that the move was influenced by a driving-related reason (i.e., that

**Table 2**  
Reported avoidance and other practices/behaviors at the life-goal, strategic, and tactical levels.

	Yes		No	
	Number	Percent	Number	Percent
<b>Life-goal level</b>				
Moved to a new location	4	1.6	242	98.4
Bought a new vehicle	28	11.4	218	88.6
Began a regular exercise program or fitness regime	69	28.2	176	71.8
<b>Strategic level</b>				
Do you try to avoid...?				
Driving at night	55	22.4	191	77.6
Making unprotected right turns	26	10.6	220	89.4
Driving in bad weather	86	35.0	160	65.0
Driving on busy roads	41	16.7	205	83.3
Driving in unfamiliar areas	34	13.8	212	86.2
Driving alone	3	1.2	242	98.8
Driving at night in bad weather	108	44.3	136	55.7
Driving during rush hour traffic	113	46.3	131	53.7
Driving on the freeway	20	8.2	224	91.8
Reversing	29	11.9	215	88.1
Do/have you?				
Plan your route ahead of time	167	69.3	74	30.7
Make a practice run to become familiar with your route	19	7.9	221	92.1
Combine trips into a single outing	165	68.5	76	31.5
Bring passengers along to help navigate	3	1.2	238	98.8
Reduced your driving in the past year in any way	19	7.7	227	92.3
<b>Tactical level</b>				
While driving, do you try to avoid...?				
Chatting with passengers	70	28.7	174	71.3
Eating	193	79.1	51	20.9
Reading a road map	225	92.2	19	7.8
Changing radio stations	76	31.1	168	68.9
Talking on a mobile phone	233	96.3	9	3.7
Personal grooming	230	95.8	10	4.2
Do you...?				
Leave more room between your car and the car ahead	101	41.9	140	58.1

he or she wanted to be closer to normally visited destinations). Of the 28 respondents who reported having bought a different vehicle, one reported not feeling comfortable driving his or her previous car and eight cited other driving-related reasons (e.g., switched cars to prepare when/if hips or knees fail, did not like poor turning circle of previous car, could not see over dashboard of previous car adequately). Of the 69 respondents who reported having begun a regular exercise program or fitness regime, most recorded verbatim reasons having to do with a desire to maintain or improve their health and fitness. Several respondents specifically mentioned wanting to improve their flexibility, strength, or general mobility.

Table 3 summarizes reported motivations for avoiding driving situations or engaging in other driving practices at the strategic and tactical levels. As can be seen, overall motivations varied considerably across the levels and specific driving situations. At the strategic level, the most frequently cited reasons for avoiding a driving situation tended to be “don’t feel comfortable” (with percentages ranging from 27 to 62) and “don’t need to” (with percentages ranging from 4 to 71). Sizable proportions also cited “have always tried to” and “don’t feel safe.” The most frequently cited reasons for engaging in other practices (e.g., planning route ahead of time) tended to be “have always tried to engage in practice” (with percentages ranging from 33 to 75) or “other” (with percentages ranging from 14 to 67), although a quarter of respondents reporting

that they planned their route ahead of time attributed this practice to not feeling comfortable going out without doing so.

Looking specifically at the motivations considered to relate to self-regulation (the first six categories), fewer respondents cited difficulties in visual, cognitive, or psychomotor skills compared with more general feelings of discomfort or lack of safety. Notable exceptions were found for a few situations for which sizable minorities cited difficulty seeing during the day or night (avoiding driving at night or in bad weather), difficulty concentrating on more than one thing at a time (avoiding driving in unfamiliar areas), and reduced strength, flexibility, or general mobility (avoiding reversing). The reason “don’t feel safe” was cited by respondents across all situations but considerably less frequently than “don’t feel comfortable.”

At the tactical level, the most frequently cited reasons for avoiding in-vehicle distractions were “have always tried to avoid” (with percentages ranging from 23 to 70) or “don’t need to avoid” (with percentages ranging from 19 to 77). By comparison, most respondents who reported leaving more room than they used to between their car and the car ahead of them attributed this practice to not feeling comfortable or not feeling safe leaving less room (52% and 55%, respectively).

