Are Older Drivers' Perceptions Of Their Driving Ability Accurately Reflected In Performance On A Driving Simulation Task?

FINAL REPORT

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EXECUTIVE SUMMARY

This study sought to determine the relationship between performance on a computer simulated hazard perception task (as a surrogate measure of crash risk) and the perceptions of driving ability, driving confidence, and avoidance of dangerous driving conditions among a sample of 98 older drivers (aged 65 years and over).

Analysis revealed that there were minimal relationships between performance on the hazard perception test and self-rated driving ability, confidence, and avoidance of particular driving situations suggesting that these self-assessments are not an accurate reflection of a proxy measure of driving ability, or more specifically crash risk. If older drivers are poor at judging their own crash risk then this could hamper their attempts to self-regulate this risk through countermeasures such as self-imposed driving restrictions.

ACKNOWLEDGEMENTS

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The work has been prepared exclusively by the authors and is not endorsed or guaranteed by the Trust or the Department.

ABBREVIATIONS

DBQ = Manchester Driver Behaviour Questionnaire

DMQ-A = Driver Mobility Questionnaire – Avoidance Subscale

DMQ-C = Driver Mobility Questionnaire – Confidence Subscale

M = Mean score

QSHPT = Queensland Spatial Hazard Perception Test

SD = Standard Deviation

SMMSE = Standardised Mini Mental Status Examination

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PREFACE

This project was approved by the Queensland University of Technology Human Research Ethics Committee (0900000678).

An occupational health and safety risk assessment for this project was completed and approved by the Queensland University of Technology.

Related publications as of December, 2010.

Sullivan, K.A., Smith, S. S., Horswill, M., & Lurie-Beck, J. (in press; accepted November 30, 2010). Older adults' safety perceptions of driving situations: Towards a new avoidance scale. *Accident Analysis and Prevention*.

INTRODUCTION

Age brings with it a decrease in various cognitive, motor and sensory abilities that are related to driving skill (Horswill et al., 2008). This naturally occurring deterioration is paired with the increasing presentation of various medical conditions that can further impair driving ability. The weighing of these issues by older drivers feeds, or at least should, feed into the often difficult decision to restrict or cease driving.

The cessation of driving is a watershed moment in the life of an adult. It may be perceived as signalling an immediate restriction in freedom and independence which can have negative implications for mental health. The extent to which such perceptions match reality may depend on a host of factors, including the availability of alternate means of transport, as well as other social and cultural factors. Nevertheless, for many older drivers, there is a reluctance to give up driving. Rather than ceasing driving completely, it has been suggested that older drivers may restrict their own driving exposure by minimising or avoiding driving in situations that they perceive as hazardous, such as driving at night, in the rain, or on highly trafficked or high speed roads.

If older drivers are basing their decision to restrict or cease driving largely on self-assessment it is pertinent to ask how accurately such self-assessments reflect actual driving skill. Strong relationships between driving ability and driver perceptions would suggest that older drivers can make relatively accurate self-assessments that may then be translated into voluntary license surrender or modified driving. However, if the relationship between these variables and driving ability is weak or non-existent, this would suggest that older drivers' perceptions are not an accurate reflection of their true driving ability, and therefore not a good basis for decisions regarding continued driving. This study sought to examine the nature of the relationship between these variables.

The specific aspect of driving ability measured in this study was hazard perception, as measured by the Queensland Spatial Hazard Perception Task (QSHPT). Horswill and McKenna (2004) define hazard perception as "situation awareness for dangerous situations in the traffic environment." This represents the initial element of accident avoidance as one must be able to recognise that a potential hazard is there in order to take evasive action. Numerous studies have shown a relationship between the reaction time on computer-based hazard perception tests and crash frequency (Hull & Christie, 1992; McKenna & Horswill, 1999; Quimby, Maycock, Carter, Dixon, & Wall, 1986) suggesting it is appropriate to use as a proxy measure of how safely a person drives.

While the relationship between driving skill and confidence has been examined before (e.g., Baldock, Mathias, McLean, & Berndt, 2006; Marottoli & Richardson, 1998), an assessment of the relationship between self-assessment of driving ability and an objective measure of the more specific skill of hazard perception has yet to conducted. Previous research has found that confidence in driving ability is at best only weakly related to actual driving performance. It remains to be seen if the relationships between hazard perception skill and older driver confidence and perceptions of ability are of a similar nature. This study provides an assessment of these relationships in a sample of older drivers.

STUDY AIMS

Two study aims were articulated, the first of which was designed to explore the relationship between driving self-ratings and a proxy test of driving ability. The second general aim was to explore the adequacy of self-restriction as a road safety countermeasure in older adults by looking at the relationship between those situations that drivers reported avoiding and driving ability on the proxy task.

In particular, this study aimed to:

1. Determine whether performance on a computer based hazard perception test is reflected in appropriate perceptions of and confidence in driving ability. Specifically do drivers who perform less well on the test rate their ability lower and have less confidence in their driving ability than drivers who perform better on the QSHPT?

