Returning to driving post-stroke:

Identifying key factors for best practice decision making over the recovery trajectory

Annabel McNamara
Bch. App. Sc. (OT), MHsc., MBA

For the degree of Doctor of Philosophy

Department of Rehabilitation, Aged and Extended Care
School of Health Sciences
Flinders University
Adelaide, Australia
July, 2016

Word Count: 52,781

Table of Contents

Summary

The purpose of this thesis is to examine the process of returning to driving post-stroke in order to contribute to best practice decision making. A decision tree is suggested to build patient-centred procedures for returning to driving along the post-stroke recovery trajectory.

Part one reviews literature on the return to driving process post-stroke and identifies gaps in knowledge. The stroke recovery trajectory's three main phases of recovery (acute, rehabilitation and community care) are outlined and act as a framework for the thesis structure. Part two of the thesis describes five separate but related studies carried out to address the research gaps identified.

The first study is a qualitative study that examines attitudes and perceptions of stroke survivors from one to 16 weeks post-stroke. Independence was found to be the primary motivator in stroke survivors' decisions about fitness to drive. However, during the acute phase stroke survivors were focused on their physical recovery, not returning to driving. Study participants had little knowledge of return to driving procedures or legislation, despite information being available. Gender differences were apparent in factors affecting the return to driving decision making.

The second study examines the psychometric property of practice effect on the Useful Field of View (UFOV, Ball & Owsley, 1993) a pre-driving screening assessment. UFOV scores have been found to be associated with on-road driving assessment scores (George & Crotty, 2010) and used in medical recommendations. Study participants were all stroke survivors with a control group performing the UFOV at three months and assessment group at one, two and three months post-stroke. Findings suggest there was no practice effect in relation to a single three month post-stroke time point. Timing of reassessment was also examined.

The third study examined self-perceived driving confidence measured by the Adelaide Driving Self Efficacy Scale (ADSES, George et al., 2007; George & Crotty, 2010) and driving habits. Results indicated there was a significant statistical association between low self-perceived driving confidence and lower kilometres driven per week, reduce driving scope, driving closer to home and avoiding challenging driving situations.

The fourth study explored self-perceived driving confidence of post-stroke drivers and their non-stroke, aged-matched driving peers measured by the ADSES. No difference was found, suggesting once stroke survivors have returned to driving they have the same levels of self-perceived driving confidence and potential driving scope as their non-stroke driving peers.

The final study focused on decisions to relinquish a driver's licence among the older Australian general population and used a novel Discrete Choice Experiment (DCE) methodological approach. A general population was used to establish a norm with which future research on specific chronic conditions such as stroke could make comparison. Recommendation of General Practitioners' (GPs), participants' local doctors was found to be the primary influencing factor in the decision of older Australians to relinquish their driver's licence. Advice from family and friends, age and crash risk in the next year were also influencing factors. The costs and availability of public transport options were not influencing factors.

The last chapter of this thesis is the Discussion section which identifies the common themes emerging along with limitations and recommendations for future research directions.

Publications arising from this research

Refereed manuscripts

McNamara, A., Chen, G., George, S., Walker, R. & Ratcliffe, J. (2013). What factors influence older people in the decision to relinquish their driver's licence? : A discrete choice experiment. Accid Anal Prev, 55:178-184. doi:10,1016/j.aap.2013.02.034.

McNamara, A., Ratcliffe, J. & George, S. (2014). Evaluation of driving confidence in post stroke older drivers in South Australia. Australas J Ageing, 33:3:205-7. doi:10.1111/ajag.12117.

McNamara, A., McCluskey, A., White, J. & George, S. (2014). The need for consistency and equity in driver education and assessment post-stroke. J Transp Health, 1:2:95-99. doi:10.1016/j.jth.2014.02.002.

McNamara, A., George, S, Ratcliffe, J. & Walker, R. (2015). Older people's attitudes toward returning to driving in the first four months post-stroke. Australas J Ageing, 34:1:E13-8. doi:10.1111/ajag.12135.

McNamara, A., Walker, R., Ratcliffe, J. & George, S. (2015). Perceived confidence relates to driving habits post-stroke. Disabil Rehabil, 37:14:1228-33. doi:10.3109/09638288.2014.958619.

Conference presentations

McNamara, A. (2010). Driving after a stroke: A snapshot of the first four months post-stroke. Poster presentation. Victorian State Occupational Therapy Conference, Melbourne, Australia.

McNamara, A. (2011). Confidence driving post-stroke and its effects on driving habits. Oral presentation. Australasian Stroke Conference, Adelaide, Australia.

McNamara, A. (2012). Confidence driving post-stroke and its effects on driving habits. Poster presentation. 7th World Congress of Neurology Rehabilitation, Melbourne, Australia.

McNamara, A. (2013). Driving after a stroke: A snapshot of the first four months post-stroke. Oral presentation. National Occupational Therapy Conference, Adelaide, Australia.

McNamara, A. (2013). Confidence driving post-stroke and its effects on driving habits. Oral presentation. National Occupational Therapy Conference, Adelaide, Australia.

McNamara, A. (2013). What factors influence older people in the decision to relinquish their driver's licence? : A discrete choice experiment. Oral presentation. National Occupational Therapy Conference, Adelaide, Australia.

McNamara, A. (2013). Test retest reliability of the Useful Field of View assessment with stroke survivors. Poster presentation. National Occupational Therapy Conference, Adelaide, Australia.

Declaration

I was involved in the design of the following research studies including the completion and submission of ethics approval applications.

Literature reviews search strategies were developed in consultation with Nikki May, the Health Sciences consultant librarian at Flinders University.

Upon commencement of the studies, I was solely responsible for screening potential patient participants for eligibility, recruitment and conducting the data collection, including; interviews in the qualitative study in the acute phase of stroke recovery, collecting UFOV Assessment scores for the rehabilitation phase study and telephone interviews for the Driving Habits Questionnaire (DHQ) for the community phase study. The questions for the Discrete Choice Experiment (DCE) study were selected in consultation with my supervisors and an experienced rehabilitation physician, Professor Maria Crotty. I was assisted in the statistical design for the DCE study by my supervisors and Dr Gang Chen, Flinders University.

I was responsible for the data entry of all studies data. I was involved in all data analysis and interpretation of results with the advice of my supervisors and assistance from Dr Chris Ball, Flinders University, for the UFOV study and Dr Gang Chen for the DCE study.

During these studies I was supported financially with a Flinders University Research Scholarship and had financial support from the Repatriation General Hospital Foundation for the UFOV practice effect research in the rehabilitation phase study.

I certify that this thesis does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any university, and that to the best of my knowledge and belief it does not contain any material previously published or written by another person except where due reference is made in the text;

Annabel McNamara

Acknowledgments

The work presented in this thesis could not have been completed without the unwavering support of my supervisors: Associate Professor Stacey George, Professor Julie Ratcliffe and Dr Ruth Walker. Thank you for all you have taught me, for sharing your experience and knowledge, and for your support and encouragement. In particular, I would like to thank Stacey George, who was my principal supervisor, for her extremely helpful feedback and advice which greatly improved the quality of my work, and above all to thank her for her patience and perseverance with me.

To Professor Maria Crotty, thank you for giving me the opportunity to complete my PhD in the Rehabilitation Department at the Repatriation General Hospital, Adelaide.

For the acute phase, qualitative study, thanks to John Stanfield, stroke nurse, who helped with access to patients and patient records, allowing me to conduct recruitment for this study. Also, thanks must go to the staff of the Rehabilitation Wards A and B at The Repatriation General Hospital for their support.

For the rehabilitation phase, UFOV study I must acknowledge help from Dr Andrew Lee, Head of the stroke ward and Natasha Reid, Charge Nurse at Flinders Medical Centre, for allowing me to recruit patients for this study. Thanks must also go to Claire Morris, Program Manager of the Rehabilitation in the Home (RITHOM) program and Emma Mills, Manager of the Day Rehabilitation area at the Repatriation General Hospital for helping me with access for recruitment for the UFOV study.

For the rehabilitation phase UFOV study and the community phase DCE study; my thanks are extended to Dr Chris Barr and Dr Gang Chen respectively for their invaluable statistical advice and assistance. Also during the community phase for the DHQ study I would also like to acknowledge the support and assistance of the Occupational Therapy Department and, in particular, Mr. Brad Williams, Driving Occupational Therapist at The Repatriation General Hospital for assistance in allowing me to access the Driving Assessment Unit files.

For all of my studies conducted towards this PhD I would like to thank the participants and their families for agreeing to take part, and contribute to knowledge and understanding of the topic of driving post-stroke.

Acknowledgment must also be made to Dr Diane Brown, who professionally edited this thesis within the guidelines of Flinders University and the Australian Standards for Editing Practice (2013).