### 5.3. Extent and type of self-regulation taking motivations into account

Based on respondents’ self-reported motivations for avoiding specific driving situations or engaging in other practices, a three-level variable was created for each situation at the strategic and tactical levels (Table 4). The life-goal level was not submitted to the same analysis given the relatively small numbers of respondents reporting life-goal changes in the past year.

At the strategic level, separating out respondents who modified their driving for reasons related to self-regulation (“self-regulators”) from respondents who modified their driving but not for reasons related to self-regulation (“others”) led to different outcomes depending on the driving situation being examined. Considerable numbers of respondents across the driving situations were deemed “others.” At the same time, for many situations, self-regulators remained the majority of respondents who modified their driving for any reason (e.g., for driving at night, making unprotected left turns, and driving in bad weather, unfamiliar areas, and at night in bad weather). For other driving situations, however, after separating out “others” from the overall group of respondents who modified their driving for any reason, there were less than half remaining as “self-regulators” (e.g., driving on busy roads, driving in rush hour traffic, planning out route ahead of time), and in a few cases (e.g., making a practice run, combining trips into a single outing), fewer than 10% were deemed “self-regulators.”

At the tactical level, “self-regulators” outnumbered “others” for only one driving situation: leaving more room between respondents’ car and the car ahead of them. For all of the in-vehicle distractions, the majority of respondents who modified their driving cited reasons not related to self-regulation. As a result, there were up to twice or three times as many respondents in the “others” group as the “self-regulators” group for some situations (e.g., changing radio stations while driving, personal grooming while driving).

Across all strategic and tactical driving situations, the percentage of non-modifiers ranged from 3.7 to 98.9, the percentage of self-regulators ranged from 0 to 41.4, and the percentage of others ranged from 0.8 to 71.7. On average, across all driving situations, self-regulators comprised about 15% of participants. Broken out by level of self-regulation, this translated into 8.9% for strategic self-regulation and 28.1% for tactical self-regulation.

**Table 3**  
Reported motivations for avoidance and other practices at the strategic and tactical levels.

Practice (total N reporting practice)	Reasons for practice (% reporting each reason)								
	Difficulty seeing during day or night (%)	Difficulty remembering things (%)	Difficulty concentrating on more than one thing at a time (%)	Reduced strength, flexibility, general mobility (%)	Don't feel comfortable (%)	Don't feel safe (%)	Have always tried to (%)	Don't need to do it (%)	Other (%)
<b>Strategic level</b>									
<b>Avoidance</b>									
At night (55)	16.4	0	1.8	1.8	61.8	21.8	14.5	49.1	16.4
Making turns (26)	0	0	0	0	46.2	23.1	19.2	3.8	26.9
Bad weather (86)	12.8	0	2.3	1.2	48.8	23.3	29.1	52.3	14.0
Busy roads (41)	0	0	4.9	0	26.8	9.8	34.1	51.2	12.2
Unfamiliar areas (34)	0	2.9	11.8	2.9	52.9	11.8	14.7	23.5	14.7
Driving alone (3)	0	0	0	0	0	0	0	0	0
At night in bad weather (108)	10.2	0	1.9	0.9	57.4	21.3	29.6	50.0	7.4
Rush hour (113)	0	0	2.7	0	26.5	10.6	27.4	70.8	10.6
On the freeway (20)	0	0	5.0	0	40.0	10.0	30.0	40.0	20.0
Reversing (29)	6.9	0	3.4	13.8	34.5	13.8	31.0	10.3	10.3
<b>Practice</b>									
Plan route (167)	0	1.8	1.8	0	25.1	12.0	75.4	-	13.8
Make practice run (19)	0	0	0	0	5.3	0	26.3	-	57.9
Combining trips (165)	0	0	0	0	3.0	0.6	64.2	-	87.8 <sup>a</sup>
Bring passenger (3)	0	0	0	0	33.3	33.3	33.3	-	66.7
Reduced driving (19)	4.8	0	0	9.5	0	0	-	42.9	71.4
<b>Tactical level</b>									
<b>Avoidance</b>									
Chatting (70)	0	1.4	27.1	0	24.3	10.0	52.9	-	18.6
Eating (193)	0.5	0	2.6	2.1	32.6	21.2	69.9	-	17.1
Reading map (225)	0.4	0	5.8	0	15.6	39.1	36.4	19.1	28.4
Changing radio (76)	0	0	6.6	0	19.7	22.4	35.5	25.0	21.1
Talking on phone (233)	0.4	0	4.3	0	12.0	35.3	-	-	57.3 <sup>b</sup>
Personal grooming (230)	0	0	4.3	0	10.4	22.2	22.6	77.4	11.3
<b>Practice</b>									
Leave more room (101)	0	0	0	2.0	51.5	55.4	-	-	21.8

