

Self-regulation of driving and its relationship to driving ability among older adults

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Abstract

Although it is known that older drivers limit their driving, it is not known whether this self-regulation is related to actual driving ability. A sample of 104 older drivers, aged between 60 and 92, completed a questionnaire about driving habits and attitudes. Ninety of these drivers also completed a structured on-road driving test. The driving habits questionnaire provided measures of perceived driving ability, confidence in difficult driving situations, driving exposure, avoidance of difficult driving situations, ease of avoiding difficult situations, and perceived barriers to restriction of driving. The measure of avoidance of difficult driving situations was used as an index of self-regulation. The on-road driving test was a standard assessment procedure used to determine fitness to drive. Of the 90 participants who completed the driving assessment, 68 passed the test, eight passed but were recommended to have driving lessons and 14 failed. Driving test scores for the study were based on the number of errors committed in the driving tests, with weightings given according to the seriousness of the errors. The most commonly avoided difficult driving situations were parallel parking and driving at night in the rain, while the least avoided situation was driving alone. Poorer performance on the driving test was not strongly related to overall avoidance of difficult driving situations. Stronger relationships were found between driving ability and avoidance of specific difficult driving situations. These specific driving situations were the ones in which the drivers had low confidence and that the drivers were most able to avoid if they wished to. These results may reflect a tendency for those with lower driving ability to lose confidence in their driving, and begin to avoid difficult driving situations. However, there are a number of situations that drivers find difficult to avoid.

Introduction

Considerable attention has been directed toward the subject of older drivers (those aged over 65) because of the finding that this group of drivers has a greater risk of crash involvement than middle-aged drivers on a per kilometre basis (Federal Office of Road Safety, 1996; Lyman, Ferguson, Braver, & Williams, 2002; Maycock, 1997). There is debate concerning the appropriate interpretation of this finding, with some authors arguing that the increased crash risk of older drivers is due to the effects of cohort differences, older adults' frailty or the lower annual mileage of older drivers (Hakamies-Blomqvist, 1998; Maycock, 1997; OECD, 2001). However, it has also been argued that the increased risk is due, at least partly, to a greater prevalence of medical conditions and functional impairments among older adults (Klavora & Heslegrave, 2002; Sims, McGwin Jr, Allman, Ball, & Owsley, 2000; Wallace & Retchin, 1992). This has inspired a large number of studies that have been conducted to develop batteries of tests that could be used to identify at-risk drivers among the older adult population (Charlton, 2002; Janke, 2001; Marottoli et al., 1998).

Although much work has been undertaken to develop screening procedures for older drivers, research has indicated that screening *all* drivers once they reach a specific age does not produce a safety benefit (Hakamies-Blomqvist, Johansson, & Lundberg, 1996; Torpey, 1986). Furthermore, such screening practices may result in some older adults voluntarily surrendering their licences prematurely, causing an unnecessary loss of mobility (Charlton, 2002). Mobility for older adults has been identified as being very important for independence (Burns, 1999; Kostyniuk, Shope, & Molnar, 2000), and the loss of mobility has been linked to depression and decreased activity (Fonda, Wallace, & Herzog, 2001; Marottoli et al., 2000). This research on the negative effects of the loss of mobility has resulted in a shift of emphasis in the literature from identifying unfit drivers to highlighting the importance of maintaining older driver mobility (Hakamies-Blomqvist, 2003; OECD, 2001). The recent OECD report on the topic of older drivers concluded that two of the most important areas for future policy were "support and funding to enable lifelong mobility" and "support for older people to continue driving safely" (OECD, 2001, p121).

One possible method of maintaining the mobility of older adults, despite declining functional ability, is to promote the self-regulation of driving behaviour. This involves drivers evaluating their own driving ability and adjusting their driving behaviour in accordance with this assessment, reducing exposure to driving situations they find difficult (Charlton, Oxley, Fildes, & Les, 2001). Successful self-regulation should result in decreased older driver crashes through a reduction in exposure and, particularly, a reduction in exposure to difficult situations and conditions, whilst still allowing the maintenance of

mobility (Stalvey & Owsley, 2000). Studies of self-regulatory practices of older drivers have found that the most commonly avoided driving condition is night driving (Charlton, 2002). Inclement weather, busy traffic, high speed roads, unfamiliar roads, and unprotected turns across oncoming traffic are also commonly avoided (Fildes, Lee, Kenny, & Foddy, 1994).

