The effect of age, gender and attitudes on self-regulation in driving

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ABSTRACT

Self-regulation in driving has primarily been studied as a precursor to driving cessation in older people, who minimise driving risk and compensate for physical and cognitive decline by avoiding driving in challenging circumstances, e.g. poor weather conditions, in the dark and at busy times. This research explores whether other demographic groups of drivers adopt self-regulatory behaviours and examines the effects of affective and instrumental attitudes on self-regulation across the lifespan. Quantitative data were collected from 395 drivers. Women were significantly more likely than men to engage in self-regulation, and to be negatively influenced by their emotions (affective attitude). A quadratic effect of age on self-regulation was determined such that younger and older drivers reported higher scores for self-regulation than middle-years' drivers. However, this effect was affected by experience such that when experience was controlled for, self-regulation increased with age. Nevertheless, anxious driving style and negative affective attitude were independent predictors of self-regulation behaviours. Results suggest that self-regulation behaviours are present across the driving lifespan and may occur as a result of driving anxiety or low confidence rather than as an effect of ageing.

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1. Introduction

Self-regulation has been widely researched in 'older' drivers as a mechanism for safely extending driving mobility and independence in an ageing population. The definition of 'older' varies between studies with inclusion criteria ranging from 50 to over 70 years of age. Although self-regulation may be a precursor to driving cessation, it can be considered on a continuum (Lyman et al., 2001). The spectrum runs from complete driving independence through voluntary reduction of driving exposure, e.g. trips and reduced distances (Marottoli and Richardson, 1998; Charlton et al., 2006) as well as avoidance of challenging driving circumstances, e.g. unfamiliar routes, poor weather, heavy traffic (Ball et al., 1998; Stalvey and Owsley, 2003; Baldock et al., 2006; Charlton et al., 2006) to complete driving cessation.

Self-regulation has generally been thought of as a compensatory coping strategy for older drivers who, recognising some physical, cognitive or functional impairment, purposely limit or restrict their driving, in order to maintain independence but reduce accident risk (e.g. Ball et al., 1998; Hakamies-Blomqvist and Wahlström, 1998; Baldock et al., 2006). However, it may also reflect lifestyle changes, be used as a coping mechanism following a traumatic experience such as a crash (Blanchard et al., 1994) or as a sensible general risk

reduction strategy (Charlton et al., 2006). It is this latter process which is of most interest to this research.

If self-regulation is thought of on a continuum and as a risk reduction strategy, then it is possible that a wider population could use self-regulatory behaviours to manage driving risk. Certainly, since self-regulation incorporates a wide range of driving behaviours, from driving avoidance through active planning and preparation including route planning and trial runs, pre-arranging rest stops and making vehicle adaptations (Molnar et al., 2009), it is likely that all drivers are to some extent 'self-regulators'. If self-regulation is used to manage driving risk, then the theoretical models that have been applied to decision making about risky health behaviours can also be applied to self-regulatory driving practices.

The theory of planned behaviour assumes that behaviours are chosen and rational, specifically that behaviours are determined by intentions which are based, in part, on an individual's attitudes towards that behaviour (Ajzen, 1985, 1991). The theory has been used extensively to understand and predict people's attitudes towards their health (e.g. exercise, dieting, smoking habits, binge drinking), as well as travel choices and driving behaviour (e.g. seat belt usage, drink driving and intention to violate traffic laws). For example, behaviours such as speeding in urban areas and overtaking have been linked to attitude in terms of beliefs about getting to a destination faster (Parker et al., 1992; Wallén Warner and Aberg, 2008). In the case of self-regulation, it is possible that an individual's beliefs and attitudes about driving risk may affect their intention to drive and ultimately alter their driving behaviour, and

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consequently the role of attitudes on self-regulation will be examined in this study.

Studies in older drivers reveal that the extent of self-regulation varies between individuals and that complex interactions exist between age, gender, health status and driving confidence which influence self-regulatory driving practices. Although self-regulation has been shown to increase with age (e.g. Bauer et al., 2003), this is tempered by health status, such that in a sample of drivers aged over 50 years, older people in better health self-regulated less than younger people in poorer health (D'Ambrosio et al., 2008; Donorfio et al., 2008). The current study seeks to examine whether self-regulation behaviours occur across the full driving age spectrum.

The most consistent predictor of self-regulation is gender, with women adopting more restrictive driving habits than men (Jette and Branch, 1992; Bauer et al., 2003; Hakamies-Blomqvist and Siren, 2003; Siren and Hakamies-Blomqvist, 2005). This has been described as a cohort effect, since the older generation of women have not traditionally been the main household driver, and so may have less experience than their male counterparts and therefore feel less confident when driving (Kostyniuk and Shope, 1998).

Several studies have demonstrated that older women have less driving experience than their male counterparts (e.g. Marottoli et al., 1993; Rosenbloom, 1993), but the effects of experience on self-regulation behaviours have not been fully explored. This is not surprising given the population under scrutiny. Accurate assessments of duration of driving experience are difficult to obtain and are generally aggregate estimates of time since licensure by age (McCartt et al., 2003). Consequently, older people of the same age tend to have relatively similar levels of experience. Some researchers have managed experience differences by recruiting only experienced participants (e.g. >10 years driving experience; Baldock et al., 2006). This assumes that drivers achieve a level of competence after an elapsed period of time but does not account for differences in driving patterns (i.e. amount of driving). Hakamies-Blomqvist and Siren (2003) reviewed driving habits in a sample of Finnish women drivers and recent ex-drivers aged over 70 years. They determined that the current drivers had been more active and driven greater distances throughout their driving career than those women who had chosen not to renew their licences. They concluded that women with an active driving history were more likely to continue driving later in life. This finding suggests that driving habits are of interest in this study. Given that age and duration of driving experience are closely related and that self-regulation increases with age, it follows that self-regulation will also increase with duration of driving experience. However, differences in driving habits may also affect self-regulation behaviour such that more active drivers, i.e. those who drive more often, should self-regulate less than their less active counterparts. So, the question is whether self-regulation behaviours are affected by duration of experience (time since licensure) or amount of experience (driving habits), or both.