<sup>a</sup> Of the 87.8% reporting other reasons for combining trips into a single outing, 43% selected a special category called “financial reasons” (e.g., saving fuel or wear and tear on vehicle) and 24.8% selected a special category called “environmental reasons” (e.g., lowering emissions).

<sup>b</sup> The most commonly reported reason in the “other” category was that talking on a mobile phone while driving was against the law. In addition, of the 57.3% reporting other reasons for avoiding talking on a mobile phone, 19.4% reported that they did not have a mobile phone.

**Table 4**  
Driver groups at strategic and tactical levels.

Strategic level	Number <sup>a</sup>	Percent
Driving at night		
Non-modifiers	191	77.6
Self-regulators	40	16.3
Others	15	6.1
Making unprotected right turns		
Non-modifiers	220	89.4
Self-regulators	17	6.9
Others	9	3.7
Driving in bad weather		
Non-modifiers	160	65.0
Self-regulators	49	19.9
Others	37	15.0
Driving on busy roads		
Non-modifiers	205	83.3
Self-regulators	12	4.9
Others	29	11.8
Driving in unfamiliar areas		
Non-modifiers	212	86.2
Self-regulators	21	8.5
Others	13	5.3
Driving alone		
Non-modifiers	242	98.8
Self-regulators	-	-
Others	3	1.2
Driving at night in bad weather		
Non-modifiers	136	55.7
Self-regulators	70	28.7
Others	38	15.6
Driving during rush hour traffic		
Non-modifiers	131	51.0
Self-regulators	32	12.5
Others	81	31.5
Driving on the freeway		
Non-modifiers	224	91.8
Self-regulators	10	4.1
Others	10	4.1
Reversing		
Non-modifiers	215	88.1
Self-regulators	16	6.6
Others	13	5.3
Plan your route ahead of time		
Non-modifiers	74	30.7
Self-regulators	48	19.9
Others	119	49.4
Make a practice run to become familiar with your route		
Non-modifiers	221	92.1
Self-regulators	1	0.4
Others	18	7.5
Combine trips into a single outing		
Non-modifiers	76	31.5
Self-regulators	5	2.1
Others	160	66.4
Bring passengers along to help navigate		
Non-modifiers	238	98.9
Self-regulators	1	0.4
Others	2	0.8
Reduced your driving in the past year in any way		
Non-modifiers	227	92.3
Self-regulators	3	1.2
Others	16	6.5
Tactical level	Number <sup>a</sup>	Percent
Chatting with passengers while driving		
Non-modifiers	174	71.3
Self-regulators	34	13.9
Others	36	14.8
Eating while driving		
Non-modifiers	51	20.9
Self-regulators	84	34.4
Others	109	44.7
Reading a road map while driving		
Non-modifiers	19	7.8
Self-regulators	101	41.4
Others	124	50.8

Table 4 (Continued)

Tactical level	Number <sup>a</sup>	Percent
Changing radio stations while driving		
Non-modifiers	168	68.9
Self-regulators	25	10.2
Others	51	20.9
Talking on a mobile phone while driving		
Non-modifiers	9	3.7
Self-regulators	89	36.9
Others	143	59.3
Personal grooming while driving		
Non-modifiers	10	4.2
Self-regulators	58	24.2
Others	172	71.7
Leave more room between your car and the car ahead		
Non-modifiers	140	58.1
Self-regulators	86	35.7
Others	15	6.2

<sup>a</sup> Numbers may not add to 246 for each situation due to missing data.