Although many drivers do avoid difficult driving situations, it is necessary to determine whether this self-regulation is occurring in response to accurate self-assessments of driving ability. However, there are few studies comparing older drivers' self-ratings of driving ability or level of driving restriction with actual on-road ability, and those that have done so have not used representative samples of older drivers. Cushman (1996) found no relationship between self-perceived and actual driving ability among a sample of older drivers but a third of the drivers participating in the study had suspected dementia. Two other studies on related topics used samples of very old drivers. Marottoli and Richardson (1998) found a discrepancy between self-rated and actual driving ability among drivers aged over 76, while Charlton et al. (2001) found that self-regulation of driving behaviour was not reliably associated with driving ability among drivers aged over 84. Charlton et al. acknowledged that the study used a restricted sample, noting that, by the age of 85, a large proportion of older drivers have ceased driving and it could be that these older adults were better at self-regulation than those still driving well into their eighties (Charlton et al., 2001).

The present study was therefore designed to examine self-regulation among a broader sample of older drivers in South Australia. Specifically, the extent of self-regulatory practices was determined using a questionnaire about driving attitudes and behaviour, and the relationship between self-regulation and driving ability was determined by examining correlations between self-regulation of driving behaviour and performance on an on-road driving test.

Method

Participants

A group of 104 older drivers (aged 60 years or more) were recruited from two sources: the general community ($n = 93$) and the Driver Assessment Rehabilitation Service (DARS) at the University of South Australia ($n = 11$). Community participants were recruited through Senior Citizens' clubs and Australian Retired Persons Association clubs in metropolitan Adelaide. The group of drivers from the DARS client pool were referred, mostly by general practitioners, for an assessment of their ability to drive and their right to hold a driver's licence.

The total sample consisted of 65 females and 39 males, and their ages ranged from 60 to 92 ($M = 74.2$, $SD = 6.3$). They had completed an average of 10.9 years of formal education ($SD = 3.0$), and their self-reported driving exposure ranged from 15 to 360 km per week, with a median of 110 km.

All participants were required to be fluent in English, in possession of a full driver's licence for non-commercial motor vehicles, and have been driving for over ten years. The latter requirement was imposed to ensure that all participants were experienced drivers. Participants were excluded if they had suffered a cerebrovascular accident (stroke), traumatic brain injury, or other event causing a sudden loss of functioning, in the past year.

Materials

The questionnaire used in the study was based on selected questions from the Driving Habits Questionnaire used by Owsley, Stalvey, Wells and Sloane (1999) and the Driver Perceptions and Practices Questionnaire used by Stalvey and Owsley (2000), with questions adjusted when necessary for an Australian, rather than American, context. Participants were asked to rate their driving ability on a five point scale from 1 (poor) to 5 (excellent). They were also asked to rate their confidence in 9 difficult driving situations (e.g. driving in the rain, driving at night) on a scale from 1 (not at all confident) to 5 (completely confident). These confidence ratings were summed to produce an overall driving confidence score on a scale from 9 (not confident in any situation) to 45 (completely confident in all situations). Similarly, participants reported their level of avoidance of the same difficult driving situations on a scale from 1 (never avoid) to 5 (always avoid), and the sum of these scores provided a measure of overall avoidance on a scale from 9 (never avoid any situations) to 45 (always avoid all difficult situations). This measure of overall avoidance was used as an index of self-regulation of driving behaviour. To measure regulatory self-efficacy, participants reported the ease of avoiding each of 8 driving situations on a scale of 1 (very hard) to 3 (not hard at all). These ratings were summed to produce a self-efficacy score ranging from 8 (low self-efficacy) to 24 (high self-efficacy). Finally, for perceived barriers of self-regulation, participants had to indicate whether they strongly agreed, agreed, disagreed or strongly disagreed that each of six factors (e.g. unavailability of public transport) stopped them from changing when and where they drove. Scores on a four point scale for each factor (strongly

agree = 4, strongly disagree = 1) were summed to produce an overall score ranging from 6 (no barriers to self-regulation) to 24 (many barriers to self-regulation).