The effects of confidence and self-efficacy on self-regulation have been found in a number of studies. Stacey and Kendig (1997) revealed that low self-efficacy scores were associated with driving cessation in older drivers. Marottoli and Richardson (1998) found that low confidence was associated with reduced driving frequency and mileage in a sample of drivers aged over 77 years. Baldock et al. (2006) investigated whether self-regulation was related to actual driving ability in a community sample of 90 older drivers, aged between 60 and 92 years and found that where self-reported driving confidence was low, there was a high avoidance of easily avoided but challenging driving tasks (e.g. parallel parking and driving at night in the rain). Charlton et al. (2006) reviewed self-regulatory driving practices, focusing on avoidance behaviours, in Australian drivers aged over 55 years, and although avoidance rates

were low across the sample, they found that driving confidence was strongly predictive of avoidance behaviour. The results of these studies, as well as their own findings, led Kostyniuk and Molnar (2008) to question whether the gender effect seen in self-regulatory studies is in fact a confidence effect, and to this end, the role of gender and confidence in self-regulation will be examined in this study.

The factors influencing self-regulatory behaviours are complex but several questions can be answered by extending the scope of self-regulation studies to a wider population. The first question of interest is whether drivers in younger age groups also employ self-regulatory techniques to manage driving risk. Secondly, the appearance of a gender effect in younger drivers will go some way to refuting the cohort effect theory in older women drivers. Next, driving habits can be reviewed to determine whether self-regulation behaviours are affected by the amount, rather than duration of driving experience. Finally, taking a measure of participants' driving style will assist in understanding the characteristics of high self-regulators and determining whether self-regulation is influenced by driving confidence.

Driving style refers to the way drivers habitually choose to drive and is an established pattern of driving behaviour encompassing speed choice, overtaking behaviours and attitudes to other road users (Elander et al., 1993; Taubman-Ben-Ari et al., 2004). In order to measure driving style, the Multidimensional Driving Styles Inventory (MDSI; Taubman-Ben-Ari et al., 2004) was used. The MDSI is a reliable and validated scale which consists of 44 statements relating to eight driving styles. These are (i) dissociative, which measures distractibility, (ii) anxious driving, which reviews distress and lack of confidence, (iii) risky driving which looks at sensation seeking and risky decisions, (iv) angry driving which reviews aggression and hostility towards other drivers, (v) high-velocity driving which looks at orientation towards high speed driving, (vi) distress reduction which examines engagement in relaxing activities when driving, (vii) patient driving which looks at courtesy towards other drivers and finally (viii) careful driving style, which refers to planning and problem solving in the driving task.

One final area of interest for this study is the role of attitudes in predicting self-regulation. Attitudes are important in determining the individual's overall assessment of the desire to perform a particular behaviour. Attitudes towards a behaviour are deemed to be composed of affective (e.g. like/dislike) and instrumental (e.g. beneficial/harmful) appraisals (Ajzen, 1991). Theoretical models of decision making and persuasion recognise the role of these affective (emotional) and instrumental (cognitive) components in attitudinal measurement. The extension of the theory of planned behaviour (TPB; Ajzen, 1985, 1991), to incorporate two subcomponents of attitude, affective as well as instrumental, has received wide empirical support, given that it increases the predictive power of the model (Ajzen and Timko, 1986; Ajzen, 1991; Ajzen and Driver, 1992; Conner and Armitage, 1998; Trafimow et al., 2010). Further, recent work in decision making has focused on the implications of a dual process model of information processing (e.g. Smith and DeCoster, 2000; Gerrard et al., 2008). These models also propose two modes of behavioural decision making, one based on heuristics and affect, the other on systematic reasoning or cognition (Gerrard et al., 2008). Instrumental attitude would provide a logical basis for decision making and as such could be considered a component of the latter mode.

The role of affective attitude in driving is intuitive; some people simply enjoy driving more than others. Instrumental attitudes stem from evaluations about driving being beneficial or harmful, and as such may be influenced by lifestyle and employment choices, as well as risk perceptions. In the context of self-regulation, although visiting friends may be enjoyable (affect), a driver may decide not to travel if the roads are icy because it is unsafe (cognition).

Alternatively, they may choose to drive their children to school during rush hour even though they fear or dislike driving at busy times (affect) because it is in their children's best interests to attend school on time (cognition). Assuming that self-regulation behaviours stem from rational choices about driving risk, then a clear relationship should be found between instrumental attitude and self-regulation across the driving lifespan. However, a relationship may also exist between affective attitudes and self-regulation, if these behaviours develop as a result of low confidence, fears or worries about driving. To summarise, the purpose of the current study was to examine self-regulation as a risk management strategy in drivers across the lifespan and to determine whether age, gender, duration of experience, driving patterns (weekly mileage), style or attitude affect self-regulation behaviours. In order to achieve this, the following hypotheses were tested.

Hypothesis 1.　Female drivers will self-regulate more than male drivers.

Hypothesis 2.　Self-regulation behaviours will increase with age.

Hypothesis 3.　Duration of driving experience (time since licensure) and amount of driving experience (weekly mileage) will influence self-regulation behaviour such that self-regulation will increase with experience duration and decrease with increased mileage.

Hypothesis 4.　Driving style will influence the level of reported self-regulation. No directional hypotheses are proposed.

Hypothesis 5.　Instrumental and affective attitudes towards driving will mediate the relationship between age and self-regulation.

2. Methods

2.1. Participants

Participants comprised 395 drivers (267 women and 128 men) aged between 18 and 78 years ($M = 32.9$ years, $S.D. = 13.89$). Participants' duration of driving experience ranged from 2 months to 55 years ($M = 13.21$ years, $S.D. = 12.85$). 57.1% of drivers had a prior history of collision involvement.