2. Determine whether performance on a computer based hazard perception test is related to avoidance of driving in potential hazardous conditions and lower driving frequency and mileage. Specifically do drivers who perform less well on the QSHPT report a higher degree of avoidance of these conditions suggesting they are restricting their driving?

METHOD

PARTICIPANTS

Personal characteristics

A sample of 98 drivers aged 65 years and over participated in the study, of which 63% were male and 37% were female. The average age of participants was 71 years (*SD* = 5.13 years; age range 65 to 90 years). Using the Australian Bureau of Statistics classifications, 57% resided in outer Brisbane, 29% resided in inner Brisbane while the remainder lived further afield on the outskirts of Brisbane. The sample was relatively well educated with 57% indicating they had a university or TAFE qualification. One fifth (21%) of the sample was employed in a full or part time capacity. Just under half of the sample (47%) was not in paid employment but conducted voluntary work.

Driving characteristics

On average, participants had held a drivers' license for 50.92 years (*SD* = 6.02 years). One fifth of the sample (21%) indicated that they had undertaken some form of advanced driver training. Almost half of the sample (47%) indicated that they predominantly drove in suburban areas. 10% nominated city driving as their dominant driving environment and 40% reported driving on a mixture of city and suburban roads. The vast majority of participants (83%) indicated that they generally travel at the same speed as the general flow of traffic. Less than 10% of the sample indicated driving somewhat or much slower (7%) or somewhat or much faster (4%) than the surrounding traffic. Table 1 below provides a profile of the participants' self-reported road safety record for the past five years.

Table 1.

Percentage of participants reporting involvement in at least one traffic incident in the last five years.

Incident Type	Percentage (n = 98)
No accidents	81%
Pulled over by police (regardless of whether a ticket was received)	10%
Received a traffic ticket	6%
Accident in which you were partly to blame	17%
Accident resulting in serious injury or death	0%
Accident involving another vehicle	16%
Accident that could have been prevented if you had paid more attention	9%
Accident that could have been prevented if you were able to predict traffic conflicts earlier	6%

Notes: This table shows self-reported traffic incident data. Does not sum to 100%; multiple responses were allowed.

MATERIALS AND PROCEDURE

Information about the study was provided via an informed consent package to each participant. Each participant completed a 90 minute testing session comprised of a paper and pencil survey, structured interview and the computer based simple reaction time task and Queensland Spatial Hazard Perception Test (QSHPT). Participants were tested individually on the Kelvin Grove Campus of Queensland University of Technology. An experimenter was present during testing to provide assistance when necessary. At the completion of testing, volunteers received $20 (AUD) in return for participation.

Tests and questionnaires were ordered in such a way as to minimize potential biases in responses due to test experience. These materials will be described in the order that they were presented to participants. Copies of the informed consent package, questionnaires and structured interview that were used in this study are available on request.

Preliminary tests / Screening measures

Standardised Mini-Mental State Examination (SMMSE)

All potential participants were initially screened using the SMMSE (Molloy & Standish, 1997). This screening test was administered to ensure adequate cognitive function to complete tasks and the absence of gross impairments in cognitive function. Every person tested achieved above the threshold score of 27 out of 30. All screened participants were retained in the sample.

Demographics Questionnaire

The first part of the questionnaire booklet collected general demographic data in relation to gender, age, education, employment status and frequency and type of driving.

Alertness Check

In order to check for the potential influence of alertness on the variables of interest, and in particular the QSHPT and a simple reaction time task, participants were asked to rate their level of alertness at the time of testing. Possible responses ranged from 1 (*very alert*), 3 (*alert*), 5 (*neither alert nor sleepy*), 7 (*sleepy*) to 9 (*very sleepy*). The average score on this item was 2.84 (SD = 1.22), with 83% of participants rating themselves alert to very alert. The highest rating given by any participant on this item was a 6. Scores on this variable did not relate significantly to any variables of import.

Driving Confidence (DMQ-C) and Avoidance (DMQ-A)

Driving confidence was measured using Baldock, Mathias, McLean and Berndt's (2006) confidence sub-scale of the Driver Mobility Questionnaire (DMQ – C). Baldock et al. (2006) based their scale on Australian-centric adaptations of items from Owsley, Stalvey, Wells and Slone's (1999) Driving Habits Questionnaire. Participants were asked to rate the extent to which they felt confident driving in nine potentially hazardous driving conditions (such as in the rain or on heavily trafficked roads). Responses are made on a 5-point likert scale where 1 is *not at all confident* and 5 is *completely confident*.

Driving avoidance was measured using the Driver Mobility Questionnaire – Avoidance (DMQ-A). Participants rated the same nine situations from the confidence scale in terms of the extent to which they avoided driving in those situations. A 5-point likert scale was again employed to assess responses. A rating of 1 indicated that the situation was not avoided at all. A rating of 5 indicated that the situation was avoided completely.