I would like to acknowledge my PhD candidate colleagues Leah Couzner and Rachel Milte for their friendship and constant support during my PhD studies.

Finally, my gratitude must go to my husband, my children and my parents for their love and constant encouragement and to my Uncle Frank for reminding me never to quit.

List of Figures

List of Tables

List of Abbreviations

ADL – Activities of Daily Living

ADSES – Adelaide Driving Self Efficacy Scale

AIHW – Australian Institute of Health and Welfare

DCE – Discrete Choice Experiment

DHQ – Driving Habits Questionnaire

GP – General Practitioner

MMSE – Mini Mental State Exam

NIHSS – National Institute for Health Stroke Scale

NSF – National Stroke Foundation

RITHOM – Rehabilitation in the Home

SA – South Australia

SACHREC – Southern Adelaide Clinical Human Research Committee

SAFUHREC – Southern Adelaide Health Service/Flinders University Human Research Ethics Committee

SDSA – Stroke Drivers Screening Assessment

TMT – Trail Maker Test

UFOV – Useful Field of View

USA – United States of America

VKT – Vehicle Kilometres Travelled

WHF – World Heart Federation

WHO – World Health Organization

Chapter One: Introduction

1.1 Implications of inconsistent returning to driving process in Australia

With increasing numbers of older people experiencing stroke in the future (WHF, 2015) there are likely to be larger amounts of older people faced with the decision about whether to return to driving post-stroke. In turn, this will place pressure on existing driving assessment services and licensing authorities in order to adequately address road safety issues. The potential for more post-stroke drivers on the roads not formally being assessed exists. It is therefore imperative that Australia has a clear, equitable and best practice approach towards the process for returning to driving post-stroke.

1.2 Overview of thesis

Neurological and functional recovery post-stroke occurs in three phase; acute, rehabilitation and community (Kiran, 2012). This thesis is structured to reflect these three phases and presents studies on the returning to driving process post-stroke in each of the three phases. The main objective of this thesis is to contribute to best practise decision making for future intervention strategies in the return to driving process post-stroke in Australia and overseas.

1.3 Research aims

The research reported upon in this PhD thesis aims to contribute a more detailed understanding of the process associated with returning to driving post-stroke, providing insights from our local experience in Adelaide, Australia in order to inform best practice guidelines and reduce inconsistencies. Stroke survivors aged over 65 years have been identified as the main focus of the research reported upon in this thesis as they represent the majority of stroke survivors (Australian Institute of Health and Welfare, AIHW, 2014). The four main aims of this thesis are:

- to further explore the perceptions and attitudes about driving post-stroke that currently exist in stroke survivors during the acute phase of their recovery trajectory;
- to explore an objective cognitive measure, used over a three month time frame to determine its potential to map the trajectory of recovery to indicate timing of an on-road assessment. The specific psychometric property of practice effect was examined on the pre-driving screening assessment, the Useful Field of View (UFOV, Ball, Beard, Roenker, Miller & Griggs, 1988);
- to identify driving habits once stroke survivor's returning to driving, whether they differ from non-stroke drivers and to examine the specific influence confidence might have on these behaviours; and
- to contribute to knowledge on the topic of the decision to relinquish a driver's licence in older Australian drivers. This will allow health care professionals to differentiate between usual factors in deciding to relinquish a driver's licence in older age and added factors that may result from medical conditions such as stroke.

1.4 Research questions

In order to achieve these aims this PhD thesis presents and discusses the findings of research undertaken to address the following research questions (RQ).

RQ1: What are the perceptions of older people toward driving post-stroke in the early stages of stroke recovery, and how might this inform content and timing of post-stroke driving education?

RQ2: Is there a practice effect at one month intervals, for three months, for the UFOV assessment (Ball et al., 1988) in an older Australian, post-stroke population?

RQ3: Are self-perceived driving confidence levels lower in the post-stroke driving population compared to their aged-matched non-stroke driving peers?

RQ4: Are self-perceived confidence levels associated with self-regulation of driving in the post-stroke population?

RQ5: What is the relative importance of key factors (driving confidence, crash risk, age, general practitioner's or family and friend's recommendations to cease driving, and the cost and availability of other transport options) to an older Australian's decision to relinquish their driver's licence?

1.5 Overview of chapter contents

Chapter One of this theses provides an introduction and overview of the thesis and an outline of the thesis structure and research aims. Chapter Two then presents the literature review which discusses driving in older Australians, including regulations, limiting driving and driving cessation. The literature pertaining to driving post-stroke is also reviewed followed by the process of returning to driving in the post-stroke population throughout the recovery trajectory.

Chapter Three describes the first study examining older people's attitudes toward resuming driving in the acute phase post-stroke in Adelaide, Australia which is detailed in this chapter including design, methods and results.

The second study examines one of the psychometric properties of the UFOV assessment: a standardised pre-driving screening assessment which is currently used in clinical practice by occupational therapists in Australia during the rehabilitation phase of recovery post-stroke. This study examines whether or not there is a practice effect evident when using the UFOV once a month for three months post-stroke, which correlates with timing of pre-driving

assessments due to current Australian driving post-stroke regulations. Study design, methods and results are discussed.

The final three studies examine issues that arise post-stroke in the community phase of recovery. The third and fourth studies examine the impact of confidence when driving post-stroke. Firstly, the third study in Chapter Five examines whether post-stroke driver's confidence levels differ from non-stroke drivers of aged-matched peers. Study design, methods and results are discussed. The fourth study examines driving habits of post-stroke drivers and potential influence of confidence. Study design, methods and results are discussed. The fifth and final study examines what factors contribute to older Australian drivers deciding to relinquish their driver's licence. Study design, method and results are discussed.

In the final chapter the major findings are summarised and discussed with reference to current knowledge and research. Limitations for each study and overall are discussed. Implications for clinical practice and policy in view of the results from this thesis are discussed along with recommendations for future research directions.

`Chapter Two: Literature Review

2.1 Introduction

Stroke is Australia's second biggest killer after coronary heart disease and a leading cause of disability (Australian Institute of Health and Welfare, AIHW, 2014), with the mean age of first ever stroke in Australia in 2000–2001 being 77 years (AIHW, 2014). Accordingly, the number of people experiencing stroke is predicted to continue to increase in Australia and internationally due to the ageing of the population, and will see a consequential increase in those living longer with chronic diseases including stroke (AIHW, 2014). It is therefore likely there will be a commensurate increase in the number of stroke survivors who face the decision about whether to return to driving. The scope of this literature review aims to examine the current evidence relating to the process of returning to driving post-stroke and the decision to relinquish a driver's licence both within Australia and internationally. Driving in older Australians is explored in order to inform driving in stroke survivors, as two-thirds are over the age of 65 years (AIHW, 2014). History of research on driving post-stroke will be examined and issues that influence the trajectory of recovery for stroke survivors considering returning to driving follow.

2.2 Previous research on driving post-stroke

Initial research on the relationship between driving safety and older drivers was conducted in the 1960s and tended to be more generically than specifically focused upon particular populations of older people such as stroke survivors. Findings from research in the 1960s found that relative to younger drivers, older drivers tended to have fewer crashes overall but they also tended to drive less with more crashes per mile driven (Finesilver, 1969; Smeed, 1968). In the 1970s and 1980s the focus of research on this topic shifted towards a more detailed consideration of what it was about the ageing process that contributed to increased risk for older drivers. Age-related functional deficits were found to be the main reason for increased crash risk (Evans, 1988). However, older drivers were found to be less likely to be reported for speeding or drink driving and were more likely to wear seatbelts (Evans, 1988). In the 1990s research continued to focus upon safety issues related to older drivers but also began to consider the broader issues of transportation and mobility needs (Ball et al., 1998;

Hakamies-Blomqvist & Whalstrom, 1998; Marottoli et al., 1993; Safe Mobility for Older Americans, 2005).

More recently, within the last two decades, a large body of research has been conducted about the development of off- and on-road assessment methods for assessing the fitness to drive of older people in general, and in more specific conditions such as stroke (Akinwuntan, Feys & De Weerdt, 2002; Bouillon, Mazer & Gelinas, 2006; Devos et al., 2011; Fisk et al., 1997; Unsworth, Pallant, Russell, Germano & Odell, 2010). Fisk et al. (1997) examined the prevalence of driving post-stroke, the evaluation process and advice stroke survivors and their families had received about returning to driving. Fisk et al (1997) research focused on the post-stroke evaluation process, and usually from the health professional's perspective. Currently, there is a lack of research considering attitudes and perceptions of all stakeholders, and more specifically those of stroke survivor's themselves about the decision to return to driving post-stroke. However such information is vital to facilitate informed decisions about best practice treatment interventions and patient-centred assessment processes.