Some participants were students at the University of Aston, enrolled on the undergraduate psychology course who received course credits for their participation. Participants from the wider community were sourced through advertising on social networking sites, at health clinics and local hospitals. Older participants were specifically targeted through the Aston Research Centre for Healthy Ageing (ARCHA) programme and by direct approach to the University of the Third Age. The only pre-determined criteria for inclusion were that participants had to be over 17 years of age and hold a full driving licence.

2.2. Materials

The questionnaire comprised three sections. The first section included demographic information (age and gender), driving experience (length of time an individual had been in possession of a full driving licence), driving patterns (number of miles driven per week) and crash history.

The second section measured driving style using the Multi-Dimensional Driving Styles Index (MDSI; Taubman-Ben-Ari et al., 2004) which consists of 44 items across eight different driving styles and coping strategies (e.g. careful, anxious, dissociative) on a six point likert type scale from 'not at all' (1) to 'very much' (6). Example items include "It worries me when driving in bad weather" (anxious); "I like to take risks while driving" (risky) or "I drive

Table 1
Questionnaire items and internal consistency (Cronbach's alpha).

	Items	Cronbach's alpha
Instrumental attitude	Driving a car is central to my independence	0.85
	Being able to drive is important to me	
	Being able to drive is important to my work or family life	
	Driving is necessary to give me the flexibility I need	
Affective attitude	Driving a car is pleasurable (−)	0.85
	I am apprehensive about driving	
	I am concerned about the unsafe and aggressive behaviours of other drivers	
	I would be anxious driving an unfamiliar route	
	I worry about getting lost when I drive	
	I am happy to overtake other vehicles (−)	
	I feel comfortable when driving (−)	
	I am happy to drive in the dark (−)	
	I worry about breaking down or getting a puncture	
Avoidance	I avoid driving on the motorway	0.79
	I avoid changing lanes or overtaking on the motorway	
	I avoid making right hand turns at busy junctions	
	I avoid driving in bad weather, e.g. heavy rain, snow or ice	
	I avoid driving in heavy traffic, e.g. at rush hour	

cautiously" (cautious). Participants' scores for each of the eight styles were calculated.

The third section measured instrumental and affective attitudes and self-regulation behaviours using 18 items on a likert type scale from (1) 'strongly disagree' to (5) 'strongly agree'. A list of questionnaire items and internal consistency (Cronbach's alpha) for all three factors can be found in Table 1.

Items relating to instrumental and affective attitude were adapted and extended from an existing survey (Lindstrom-Forneri et al., 2007) reviewing driver attitudes and behaviour change in older adults (>60 years). Affective attitude questions were worded to derive a measure of negative affect. The self-regulation factor consisted of five items relating to commonly avoided difficult driving situations adapted from the Driving Habits Questionnaire (DHQ; Owsley et al., 1999).

2.3. Design

A between participants design was employed. Participants were divided by gender and age into three groups – young drivers (18–25 years), middle years (26–64 years) and older drivers (over 65 years). Scores for self-regulation, instrumental attitude and affective attitude were used as dependent variables.

2.4. Procedure

After Aston University Ethics Committee approval and informed consent were obtained, participants were asked to complete the self-report questionnaire using the online electronic survey creator SurveyMonkey® at a time and place convenient for them. The instrument was administered as part of a wider study on risk perception and feelings of vulnerability in driving. Data were analysed using PASW statistics version 18.

2.5. Analysis

Descriptive analyses were performed on demographic information and avoidance behaviour. A series of ANOVAs and ANCOVAs

Table 2
Levels of avoidance (%) in difficult driving situations by gender and age group.

Driving situation	Male			Female		
	18–25	26–64	65+	18–25	26–64	65+
N	42	62	7	102	132	10
Motorway	2.4	3.2	0	21.5	11.3	12.5
Bad weather	26.2	37.1	57.2	62	61.9	70
Lane change	4.8	1.6	14.3	15.9	10.6	0
Heavy traffic	11.9	0	28.6	15.9	14.2	10
Right hand turn	2.4	8	18.6	13.7	12.1	0

Note: After excluding missing variables, analyses were conducted on 355 participants.

Table 3
Mean levels of avoidance in difficult driving situations by gender and age group.

Driving situation	Male						Female					
	18–25		26–64		65+		18–25		26–64		65+	
N	42		62		7		102		132		10	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Motorway	1.45	0.74	1.44	0.74	1.57	0.53	2.27	1.27	1.91	1.10	2.00	0.93
Bad weather	2.57	1.11	2.65	1.26	3.29	1.60	3.61	1.02	3.42	1.17	3.70	0.82
Lane change	1.71	0.86	1.40	0.61	2.00	1.15	2.29	1.11	2.00	1.03	2.22	0.44
Heavy traffic	2.05	0.99	1.79	0.76	2.43	1.27	2.41	1.04	2.21	1.05	2.60	0.70
Right hand turn	1.86	0.81	1.71	1.03	2.14	1.35	2.24	1.02	2.03	1.13	1.90	0.74

Scale score minimum = 1, maximum = 5.
Note: After excluding missing variables, analyses were conducted on 355 participants.

were conducted to review the effects of gender and age on self-regulation behaviours and attitudes whilst controlling for experience duration. To further examine any gender effects on self-regulation, correlation analyses were carried out separately for men and women.

Mediation analyses were conducted to test the effects of instrumental and affective attitudes on the relationship between age and self-regulation using an SPSS macro for the bootstrapped sampling distribution model (Preacher and Hayes, 2004). Bootstrapping has been widely advocated as a more accurate method of assessing the indirect effects of variables, overcoming some of the limitations associated with Baron & Kenny's (1986) four-steps method (Shrout and Bolger, 2002; Preacher and Hayes, 2004; MacKinnon et al., 2007). Finally, step-wise regression modelling by age group was used to identify the best predictors of self-regulation.