## 6. Conclusion and discussion

This study examined the nature and extent of self-regulation by older drivers at multiple levels of driver performance and decision making, taking into account the specific motivations for avoiding particular driving situations or engaging in other driving practices. Results suggest that self-regulation is a complex process that cannot be defined simply by the reported driving modification – avoiding certain driving situations or engaging in other practices. Understanding the motivations for these behaviors is necessary and the study showed that they are varied and differ considerably across driving situations. Reasons for driving avoidance or other practices were often more closely related to lifestyle or preferences than to self-regulation, consistent with findings by others (e.g., [Charlton et al., 2006](#); [Myers et al., 2008](#); [Blanchard and Myers, 2010](#)). Thus, to better understand self-regulation among older adults, it is not sufficient to ask people if they avoid specific driving situations or engage in practices that seemingly suggest self-regulatory behavior; it is important to understand their reasons for doing so. Another important finding from this study is that self-regulatory behavior appears to be closely tied to the specific driving situation in which it is being examined; thus, context should be taken into account in understanding self-regulation.

Three distinct groups of older adults with respect to self-regulation were identified based on their reported motivations for modifying their driving, consisting of non-modifiers, self-regulators, and others. It is possible that some individuals who cited non-self-regulatory reasons for modifying their driving were actually self-regulators who either did not recognize it or chose not to admit to it. Further work is underway to examine these three groups more fully through statistical modeling to identify differences, particularly between the groups who do modify their driving, that go beyond their stated reasons for avoidance or engagement. If these groups are in fact different in important ways with regard to driving avoidance patterns, this could be reflected in differences in other health and driving measures.

This study is the first to address life-goal self-regulation. Relatively few respondents reported engaging in life-goal self-regulatory practices. While this result makes it difficult to reach meaningful conclusions about motivations for life-goal changes, it does show how infrequently life-goal decisions are made. Life-goal self-regulatory practices involve important decisions that affect most aspects of a person's life (of which driving is just one part). Many people may not be ready to face those decisions when they still consider themselves to be relatively highly functioning as was the Ozcandrive sample. As participants age over the course of the 5-year study, one would expect increased loss in functioning

and possibly more life-goal self-regulation. However, the research reported here was confined to data generated early in the first year of the study, when participants were relatively healthy and active in their driving (as indicated by the eligibility requirement that they were driving at least four times per week at the time of recruitment). It is important to continue to study self-regulation at this level, especially because of the opportunity that life-goal decisions afford for enhancing older adult mobility. Different study designs may be necessary to recruit sufficient numbers of participants making decisions at the life-goal level so that motivations can be fully explored.

The study had some limitations. The sample was comprised of a convenience cohort of drivers age 75 years and older. A convenience rather than random sampling approach was used because a truly random and representative sample can only be achieved through mandatory participation, which would have been neither possible nor desired. The reasons which prevented a random sample included: concern for possible negative impact on licensure will almost certainly lead to a level of volunteer bias; and 'cold calling' potential recruits is unlikely to yield a high response rate for a study requiring a 5-year commitment from participants. Thus, there was likely a bias toward a healthier sample, resulting possibly in less self-regulation being reported than might have been found in a more general population with a greater range of impairments.

The rate of self-reported self-regulation was also influenced by the gender makeup of the sample. The majority of study participants were men. In a separate analysis of gender effects on self-regulation using this dataset, the authors found that men reported less self-regulation than women for several driving situations including driving at night, in bad weather, in unfamiliar areas, at night in bad weather, and on the freeway, as well as reversing (Molnar et al., 2012). These gender differences are consistent with many other studies that found men to be less likely to report self-regulation than women (e.g., Charlton et al., 2006; D'Ambrosio et al., 2008; Kostyniuk and Molnar, 2008; Naumann et al., 2011). However, findings from some recent studies have not supported this association with regard to older drivers (e.g., Blanchard and Myers, 2010; Molnar et al., 2009; Ross et al., 2009b). Further work is underway to identify other individual, social, and environmental factors that may be influencing self-regulation among this sample.