2.3 Incidence of stroke

Demographic data worldwide, both in Australia and overseas, indicates that there will be growth in older populations over the coming decades as people over the age of 65 years reach retirement (Desapriya et al., 2014). Thus as populations worldwide age, there will be increasing numbers of older people with chronic health issues facing the decision as to whether to continue to drive. One such health issue older drivers are predicted to experience in larger numbers more than ever is stroke (National Stroke Foundation, NSF, Clinical Guidelines for Stroke Management, 2010). The incidence of stroke worldwide is reportedly 15 million with six million of these people dying, five million being left permanently disabled and four million recovering (World Heart Federation, WHF, 2015). In Australia in 2015 there are 440,000 people living with the effects of stroke and this is predicted to increase to 709,000 in 2032 (NSF, 2015). Given this environment, health care professionals will need to be informed about how best to support stroke survivors in return to driving process or in their decision to cease driving, and in making the psychological and functional adjustments needed to utilise alternative transport options.

2.4 Rates of returning to driving post-stroke

Returning to driving post-stroke has been shown to reduce the likelihood of community isolation and depression for the stroke survivor (White et al., 2012a). Research on the percentage of stroke survivors who return to driving post-stroke is perhaps most reflective of the effectiveness of health care interventions in returning stroke survivors safely to driving and avoiding poor outcomes such as social isolation and depression. In Australia returning to driving post-stroke figures are low with one Australian study showing rates to be as low as 19% (Allen et al., 2007). Allen, Halbert and Huang (2007) examined returning to driving rates in 53 stroke patients admitted to a specialised rehabilitation ward in Adelaide, South Australia over a period of six months. On admission participants were surveyed and case notes reviewed for notations about driving and actions taken about driving during admission. Twenty-six of the 53 participants with a mean age of 77.0 years (SD, 10.7 years), were current drivers on admission. On discharge 12 of the 26 drivers had their licence cancelled, 11 were sent for medical review, two were sent to a driving trained occupational therapist for assessment and one was advised not to drive for six weeks. Six months post-stroke the researchers telephoned the participants and asked if they were driving and if not, why. It was found that only five of the 26 original drivers held a current driver's licence. However, it was reported that this proportion was higher than the South Australian rate (at the time of the study) of less than 10% of people in the general population aged 75 years and older holding a current driver's licence (Allen et al., 2007). Allen et al. (2007) concluded that the low rate of returning to driving in this post-stroke population may represent a lack of formal assessment, GP tools for fitness to drive decision making and driver rehabilitation opportunities in Australia. This low figure for the returning to driving rate post-stroke in this Australian study would suggest that multiple clinical and social needs remain unmet and continue long after stroke rehabilitation occurs (McKevit, 2011).

Overseas studies report much higher rates of returning to driving post-stroke with rates between 30-68% reported (Fisk et al., 1997; Lee et al., 2003; Legh-Smith et al., 1986; Perrier et al., 2010a; Tan et al., 2011). One American survey of 300 stroke patients between three months and six years (average 2.9 years) post-stroke found that only 30% of stroke survivors had returned to driving (Fisk, Owsley & Pulley, 1997) in the longer term. It is important to consider that variability in rates of return to driving data is likely to be dependent on and

influenced by when data is collected on the recovery continuum, and types and intensity of interventions available to stroke survivor study participants during their recovery process.

2.5 Older Australian drivers and the regulatory process

The regulatory process related to older drivers in Australia varies between states. Currently in South Australia driving regulations state that South Australian drivers, 70 years of age and older, are no longer required to have mandatory medical testing each year for their car licence, if they do not have a medical condition that affects their fitness to drive. If an individual is 85 years of age or older and holds a class of licence other than a car licence; they need to pass a practical driving test each year to retain that class of licence. No driving test is required if you only wish to hold a car licence (Government of South Australia, Department of Transport, Travel and Motoring, 2015b). There are currently no standardised regulations nationwide governing the driving status of older people.

A number of Australian studies have investigated the effectiveness of age based mandatory licence programs for reducing older driver crash risk (Langford, Bohensky, Koppel & Newstead, 2008; Langford, Fitzharris, Koppel & Newstead, 2004a; Langford, Fitzharris, Newstead & Koppel, 2004b; Torpey, 1986). Findings showed that crash rates in older drivers were not different for those states that did not have mandatory testing of older drivers (Langford et al., 2008; Langford et al., 2004a).

2.6 Current Australian process for returning to driving post-stroke

National guidelines in Australia recommend that people who have survived a stroke are not to drive for at least one month (Austroads, 2012, see Appendix II). At one month post-stroke if there is concern about the stroke survivor's ability to drive, they are then required to obtain a certificate of fitness to drive which is completed by a medical practitioner who is usually the stroke survivor's general practitioner (GP). To gain a fitness to drive certificate in Australia, stroke survivors are required by law to meet the vision guidelines which are 6/12 visual acuity and 120 degrees of binocular vision. The fitness to drive is assessed by the GP during a medical consultation. In the event that the GP has any concerns about the stroke survivors driving ability they can then refer the stroke survivor to an occupational therapist for a

driving assessment, and if necessary for further driving rehabilitation (Austroads, 2012, see Appendix II). What actually happens to stroke survivors after the one month period currently in Australia is variable and inconsistent (Unsworth & Baker, 2014).

2.7 Recovery trajectory

Recovery post-stroke is often a long, slow process. Research has shown that most functional recovery happens in the first six months post-stroke (Bonita & Beaglehole, 1988; Duncan, Goldstein, Matchar, Divine & Feussner, 1992; Hendricks, van Limbeek & Geurts, 2002). Bonita and Beaglehole (1988) studied 680 New Zealand stroke survivors with an equal proportion of mild, moderate and severe motor deficits. Results showed that at six months, 76% of those post-stroke participants who had survived had either none or only mild motor deficits. A British study, which examined the functional performance of 976 stroke survivors, also showed good recovery for the majority of stroke survivors with over 45% of participants at six months post-stroke being functionally independent in ADL skills and some recovery occurring for all participants between three weeks and six months post-stroke (Wade & Hewer, 1987). Teasell, Bayona and Bitensky (2013) defined recovery after stroke as either functional or neurological. Functional recovery covers a wide collection of improvements, being explained as "more multi-faceted and influenced by rehabilitation" (p. 8) whilst neurological recovery is explained as "a result of the brain repairing and reorganising itself" (p. 8).

With advances in medical imaging techniques, health care professionals are now able to view and monitor changes in the brain post-stroke enabling a better understanding of the natural recovery trajectory and the link with these changes to functional improvements in stroke survivors (Nudo, 2013). Kiran (2012) described recovery of brain function after stroke as occurring in three overlapping phases. The first phase is the acute phase which lasts for approximately two weeks post-stroke. This phase of recovery is thought to occur due to reperfusion of the ischemic area of the brain damaged by the stroke and a reduction in oedema also attributed to the stroke (Barbar et al., 1998; Dombovy, 1991). The sub-acute phase follows and is usually considered to last for approximately six months after the onset of the stroke (Kiran, 2012). During this second phase of neurological recovery post-stroke it is thought that due to the brain's neuroplasticity there are new neuronal networks built and

transfer of function to other areas of the brain as these new neural pathways are developed (Dombovy, 1991; Johansson, 2000; Silbeck, Wade, Hewer & Wood, 1983). Finally there is the chronic phase following the sub-acute phase, which is thought to last for months or years post-stroke or may even continue for the rest of the stroke survivor's lifespan (Kiran, 2012). During the chronic phase of recovery stroke survivors gradually accommodate their disability as a result of their stroke and learn compensatory techniques to enhance functional abilities although psychological recovery can often take much longer and last a lifetime. Kiran (2012) suggests that the most recovery in the brain post-stroke is likely to occur in the first three to six months. Rehabilitation aims to stimulate and enhance neural recovery and encourage transfer of responsibility of functions previously carried out by the area of the brain damaged by the stroke.

Rehabilitation post-stroke is usually provided according to the arrangement of health care facilities of acute, rehabilitation and community services administered for the care and rehabilitation of stroke survivors. This arrangement of health care services is based on a stroke survivor's functional recovery. Functional recovery occurs alongside the natural trajectory of neurological recovery of the stroke survivor.