Summary scores for the DMQ-C and DMQ-A were derived by averaging scores on the nine items in each scale. Both summary scores were found to have high internal consistency within the current sample as measured by Cronbach's alpha reliability analysis (confidence = 0.92; avoidance = 0.89).

Driving Behaviour Questionnaire (DBQ)

Driving behaviour was measured using an extended version of the Manchester Driver Behaviour Questionnaire (DBQ; Lawton, Parker, Manstead, & Stradling, 1997). This version included the original 24 DBQ items and subscales (Parker, Reason, Manstead, & Stradling, 1995). The DBQ items assess the frequency over the past six months of lapses (8 items), errors (8 items), and driving violations (8 items).

However, as per the Lawton DBQ revision, one of the original violation items ('*disregarding the speed limits late at night or early in the morning'*) was modified to create two replacement items ('*disregarding the speed limits on highways/freeways or residential roads respectively'*) and three violations were added '*sounding horn to indicate annoyance to another driver*', '*staying in a lane that you know will be closed ahead until the last minute before forcing your way into another lane*' and '*pulling out of a junction so far that you disrupt the flow of traffic*'). The final violations subscale item had 12 items, describing 6 'ordinary' violations and six 'aggressive violations'. Responses are rated on a 6-point likert scale ranging from '*never*' to '*almost all the time*".

As per other studies (e.g., Bener, Özkan, & Lajunen, 2008; Lajunen, Parker, & Summala, 2004; Özkan, Lajunen, & Summala, 2006), DBQ subscale scores were calculated by summing subscale items, and dividing the result by the number of subscale items. Higher scores on the four subscale areas indicate greater frequency of relevant behaviours (i.e., lapses, errors, and so on).

Internal consistency of the four DBQ subscales was found to be fair to moderate using Cronbach's alpha reliability analysis (aggressive violations = 0.53; ordinary violations = 0.75; errors = 0.71; lapses = 0.79).

Perception of Relative Driving Skill

Perceived relative driving skill was measured using an approach developed by Horswill, Waylen and Tofield (2004). Participants were asked to rate their perceived abilities on a range of elements of driving on an 11-point likert scale where 1 corresponds to *the bottom 10% of other Brisbane drivers,* 6 corresponds to *the average Brisbane driver (defined as 50% are more skilful and 50% are less skilful)* and 11 corresponds to *the top 10% of other Brisbane drivers*. This data was used as a further indicator of driving confidence/self-assessment.

Ratings were given of overall driving skill as well as six hazard perception items and nine vehicular control items. Hazard perception items included (1) maintaining appropriate speeds for conditions, (2) awareness and anticipation of pedestrian activity, (3) monitoring of junctions/bends, (4) knowing when to overtake, (5) awareness/anticipation of other road users' behaviour and (6) maintaining appropriate following distances. Vehicle control items rated were (1) proper use of mirrors, (2) reversing/manoeuvring, (3) smooth cornering, (4) appropriate use of gears, (5) hill starts, (6) adapting to conditions, (7) appropriate use of signals, (8) controlled emergency stops and (9) parking. Participants were also asked to consider their awareness of their own fitness to drive and knowledge of the road rules. As well as rating their own perceived ability relative to other Brisbane drivers, participants were asked to assess the driving ability of their *cohort* (defined as other Brisbane drivers of the same gender, age, occupation, driving training and experience as you) relative to other Brisbane drivers. Reliability analysis was conducted for the four subscales, with three subscales attaining high reliability and one subscale attaining marginal reliability (hazard perception of self [0.59] and cohort [0.95] and vehicular control of self [0.95] and cohort [0.97]).

Computer and Touch screen based tests

After the completion of the screening tests and self-report scales, participants were asked to complete two tasks using a computer and touch screen. Prior to commencement participants were briefed on establishing an ergonomically comfortable position in front of the touch screen computer monitor. Those wearing glasses were asked to test their comfort both with and without their glasses when using the touch screen. Earphones were worn by participants to receive instructions in the introduction of the QSHPT, and then to minimize distraction. Participants were informed they could cease or pause the computer tasks at anytime.

The first of these tasks, the *simple spatial reaction time task*, was administered as a control measure for the QSHPT.

Simple Spatial Reaction Time Task

The simple spatial reaction time task required participants to touch rectangles which flashed up in different locations of the screen. In all 33 rectangles appeared on the screen. The average reaction time across all 33 responses was calculated. The average response time for the current sample was 0.85 of a second (*SD* = 0.16).

Queensland Spatial Hazard Perception Test

Driving ability (proxy task) was assessed using a project specific variant of the Queensland Spatial Hazard Perception Test (QSHPT; Horswill et al., 2008). The QSHPT involved participants viewing various genuine traffic situations filmed from the driver's perspective. The footage included a number of potential traffic conflicts (in which the camera car was required to take evasive action to avoid a collision or near collision with another road user). A typical example would be a car turning in the road ahead, forcing the vehicle immediately in front of the camera car to brake. Scenes were chosen to allow potential for the anticipation of traffic conflicts; that is, participants who were looking further ahead down the road, proactively searching for hazards, might be able to predict that the turning car would eventually lead to a traffic conflict, some time before the vehicle in front actually braked. Key features of this test included the following: (1) all the traffic conflicts were genuine (previous tests have been criticised for using staged events), (2) the touch screen response mode yielded precise information on what is being responded to (in earlier tests, participants pressed a button when they detected a hazard and this could result in response ambiguity in complex situations).