Another limitation was that even though the data for the research came from a longitudinal cohort study, the data presented here were necessarily cross sectional in nature given that only one wave of data was available at the time the research was undertaken. It will be important to examine changes in participants' self-regulatory driving behaviors over time as they age and increasingly experience declines in health and functioning. Continuing efforts are underway by the Candrive/Ozcandrive research team to investigate changes over time using a large set of clinical and psychosocial measures. Finally, all self-regulatory practices were self-reported and may not represent the actual behavior or decision of participants. Further work is also underway to supplement the self-reported data with naturalistic driving data to further untangle the complexity of the self-regulatory process among older adults.

## Acknowledgments

This study was part-funded by a Team Grant from Canadian Institutes of Health Research (CIHR) entitled "The CIHR Team in Driving in Older Persons (Candrive II) Research Program" in partnership with an Australian Research Council Linkage grant (Managing older driver safe mobility: An international collaboration). The Australian Research Council Linkage grant is also supported by VicRoads, Victoria Police, the Transport Accident Commission (TAC, Victoria), Road Safety Trust New Zealand and

Eastern Health in Australia. Partial funding for this project also came from the Michigan Center for Advancing Safe Transportation throughout the Lifespan (M-CASTL).

The authors acknowledge and thank the Candrive and Ozcandrive Research Teams and cohort study participants for their dedication. Without this support, this publication would not have been possible. The authors also thank several individuals who were instrumental to the completion of this project. Abigail Harding, Elizabeth Jacobs, Kate Mora, and Louise Beasley administered the questionnaires to Ozcandrive study participants. Renée St. Louis assisted in processing of the questionnaire data and setting up data files for analysis. Giselle Kolenic and Stuart Newstead offered invaluable input on the statistical analyses. Judy Settles and Amanda Dallaire provided administrative support for the project.

This work was completed in partial satisfaction of the requirements for a doctorate degree from Monash Injury Research Institute (MIRI), Monash University for the first author. As such, the first author thanks the Monash University Accident Research Centre (MUARC) of MIRI with whom she has collaborated on this program of research, as well as the Candrive/Ozcandrive older driver research initiative (of which MUARC is a part) that has graciously shared data collection protocols and provided participants for later stages of her research on self-regulation of driving among older adults.

## References

- Adler, G., Rottunda, S., 2006. Older adults' perspectives on driving cessation. *Journal of Aging Studies* 20, 227–235.
- Australian Bureau of Statistics, 2012. Australian Demographic Statistics, Available at [http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/A535F84F4393C62\\_FCA257AD7000D113E/\\$File/31010\\_jun%202012.pdf](http://www.ausstats.abs.gov.au/ausstats/subscriber.nsf/0/A535F84F4393C62_FCA257AD7000D113E/$File/31010_jun%202012.pdf) (accessed 27.03.13).