During the acute neurological recovery phase over the first two weeks post-stroke, stroke survivors in Australia are usually cared for in acute hospital facilities. As neurological recovery occurs, stroke survivors are moved to rehabilitation health care facilities or home, depending on the severity of the stroke. The move from an acute to rehabilitation facility or home often occurs around the neurological recovery from acute to sub-acute time frame described by Kiran (2012). Decisions about transfers from one facility to another involve the stroke survivor's functional state, the stroke survivor's wishes and family support as well as bed availability at the rehabilitation facility. Often stroke survivors are considered functionally ready to move from the acute to the rehabilitation phase when they begin to stand and take some steps. Functions such as continence and learning capacity are also considerations of transfer from an acute health care facility to a rehabilitation facility.

From the rehabilitation facility stroke survivors then get discharged home, often with ongoing outpatient rehabilitation programs that are either conducted at the rehabilitation health care facility through outpatient programs or through community health care services. Timing of discharge into the community phase of recovery is determined mainly by the functional recovery of the stroke survivor and formal and informal support services available, but in the majority of cases in Australia discharge does occur within six months post-stroke (NSF, Clinical Guidelines for Stroke Management, 2010 p. 43). This move from the rehabilitation phase to the community phase of recovery also generally correlates to Kiran's (2012) description of neurological brain recovery, but movement through the different stages of health care differs for individuals depending on the impact of their stroke and their individual circumstances. Functionally, the aim is to have stroke survivors as independent as possible in their own self-care activities on returning home to the community. If this is not possible at the time of discharge home, training is provided to carers and community services are arranged in order to reduce carer burden. The decision to discharge home is often made when there appears to be a plateau in recovery, but when recovery is sufficient for the stroke survivor and their carers to cope with activities of daily living requirements at home with the support of community services and appropriate equipment provisions. For a few stroke survivors living at home is not possible and they are cared for in residential care facilities.

Driving is not always a priority during the acute phase of recovery, but driver's licences may be suspended if a doctor finds it appropriate at the time of admission or during the acute phase of treatment in keeping with the Australian medical guidelines, Austroads (2012, see Appendix II). Stroke survivors in the acute phase of their recovery are beginning their neurological and functional recovery, are still being assessed medically and functionally and being treated to stabilise their condition in order to maximise their recovery. The NSF Clinical Guidelines (2010, see Appendix I) suggest post-stroke driving education occur in the early stage of recovery, however, this is not currently a standardised practice Australia wide. Rehabilitation focused on returning to driving in Australia is usually commenced during the rehabilitation phase of functional recovery which for some stroke survivors still conforms to Austroads (2012, see Appendix II) regulations which state some stroke survivors can return to driving one month post-stroke providing they are assessed by a medical practitioner as fit to drive. Driving rehabilitation of post-stroke drivers can be in the form of off- road driving skills training, pre-driving assessment and post-stroke driving education. Occasionally on-

road driving assessments can occur whilst the stroke survivor is still an inpatient at a rehabilitation health care facility, but usually happens once they have been discharged back into the community. Driving rehabilitation also continues in the community after discharge from the rehabilitation health care facility in the form of driving lessons and off and on-road driving assessment, by driver trained occupational therapists and specialized driving instructors (NSF, 2010, see Appendix I). There is a lack of consistency in the process of helping post-stroke drivers in Australia to return to driving.

Driving post-stroke is one step in the recovery trajectory and facilitation of a return to driving post-stroke helps assist in this recovery and interrupts the progression to depression and further illness (White et al., 2012a). This link between the recovery process and independence highlights the need to have a better understanding of the post-stroke recovery trajectory and complexities of the adjustment process (White et al., 2012a). Developing an informed understanding of the post-stroke recovery trajectory can provide insights into progression and resolution of recovery and assist with the planning of appropriately timed service delivery (Murray et al., 2009), reducing the likelihood of further subsequent disability (Szczerbiriska, Topinkova, Ceremnych, Gindin & Magg, 2010).

2.8 Acute phase

In the acute phase of recovery post-stroke, stroke survivors are often faced with decisions about returning to driving early on in their recovery trajectory (Chua, McCluskey & Smead, 2012). Regulations in Australia enable some stroke survivors to return to driving at one month post-stroke (Austroads, 2012, see Appendix II). For some stroke survivors this is when they are still in an acute hospital, for others it occurs while they are in rehabilitation programs and others have already returned home to the community at one month post-stroke. The timing of decision making about returning to driving post-stroke is potentially affected by the individual's recovery trajectory, and the professional support and services they and their families are exposed to at the time of this decision making (Chua, McCluskey & Smead, 2012). One way of understanding how best to support stroke survivors and their families in making this decision is to know more about the decision making process from all stakeholders' perspectives.

2.8.1 Post-stroke driving education

Many stroke survivors and their families do not receive information or education on the return to driving process and alternative transport options both in the short and long term post-stroke (Chua, McCluskey & Smead, 2012). Timing of post-stroke driving education by health care professionals occurs in the early weeks of recovery and is driven by regulations, not based on whether or not the stroke survivor is ready to absorb or able to retain this information. Existing guidelines in Australia (Austroads, 2012, see Appendix I; NSF, 2010, see Appendix II) do recommend post-stroke driver education but despite this recommendation, stroke survivors and their families are often given inconsistent and inadequate advice about returning to driving which results in stroke survivors having limited knowledge of driving regulations, and limited access to services which can result in considerable costs being involved in retraining and regaining their driver's licence (Chua et al., 2012; White et al., 2012a). Overseas research reflects this inconsistency with only 15% of people in one American study who wished to return to driving post-stroke receiving comprehensive driving evaluation and advice, potentially putting those not assessed or informed and the public at risk (Fisk et al., 1997).

Stroke survivors and their families are often unaware of the formal procedures concerning returning to driving, particularly when the topic of relinquishing their driver's licence has not been addressed by a health professional (Fisk et al., 1997). Anecdotal reports and some published data suggest that stroke survivors and their families, both in Australia and overseas, often make decisions about returning to driving without professional advice or evaluation and with limited or no knowledge of driving legislation (Carter & Major, 2003; Chua et al., 2012; Fisk, Novack, Mennemeier & Roenker, 2002a). As a consequence many are left making the decision concerning returning to driving themselves (Fisk et al., 1997). The validity of these decisions are questionable given that many stroke survivors have been shown to have limited awareness of their own abilities and disproportionately overestimate their actual driving competence (Patomella, Kottorp & Tham, 2008; Scott et al., 2009). Research by Fisk, Owsley and Pulley (1997) found that participants who were given advice on returning to driving process post-stroke were six times more likely to do so when compared with stroke survivors who were not given driving advice. These results suggest that driving advice

should be standard practice prior to discharge and continue once the stroke survivor has returned to the community (Finestone et al., 2010; Fisk et al., 1997).

In 2014 an audit of 111 rehabilitation facilities across Australia where treatment of stroke survivors took place which investigated how well clinical guidelines are being adhered to across Australia (NSF Rehabilitation Audit, 2014). Advice to post-stroke drivers is recommended in the NSF Clinical Guidelines 2010, (refer to Appendix I) and ninety percent of the 111 rehabilitation facilities in the audit had documented that patient education sessions had occurred with 97% of these sessions involved post-stroke driving education. However, driving education only occurred if the stroke survivor stated that they wanted to return to driving. None of these rehabilitation facilities reported the content of their post-stroke driving education sessions or evaluation of whether the information was retained by the stroke survivors. There does appear to be a gap in targeted interventions that consider attitudes and perceptions about returning to driving post-stroke that may prove to be barriers. The content and timing of driving education was not considered in the NSF National Stroke Rehabilitation Audit (2014) or whether driving education interventions addressed factors, such as gender or confidence, in returning to driving decision making.

Little information is available in Australia concerning what stroke survivors and their families want in terms of assistance in addressing the issue of driving post-stroke in the acute phase of their recovery. One Australian study (Lister, 1999) considered the experiences early post-stroke of three older people on discharge from hospital. Semi-structured interviews revealed that the significance of the loss of a driver's licence was realised more on returning home from hospital than at the time they were told. Study participants reported the unexpected nature of their driver's licences being revoked and feelings of loss, lack of control and independence.

Overseas studies have found similar issues about driving education post-stroke (Heikkila et al., 1999). Heikkila, Korpelainen, Turkka, Kallanrante & Summala (1999) identified the shortfall in stroke survivors and their family's understanding and insight of the stroke survivors actual driving abilities, and the extent to which they might affect decisions about

driving. Twenty male stroke survivors and 20 aged-matched non-stroke male peers were assessed using clinical examination by a neurologist and a multidisciplinary team consisting of an occupational therapist, physiotherapist, speech pathologist and neuro-psychologist for fitness to drive. A traffic psychologist then assessed both the control and assessment group using cognitive and psychomotor lab tests such as the visual short term memory test, the perceptual flexibility and decision making test, a vigilance test and the complex choice reaction time test (Heikkila et al., 1999). The tests performed were computer aided driving related laboratory tests that have previously shown to correlate with driving ability measured by on-road driving assessments (Heikkila et al., 1999). After these assessments, stroke survivors and their spouses were asked to estimate the stroke survivor's driving ability on a 10-point scale. The stroke survivors and their families had a clear tendency to overestimate the stroke survivor's driving ability compared with the neurologist and the traffic psychologist. The neurologist and traffic psychologist estimations of driving ability based on the laboratory test results correlated significantly with each other, but were not significantly correlated to the patient estimations (Heikkila et al., 1999). Conclusions drawn from this study recommended driving ability is evaluated post-stroke, and that stroke survivors and their families may need to be educated to increase insight.