The QSHPT was preceded by a brief instructional video, explaining how to respond during the test. The order in which the scenes were presented to participants was randomized to eliminate order effects. The footage was shown on a 15-inch touch screen computer monitor and participants were required to anticipate the potential traffic conflicts by touching them on the screen. Specially-developed software recorded the time and location of each touch and yielded a reaction time to each traffic conflict detected.

Two performance scores were derived from the QSHPT; a mean reaction time (or response latency score) as well as the proportion of hazards responded to (or hit rate). The first of these measures is the key outcome variable for this test. The hit rate data is presented for completeness only.

In the calculation of mean reaction time, if a participant missed a potential traffic conflict, the mean reaction time score for their group for that event was substituted. That is, participants were not penalised for failing to respond. This method of data management is an accepted approach to the analysis of hazard perception responses. The overall hazard perception response latency score was the average reaction time across all the potential traffic conflicts.

The proportion of hazards responded to, or hit rate, reflects the proportion of the number of hazards presented in the QSHPT that were responded to with a touch on the touch screen. Hit rates for this test are always very high as the hazards used in the test were chosen on the basis of a high degree of recognition.

This averaged response latency score had high internal consistency in this sample (Cronbach's α = 0.88). A Cronbach's α for hit rate was not calculated because it would not be interpretable.

Perception of QSHPT performance

Perception of QSHPT performance was measured to obtain further data on relative driving perception but in the context of this task. Upon completion of the QSHPT participants were shown 10 short clips (with an average duration of 10 seconds) from the test and asked to rate how well they thought they responded to that part of the test. The order in which the 10 clips were shown to participants was randomized to minimize potential order effects. Participants remained seated in front of the touch screen to view these clips but were not required to respond to them by touching the screen. The experimenter then asked whether the participant whether they thought there was anything worth responding to in the clip and whether they thought they actually had responded during the test. They were then asked to rate on an 11-point scale, where 1 is very early and 11 is very late, how quickly they believe they personally responded compared to how an average Brisbane driver would respond as well as how quickly they believe other Brisbane drivers of the same gender, age, occupation and driving training and experience as themselves would respond compared to the average Brisbane driver. Participants were also asked to rate how well overall they performed, as well as how well other similar Brisbane drivers might perform, on the QSHPT and how well they thought their performance on the QSHPT reflected how well they would respond in real life.

External Perceptions of Driving Adequacy and Driving Incident History

Other's perception of the participants driving skill, and *driving incident history* were assessed using a self-completed survey. This survey included a number of potentially sensitive questions and so was placed at the end of the testing so as not to influence responses to prior questions. In the initial section participants were asked questions regarding others suggesting that they should limit or cease driving and how they would (or did) respond to this. Information pertaining to the number, nature and frequency of a number of traffic infringements and accidents was also gathered.

RESULTS

Perceived Driving Ability

The older drivers who participated in this study had generally positive perceptions of their driving skills. These drivers rated themselves as considerably more skilled than the average Brisbane driver. In addition they also rated themselves as significantly more skilled than their cohort (i.e., relative to other Brisbane drivers). Cohort ratings were all significantly lower (all at $p < 0.001$) than self-ratings. Table 2 below presents the mean ratings of self and cohort.

Table 2.

Mean level of perceived relative skill for a range of elements of driving.

Element of Driving	Perception of self compared to other Brisbane drivers *M* (*SD*)	Perception of cohort compared to other Brisbane drivers *M* (*SD*)
Overall driving skill	8.07 (1.82)	6.90 (1.99)
Mean of hazard perception items	8.91 (1.75)	6.84 (2.14)
Mean of vehicle control items	8.66 (1.72)	6.60 (2.19)
Merging with traffic/changing lanes [a]	8.48 (1.93)	6.18 (2.67)
Awareness of own fitness to drive	8.99 (1.85)	6.55 (2.63)
Knowledge of the road rules	7.94 (2.14)	6.23 (2.46)

Notes: Relative perceived ability was rated on an 11-point likert scale where 1 equated to the bottom 10% of other Brisbane drivers, 6 equated to an average Brisbane driver where 50% are more skilful and 50% are less skilful, and 11 equated to the top 10% of other Brisbane drivers. Cohort was defined as other Brisbane drivers of the same gender, age, occupation, driving training and experience as the respondee.

[a] Merging with traffic/changing lanes was deemed to potentially measure both hazard perception and vehicle control when rated via experienced drivers during scale development in Horswill et al.'s study (2004) and was therefore kept as a separate item.