3. Results

3.1. Descriptives

Overall avoidance of the difficult driving scenarios ranged between 10.1% and 12% of the participants, with the exception of avoidance of inclement weather which was significantly higher at 53.4%. Table 2 shows a breakdown of the level of avoidance in each of the challenging driving circumstances by gender and age. The most commonly avoided situation was driving in bad weather, including heavy rain, ice or snow and over half of the sample reported that they had adopted this strategy. The least commonly avoided situation was changing lanes or overtaking on the motorway. A series of two-way ANOVAs were used to review individual avoidance behaviours by gender and age group, see Tables 3 and 4, with partial η^2 used to calculate effect size (0.01 = small effect, 0.06 = medium effect, >0.15 = large effect, Field, 2000). Women were consistently more likely than men to avoid all types of difficult driving circumstances except for right hand turns. Main effects for age were seen in terms of avoidance of lane changes on the motorway and driving in heavy traffic. In both circumstances younger drivers were more likely than middle-years'

drivers to report avoidance behaviours. No interaction effects were found.

An index of self-regulation was generated using scores from all ($N = 5$) avoidance items (Cronbach's alpha = 0.79). In this study, self-regulators were defined using an existing definition as "those who avoided one or more difficult driving situations" (Charlton et al., 2006, p. 370). Overall self-regulation (on a scale from 5 to 25) ranged between 5 and 24 ($M = 11.2$, $S.D. = 3.98$), suggesting that self-regulatory behaviour was common within the sample. Means and standard deviations for self-regulation and all other variables are presented in Table 5 by gender and age group.

3.2. Effect of age and gender on self-regulation

A two-way between groups ANOVA was conducted to explore the relationships between self-regulation, gender and age. A main effect for gender, $F (1,356) = 8.32$, $p < 0.01$, $\eta^2 = 0.02$, confirmed Hypothesis 1 that women were more likely than men to self-regulate, see Table 5. Although there was no significant main effect of age on self-regulation, $F (2,356) = 2.75$, $p = 0.06$, a plot of mean self-regulation scores, shown in Fig. 1, revealed a significant ($p < 0.05$) quadratic effect such that younger and older participants' reported higher scores than middle-years' drivers. No age by gender

Table 4
ANOVA results for avoidance in difficult driving situations by gender and age.

Driving situation		F ratio	Partial η^2
Motorway	Gender	8.23[**]	0.02
	Age	1.15	0.007
Bad weather	Gender	12.67[**]	0.03
	Age	1.23	0.007
Lane change	Gender	6.66[**]	0.01
	Age	3.99[**]	0.02
Heavy traffic	Gender	3.07	0.009
	Age	3.26[*]	0.01
Right hand turn	Gender	0.63	0.002
	Age	1.04	0.006

[*] $p < 0.05$.
[**] $p < 0.01$.

Table 5
Means and standard deviations by gender and age group.

Scale	Gender				Age group (years)						Male						Female					
	Male		Female		18–25		26–64		65+		18–25		26–64		65+		18–25		26–64		65+	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Self-regulation	9.36	3.33	12.00	3.99	11.80	3.95	10.68	4.00	11.64	3.35	9.64	3.29	8.95	3.17	11.43	4.50	12.70	3.88	11.49	4.11	11.80	2.53
Instrumental	16.89	3.12	17.03	3.26	16.62	3.05	17.21	3.36	17.63	2.87	16.40	3.31	17.16	3.08	17.43	2.30	16.72	2.95	17.20	3.49	17.78	3.38
Affective	18.93	5.59	23.75	6.32	23.16	6.03	21.67	6.85	21.82	5.69	19.86	5.62	18.18	5.31	20.14	7.58	24.53	5.68	23.25	6.92	23.00	3.94
Dissociative	13.25	3.37	14.03	3.31	13.79	3.66	13.87	3.20	12.88	1.90	12.53	3.47	13.83	3.33	12.57	2.51	14.35	3.62	13.87	3.16	13.10	1.45
Anxious	13.51	3.87	16.76	4.37	15.63	4.88	16.03	4.26	14.00	3.14	12.89	4.13	14.02	3.64	13.29	3.73	16.91	4.70	16.89	4.18	14.50	2.76
Risky	7.87	3.42	6.92	2.40	8.15	3.44	6.65	2.10	6.18	2.04	9.93	4.21	6.76	2.16	5.14	0.38	7.39	2.74	6.59	2.08	6.90	2.42
Angry	10.97	3.25	10.03	3.00	10.73	3.31	10.20	2.95	8.31	2.15	12.22	3.54	10.43	2.87	8.43	1.81	10.12	3.02	10.08	3.00	8.22	2.49
High velocity	13.48	3.61	12.57	3.22	13.59	3.73	12.55	3.01	10.12	2.03	14.39	4.33	13.16	2.91	10.29	1.50	13.22	3.38	12.28	3.04	10.00	2.40
Distress reduction	8.22	2.76	7.43	2.17	7.60	2.40	7.67	2.37	8.47	2.74	7.98	2.93	8.46	2.79	7.57	0.79	7.43	2.12	7.32	2.06	9.10	3.45
Patient	15.86	2.59	16.37	2.22	15.53	2.69	16.56	1.96	17.81	1.87	14.82	3.00	16.31	1.97	18.57	1.27	15.85	2.48	16.68	1.95	17.22	2.11
Careful	20.57	2.59	20.57	2.22	20.14	2.65	20.85	2.05	20.82	2.38	19.49	3.03	21.09	2.04	22.43	1.72	20.42	2.43	20.73	2.06	19.70	2.16