In Australia, there appears to be a lack of research on the stroke survivor's perspective in regards to driving post-stroke. However, such research is important to inform service delivery and to ensure patient-centred education. Further research is also important for health care professionals to understand optimal timing for post-stroke driving education to be implemented, and to find out how best to support stroke survivors in their decisions about driving and alternative mobility options. Therefore a study has been included in this thesis that considers attitudes and perceptions of stroke survivors in the acute phase of recovery. Factors examined include what stroke survivors are focused on during the acute phase of their recovery with an aim to inform timing and content of post-stroke driving education.

2.9 Rehabilitation phase

Once a stroke survivor has moved from the acute phase of recovery and is more medically stable, the rehabilitation phase of the stroke recovery trajectory usually begins. Kirkevold (2002) suggested there are two phases in stroke rehabilitation. The first phase is initial

rehabilitation that occurs up to eight weeks post-stroke and usually takes place in the rehabilitation unit. The second phase of rehabilitation continues as an outpatient in the patient's home and on visits to an outpatient rehabilitation facility for up to six months post-stroke (Kirkevold, 2002). Stroke survivors and their families are often starting to come to terms with disability as a result of the stroke during the rehabilitation phase and the impact this is likely to have on ongoing functional abilities. The rehabilitation phase is often when functional abilities are being assessed and this includes formal driving assessments which are preceded by retraining in pre-driving skills. Factors which will influence the ability to return to driving post-stroke start to become a focus, as is the likelihood of not returning to driving which may include the beginning of exploration of ideas about alternative transport options.

An Australian study by Liddle, et al. (2009) found that individuals who cease driving following stroke have unmet needs. In order to avoid negative consequences, Liddle, et al. (2009) and other researchers (Anstey et al., 2006; McCluskey et al., 2013) have recommended that driving cessation planning is introduced early in the decision making process and should include problem solving with stroke survivors, and their family and friends to examine alternative strategies for driving. Australian research (Anstey et al., 2006; Liddle et al., 2009; McCluskey et al., 2013) has found that arranging alternative strategies for transport to out-of-home activities prior to driving cessation may assist in maintaining quality of life and prolong driving cessation, as it supports appropriate limiting driving decisions.

2.9.1 Factors influencing returning to driving post-stroke

There are a number of factors that have been found to influence post-stroke driver success in returning to driving (Finestone et al., 2009; Gadidi, Katz-Leurer, Carmeli & Bornstein, 2011; Griffen et al., 2009; Smith-Arena et al., 2006; Sundet, Goffeng & Hofft, 1995). Physical disability post-stroke impacts on functional abilities and results in limitations to activities such as driving (Gadidi et al., 2011; Griffen et al., 2009) as does cognition, perception and vision. Smith-Arena, Edelstein and Rabadi (2006) studied 45 stroke patients (mean age of 71 years, SD 9.8 years) in the USA, who undertook an in-clinic driver evaluation, a mini mental state exam (MMSE, Folstein et al., 1975), which is a cognitive assessment, and were assessed in terms of Motoricity Index scores for upper and lower limbs which is used to measure strength post-stroke. Patients who undertook and passed the in-clinic driver evaluation were

found to have higher MMSE and Motoricity Index scores with normal visual fields upon admission to hospital, relative to those who failed the in-clinic driver evaluation.

The amount of social support has also been found to be an important determinant in returning to driving and maintaining community integration post-stroke (Griffen et al., 2009; White et al., 2012a). The larger your social network, the more motivation you have to try to maintain these social connections post-stroke by driving (White et al., 2012a). Griffen et al. (2009) interviewed 90 pairs of stroke survivors and informants, made up of next of kin, in Michigan, USA. Drivers with better social support showed better community integration than non-drivers and drivers with less social support. Social support facilitated community integration but did not substantially buffer the effects of driving cessation altogether. Gender differences revealed that male non-drivers were substantially worse than male drivers post-stroke in social integration, mobility and occupation. Women in this study showed equivalent social integration for both drivers and non-drivers, suggesting that different intervention approaches for men and women may be required.

White et al. (2012b) in their study on the trajectories of psychological distress post-stroke suggest that the stroke survivor's pre-morbid personalities in regards to resilience and locus of control relate significantly to their psychological and functional adjustment during their post-stroke recovery. Those stroke survivors with a past history of full recovery after a previous significant illness and who had a positive attitude towards the challenges of disabilities as a result of stroke tended to cope better psychologically post-stroke (White et al., 2012b).

2.9.2 Rehabilitation Audit

In 2013 the NSF completed an audit of 124 Australian acute hospitals and 3,741 patient's medical histories (National Stroke Acute Audit, 2013). The acute audit was completed to determine whether or not the NSF Clinical Guidelines (2010) were being adhered to in post-stroke acute care across Australia. Findings demonstrated that only 25% of stroke survivors had a multidisciplinary team meeting to discuss their treatment and discharge plans. Fifty-two percent of stroke survivors leaving acute care services went on to rehabilitation post-

acute care, but only 75% of these stroke survivors received inpatient rehabilitation services. The other 25% of stroke survivors who required rehabilitation attended outpatient services at rehabilitation facilities or received rehabilitation in the community. This was despite the finding that only 41% of stroke survivors had only mild or no disability on discharge from acute hospital care.

As returning to driving post-stroke has been found to equate with improved quality of life and a reduction in resulting health care burden, it is essential that the potential for stroke survivors to return to driving is recognised and incorporated as an integral component of post-stroke rehabilitation. One Australian study conducted by Rowland, Cooke and Gustafsson (2008) examined occupational therapy best practice approach to rehabilitation post-stroke and recognised the importance of a multidisciplinary team approach that needed to occur early in the recovery trajectory. Rowland et al. (2008) highlighted the importance of using standardised assessments to assess the impact of changes as a result of stroke, and the importance of interventions to improve participation in meaningful roles, tasks and activities including driving. A Canadian study by Petzold et al. (2010) surveyed 480 occupational therapists who provided stroke rehabilitation in both inpatient and community settings. Between 20-32% of responding occupational therapists recognised getting help for post-stroke survivors to resume driving was a problem for stroke survivors and their families. Less than six percent of clinicians offered driving retraining and only 12% of those conducted driving rehabilitation using driving specific assessment. The authors concluded that many stroke survivors attempted to return to driving on their own or never returned to driving because of a lack of attention to driving during their rehabilitation (Petzold et al., 2010).

It is important, therefore, that the appropriate multidisciplinary assessments occur along with patient-centred interventions to guide decision making about returning to driving and to reduce crash risks for those stroke survivors who do return to driving (Motta, Lee & Falkmer, 2014; Rabadi, Akinwuntan & Gorelick, 2010). Patient-centred professional input in the decision to return to driving based on standardised assessment of post-stroke driving ability is essential to ensure safety for the stroke survivor and other road users, and to avoid uninformed decision making by stroke survivors and their families. Barriers to using all forms of transport post-stroke can be overcome by appropriate patient-centred interventions

that enable informed decision making (Tan et al., 2011). By understanding the patient's needs, health care professionals can tailor their interventions more effectively.

It is important to consider how best to enable stroke survivors to get back to driving safely and to avoid the negative consequences of loss of driver's licence. Resumption of driving post-stroke is an important rehabilitation goal as it helps regain independence and quality of life, maintains community interaction and helps people to access the world around them (Allen et al., 2007; Unsworth & Baker, 2014). Logan and Dyas (2004) suggested that if it is not possible to return to driving, it is important during rehabilitation to focus on psychological coping mechanism and the process of adjustment to driving cessation along with practical considerations of utilising alternate transport options. These considerations may include retraining to use public transport and the safe use of pavement scooters to enable community participation (Logan & Dyas, 2004).