Driving behaviour data showed the four classes of negative driving behaviour were all rated as relatively infrequent occurrences. The mean DBQ subscale ratings fell between the "never" and "hardly ever" response categories (see Table 3 below).

Table 3.

Mean scores for the Manchester Driver Behaviour Questionnaire (DBQ) Subscales.

DBQ Subscale	*M* (*SD*)
Aggressive Violations	1.71 (0.49)
Ordinary Violations	1.44 (0.37)
Errors	1.49 (0.40)
Lapses	1.56 (0.42)

Notes: Participants were asked to rate the frequency of each driver behaviour over the past six months. Each item was rated on a 6-point likert scale where 1 equals *never* and 6 equals *nearly all the time.*

Confidence and avoidance of potentially dangerous driving conditions

Generally, participants indicated that they were confident driving in a range of potentially dangerous driving conditions. Lowest confidence was noted for driving in the rain, at night or at night in the rain. Overall, participants rated themselves as "*very confident*" driving in a range of situations.

Degree of avoidance of the same set of driving conditions generally matched confidence levels. Thus, driving in the rain, at night or at night in the rain obtaining the highest avoidance ratings, although it should be noted that these mean scores equated to a response of "*not often*". The remaining driving conditions were placed at the midpoint between avoiding "*not at all*" and "*not often*." The moderate to strong negative correlations between confidence and avoidance ratings suggest that generally as confidence surrounding a given driving condition decreases avoidance of it increases to some extent. Table 4 displays the mean scores for confidence and avoidance ratings, the percentage of participants indicating that they avoided the driving condition *very often* or *completely, as well as the correlations between confidence and avoidance ratings*

Table 4.

Mean levels of and correlations between confidence and avoidance of potentially dangerous driving conditions.

	Confidence in Driving Condition (DMQ-C)	Avoidance of Driving Condition (DMQ-A)		Confidence/avoidance correlation
Dangerous Driving Condition	*M* (*SD*)	*M* (*SD*)	% avoid very often or completely	
In the rain	3.92 (0.79)	1.76 (0.86)	4%	- 0.59 **
When alone	4.58 (0.63)	1.23 (0.57)	1%	- 0.53 **
Parallel parking	4.16 (0.95)	1.46 (0.77)	3%	- 0.48 **
Right turns	4.56 (0.61)	1.27 (0.67)	2%	- 0.35 **
Freeways	4.32 (0.88)	1.43 (0.79)	5%	- 0.67 **
High traffic roads	4.10 (0.99)	1.57 (0.78)	2%	- 0.64 **
Peak hour	4.13 (0.95)	1.73 (0.94)	7%	- 0.68 **
At night	3.77 (0.93)	1.75 (0.93)	5%	- 0.63 **
At night in the rain	3.36 (1.09)	2.02 (1.09)	12%	- 0.68 **
Overall (mean)	4.09 (0.70)	1.58 (0.60)	-	- 0.73 **

Notes: ** $p < .01$; Confidence was rated on a 5-point likert scale where 1 equals *not at all confident* and 5 equals *completely confident*. Avoidance was rated on a 5-point likert scale were 1 equals *not avoided at all* and 5 equals *avoided completely*. DMQ-C = Driver Mobility Questionnaire – Confidence subscale, DMQ-A = Driver Mobility Questionnaire – Avoidance Subscale.

Performance and perception of performance on the Queensland Spatial Hazard Perception Test

Participants responded to the traffic hazards in the QSHPT with an average response latency of 3.66 seconds (*SD* = 1.43 seconds). The shortest response latency was 1.22 seconds and the longest was 8.59 seconds. On average, 90% of the hazards were responded to. However it should be borne in mind that it is unclear whether hazards not responded to where truly not identified or simply not responded to as they were not considered a dangerous enough hazard to warrant a response. This ambiguity in the interpretation of the hit rate variable, along with its inherent skewed distribution (due to the majority of respondents scoring a near perfect response rate), means that the reader should interpret the assessments of relationships with this particular QSHPT with caution.

Perceptions of the adequacy of the QSHPT in representing participant's probable real life driving reactions were generally positive with 70% of participants suggesting the test did this well or very well (rating of 4 or 5 on a 5-point likert scale where 1 was *not at all* and 5 was *very well*).

Just as participants had a significantly more positive perception of their own driving skill compared to others in the cohort, a significant positive bias in perceptions of performance on the QSHPT was also found. Specifically, participants rated their own performance on the QSHPT overall at 7.47 (*SD* = 2.09) while anticipating that other drivers of their cohort would rate at 6.25 (1.87), t (96) = 5.45, $p < 0.001$. This result was based on the same 11 point scale as used for the driving skill items where 1 = *bottom 10%,* 6 = midpoint and 11 = *top 10%.*

Participants also rated their own performance as well as providing a rating for the imagined performance of their cohort as a whole in terms of the rapidity of their response to the hazards in the QSHPT. An 11-point likert scale was used to represent the continuum where 1 equated to a very early response and 11 a very late response. Ten clips from the QSHPT were rated and an average rating obtained. On average, participants placed themselves at 3.76 (*SD* = 1.58) on this scale while rating their cohorts' probable performance significantly slower at 4.79 (*SD* = 1.45), t (95) = 8.33, $p < 0.001$.