Scale scores: self-regulation, instrumental and affective attitudes (1–5): minimum = 5, maximum = 25. Driving styles (1–6): minimum = 6, maximum = 36.
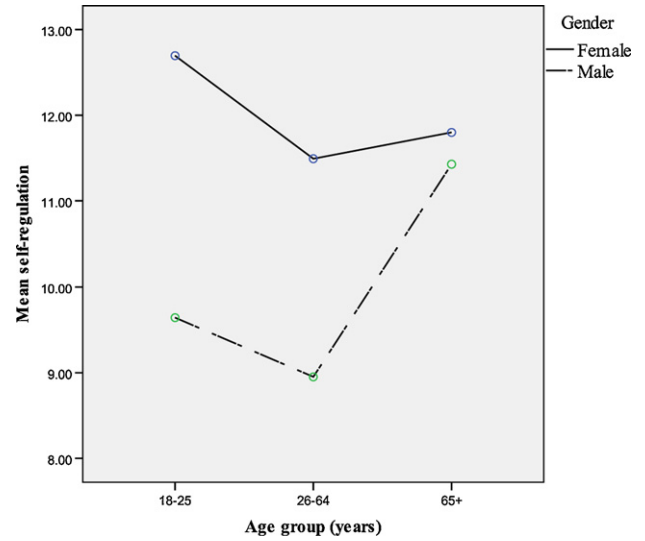

Fig. 1. Mean self-regulation scores by gender and age group.

interactions were found $F(2,356) = 0.93$, $p = 0.39$. In order to further explore the gender effect, and the second hypothesis that self-regulation would increase with age, post hoc comparisons were conducted. Contrary to expectations, the Hochberg GT2 test for use with different sample sizes (Field, 2000) indicated that the mean self-regulation score for younger participants was significantly higher than middle-years' drivers. Further post hoc analyses revealed that younger and middle-years women were significantly more likely than younger and middle-years men to engage in self-regulatory behaviours, respectively (18–25: $t(139) = 491$, $p < 0.01$; 26–64: $t(147) = 4.54$, $p < 0.01$), but that there were no significant differences by gender in the older age group.

3.3. Effect of experience on self-regulation

In order to determine whether self-regulation in young drivers was occurring as a function of inexperience, an ANCOVA was conducted. The above age by gender analysis was repeated with experience (time since licensure) as a covariate. In this model, the effect of experience on self-regulation was significant ($F(1,349) = 11.19$, $p < 0.01$, partial $\eta^2 = 0.3$). When experience was controlled for, the gender effect diminished but remained significant ($F(1,348) = 4.78$, $p < 0.05$, partial $\eta^2 = 0.01$) whilst the age effect became significant ($F(2,348) = 4.87$, $p < 0.01$, partial $\eta^2 = 0.03$). These results provide additional support for Hypotheses 1–3, respectively, that women self-regulate more than men and that when experience is controlled for, self-regulation increases with age. Means and adjusted means can be found in Table 6.

3.4. Effect of driving styles and attitudes on self-regulation: correlation analyses

The relationships between age, experience, crash history, driving habits, self-regulatory behaviours, attitudes (instrumental attitude and affective attitude) and driving style were explored using bivariate correlations separately for men (see Table 7) and women (see Table 8).

3.4.1. Associations by age

Contrary to Hypothesis 2, age was negatively correlated with self-regulation and this relationship was significant in female participants. This may reflect the quadratic effects of age on self-regulation such that younger and older groups of drivers report higher scores. However, after controlling for experience (time since

Table 6
Means, standard deviations and adjusted means by gender and age group for self-regulation.

Gender	Age group (years)	N	Mean	S.D.	Adjusted mean	S.E.
Male	18–25	40	9.55	3.18	8.66	0.64
	26–64	62	8.95	3.17	9.56	0.50
	65+	7	11.42	4.50	14.62	1.69
Female	18–25	96	12.47	3.81	11.56	0.46
	26–64	134	11.49	4.10	11.79	0.33
	65+	10	11.80	2.52	14.01	1.34

Note: Adjusted means are adjusted based on the participants' driving experience.

licensure) by calculating a partial correlation, a significant positive correlation was determined between age and self-regulation in the entire sample ($r = .14$, df = 348, $p < 0.01$).

In the whole sample, age was significantly positively correlated with instrumental attitude ($r(393) = 12$, $p < 0.05$) suggesting that the relative importance of a car increases with age. However, when the sample was divided by gender, this association was no longer significant. Similarly, age was significantly negatively correlated with affective attitude in the whole sample ($r(393) = -.11$, $p < 0.05$), suggesting that emotions affect older drivers less. Again this did not hold true for the divided sample.

In keeping with previous research (Taubman-Ben-Ari et al., 2004) age was significantly negatively correlated with maladaptive driving styles including risky, angry and high velocity styles and significantly positively correlated with a patient style in both genders. Significant relationships between age and a careful driving style were also noted in male drivers. No relationships were found between age and anxious driving, dissociative or distress reduction driving styles.

3.4.2. Associations by driving experience, patterns and crash history

Driving experience (time since licensure) was negatively associated with self-regulation such that as driving experience increased, self-regulation behaviours decreased. This association was significant in female drivers. These findings provided evidence of the effects of driving experience on self-regulation behaviours but the direction of effect was contrary to that anticipated in Hypothesis 3.

Drivers reporting considerable lengths of driving experience were found to report significantly higher levels of instrumental attitude than those with less driving experience, suggesting that their car was more important to them. Further, low levels of driving experience were significantly associated with higher levels of negative affect, suggesting that participants with limited driving experience had greater worries and concerns about driving.

Significant relationships between driving experience and driving style were also noted. Of particular interest to this study was the significant relationship between experience and an anxious driving style in women, such that women with greater driving experience were less likely to report anxious feelings when driving.

As anticipated in Hypothesis 3, higher weekly mileages were significantly associated with lower levels of self-regulation, higher instrumental attitudes and lower affective attitudes in both genders. There was a significant negative relationship between weekly mileage and an anxious driving style such that anxious drivers reported lower mileages than less anxious drivers.