2.9.3 Medical fitness to drive assessment post-stroke

The process of determining the ability to resume driving post-stroke differs considerably between countries and between different states within countries and this is the case for Australia (Aslaksen, Orbo, Elvestad, Schafer & Anke, 2013; Austroads, 2012; Finestone et al., 2009). All Australian states require the stroke survivor to report their stroke to the state driving authorities, but have different approaches to access fitness to drive and the process of assessment (ACT Government Road Transport Authority, 2015a; Government of South Australia, Department of Transport, Travel and Motoring, 2015a; Northern Territory Government, Department of Transport, 2015a; NSW Department of Roads and Maritime, 2015a; Queensland Government, Department of Transport and Main Roads, 2015a; Tasmanian Government, Department of State Growth Transport, 2015a; Vicroads, 2015a; Western Australian Government, Department of Transport, 2015a). Best practice research suggests that if there are any doubts about a stroke survivor's ability to drive, they should be assessed by a multidisciplinary team of health care professionals using standardised assessments (Murie-Fernandez, Iturralde, Cenoz, Casado & Teasell, 2014).

Currently internationally there is a lack of consensus exists about which measures and pre-driving assessments are appropriate and predictive of driving skills (Devos et al, 2011). White et al. (2012a) suggests "there is no gold standard for the assessment of driving and determining fitness to drive, decision making around this issue remains problematic" (p.831). Indeed, Dickerson, Brown Mueul, Ridenour and Cooper (2014) suggest on-road driving assessment is the only 'gold standard' for assessing fitness to drive. A systematic review and meta-analysis by Devos et al. (2011) did find that the Road Sign Recognition, Compass and Trail Maker Test (TMT) B assessments were statistically significantly associated with the risk of failing on-road assessment; however, across Australia debate still exists about which pre-driving standardised assessments should be used. This inconsistency leads to a variety of experiences for the stroke survivor in the return to driving process with variations in fitness to drive assessments used, leading to inequities and inefficiencies for stroke survivors and their families (Akinwuntan et al., 2003).

The driving evaluation process can be very stressful for stroke survivors as they are well aware that results of such assessment have significant implications. Chua, McCluskey and Smead (2012) found that stroke survivors exhibited an overriding fear of failure and its consequences if they sought out and engaged in the formal fitness to drive assessment processes, leading to stroke survivors choosing to avoid the formal assessment process altogether. Consequently, standardised assessments with known validity and reliability are essential to ensure an appropriate testing process (Patomella, Tham, Johansson & Kottorp, 2010). Although there is disagreement about which are the best assessments to use, there is a significant body of evidence to indicate that a multidisciplinary approach, using standardised assessments to enable comprehensive pre-driving evaluation in conjunction with on-road testing, is the most appropriate way of assessing fitness to drive post-stroke (Akinwuntan et al., 2003; George, Clark & Crotty, 2007; George & Crotty, 2010; Murie-Fernandez et al., 2014; Rabadi et. al., 2010). Research findings demonstrate that cognitive skills, perceptual ability and vision are important skills to assess when determining fitness to drive, although there is still no consensus about where the specific focus of assessment should be within these spheres (Chua et al., 2012; Marshall et al., 2007; Motta et al., 2014; Patomella et al., 2010; Smith-Arena, Edelstein & Rabadi, 2006; Stapleton & Connelly, 2010). Given the current inconsistencies in fitness to drive assessment and the significant implications of failing post-stroke driving assessment, stroke survivors can be apprehensive about returning

to driving. Such apprehension can contribute to unnecessary delay or avoidance of completing an assessment altogether, with resulting ramifications for community participation (Barnsley et al., 2012). This is of concern, given current literature identifying loss of licence as a precursor for depressive symptoms and low self-esteem (Marottoli et al., 1997; Ragland, Satariano & MacLeod, 2005; Whitehead, Howie & Lovell, 2006).

2.9.4 Off-road driving skills assessments

Off-road driving skills assessments are critical to ensure appropriate timing and safety during on-road assessments, as they assess skills necessary for driving. Off-road assessments include the assessment of cognitive skills, visuospatial skill and logical reasoning abilities needed to problem solve and act safely when driving. One Canadian study by Hird, Vetivelu, Saposhik and Schweizer (2014) examined fitness to drive assessments for stroke survivors including cognitive, on-road and simulator based driving assessments. Findings suggested that the Stroke Drivers Screening Assessment (SDSA), the UFOV assessment and the Rey-O complex figure test all had some ability to predict on-road assessment performance. Overall, predictability of standardised assessments on pass/fail rates of 1413 stroke survivors was explored and found no consensus on which standardised assessment could be used reliably. Hird et al. (2014) suggested that standardised driving assessments have been minimally explored and that they are used with much inconsistency. Devos et al. (2011) conducted a systematic review of 30 studies and a meta-analysis of 37 studies on fitness to drive assessments post-stroke and found the Road Sign Recognition, Compass and TMT B assessments scores were associated with risk of failure on on-road assessments. Currently, however, neither the NSF clinical guidelines (NSF, 2010, see Appendix I) or the 'Assessing Fitness to Drive' (Austroads, 2012, see Appendix II) documents state any one particular off-road driving skills screen should specifically be used. Future research needs to focus on which are the most valid and reliable pre-driving assessments that will inform a patient-centred approach to returning to driving post-stroke, and help to determine the best time to attempt an on-road assessment to increase chances of success.

Along with choosing the most predictive standardised off-road pre-driving assessments to determine post-stroke driving ability, it is important to understand the influence psychometric properties might have on the scores gained during these assessments (George & Crotty,

2010). Research should include examining the validity, utility and accuracy of standardised off-road assessments to validate their ability to predict on-road driving skills and safety with particular patient populations and thereby reinforcing their ability to inform clinical best practice. Practise effect is one example of a psychometric property of a standardised assessment which can influence assessment scores and so needs to be understood. Practise effects can be defined as influences on performance that arises from a practicing a task (Heiman, 2002). So if, on repeating an assessment, the assessment score improves, it is important to know whether this is due to an improvement in skills or an improvement in completing the assessment due to a practise effect.

One study has investigated the psychometric property of practice effect of the UFOV assessment (Bentley, LeBlanc, Nicolela & Chauban, 2012), a pre-driving screening assessment used in Australia. Bentley, LeBlanc, Nicolela and Chauban (2012) completed three sub studies on the UFOV assessment, the third study considering practice effect and repeatability of the UFOV assessment (Ball et al., 1988). The participants (n=17) had a mean age of 33 years (SD 8 years) and repeated the UFOV assessment five times in one day (Bentley et al., 2012). Findings found that performance on the UFOV assessment changed very little after the second assessment, with a difference in mean processing time between all five assessments of less than six milliseconds (Bentley et al., 2012). There were no studies identified in this literature review that considered the practice effect of the UFOV assessment in older driving participants and hence a gap in the literature was identified. Therefore, in this thesis we have included a study which endeavours to research practice effect in the UFOV assessment with an older, post-stroke Australian population of participants.

In Australia, once passed an off-road assessments, the stroke survivor undergoes on-road assessment (NSF guidelines, 2010, see Appendix II) with an occupational therapist and a driving instructor. This usually involves following a pre-set route that assesses particular driving skills. The on-road assessment has consistently been found to be significantly predictive of driving performance and crash rates post-stroke (Akinwuntan et al., 2002; Akinwuntan, Arno, De Weerdt, Feys & Kiekens, 2006; Karceski & Gold, 2011).

2.9.5 Post-stroke driving behaviour

A body of evidence exists indicating that a proportion of older drivers modify or self-regulate their driving habits (Ball et al., 1998; Charlton, Oxley, Fildes, Oxley & Newstead, 2006; Edwards et al., 2009; Ross, Dodson, Edwards, Ackerman & Ball, 2009; Sullivan, Smith, Horswil & Lurie-Beck, 2011; Unsworth, Wells, Browning, Thomas & Kendig, 2007). Research on the older driver informs understanding of driving behaviours in stroke survivors as many conditions such as poor eyesight, decline in cognition, decreasing physical abilities and weakness experienced by older drivers are also experienced by stroke survivors and because the majority of stroke survivors are over the age of 65 years (AIHW, 2014; Goode et al., 1998). Advancing age and having more than one medical condition were found to increase the likelihood of driving self-regulation in Australian divers (Sargent-Cox, Windsor, Walker and Anstey, 2011). Sargent-Cox, et al. (2011) reported upon the findings from telephone interviews with 322 Australian drivers (63.9% male) aged 65 years or above (M=77.35 years, SD=7.35 years), secured by random convenience sampling. Other studies have also found that individual characteristics and certain medical conditions, such as poor cognitive performance, older age and hearing conditions, may influence an increase in self-limiting driving behaviour in older drivers (Anstey & Smith, 2003; Edwards et al., 2008; Petrakos & Freund, 2009; Ross et al., 2009; Vance et al., 2006).