Demographic differences in hazard perception test performance

Participant age was quite strongly related to performance on the QSHPT correlating with mean reaction time on the test at 0.46 ($p < 0.001$). While based on a slightly different version of the QSHPT, the age-related differences in performance of the participants in the current study closely match that of participants in a study by Horswill et al. (2009). Horswill et al (2009) compared participants in differing age brackets on QSHPT. They found that their 34 participants aged 65-74 had a mean reaction time of 3.50 (compared to 3.49 for the 78 participants in the current study in the same age bracket), and their 23 participants aged 75-84 had a mean reaction time of 3.90 (compared to 4.11 for the 16 participants in the current study). The current study additionally had two participants aged over 84 who collectively scored a mean reaction time of 6.78. It is clear from these findings that hazard perception ability decreases with age.

There were no gender differences in hazard perception test performance in the current study. In fact, performance was very consistent between the genders on both the mean reaction time (Males *M* = 3.66, *SD* = 1.54; Females = 3.66, *SD* = 1.25) and hit rate (Males *M* = 90%, *SD* = 10.5%; Females *M* = 90%, *SD* = 8.1%).

Relationship between hazard perception test performance and perceptions of driving ability

Driving experience variables displayed minimal or weak relationship to hazard perception test performance when measured by mean reaction time as shown in Table 5. Relationships to hit rate (proportion of hazards identified) were relatively weak but statistically significant but readers are reminded to interpret correlations based on hit rate with caution (as mentioned in the *Performance and perception of performance on the Queensland Spatial Hazard Perception Test* sub-section of the Results section).

Table 5.

Correlations between QSHPT performance and driving experience and frequency.

Variable	Correlation with mean reaction time to hazards	Correlation with proportion of hazards identified
Years since obtained license	0.12	- 0.15
Frequency drive on familiar roads	0.02	- 0.04
Frequency drive on unfamiliar roads	- 0.09	0.23 *
Frequency of extended trips	- 0.18	0.25 *
Annual kms driven over last three years	- 0.16	0.22 *
Hours driven per week	- 0.10	0.13

Notes: * $p < 0.05$; identified hazards were those that were responded to.

Table 6 displays the correlations between actual and perceived performance on the QSHPT test. As can be seen there were only weak correlations between perceptions of relative performance on the test and actual performance as well as perceptions of the rapidity. This result suggests that participants' perception of their performance has minimal accuracy.

Table 6.

Correlations between QSHPT performance and perceptions of performance on the QSHPT.

Variable	Correlation with mean reaction time to hazards	Correlation with proportion of hazards identified
Perception of overall performance on QSHPT compared to other Brisbane drivers	- 0.19	0.20
Perception of rapidity of response to selection of QSHPT hazards	0.10	- 0.15

Notes: identified hazards were those that were responded to.

Correlations between QSHPT performance and general and specific perceptions of driving ability are presented in Table 7. Perceptions of hazard perception while driving were completely unrelated to actual hazard perception performance as measured by the QSHPT via either score. The reported frequency of violations, errors and lapses while driving as measured by the DBQ were also unrelated to performance on the test. Self-assessment of vehicle control was also not related to hazard perception test performance. While a significant but weak relationship was noted between ratings of overall driving skill and proportion of hazards responded to, or hit rate, it should be borne in mind that this correlation is unlikely to represent the true relationship between the two variables due to the afore-mentioned ceiling effect for the hit rate variable. Finally, participants' perception of their comparative ability to judge their fitness to drive was also unrelated to performance on the test.

Table 7.

Correlations between QSHPT performance and perceptions of driving ability.

Variable	Correlation with mean reaction time to hazards	Correlation with proportion of identified hazards
Rating of overall driving skill	- 0.15	0.25 *
Mean rating of hazard perception ability	0.05	0.00
Mean rating of vehicle control ability	- 0.06	0.14
DBQ – Aggressive Violations	0.05	- 0.05
DBQ – Ordinary Violations	- 0.06	- 0.03
DBQ – Errors	- 0.19	0.06
DBQ – Lapses	- 0.03	- 0.06
Awareness of fitness to drive compared to other Brisbane drivers	- 0.08	0.03

Notes: * $p < 0.05$; identified hazards were those that were responded to. DBQ = Manchester Driver Behaviour Questionnaire. DBQ subscale scores are shown.

Relationship between hazard perception test performance and avoidance of and confidence in driving in potentially dangerous driving conditions

It is of interest to see whether participants' confidence in their ability to handle more difficult driving conditions relates to better driving safety (as measured by performance on the QSHPT). As can be seen in Table 8 below, confident driving in these conditions was unrelated to hazard perception suggesting that decreases in hazard perception ability were not accompanied by a commensurate reduction in confidence in handling difficult driving conditions.