The driving assessments consisted of standardised on-road driving tests conducted by an occupational therapist from DARS with postgraduate training in driver assessment and rehabilitation, and a professional driving instructor. The driving instructor directed the participant through the driving route and used dual brakes to maintain safety, while the occupational therapist scored the participant's driving performance. A set test route based on testing procedures used in other studies (Dobbs, 1997; Hunt et al., 1997; Parasuraman & Nestor, 1991) was designed specifically for this study. The test was broken into four sections: familiarisation, low demand, moderate demand, and high demand. The familiarisation section involved familiarising the driver with the vehicle, and assessing whether the driver could perform basic vehicle control tasks (e.g. starting a car, moving off). The low demand section was conducted on low traffic roads and mainly involved negotiating roundabouts. The moderate demand section involved driving on main roads but did not require complex manoeuvres. In this section, all intersections were negotiated by driving straight through or turning with a dedicated turning arrow. In the high demand section, drivers had to perform unprotected turns across traffic at intersections on main roads, as well as merging manoeuvres on multi-lane roads, and driving in areas featuring high pedestrian activity. The driving test, therefore, involved progressively more difficult manoeuvres completed in the presence of increasingly more complex traffic conditions. It took from 40 minutes to an hour to complete.

The on-road driving tests were all conducted in dual-controlled, medium-sized sedans (1997 Toyota Corollas), fitted with power steering and manual or automatic transmission, depending on the participant's preference. Two occupational therapists were employed for the study, and completed 57 and 43% of the assessments, respectively. The same driving instructor was available for 95% of the assessments. Assessments were conducted at 9:30am, 11:00am or 1:00pm, so that drivers were not assessed during peak hour traffic.

As is standard practice for DARS, test failure was based on agreement between the occupational therapist and driving instructor about the safety risk posed by the driver, given the types of errors they made and the level of active intervention required on the part of the driving instructor to ensure safety during the test (applying brakes, taking hold of the steering wheel, explicit verbal guidance). Errors that posed a greater safety risk, such as speeding, disregarding traffic signals and Stop or Give Way signs, drifting into other lanes, and stopping unexpectedly without reason, were most likely to lead to failure of the test.

In keeping with other studies of driving performance and aging that weighted different road test errors (Dobbs, Heller, & Schopflocher, 1998; Janke & Eberhard, 1998; Staplin, Gish, Decina, Lococo, & McKnight, 1998), a scoring system was developed that assigned different weightings to specific errors in order to produce an overall score that more closely matched the outcomes of the assessments (i.e. pass or fail). Greater weightings were assigned to errors requiring the intervention of the driving instructor, with lower weightings given to what were termed "hazardous" errors (exceeding the speed limit, inappropriate high speed, unsafe gap selection, unsafe positioning, disobeying Stop signs or traffic lights), and no extra weightings given for what were termed "habitual" errors (e.g. failure to check mirrors or blind spots, failure to indicate, inappropriate lane selection, poor parking ability). It was found that, using a weighting of 10 for driving instructor interventions, five for hazardous errors and one for habitual errors, it was possible to accurately predict test outcomes in 94% of cases, with 79% sensitivity (correctly identified failures) and 97% specificity (correctly identified passes). This weighted error score was used as the outcome measure for the driving assessment.

Procedure

All participants provided informed consent prior to being involved in the study. Questionnaires were completed first and the investigator ensured that all questions were understood by the participant. Next, participants undertook the on-road driving test. Feedback on driving test performance was given to each driver by the driving instructor and occupational therapist at the end of the test. Drivers recruited from the general community who failed the test did not lose their driver's licence but a letter was sent to their general practitioner describing the study and indicating the driving test outcome. The general practitioner could then decide what action, if any, was required. Participants who had been referred to DARS for an assessment did have to surrender their driver's licence in the event of failing the driving test. All participants were paid a nominal amount for their involvement.

Results

Questionnaire Results

When asked to rate their own driving ability, only one participant claimed that they were below average (“fair”). Forty participants (38.5%) judged themselves to be average drivers, 60 (57.7%) said they were “good” drivers, and the remaining three participants claimed that they were “excellent”. This suggests a generally positive self-assessment of driving ability among the participants.