- Baldock, M.R.J., Mathias, J.L., McLean, A.J., Berndt, A., 2006. Self-regulation of driving and its relationship to driving ability among older adults. *Accident Analysis and Prevention* 38, 1038–1045.
- Ball, K.K., Owsley, C., Stalvey, B., Roenker, D.L., Sloane, M.E., Graves, M., 1998. Driving avoidance and functional impairment in older drivers. *Accident Analysis and Prevention* 30, 313–322.
- Bauer, M.J., Rottunda, S., Adler, G., 2003. Older women and driving cessation. *Qualitative Social Work* 2, 309–325.
- Blanchard, R.A., Myers, A., 2010. Examination of comfort and self-regulatory practices in older adults using in-vehicle devices to assess natural driving patterns. *Accident Analysis and Prevention* 42, 1213–1219.
- Charlton, J.L., Oxley, J., Fildes, B., Oxley, P., Newstead, S., Koppel, S., O'Hare, M., 2006. Characteristics of older drivers who adopt self-regulatory driving behaviors. *Transportation Research Part F* 9, 363–373.
- D'Ambrosio, L.A., Donorfio, L.K.M., Coughlin, J.F., Mohyde, M., Meyer, J., 2008. Gender differences in self-regulation patterns and attitudes toward driving among older adults. *Journal of Women and Aging* 20, 265–282.
- Dickerson, A.E., Molnar, L.J., Eby, D.W., Adler, G., Bédard, M., Berg-Weger, M., Classen, S., Foley, D., Horowitz, A., Kerschner, H., Page, O., Silverstein, N.M., Staplin, L., Trujillo, L., 2007. Transportation and aging: a research agenda for advancing safe mobility. *The Gerontologist* 47, 578–590.
- Dobbs, B.M., Dobbs, A.R., 2001. Improving the safety and mobility of older drivers: a conceptual framework. Paper presented at the Road Safety Research, Policing, and Education Conference. Melbourne, Australia.
- Eby, D.W., Molnar, L.J., 2012. Has the Time Come for an Older Driver Vehicle? Report No. UMTRI-2012-5. University of Michigan Transportation Research Institute, Ann Arbor, MI.
- Eby, D.W., Molnar, L.J., Kartje, P.S., 2009. *Maintaining Safe Mobility in an Aging Society*. CRC Press, New York, NY.
- Eby, D.W., Trombley, D., Molnar, L.J., Shope, J.T., 1998. The Assessment of Older Drivers' Capabilities: A Review of the Literature. Report No. UMTRI-98-24. University of Michigan Transportation Research Institute, Ann Arbor, MI.
- Edwards, J.D., Lunsman, M., Perkins, M., Rebok, G.W., Roth, D.L., 2009. Driving cessation and health trajectories in older adults. *Journal of Gerontology: Medical Sciences* 64, 300–305.
- European Road Safety Observatory, 2006. Older Drivers. <http://www.erso.eu>
- Fonda, S.J., Wallace, R.B., Herzog, A.R., 2001. Changes in driving patterns and worsening depressive symptoms among older adults. *Journal of Gerontology Series B: Psychological Sciences and Social Sciences* 56, S343–S351.
- Hakamies-Blomqvist, L., Wahlström, B., 1998. Why do older drivers give up driving? *Accident Analysis and Prevention* 30, 305–312.
- Jones, V.C., Cho, J., Abendschoen-Milani, J., Gielen, A., 2011. Driving habits and risk exposure in older drivers: lessons learned from the implementation of a self-regulation curriculum. *Traffic Injury Prevention* 12, 468–474.
- Keskinen, E., 1996. Why do young drivers have more accidents? Junge Fahrer Und Fahrerinnen. Referate der Esten Interdisziplinären Fachkonferenz