Crash history was significantly negatively correlated with self-regulation behaviours in women only such that as the number of reported collisions increased, self-regulation behaviours reduced.

3.4.3. Associations by attitudes

Self-regulation was strongly, significantly negatively correlated with instrumental attitude in both genders such that the more a person agreed with statements such as 'driving a car is important

to me', then the less they adopted self-regulation behaviours. However, it was positively associated with affective attitude in both men and women, which suggests that the more a person reports worries and concerns about driving, the more likely they are to avoid driving.

3.4.4. Associations by driving style

Confirming the fourth hypothesis that driving style will affect reported self-regulation, self-regulation was significantly associated with an anxious driving style in both genders and negatively correlated with the risky, angry and high-velocity maladaptive driving styles in women only. These findings suggest that drivers who report high avoidance scores are apprehensive about driving. Self-regulation was also significantly highly correlated with a dissociative driving style in both genders.

3.5. Mediation analysis

In order to test Hypothesis 5, that instrumental and affective attitudes towards driving would mediate the relationship between age and self-regulation, mediation analyses were conducted. The analyses used 5000 bootstrap resamples of the data with replacement and alpha was set at .05.

There was a significant mediation effect of instrumental attitude on the relationship between age and self-regulation (estimate = −2.02; $CI_{95\%}$ = −.01 to .001) such that older participants with high instrumental attitude scores were less likely to self-regulate. There was also a significant mediation effect of affective attitude on the relationship between age and self-regulation (estimate = −2.16; $CI_{95\%}$ = −.05 to .003) such that after controlling for affective attitude, the effect of age on self-regulation decreased. These findings support Hypothesis 5, that the relationship between age and self-regulation is mediated by attitudes.

3.6. Regression analyses

In order to identify the most salient predictors of self-regulation, a hierarchical regression analysis was conducted. The entry criterion was set at $alpha = 05$. Only the variables found to be significantly correlated with self-regulation in both genders were entered, i.e., driving experience, dissociative and anxious driving styles and instrumental and affective attitudes. Given the significance of experience on self-regulation, this was entered at Step 1. Dissociative and anxious driving styles were entered at Step 2. Finally, affective and instrumental attitudes towards driving were entered at Step 3. Given the effect of experience on self-regulation by age, analyses were carried out separately for each age group. The results are displayed in Table 9. The models explained between 61% and 67% of the variance in self-regulation by age group.

In the youngest age group (18–25 years), the overall model accounted for 67% of the total variance in self-regulation. In Step 1, experience accounted for a significant 3% of the variance. The addition of anxious and dissociative driving styles in Step 2, accounted for an additional, significant 51% of the variance. The

Table 7
Correlations between age, self-regulation, attitudes and driving style in male drivers.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Age	1														
2	Experience	.98**	1													
3	Weekly Mileage	.23**	.26**	1												
4	Crash involvement	.51**	.53**	.25**	1											
5	Self Regulation	0.00	−0.01	−.48**	−0.15	1										
6	Instrumental Attitude	0.14	.19*	.55**	.29**	−.41**	1									
7	Affective Attitude	−0.06	−0.10	−.47**	−.24*	.72**	−.55**	1								
8	Dissociative	0.13	0.13	−.25**	0.13	.28**	−.25*	.34**	1							
9	Anxious	0.11	0.06	−.28**	0.01	.58**	−.39**	.72**	.42**	1						
10	Risky	−.48**	−.45**	0.00	−.22*	−0.15	0.05	−0.18	0.09	−.23*	1					
11	Angry	−.30**	−.27**	0.10	−0.08	−0.11	0.09	−0.11	0.13	−0.19	.39**	1				
12	High Velocity	−.25**	−.20*	0.10	−0.02	−0.16	0.10	−0.07	0.19	−.24*	.53**	.54**	1			
13	Distress Reduction	0.10	0.11	0.03	0.16	−0.01	0.05	0.04	.29**	−0.02	0.12	.25**	.19*	1		
14	Patience	.35**	.34**	0.10	0.12	0.05	−0.03	0.07	−0.13	0.11	−.47**	−.39**	−.42**	0.03	1	
15	Careful	.39**	.37**	0.12	.26**	0.03	0.13	0.00	−.22*	0.02	−.64**	−0.18	−.36**	0.07	.58**	1

* $p < 0.05$ (N ranges from 110 to 127).
** $p < 0.01$ (N ranges from 110 to 127).

Table 8
Correlations between age, self-regulation, attitudes and driving style in female drivers.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Age	1														
2	Experience	.93**	1													
3	Weekly mileage	.24**	.26**	1												
4	Crash involvement	.39**	.42**	.26**	1											
5	Self regulation	−.14*	−.21**	−.31**	−.16*	1										
6	Instrumental attitude	0.11	.13*	.44**	.18**	−.26**	1									
7	Affective attitude	−0.10	−.17**	−.24**	−.14*	.79**	−.30**	1								
8	Dissociative	−0.09	−0.11	−0.04	0.00	.26**	−0.09	.30**	1							
9	Anxious	−0.10	−.16*	−.24**	−0.09	.69**	−.26**	.75**	.34**	1						
10	Risky	−.13*	−0.07	0.02	0.03	−.21**	0.06	−.30**	0.09	−.22**	1					
11	Angry	−.16*	−0.10	0.09	−0.01	−.23**	0.09	−.24**	0.01	−0.07	.17**	1				
12	High velocity	−.22**	−.14*	0.08	0.05	−.19**	.18**	−.23**	.23**	−0.09	.44**	.45**	1			
13	Distress reduction	0.12	0.09	0.11	0.09	−0.01	−0.01	0.01	.18**	−0.08	0.03	−0.01	0.12	1		
14	Patience	.24**	.14*	−0.05	−0.01	0.10	−0.05	.15*	−0.05	.15*	−.32**	−.30**	−.39**	0.04	1	
15	Careful	0.03	−0.04	−0.07	−0.03	0.10	−0.02	.16*	−.30**	0.08	−.37**	−.21**	−.29**	−0.02	.51**	1

* $p < 0.05$ (N ranges from 238 to 264).
** $p < 0.01$ (N ranges from 238 to 264).