The results for driving confidence in nine difficult driving situations are provided in Table 1, which shows that the situation in which participants were most confident was driving alone, while the situations in which there was the least confidence were reverse parallel parking and driving at night in the rain. The most common response for six of the nine categories was “reasonably confident” and participants were more likely to report being “very” or “completely” confident than they were to report being “not confident at all” or “not very confident”. The overall confidence scores (on a possible scale of 9 to 45) reflected this, with a mean of 33.1 ($SD = 6.5$).

Table 1
Levels of confidence in difficult driving situations, percentages (N = 104)

Driving situation	Level of confidence				
	Not at all	Not very	Reasonably	Very	Completely
In the rain	1.0	3.8	51.0	27.9	16.3
When alone	0.0	0.0	16.3	33.7	50.0
Parallel parking	7.7	24.0	37.5	18.3	12.5
Right turns	1.0	3.8	32.7	31.7	30.8
Freeways	1.0	4.8	25.0	34.6	34.6
High traffic roads	0.0	2.9	31.7	37.5	27.9
Peak hour	0.0	4.8	38.5	32.7	24.0
At night	2.9	11.5	36.5	29.8	19.2
At night in the rain	6.7	17.3	45.2	20.2	10.6

Table 2 shows the level of avoidance of each of the difficult driving situations. It can be seen that there was a tendency to report never avoiding these situations. Only reverse parallel parking was avoided at least rarely by over half of the participants. Along with parallel parking, the most avoided difficult driving situation was driving at night in the rain. The least avoided driving situation was driving alone. The overall avoidance scores (on a possible scale of 9 to 45) had a mean of 13.9 ($SD = 5.6$).

Table 2
Levels of avoidance of difficult driving situations, percentages (N = 104)

Driving situation	Level of avoidance				
	Never	Rarely	Sometimes	Often	Always
In the rain	67.3	19.2	11.5	1.0	1.0
When alone	95.2	4.8	0.0	0.0	0.0
Parallel parking	47.1	16.3	17.3	8.7	10.6
Right turns	71.2	15.4	10.6	1.9	1.0
Freeways	82.7	9.6	2.9	1.0	3.8
High traffic roads	76.9	12.5	9.6	1.0	0.0
Peak hour	68.3	10.6	18.3	2.9	0.0
At night	67.3	13.5	11.5	2.9	4.8
At night in the rain	57.7	18.3	11.5	5.8	6.7

A summary of participant responses to questions regarding perceived barriers to self-regulation is provided in Table 3. The greatest barrier to self-regulation among the participants was lifestyle. That is, many participants were accustomed to a certain lifestyle that entailed a certain amount of driving, and maintenance of this lifestyle required maintenance of their driving behaviour. The lack of availability of others to provide transport and the participants’ lack of willingness to ask others were the next greatest barriers to self-regulation. The total scores for perceived barriers to self-regulation (on a possible scale of 6 to 24) had a mean of 14.3 ($SD = 4.3$).

Table 3

Perceived barriers to self-regulation, percentage of participants (N = 104)

Type of barrier	Strongly disagree (%)	Disagree (%)	Agree (%)	Strongly agree (%)
Lifestyle	6.7	25.0	29.8	38.5
Relied on to drive others	23.1	38.5	23.1	15.4
No public transport	32.7	40.4	14.4	12.5
Don't like public transport	26.9	46.2	12.5	14.4
Family or friends unavailable	24.0	33.7	24.0	18.3
Would not ask family or friends	20.2	35.6	24.0	20.2

Table 4 shows participants' ratings of the ease of avoiding eight difficult driving situations on a three point scale. The hardest situations to avoid, according to the participants, were driving alone (the situation most often designated as very hard to avoid) and high traffic roads (the situation least often designated as not hard at all to avoid). The situations easiest to avoid were parallel parking and peak hour. The overall scores for regulatory self-efficacy (on a possible scale from 8 to 24) had a mean of 17.4 ($SD = 4.4$).