Perhaps even more pertinent to the questions posed by this study is whether reduction in hazard perception ability relates to increased avoidance of difficult and dangerous driving conditions. The minimal correlation between mean reaction time on the test and avoidance of driving in these conditions does not suggest that such compensatory or restriction of driving is occurring for the sample of older drivers tested for this study. A stronger (though still relatively weak) and statistically significant correlation between the proportion of hazards responded to and avoidance suggests there may be some appropriate restriction of driving going on, though this compensatory action is being conducted in far fewer cases than would be optimal. Again the reader is reminded to interpret this result with caution due to the nature of the hit rate variable and its likely influence on the statistics calculated.

Table 8.

Correlations between QSHPT performance and measures of driver confidence and avoidance.

Variable	Correlation with mean reaction time to hazards	Correlation with proportion of hazards identified
Mean avoidance of potentially dangerous driving conditions	0.14	- 0.28 **
Mean confidence in potentially dangerous driving conditions	- 0.05	0.15

*Notes:*** $p < 0.01$. Identified hazards were those that were responded to.

Attitudes to driving restriction or cessation

Given that the current approach to the management of driving retirement is voluntary license surrender it is constructive to examine how older drivers would react to suggestions they might consider a reduction or cessation of driving. Participants were asked how they would respond if this request was made of them. As outlined in Table 9, two thirds indicated that they would trust their own judgement in whether or not to follow this advice. Less than one in ten suggested they would restrict or stop driving. One in five respondents indicated they would seek additional advice, whether formally (via a medical professional or driving assessment) or informally (from family or friends).

Table 9.

Probable response to suggestion of restriction or cessation of driving.

Probable response	Percentage (n = 98)
Make an assessment of my own ability and make my own decision	66%
Go to a driving school or motoring association for a driving assessment	11%
Restrict my driving	7%
Seek advice from medical professional	3%
Seek opinion from family and/or friends	3%
Ask for evidence	3%
Ignore it	3%
Stop driving	1%
Other	2%

In terms of whose advice they would be most likely to act upon (see Table 10 below), four in ten participants reported they would restrict or cease driving if their GP advised it, while almost an equal proportion said they would listen to family members or their partner. Interestingly, less than one in five said they would act when faced with a direct assessment of their driving abilities by a driving authority.

Table 10.

Person/authority whose advice to stop or restrict driving would be acted upon.

Source of advice	Percentage (*n* = 98)
General practitioner	41%
Family member or partner	37%
Driving authority such as motoring association, driving tester	19%
Friend	5%
All advice	1%

Notes. Does not sum to 100%; multiple responses were allowed.

Only three of the participants indicated that it had been suggested to them that they should limit or stop driving. Two of these participants provided further information on this point. One participant indicated that it had been suggested by their family and they ignored their advice, while the other participant indicated that it had been suggested by family, friends and a medical practitioner and they chose to restrict their driving as a result.

DISCUSSION

The aims of this study were to examine the relationship between older drivers' self-rated driving skills and an objective proxy measure of driving ability, and to explore the relationship between driving self restriction and the proxy test.

The key finding from this study is that there are weak or non-existent relationships between hazard perception skills (as tested by the QSHPT) and perceptions of driving skill, and between the QSHPT and driving self-restriction (as measured by avoidance of hazardous driving conditions). This finding suggests that perceptions of driving ability do not accurately reflect actual driving ability, and that ability is not related to driving self-restriction. While moderate to strong inverse relationships between level of confidence in a selection of dangerous driving conditions and self-rated avoidance of the same conditions seem to suggest some association between these factors; these factors were both subjectively rated (i.e., perceptions). The fact that confidence was only weakly related to performance (i.e., objectively measured driving hazard perception) means these correlations need to be interpreted cautiously. Confidence may not be the ideal basis for decisions about driving avoidance, because of the absence of a relationship between confidence and ability.

The fact that very few participants suggested they would get some form of formal assessment of their driving ability if they were asked to stop driving and would instead mostly rely on their own judgement about the appropriateness of continuing to drive highlights the significance of these findings. This study suggests that self-assessment of driving ability is likely to be a poor basis for decisions about the need for driving self-restriction, and that such perceptions are typically overly positive.

This study also shows that instead of seeking an actual driving assessment to inform driving decisions, participants would prefer to seek a medical practitioner's advice with regards to driving reduction. This finding may suggest that older people would consider changing their driving behaviour for health reasons. That is, older people may be prepared to seek health information to inform their decisions about driving, and would seek a medical assessment of their fitness to drive in preference to an assessment of their actual driving ability. Alternatively, this finding may suggest that the source of such advice is important to older people and, in particular, that the doctor's advice on such matters is valued. In any case, this result is concerning as driving skill and in particular hazard perception ability (which relates directly to crash risk) could reduce to a sub-optimal level before more major health concerns develop and a doctor's advice regarding driving was sought.