Table 9
Hierarchical multiple regression of experience, anxious and dissociative driving styles and attitudes on self-regulation by age group.

Age	Step	Variable	B	R^2	R^2 change	F
18–25 (N = 134)	1	Experience	−0.18[*]	0.03	0.03[*]	4.45[*]
	2	Experience	−0.03	0.54	0.51[**]	51.78[**]
		Dissociative	0.05			
		Anxious	0.72[**]			
	3	Experience	−0.02	0.67	0.13[**]	53.2[**]
		Dissociative	0.00			
		Anxious	0.26[*]			
		Instrumental attitude	−0.02			
		Affective attitude	0.59[**]			
26–64 (N = 184)	1	Experience	−0.26[**]	0.06	0.06[**]	12.95[**]
	2	Experience	−0.12[*]	0.53	0.46[**]	67.01[**]
		Dissociative	−0.01			
		Anxious	0.70[**]			
	3	Experience	−0.07	0.64	0.11[**]	64.26[**]
		Dissociative	−0.01			
		Anxious	0.27[**]			
		Instrumental attitude	0.01			
		Affective attitude	0.56[**]			
65+ (N = 13)	1	Experience	−0.10	0.01	0.01	0.12
	2	Experience	0.05	0.43	0.42[*]	3.1
		Dissociative	0.24			
		Anxious	0.55[*]			
	3	Experience	−0.01	0.61	0.18	3.22[*]
		Dissociative	0.09			
		Anxious	0.15			
		Instrumental attitude	−0.05			
		Affective attitude	0.60			

[*] $p < 0.05$.
[**] $p < 0.01$.

subsequent addition of attitudes in Step 3, accounted for an additional, significant 13% of the variance. In the final step of the equation, the significant predictors of self-regulation were an anxious driving style and (negative) affective attitude with higher scores for anxious driving and affective attitude predicting greater self-regulation.

A similar pattern followed in the middle-years group (26–64 years), with the overall model accounting for 64% of the variance in self-regulation. In Step 1, experience accounted for a significant 6% of variance. The addition of driving styles at Step 2, accounted for an additional, significant 46% of the variance. The subsequent addition of attitudes at Step 3, accounted for an additional, significant 11% of the variance. As with younger drivers, in the final step of the analysis, the significant predictors of self-regulation in middle-years' drivers were an anxious driving style and (negative) affective attitude such that greater anxiety and (negative) affective attitude predicted a greater level of self-regulation. In both the younger and middle-years' drivers, affective attitude recorded a higher beta value than anxious driving style.

In the older drivers (65 years and over), experience accounted for only 1% of the variance in self-regulation and this result was not significant. The addition of two driving styles in Step 2 resulted in a significant increase of 42% in the explained variance. The subsequent addition of attitudes in Step 3, accounted for an additional 18% of the variance. There were no significant predictors of self-regulation in the final step of the analysis in the oldest age group. However, the model as a whole was significant and explained 61% of the variance in self-regulation.

The results from the regression analyses provide additional support for Hypothesis 4, that driving style will influence the level of self-regulation, since an anxious driving style is a significant predictor of self-regulation behaviour in two of the three age groups. Further, the findings strengthen the argument in Hypothesis 5, that affective attitude mediates the relationship between age and self-regulation.

4. Discussion

The aim of this study was to examine self-regulation as a potential risk management strategy in a wider population than has previously been examined and to identify the characteristics of those who self-regulate. Consistent with other studies (e.g. Jette and Branch, 1992; Bauer et al., 2003; Hakamies-Blomqvist and Siren, 2003; Siren and Hakamies-Blomqvist, 2005; Kostyniuk and Molnar, 2008) and supporting Hypothesis 1, women reported higher levels of self-regulation than men, although this relationship was only significant in young and middle-years' drivers.

The finding that women, even in their younger years, self-regulate more than men demonstrates that self-regulation is not solely cohort related. Instead, self-regulation in younger drivers may be due to feelings of vulnerability in the driving task possibly arising from a lack of experience, or, as has been suggested in older adult drivers, from a lack of confidence (Siren and Hakamies-Blomqvist, 2004; Kostyniuk and Molnar, 2008). Whilst no direct measure of driving confidence was taken in this research, Taubman-Ben-Ari et al. (2004, p. 325) states that the anxious driving style reflects "a person's tendency to feel distress during driving, to display signs of anxiety due to the driving situation, and to express doubts and lack of confidence about his or her driving skills". The discovery that an anxious driving style predicted self-regulation supports previous findings that low confidence is an important factor in control of driving. Further, an anxious driving style was significantly correlated with low levels of experience in women which supports the notion that self-regulation in young drivers is a function of experience.

Hypothesis 2, that self-regulation would increase with age is partially supported. Initially, the relationships between age and self-regulation in this study appeared inconsistent with previous findings that self-regulation increases with age (e.g. Bauer et al., 2003; D'Ambrosio et al., 2008; Donorfio et al., 2008) since a negative correlation was determined between the two variables. However, after further analyses, a quadratic effect of age such that younger

and older participants reported higher scores for self-regulation than middle-years' drivers was noted. The implication here is that self-regulation is used as a coping strategy by drivers and is applied more readily by drivers at either end of the driving lifetime.