Table 4

Self-regulatory self efficacy, percentage of participants (N = 104)

Driving situation to avoid	Very hard to avoid (%)	Somewhat hard to avoid (%)	Not at all hard to avoid (%)
Rain	31.7	27.9	40.4
Alone	45.2	25.0	29.8
Parallel parking	13.5	20.2	66.3
Right turns	26.9	26.9	46.2
Freeways	26.0	30.8	43.3
High traffic roads	29.8	43.3	26.9
Peak hour	13.5	32.7	53.8
Night	25.0	31.7	43.3

Driving Test Performance

Of the 104 participants, 90 completed the driving test. Of these 90 participants, 82 were from the general community and eight were referrals. Ten of the community participants chose not to undergo the driving assessment, while three referral participants and one community participant were not able to complete the driving test and so their results for the driving component had to be discarded. The outcomes of the 90 driving tests, in terms of recommendations by the assessor, were 68 passes (75.6%), eight passes with recommendations for lessons (8.9%) and 14 failures (15.6%).

Scores were calculated for interventions by the driving instructor, hazardous errors and habitual errors. The mean number of driving instructor interventions per test was 1.1 ($SD = 1.7$), the mean number of hazardous errors was 10.5 ($SD = 10.9$) and the mean number of habitual errors was 54.0 ($SD = 17.5$). These results show that interventions by the driving instructor were rare and that hazardous errors were a lot less common than habitual errors. There was also greater variation in driving instructor interventions and hazardous errors than in habitual errors. The total weighted error scores for the driving test ranged between 18 and 443, with a mean of 117.6 ($SD = 78.3$).

Relationships Between Questionnaire Responses and Driving Test Performance

The correlations between questionnaire measures and performance in the on-road driving test are shown in Table 5. It can be seen that there was a significant correlation between on-road driving test performance and overall driving confidence ($p < .05$) but not between driving test performance and either self-rated driving ability or overall driving avoidance. However, there was a trend towards a relationship between on-road driving test performance and overall avoidance. To explore this trend, correlations were calculated between on-road driving test performance and avoidance of each of the nine specific driving situations. These correlations are displayed in Table 6, where it can be seen that poorer driving ability is only associated with greater avoidance of three specific driving situations: driving in the rain, driving at night, and driving at night in the rain.

Table 5

Correlations between on-road driving test performance and questionnaire measures (n = 90)

Questionnaire measure	Relationship with driving (r)
Self-rating of driving ability	-.14
Overall confidence	-.26*
Overall avoidance	.20

*p < .05, **p < .01

Table 6

Correlations between avoidance of difficult driving situations and driving test performance (n = 90)

Avoidance measure	Correlation with driving ability
In the rain	.33**
Alone	-.01
Parallel parking	.05
Right turns	.09
Freeways	-.02
High traffic roads	.00
Rush hour	-.10
At night	.34**
At night in rain	.35**
Overall avoidance	.20

*p < .05, **p < .01

Discussion

The results for the questionnaire used in this study suggest that most older drivers have a positive view of their own driving ability, are confident when driving, and do not often find it necessary to avoid difficult driving situations. With regard to perceived driving ability, the majority of older drivers claimed that their driving ability was above average. High self-ratings for driving ability have been reported previously in a study by Owsley et al. (1999) in which 86% of older drivers reported being above average (“good” or “excellent”) drivers.

The results for the questions about confidence in, and avoidance of, difficult driving situations were consistent with each other, with confidence scores generally at the higher end of the scale, while avoidance scores were generally at the lower end. This suggests a confident sample of drivers who did not often find it necessary to avoid difficult driving situations. Also consistent were the findings of low confidence and high avoidance for parallel parking and driving at night in the rain, while there was high confidence and low avoidance reported for driving alone. This suggests that drivers were more likely to avoid the driving situations in which they had lower levels of confidence. The finding that driving alone was the least avoided difficult situation and was not viewed as very difficult (high level of confidence) is consistent with previous studies examining this set of difficult driving situations (Ball et al., 1998; Owsley et al., 1999; Stalvey & Owsley, 2000).

When asked about the ease or difficulty of avoiding specific difficult driving situations, driving alone and high traffic roads were reported to be the most difficult to avoid, while parallel parking and peak hour were reported to be the easiest to avoid. The need to drive alone is likely to reflect a desire for independent mobility, while the difficulty of avoiding high traffic roads is likely to be due to the fact that the study participants live in the metropolitan area, a situation in which it is difficult to travel beyond one’s immediate neighbourhood without encountering an arterial road featuring heavy traffic. The relative ease of avoiding parallel parking would be due to drivers being able to find parking spaces that did not require that manoeuvre. Avoidance of peak hour, on the other hand, could be related to retirement and the ability to choose when driving is done (Eberhard, 1996).