- 12–14 Dezember 1994 in Köln. Berichte der Bundesanstalt für Strassenwesen. Mensch und Sicherheit, Heft M 52.
- Keskinen, E., 2007. What is GDE all about and what it is not. In: Henriksson, W., Stenlund, T., Sundstrom, A., Wiberg, M. (Eds.), *Proceedings from The GDE-Model as a Guide in Driver Training and Testing*. Umea University, Umea, Sweden.
- Keskinen, E., Hatakka, M., Laapotti, S., Katila, A., Peraaho, M., 2004. Driver behavior as a hierarchical system. In: Rothengatter, T., Huguenin, R.D. (Eds.), *Traffic and Transport Psychology: Theory and Application: Proceedings of the ICTTP 2000*. Elsevier, New York, NY.
- Kostyniuk, L.P., Molnar, L.J., 2008. Driving self-restriction among older adults: health, age, and sex effects. *Accident Analysis and Prevention* 40, 1576–1580.
- Laapotti, S., Keskinen, E., 2004. Has the difference in accident patterns between male and female drivers changed between 1984 and 2000? *Accident Analysis and Prevention* 36, 577–584.
- Liddle, J., McKenna, K., Broome, K., 2004. *Older Road Users: From Driving Cessation to Safe Transportation*. University of Queensland, Brisbane, Australia.
- Marottoli, R.A., Mendes de Leon, C.F., Glass, T.A., Williams, C.S., Cooney Jr., L.M., Berkman, L.F., Tinetti, M.E., 1997. Driving cessation and increased depressive symptoms: prospective evidence from the New Haven EPESE Established populations for epidemiologic studies of the elderly. *Journal of the American Geriatrics Society* 45, 202–206.
- Marshall, S., Man-Son-Hing, M., Bédard, M., Charlton, J., Gagnon, S., Célinas, I., Koppel, S., Korner-Bitensky, N., Langford, J., Mazer, B., Myers, A., Naglie, G., Polgar, J., Porter, M., Rapoport, M., Tuokko, H., Vrkljan, B., Woolnough, A. Protocol for Candrive II/Oz Candrive, a multicentre prospective older driver cohort study. *Accident Analysis and Prevention*, in press.
- Michon, J.A., 1979. Dealing with Danger: Report of the European Commission MRC Workshop on Physiological and Psychological Factors in Performance Under Hazardous Conditions. Report No. VK 79-01. Traffic Research Center, University of Groningen, Gieten, The Netherlands.
- Michon, J.A., 1985. A critical view of driver behavior models: What do we know, what should we do? In: *Human Behavior and Traffic Safety Proceedings of a General Motors Symposium on Human Behavior and Traffic Safety*. Plenum Press, New York, NY.
- Molnar, L.J., Charlton, J.L., Eby, D.W., Langford, J., Koppel, S., Marshall, S., Man-Son-Hing, M., 4–6 October 2012. Findings from the Candrive/Oz Candrive study: Self-regulatory driving practices among older adults. In *proceedings of Australasian Road Safety. Research, Policing and Education Conferenc*, Wellington, NZ.
- Molnar, L.J., Eby, D.W., 2008. The relationship between self-regulation and driving-related abilities in older drivers: An exploratory study. *Traffic Injury Prevention* 9 (4), 314–319.
- Molnar, L.J., Eby, D.W., Roberts, J.S., St. Louis, R., Langford, J., 2009. A New Approach to Assessing Self-regulation by Older Drivers: Development and Testing of a Questionnaire Instrument. Report No. M-CASTL-2009-04. University of Michigan Transportation Research Institute, Ann Arbor, MI.
- Molnar, L.J., Eby, D.W., St. Louis, R.M., Neumeyer, A.L., 2007. *Promising Approaches for Promoting Lifelong Community Mobility*. AARP, Washington, DC.
- Myers, A., Paradis, J., Blanchard, R., 2008. Conceptualizing and measuring driving confidence in older adults. *Archives of Physical Medicine and Rehabilitation* 89, 630–640.
- Naumann, R.B., Dellinger, A.M., Kresnow, M.J., 2011. Driving self-restriction in high-risk conditions: how do older drivers compare to others? *Journal of Safety Research* 42, 67–71.
- Ragland, D., Satariano, W.A., MacLeod, K.E., 2004. Reasons given by older people for limitation or avoidance of driving. *The Gerontologist* 44, 237–244.
- Ragland, D.R., Satariano, W.A., MacLeod, K.E., 2005. Driving cessation and depressive symptoms. *Journal of Gerontology: Medical Sciences* 60A, 399–403.
- Ross, L.A., Anstey, K.J., Kiely, K.M., Windsor, T.D., Byles, J.E., Luszcz, M.A., Mitchell, P., 2009a. Older drivers in Australia: trends in driving status and cognitive and visual impairment. *Journal of the American Geriatrics Society* 57, 1868–1873.
- Ross, L.A., Clay, O.J., Edwards, J.D., Ball, K.K., Wadley, V.G., Vance, D.E., Cissell, G.M., Roenker, D.L., Joyce, J.J., 2009b. Do older drivers at-risk for crashes modify their driving over time? *Journal of Gerontology B: Psychological Sciences Social Sciences* 64B, 163–170.
- Sargent-Cox, K.A., Windsor, T., Walker, J., Anstey, K.J., 2011. Health literacy of older drivers and the importance of health experience for self-regulation of driving behaviour. *Accident Analysis and Prevention* 43, 898–905.
- 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, 441–456.
- Sullivan, K.A., Smith, S.S., Horswill, M.S., Lurie-Beck, J.K., 2011. Older adults' safety perceptions of driving situations: toward a new driving self-regulation scale. *Accident Analysis and Prevention* 43, 1003–1009.
- Unsworth, C.A., Wells, Y., Browning, C., Thoman, S.A., Kendig, H., 2007. To continue modify or relinquish driving: findings from a longitudinal study of healthy ageing. *Gerontology* 53, 423–431.
- Whelan, M., Langford, J., Oxley, J., Koppel, S., Charlton, J., 2006. *The Elderly and Mobility: A Review of the Literature*. Report No. 255. Monash University Accident Research Centre, Victoria, Australia.