Unsurprisingly then, on returning to driving it has been found that many stroke drivers self-regulate their driving, strategically limit their driving exposure and rely more on others for their transportation (Fisk, Owsley & Mennemeier, 2002b). Other research has shown that stroke survivors who return to driving have more difficulty and limit their driving exposure when compared with other older adults with no neurologic or visual complications (Finestone et al., 2009; Fisk et al., 2002b; Motta et al., 2014). Fisk, Owsley and Mennemeier (2002b) studied 50 stroke survivors and 105 older adults with no neurologic or visual impairment. Results found that stroke survivors were more likely to have impaired contrast sensitivity and peripheral vision which impacted on choices about driving. Those stroke survivors who had returned to driving had less attentional impairment than their non-driving counterparts but when compared to the non-stroke older drivers, they had more difficulty in challenging driving situations, drove to fewer destinations and relied more on others for transport. Stroke survivors who had returned to driving were deliberately self-regulating and limiting their driving behaviour, choosing to avoid challenging driving situations such as driving alone,

parallel parking and driving in high traffic volume areas. They drove half as much as the non-stroke group (Fisk et al., 2002b). White et al. (2012b) found health care professionals involved in rehabilitation post-stroke in Australia "did not conceptualize or understand the pattern of psychological morbidity in stroke survivors and the influence their mood disturbances had on the levels of independence they regained during their rehabilitation" (p. 436). White et al. (2012b) found an unmet need for a better understanding of the psychological impact of stroke and a lack of ongoing support to facilitate a move towards a more positive mood, which was linked to a return to functional independence.

What is not fully understood is the relationship between factors, such as confidence and decisions about returning to driving, or how driving habits are impacted once stroke survivors have returned to driving. Further research is required into factors that contribute to decision making about returning to driving post-stroke and the consequences of that decision. Therefore, a study has been conducted as part of this thesis on whether post-stroke drivers have lower self-perceived confidence levels compared to their non-stroke aged-matched driving peers.

2.9.6 Importance of driving and driving cessation

Across a lifespan, community mobility is essential in connecting people to their communities (Unsworth, 2012). Arguably one of the most important factors in relation to independence following a stroke is retaining the ability to drive a motor vehicle, as it is an essential mode of transportation for the majority of people in industrialised countries (Rosenbloom & Morris, 1998). Driving is seen as a sign of autonomy and competence post-stroke, and is recognised as one of the most important tools to enhance activities of daily living in older people in general, including stroke survivors (Pearce et al., 2012; Persson, 1993). Importantly, driving is also a major contributing factor in a stroke survivor's ability to maintain community interaction (Chaudry, Jay & Poole, 2008). Maintaining community interaction and social integration were found to reduce social isolation and subsequent negative health issues such as depression (Murie-Fernandez et al., 2014; White et al., 2008). There are a number of Australian studies demonstrating that the implications of loss of licence can have a negative impact on quality of life (Liddle et al., 2009; White et al., 2008). One study of stroke survivors who ceased driving post-stroke reported it to be "a sudden, unexpected and intense

experience" (Liddle et al., 2009, p. 271). Liddle, et al. (2009) used a qualitative phenomenological approach involving semi-structured interviews to gain the experience of driving cessation post-stroke in 25 participants (17 men) who had all ceased driving post-stroke (mean time of five and a half years of post-stroke driving cessation). After constant comparative analysis, four themes emerged: life without driving, key times of need, alternatives and other ways of transport, and carer support and assistance (Liddle et al., 2009). Most participants raised issues including the loss of numerous life roles, challenges associated with arranging alternative transport, and increased reliance on their carer and others. Liddle et al. (2009) recognised their study participants need for more information throughout the process of decision making and accepting driving cessation post-stroke.

Overseas studies recognised the need of providing more professional advice and information to post-stroke drivers in driving decision making and driving cessation (Hakamies-Blomqvist & Wahlstrom, 1998). Findings showed a large, unmet need and difficult experiences throughout the driving cessation process post-stroke. Conclusions included the need for increased practical and psychological support at key times throughout the driving cessation process post-stroke including offering alternatives to driving. Findings suggested that such support was necessary for a positive outcome. A positive outcome was important, as a loss of independence post-stroke was found to lead to depression. When loss of a driver's licence led to depression there was an increased burden on the health of the stroke survivor coupled with a likelihood of increased incidence of carer burden, which resulted in added health care services utilisation (Liddle et al., 2009).

Several other studies concur with the findings from the previous study by Liddle et al. (2009), that an individual's decision to cease driving may lead to a reduction in out-of-home activities and a consequent increased likelihood of depression (Legh-Smith et al., 1986; Marottoli et al., 1997; Marottoli, Mendes de Leon, Glass & Williams, 2000; Ragland et al., 2005). Driving cessation in the older population has also been found to be associated with an increased risk of nursing home placement and higher mortality rates over a five year period (Freeman, Gange, Munoz & West, 2006; Marottoli et al., 2000; O'Connor, Hudak & Edwards, 2011) which is informative for the post-stroke population as two thirds are over 65 years old (AIHW, 2014).

An Australian study by Anstey, Windsor, Luszcz and Andrews (2006) examined the psychological, medical and sensory-motor risk factors that predicted driving cessation in older adults. They recruited 4,166 men and women aged 70 years and older from the electoral roll, 753 of whom were drivers. They performed interviews, assessments of self-rated health, assessed medical conditions, recorded driving status as well as compiled clinical assessments of vision, hearing, cognitive function and grip strength at baseline and two years later. Information on current driving status was collected at baseline in 1992 and subsequently in 1993, 1994, 1995 and 1997. Drivers and non-drivers were compared at baseline and driving cessation risk factors were identified using logistic regression (Anstey et al., 2006). Subsequent driving cessation was found to be associated with increased age, lower grip strength, poor cognition and poorer self-rated health which are all likely to be present in stroke survivors.

In one longitudinal Australian study by White et al. (2012a), 22 community-dwelling stroke survivors aged ranging from 50 to 92 years were interviewed over a one year period and found that the loss of a driver role in life significantly affected community participation. White and her colleagues (2012a) carried out 84 interviews over the one year period examining the impact of loss of a driver's licence post-stroke. Findings included the negative impact that loss of a driver's licence had on quality of life, and a change of role performance with significant negative personal impact to those stroke survivors who did not return to driving (White et al., 2012a).

Several other overseas studies (Ackerman, Edwards, Ross, Ball & Lunsman, 2008; Marottoli et al., 1993; Marottoli et al., 2000) have examined driving cessation in older people and have reported similar findings to the Australian study by Anstey, Windsor, Luszcz and Andrews (2006). Ackerman, Edwards, Ross, Ball and Lunsman (2008) in America, found that older women were three times more likely to relinquish their driver's licence than men, even when health and disability were taken into account and they were also more likely to report avoiding more difficult driving situations. In two other overseas studies by Marottoli et al.

(1993, 2000) physical decline and increased medical conditions were also found to be commonly associated with driving cessation in older drivers.

Overseas studies also recognise the need for more professional advice and information required post-stroke in regards to driving decision making and driving cessation (Hakamies-Blomqvist & Wahlstrom, 1998). Findings showed a large, unmet need and difficult experiences throughout the driving cessation process post-stroke. Conclusions included the need for increased practical and psychological support at key times throughout the driving cessation process post-stroke including offering alternatives to driving. Findings suggested that such support was necessary for a positive outcome. A positive outcome was important, as a loss of independence post-stroke was found to lead to depression. When loss of a driver's licence led to depression there was an increased burden on the health of the stroke survivor coupled with a likelihood of increased incidence of carer burden, which resulted in added health care services utilisation (Liddle et al., 2009).

2.10 Community phase

On return to the community, driving ability begins to impact the amount of community interaction a stroke survivor is involved in and the level of dependency on carers for transport (White et al., 2012a). Often the stroke survivor and their families turn to their GP for advice and support in regards to returning to driving post-stroke, as they may not have been exposed to post-stroke driving education in either the acute or rehabilitation facility they attended, or were unable to understand or retain information at the time information was delivered (Carr, 2000). It may also be that the stroke survivor and their family underestimate the impact stroke has on their functional ability to drive and so have not considered the necessity of driving education (Heikkila et al., 1999). If stroke survivors and their families experience an inconsistent approach to the return to driving process post-stroke there is potential for it to lead to an increased crash risk and a premature relinquishing of the driver's licence, which can lead to negative consequences for the health of stroke survivors and their carers (White et al., 2012b).

It is also important to understand if the factors influencing the decision for stroke survivors to relinquish a driver's licence are unique to stroke survivors or whether these factors are similar for their aged-matched non-stroke driving peers. Insights into older people's decision making may inform health care professionals in the provision of services to the older driving population with specific medical conditions, by revealing those decision making factors which are more generic to older people and those which may be more specifically related to medical conditions such as stroke.