The greatest perceived barrier to self-regulation was maintenance of lifestyle, reported by nearly 70% of participants, followed by the unavailability of family and friends to provide transport when needed (42%) or the unwillingness to ask them for help with transportation (44%). A quarter of participants claimed that public transportation was unavailable to them. For comparison, a study in the USA by Stalvey and Owsley (2000) found that inadequate public transportation was reported by three quarters of respondents to be a barrier to self-regulation, followed by the unavailability of friends or family (57%) and maintenance of lifestyle (54%). In both this and Stalvey and Owsley’s study, being relied on by others for transport was reported by just over 35% of drivers. It appears that the two sets of responses are broadly comparable, except that the provision of public transportation in Adelaide, South Australia was viewed more favourably than that in the region of the USA where Stalvey and Owsley conducted their study.

The analysis of relationships between questionnaire measures and performance on the driving test revealed that there is no relationship between older drivers' *perceived* driving ability and their *actual* driving ability. This finding is consistent with previous studies by Marottoli and Richardson (1998) and by Cushman (1996). This finding is important because, if drivers are unable to detect declines in driving ability, then self-regulation in response to declining ability is unlikely.

In contrast to perceived driving ability, overall confidence in difficult driving situations was related to on-road driving ability. This combination of results suggests that, when their driving ability declines, older drivers may lose confidence in difficult driving situations but do not translate this lower confidence into lower self-assessments of driving ability. This relationship between driving ability and driving confidence contradicts the findings of Marottoli and Richardson (1998), who used an older sample.

The variable of most interest to an investigation of self-regulation is the avoidance of difficult driving situations. If self-regulation occurs in response to declines in driving ability, then performance on the driving test would be expected to correlate with measures of driving avoidance. However, it was found in this study that on-road driving ability was *not* significantly correlated with overall driving avoidance, suggesting that older drivers, as a group, do not appropriately self-regulate their driving. Previous studies of self-regulation (Charlton et al., 2001; Cushman, 1996; Marottoli & Richardson, 1998) have also found that self-regulation and driving ability are not related but these studies, as previously noted, have either used very old drivers or have included a large proportion of drivers who had been diagnosed with dementia. Therefore, one important result of the present study is that these findings have now been replicated in a broader sample of community dwelling drivers aged over 60.

Another important finding was that stronger correlations between driving ability and avoidance were found for a number of specific driving situations (rain, night, night in the rain). Therefore, the apparent lack of a relationship between driving avoidance and driving ability appears to conceal significant relationships for specific situations. Older drivers *do* tend to self-regulate in a manner consistent with driving ability *but only for a small number of specific situations*. This finding, that driving ability is related to the avoidance of a number of specific difficult driving situations, is a new one in the road safety literature, as previous research has not investigated self-regulatory practices in the same depth.

There were some limitations of this study that necessitate some caution when interpreting the findings. First, the confidence and avoidance measures were self-reported and it may be that some participants tried to give a 'good' or socially desirable account of themselves, reporting high perceived driving ability, high driving confidence, and low driving avoidance. This may have affected the analyses of relationships between these variables and the driving ability measure.

Another limitation is that the assessment of on-road driving ability did not assess performance in a number of the difficult driving situations that were the focus of the questionnaire items regarding driving confidence and driving avoidance. Specifically, the driving test did not assess driving in the rain, alone, on freeways, at peak hour, at night, or at night in the rain. It also did not assess reverse parallel parking. It is likely that the driving performance scores of participants who often avoided difficult driving situations would have been poorer if their driving was assessed in these situations. Therefore, the likely result of this limitation of the driving test is that the relationships reported in this study between driving ability and both confidence in, and avoidance of, difficult driving situations under-estimate the strength of the actual relationships. However, the driving tests did assess performance in a wide variety of traffic conditions, ranging from quiet streets to busy main roads. Assessing driving performance in all of the difficult driving situations would have been impractical. Also, as noted by Lundberg et al. (1997, p34), given that some older drivers do restrict their driving in difficult driving situations, it would be "inappropriate to demand more of the elderly than they do of themselves" when assessing their on-road driving ability.