In another study funded by the NRMA-ACT Road Safety Trust, Windsor, Walker and Caldwell (2006) found that while large proportions of the older drivers were generally aware of the impacts that a range of medical conditions, as well as prescribed and non-prescribed medications could have on driving ability, there was still a sizeable minority who were inadequately informed. The results of Windsor et al.'s (2006) study also suggested that the provision of information from general practitioners about the likely impact of medical conditions and medications on driving ability was lacking but that a general practitioner was by far the most preferred source of information about driving.

Together, these findings suggest that the majority of older drivers would trust in the advice given by their general practitioner on the subject of the likely impacts of medical conditions and medications on their driving as well as whether it would be advisable for them to restrict or stop driving. It may be possible to target greater awareness of health and age-related driving impacts by disseminating information via general practitioner clinics. Such information could include statements about driving self-restriction and driving self-assessment. However, this solution would miss those 'healthy' adult drivers who may already be experiencing performance decrements, and more research is needed in order to clarify the generalisability of the findings revealed in this study..

Additionally, the results of a study by Horswill, Kemala, Wetton, Scialfa, and Pachana (2010) may suggest that hazard perception among older drivers can be improved with training. If this study can be replicated, it suggests a possible alternate or complementary pathway to education. The current study provided yet more evidence that driver hazard perception deteriorates with age. It may be possible to restore older drivers to a more adequate level of driving skill through completion of driver training, potentially including a hazard perception element. Directly addressing driving performance, as opposed to influencing perceptions of driving confidence or ability (e.g., through education), may prove a more expedient means of responding to the difficulties of relying on older driver self-assessment of their driving ability.

This study has several limitations. These limitations related to sampling, as well as the conceptual aspects of this study. In terms of sample, while efforts were made to recruit participants of differing socio-economic and educational backgrounds it should be noted this sample has a relatively large proportion of people who are tertiary educated, urban dwellers/drivers. Therefore, the results of this study may not represent the results that would be derived from older drivers of differing education and socio-economic status levels or those who reside in regional or rural locations. Participants were also required to source their own transport to participate in this study and, as a consequence, it is possible that the sample includes a relatively active sub-group of the older driver population. It is unclear whether the responses of this sub-group can be translated to other older drivers who might be more reluctant to volunteer in such a study. Both of these limitations need to be borne in mind when interpreting results, although they are probably relatively minor limitations given the similarity of results on QSHPT among older adults in this and other studies.

A third sampling factor is that these findings are based on a sample of Brisbane drivers, and the extent to which results generalise to other states is unknown. There may be difference in state level education programs or policies that impact on older drivers that may mean that differences in relationships between driving variables would be obtained in other Australian states. It is acknowledged that both the Royal Automobile Club of Queensland (RACQ) in Queensland and the National Roads and Motorists' Association (NRMA) in New South Wales and the Australian Capital Territory offer extensive internet and print-based information, as well as seminars and driver assessments and training for older drivers. It is unclear the extent to which such resources were accessed by the participants in this study. Future studies could include an item to assess exposure to such factors.

A possible conceptual limitation of this study is that driving self-restriction was operationalised using a measure of driving avoidance, as is typical in the literature. However, driving self-restriction may encompass a range of other strategies, such as driving with a passenger, increased use of other transport, and so on. In this study, the reason why drivers avoided situations was inferred, but not explicitly tested. It may be important to investigate motivation for avoiding situations. It may also be important to verify self-reported avoidance, with objective measures of driving behaviour. Future studies may also wish to consider the 'other' situations that older drivers 'avoid' that were uncovered in this study, but are not typically assessed using the scale that we and many other researchers have used for this purpose (see *in press* publication from this study, preface).

Another direction for future research is to further explore the issues of restriction and cessation of driving based on current drivers' predictions on how they would handle that process. It would be informative to take a retrospective approach and speak to retired drivers about the process by which they stopped driving, or a prospective approach to track an unfolding process. Such studies could reveal the proportion of drivers who stopped driving based on self-assessment and what cues they took from their driving behaviour and other sources of information that lead to that information. Future research is needed to follow up on the data on the relationship between driving confidence, ability, and restriction, from this study.

CONCLUSION

Our data suggests that self-assessment of driving skill among older drivers may result in an inaccurate appraisal of actual driving skill. The majority of older drivers in this sample report that they would use such an appraisal process to make decisions about the appropriateness of their continued driving. It is important that ways of improving the accuracy of this self-assessment are explored, or that education about the limitations of relying on this approach is undertaken.

Driving ability and driving self-assessment was not related to confidence and avoidance in this study. This finding has implications for the reliance on self-restriction as a road safety countermeasure for older adults.

Although not directly tested in this study, methods of improving the accuracy of older drivers' self-assessment may include an education programme, potentially delivered partially via general practitioner clinics. In this study, the doctor's appraisal of driving safety was highly valued by participants, although medical assessments of fitness to drive are also not without their limitations. The availability of, and need for greater access to, refresher driving courses aimed at optimising older driver skill levels, including training to improve hazard perception, could also be considered.

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