Self-regulation at the poles of the driving age range may be a compensatory effect. Older people may perhaps be compensating for functional decline (e.g. Ball et al., 1998; Hakamies-Blomqvist and Wahlström, 1998; Baldock et al., 2006) whereas younger, novice drivers may be compensating for not fully developed higher order driving skills. The individual review of self-reported avoidance behaviours provides some supporting evidence for this theory. For example, motorway driving and lane changes were most commonly avoided by the youngest group and avoidance of these circumstances declined with age. Both of these situations require higher order skills such as automatism in manoeuvring including correct speed control and positioning, an awareness of the dynamic traffic environment and an ability to predict other road users' behaviours which may predicate younger drivers to avoidance.

Certainly, when driving experience was controlled for, significant age effects were found on self-regulation behaviours with younger drivers self-regulating less than older drivers. This finding, which provides evidence for Hypothesis 3, suggests that experience affects the relationship between age and self-regulation. Although the reasons behind self-regulatory behaviours may vary by age, the end point is identical with drivers' reducing their crash risk whilst ensuring mobility. To this end, accurately applied self-regulation (that is, each individual applying appropriate strategies for their own needs and concerns, c.f. Berry, 2011) can be considered a positive coping strategy to manage driving risk.

The reasons for adopting this coping strategy are likely to be diverse. A further issue may be that drivers at either end of the age and experience spectrum simply have the opportunity to avoid difficult driving circumstances because they do not have the same family or employment obligations as middle-years' drivers (Eberhard, 1996). Certainly when avoidance behaviours were reviewed separately, reported avoidance of heavy traffic (rush hour) was lowest in the middle-years' groups who presumably have the greatest need to travel in peak hours to work or to take children to school whilst it was higher in both the younger and older groups. This is consistent with Baldock et al.'s (2006) finding that driving in peak hour is one of the most easily avoidable situations for older drivers.

However, unnecessary self-regulation, or over-regulation, could be detrimental to an individuals' health and wellbeing, particularly if it significantly curtails their driving. In this context, over-regulation could, to some extent, be considered a maladaptive response, perhaps to driving anxiety. The findings of this study suggest that anxious drivers and less confident drivers may be most at risk of over-regulation since an anxious driving style and negative affective attitude were significant predictors of self-regulation in regression modelling. In such cases, a balance needs to be achieved between reducing driver anxiety, encouraging safe regulation and preventing the type of self-regulation, or over-regulation that restricts mobility and social engagement.

Self-regulation was significantly positively correlated with affective attitude and the maladaptive anxious and dissociative driving styles, suggesting that drivers with high scores for self-regulation deal with the worries and stressors of driving by disconnecting from the driving task. This is of particular concern since a dissociative driving style has been linked with crash involvement (Taubman-Ben-Ari et al., 2004). Further, affective attitude mediated the relationship between age and self-regulation, such that after controlling for affective attitude, the effect of age on self-regulation reduced. This suggests that affective attitude is critical in preventing over-regulation. These findings provide support for Hypotheses 4 and 5 that driving style and attitudes influence self-regulation strategies.

Instrumental attitude was also measured in this study and found to be significantly negatively correlated with self-regulation, affective attitude and anxious driving styles in both genders. Further, supporting Hypothesis 5, instrumental attitude mediated the effect of age on self-regulation such that after controlling for instrumental attitude, the effect of age on self-regulation increased. These findings suggest that people who have a strong requirement for their car are less likely to let their age or emotions affect their driving behaviour either in terms of driving avoidance or making mistakes. Curiously, instrumental attitude was positively correlated with a high velocity driving style. This might reflect people with a strong dependence on their car, perhaps due to work or family commitments, reporting greater effects of time pressures on driving.

One of the key findings of this study was that instrumental attitude scores were significantly positively correlated with age, even in the over-65s age group, such that as age increased, the importance of the car also increased. This result supports and extends Molnar et al.'s (2009) finding that in drivers aged over 70 years, older participants rated the importance of driving higher than younger participants. Since older people tend to travel less as they age, particularly aged over 65 years (Eberhard, 1996), the assumption has been that they are less reliant on their car. However, these findings challenge that assumption and suggest that although older people may travel less and take fewer risks, their car is more important to them in terms of maintaining mobility, flexibility and independence than it is to younger drivers. The implication in this study is that the car is of greater significance to older people in terms of maintaining a lifestyle than in it is to younger drivers in terms of honouring work and family commitments.

5. Limitations

This study has some limitations. A convenience sample was used and so care should be taken when generalising to the wider population. Further, the sample size for older participants was small and consisted mainly of a group of highly motivated and well older adults. The women of this group may have been atypical of a wider driving population in that several of them were military wives and as such had to shoulder primary driving responsibility for their families whilst their husbands had been deployed. Hakamies-Blomqvist and Siren (2003) suggest that self-regulation and driving cessation are related to driving habits such that more active drivers are less likely to give up driving, regardless of their age, gender or ability. As this group of women are habitually used to driving, they may be less likely to self-regulate than the general population of older women drivers. In fact, this group may be more comparable with middle-years' women drivers in terms of habituation to driving and as such may provide insight into the driving patterns of future older female drivers.

The measure of self-regulation taken in this study was restricted to avoidance behaviours and although this is consistent with other literature in the field (e.g. Charlton et al., 2006), it provides scope for future studies to incorporate wider aspects of self-regulation including planning and coping strategies. Finally, self-regulation was only measured through self-report which may have led to over- or under-reporting of avoidance behaviours.

6. Conclusion

This work has demonstrated that self-regulation is not exclusive to older drivers but is used by drivers, to varying degrees, across the lifespan. Although appropriately applied self-regulation can be considered a positive coping strategy to reduce risk and

safely extend mobility, there is evidence that some drivers over-regulate, giving up or curtailing driving before they need to. The results from this study suggest an association between anxiety and over-regulation. Therefore, interventions designed to reduce anxiety may be successful in reducing over-regulation, encouraging safe regulation and extending mobility. Follow up work could explore this further whilst extending the definition of self-regulation to incorporate planning and coping strategies as well as driver preparedness.

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