A final limitation is that the study findings may be affected by volunteer bias. Those volunteering for a study involving an assessment of on-road driving performance may be more likely to be confident about their driving ability. Drivers volunteering for the study who have deficits in driving ability may, therefore, mainly be those who are unaware of these deficits. This would, in turn, reduce the relationships between on-road driving ability and variables such as self-reported driving ability, driving confidence, and driving avoidance. The correlations between these variables reported in this study may again, therefore, under-estimate the strength of the real relationships. The problem of volunteer bias is difficult to control for, as random sampling in tests of on-road driving ability is "neither possible nor practical" (Lee, Cameron, & Lee, 2003, p802).

Conclusion

Overall, the present study has demonstrated that older drivers do engage in a degree of self-regulation of driving behaviour, and that this self-regulation does have a relationship with driving ability. However, the relationship is not strong, suggesting that many older adults with deficits in their driving ability do not avoid difficult driving situations. This is partly because some driving situations are difficult to avoid (e.g. driving alone, high traffic roads). Another important factor is that there are a number of barriers to self-regulation of driving behaviour, the most significant of which is the desire to maintain an active lifestyle. This emphasises the need to provide viable alternative transport options for older adults. Such transport options should allow for maintenance of an active lifestyle while also allowing for self-regulation of driving behaviour. Finally, the results of the study also suggest that, if older adults are to adjust their driving behaviour in the event of declines in driving ability, it may be necessary to introduce programs designed to encourage self-regulation.

References

- Ball, 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(3), 313-322.
- Burns, P. C. (1999). Navigation and the mobility of older drivers. *Journal of Gerontology: Social Sciences*, 54B(1), S49-S55.
- Charlton, J. L. (2002). Licensing issues. In *Transcript of proceedings: Mobility and safety of older people conference, Melbourne, Victoria, August 2002* (pp. 45-65). Melbourne, Victoria: Australian College of Road Safety.
- Charlton, J. L., Oxley, J., Fildes, B., & Les, M. (2001). *Self-regulatory behaviour of older drivers*. Paper presented at the Road Safety Research, Policing and Education Conference, Melbourne, Victoria, Australia.
- Cushman, L. A. (1996). Cognitive capacity and concurrent driving performance in older drivers. *IATSS Research*, 20(1), 38-45.
- Dobbs, A. R. (1997). Evaluating the driving competence of dementia patients. *Alzheimer Disease and Associated Disorders*, 11, 8-12.
- Dobbs, A. R., Heller, R. B., & Schopflocher, D. (1998). A comparative approach to identify unsafe older drivers. *Accident Analysis and Prevention*, 30(3), 363-370.
- Eberhard, J. W. (1996). Safe mobility for senior citizens. *IATSS Research*, 20(1), 29-37.
- Federal Office of Road Safety. (1996). *Older drivers: Calculating the risk of involvement in fatal crashes* (No. Monograph 6). Canberra, ACT: Federal Office of Road Safety.
- Fildes, B., Lee, S., Kenny, D., & Foddy, W. (1994). *Survey of Older Road Users: Behavioural and Travel Issues* (No. Report No. 57). Melbourne, Australia: Monash University Accident Research Centre.
- Fonda, S. J., Wallace, R. B., & Herzog, A. R. (2001). Changes in driving patterns and worsening depressive symptoms among older adults. *Journal of Gerontology: Social Sciences*, 56B(6), S343-S351.
- Hakamies-Blomqvist, L. (1998). Older drivers' accident risk: Conceptual and methodological issues. *Accident Analysis and Prevention*, 30(3), 293-297.
- Hakamies-Blomqvist, L. (2003). *Fifth European Transport Safety Lecture: Ageing Europe, the challenges and opportunities for transport safety*. Brussels, Belgium: European Transport Safety Council.
- Hakamies-Blomqvist, L., Johansson, K., & Lundberg, C. (1996). Medical screening of older drivers as a traffic safety measure - a comparative Finnish-Swedish evaluation study. *Journal of the American Geriatrics Society*, 44, 650-653.
- Hunt, L. A., Murphy, C. F., Carr, D., Duchek, J. M., Buckles, V., & Morris, J. C. (1997). Reliability of the Washington University Road Test: A performance-based assessment for drivers with dementia of the Alzheimer type. *Archives of Neurology*, 54, 707-712.
- Janke, M. K. (2001). Assessing older drivers: Two studies. *Journal of Safety Research*, 32, 43-74.
- Janke, M. K., & Eberhard, J. W. (1998). Assessing medically impaired older drivers in a licensing agency setting. *Accident Analysis and Prevention*, 30(3), 347-361.
- Klavora, P., & Heslegrave, R. J. (2002). Senior drivers: Overview of problems and intervention strategies. *Journal of Aging and Physical Activity*, 10(3), 322-335.
- Kostyniuk, L. P., Shope, J. T., & Molnar, L. J. (2000). Driving reduction/cessation among older drivers: Towards a behavioural framework. In *9th International Association for Travel Behaviour Conference, Gold Coast, Queensland, Australia, July 2-7, 2000*.
- Lee, H. C., Cameron, D., & Lee, A. H. (2003). Assessing the driving performance of older adult drivers: On-road versus simulated driving. *Accident Analysis and Prevention*, 35(5), 797-803.

- Lundberg, C., Johansson, K., Ball, K., Bjerre, B., Blomqvist, C., Braekhus, A., et al. (1997). Dementia and driving: An attempt at consensus. *Alzheimer Disease and Associated Disorders*, 11(1), 28-37.
- Lyman, S., Ferguson, S. A., Braver, E. R., & Williams, A. F. (2002). Older driver involvements in police reported crashes and fatal crashes: trends and projections. *Injury Prevention*, 8(2), 116-120.
- Marottoli, R. A., Mendes de Leon, C. F., Glass, T. A., Williams, C. S., Cooney Jr, L. M., & Berkman, L. F. (2000). Consequences of driving cessation: Decreased out-of-home activity levels. *Journal of Gerontology: Social Sciences*, 55B(6), S334-S340.
- Marottoli, R. A., & Richardson, E. D. (1998). Confidence in, and self rating of, driving ability among older drivers. *Accident Analysis and Prevention*, 30(3), 331-336.
- Marottoli, R. A., Richardson, E. D., Stowe, M. H., Miller, E. G., Brass, L. M., Cooney Jr, L. M., et al. (1998). Development of a test battery to identify older drivers at risk for self-reported adverse driving events. *Journal of the American Geriatrics Society*, 46(5), 562-568.
- Maycock, G. (1997). *The Safety of Older Car Drivers in the European Union*. Basingstoke: AA Foundation for Road Safety Research.
- OECD. (2001). *Ageing and Transport: Mobility and Safety Issues*. Paris, France: Organisation for Economic Co-operation and Development.
- Owsley, C., Stalvey, B., Wells, J., & Sloane, M. E. (1999). Older drivers and cataract: Driving habits and crash risk. *Journal of Gerontology: Medical Sciences*, 54A(4), M203-M211.
- Parasuraman, R., & Nestor, P. G. (1991). Attention and driving skills in aging and Alzheimer's Disease. *Human Factors*, 33(5), 539-557.
- Sims, R. V., McGwin Jr, G., Allman, R. M., Ball, K., & Owsley, C. (2000). Exploratory study of incident vehicle crashes among older drivers. *Journal of Gerontology: Medical Sciences*, 55A(1), M22-M27.
- Stalvey, B. T., & Owsley, C. (2000). Self perceptions and current practices of high risk older drivers: Implications for driver safety interventions. *Journal of Health Psychology*, 5(4), 441-456.
- Staplin, L., Gish, K. W., Decina, L. E., Lococo, K. H., & McKnight, A. S. (1998). *Intersection negotiation problems of older drivers, Volume 1: Final technical report* (No. 1446/FR). Washington DC: National Highway Traffic Safety Administration.
- Torpey, S. E. (1986). *Licence Re-testing of Older Drivers* (No. 91/21). Hawthorn, Victoria, Australia: Road Traffic Authority.
- Wallace, R. B., & Retchin, S. M. (1992). A geriatric and gerontological perspective on the effects of medical conditions on older drivers: Discussions of Waller. *Human Factors*, 34(1), 17-24.

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