Discrete Choice Experiments (DCE's) are an evolving methodology that has shown considerable promise in determining those factors which are most valued by patient populations when making decisions (Ratcliffe & Buxton, 1999; Ryan, Gerard & Amaya-Amaya, 2008; Ryan, 2004). DCE studies had their origins in mathematical psychology and the methodology has been widely applied in marketing, transport and environmental economics and more recently within health economics (Louviere, Hensher & Swait, 2000; Ryan, Gerard, Amaya-Amaya, 2008). DCE methodology examines an individual's stated preferences and the approach is designed to "establish the relative importance or weight attached to salient characteristics (or attributes) in formulating a decision about a particular course of action" (Louviere et al., 2000, p. 252). A number of DCE studies have successfully been conducted, specifically with samples of older people, to understand their decisions relating to alternative service in health care setting (Laver et al., 2011; Milte et al., 2013; van Til, Stiggelbout & Ljzerman, 2009). These studies (Laver et al., 2011; Milte et al., 2013; van Til, Stiggelbout & Ljzerman, 2009), have demonstrated high levels of acceptability and understanding, suggesting that DCE methodology is an appropriate method to examine the phenomena of health care decision making.

One previous study has applied the DCE methodology with stroke participants. This was an Australian study on stroke survivor's preferences about options for different types of stroke rehabilitation methods (Laver et al., 2011). A DCE methodology was used to complete a series of face-to-face interviews with stroke survivors in order to examine their priorities and preferences for post-stroke rehabilitation. Latest technologies and therapy techniques, such as computer-based, virtual reality therapy and intensive therapy regimes, are being introduced and promoted by therapists and rehabilitation facilities as current best practice interventions.

However, given the choice between computer-delivered therapy programs, traditional therapy, and low or high intensity programs, the stroke survivors interviewed in the study by Laver et al. (2011) reported that despite therapist's views, stroke survivors had stronger preferences for low intensity programs and were averse to computer-delivered therapy techniques. Laver et al. (2011) concluded that stroke survivors may take some time to adjust to the introduction of new technologies to assist in their recovery and they may not always choose to engage in what health care professionals view as best practice service delivery. DCE methodology is a way of determining what it is that patients find acceptable and desirable in rehabilitation interventions.

A novel application of DCE would specifically involve consideration of factors influencing older people when they are in the process of deciding to relinquish their driver's licence. Such knowledge would be of significant help to health care professionals when developing strategies for post-stroke driver education for stroke survivors and their families to target needs appropriately, as most stroke survivors are over 65 years (AIHW, 2014). Therefore, this thesis contains a study addressing this issue by examining what factors influence older Australian drivers in their decision to relinquish their driver's licence using a DCE methodology.

2.10.1 Individual's role in decision making

The potential implications of developing policies and regulations that do not match stroke survivor's preferences for decision making about their rehabilitation could be devastating (Laver et al., 2011). Health care professionals involved in assessing stroke survivors for fitness to drive need to understand what preferences stroke survivors have in regards to service delivery throughout the return to driving process in order to best engage them. It is important to understand the stroke survivor's focus during each stage of recovery, their adjustment process through individual capacity for resilience and what they are most likely to be open to engage in at different stages (White et al., 2012a). By making the process more patient-centred there will be less likelihood of stroke survivors returning to driving without understanding and retaining advice from health care professionals, choosing to relinquish their driver's licences before it is necessary or returning to driving when it is not safe to do so.

An Australian study by Liddle, et al. (2009) found that individuals who cease driving following stroke have unmet needs. In order to avoid negative consequences, Liddle, et al. (2009) and other researchers (Anstey et al., 2006; McCluskey et al., 2013) have recommended that driving cessation planning is introduced early in the decision making process and should include problem solving with stroke survivors, and their family and friends to examine alternative strategies for driving. Australian research (Anstey et al., 2006; Liddle et al., 2009; McCluskey et al., 2013) has found that arranging alternative strategies for transport to out-of-home activities prior to driving cessation may assist in maintaining quality of life and prolong driving cessation, as it supports appropriate limiting driving decisions.

2.10.2 Doctor's role in decision making post-stroke

GPs should take an active role in assessing fitness to drive, preventing early driving cessation and planning for transport alternatives when driving cessation cannot be avoided to enable continued community interaction (Carr et al., 2000; Nouri, 1998). GPs are often the health care professionals that stroke survivors and their families turn to in the community on returning home post-acute or rehabilitation treatment and realising the full impact of the loss of their driver's licence. In Australia, GPs have a legal responsibility to report anyone they assess as unfit to drive (Ausroads, 2012, see Appendix II), and this can mean that stroke survivors and their families might be reluctant to discuss driving post-stroke with their doctor. A South Australian study (Wilson & Kirby, 2008) investigated GP's knowledge on driver assessments for older drivers. Ninety-nine South Australian GPs completed a survey on their knowledge of current procedures on fitness to drive assessments in older people. The GPs surveyed were found to be well informed and have knowledge of legislation and fitness to drive medical assessments. However, there was much less consistency in the GPs' knowledge on the assessment of relevant cognitive abilities required for driving. Most of the GPs surveyed believed there needed to be more transport and support services for older drivers when they ceased driving, but did not acknowledge that linking their patients to such services might be part of their role.

A number of studies have looked at how comfortable doctors are in addressing the issue of driving with their patients (Carr, 2000; Carter & Major, 2003; Drickmer & Marottoli, 1993; Fisk et al., 1997; Jang et al., 2007; Nouri, 1998). Jang et al. (2007) posted a survey out to 1000 Canadian GPs and asked them about attitudes and practices toward assessing fitness to drive and reporting medically unfit drivers. Over 45% of the GPs reported they were not confident in assessing fitness to drive and 75% stated that reporting a patient as an unsafe driver negatively impacted on their doctor–patient relationship. However, 72.4% agreed that GPs should be responsible for reporting unsafe drivers to the licensing authorities. These sentiments are echoed in another study carried out in America by Drickner and Marottoli (1993) who also surveyed licensed GPs, internists, ophthalmologists, neurologists and neurosurgeons in Connecticut, USA. Fifty-nine percent (n=590) of eligible physicians responded to the questionnaire. Seventy-seven percent stated they had discussed driving with their patients, but only 14% indicated they had reported patients to the Department of Motor Vehicles although 59% of GPs had indicated that they felt it was their responsibility to do so (Drickner & Marottoli, 1993). Patient views on the importance of the GP's role in determining fitness to drive are not known. Further research is required to understand the patient's view of the importance of the GP role in determining fitness to drive and associated assessment process.

2.10.3 Crash rates

As two-thirds of stroke survivors are over the age of 65 years (AIHW, 2014) and older drivers have one of the highest motor vehicle crash rates per kilometres driven and are more likely to be fatally or seriously injured in a crash, it is important to understand what factors influence this phenomenon (Molnar et al., 2007). A Western Australia study of older drivers measured crashes per 100 million vehicle kilometres travelled take out as not used again in thesis and from abbreviation section and calculated the respective measure of fragility and crash over-representation of older drivers (Meuleners, Harding, Lee & Legge, 2006). Data was taken from the Western Australian road injury database that recorded police reported crash data from 1st January, 1998 to 31st December, 2003. Results from the decomposition method of analysis showed that older drivers over the age of 70 years sustained serious injury rates more than twice as high as those of drivers aged 30-59 years. The increased injury rate was considered to be due to the increased physical fragility of older drivers. This fragility, such as physiological changes associated with older age, including decline in vision and

reaction time, were found to increase crash risk (Meuleners et al., 2006) and would also be present for many stroke survivors.

Similar findings are found in overseas studies. Marottoli and Richardson (1998) interviewed 125 older drivers in Connecticut, USA. They asked participants to self-rate their driving ability and then obtained a history of crashes and traffic violations from the police. Marottoli et al. (1994) also considered what factors were associated with automobile crashes and violations that required being stopped by police. Poor copying of an image of two house shapes intertwined that measures visual spatial abilities on the Mini Mental State Exam (MMSE, Folstein, Folstein & McHugh, 1975), reports of fewer blocks walked when out walking and foot abnormalities were factors that were reported to predict adverse events in driving. All of these factors are often present post-stroke.

Factors which influence the resumption of driving post-stroke include; the type of stroke, physical strength and motor ability, vision, cognition, gender and post-stroke fatigue (Perrier, Korner-Bitensky, Pertzold & Mayo, 2010b). Impairments following stroke have further safety implications with post-stroke drivers having an increased probability of being involved in an accident with an adjusted odds ratio of 1:93 (Sagberg, 2006). A review of six databases was conducted by Perrier, Korner-Bitensky and Mayo (2010b) in a Canadian study that examined research which measured post-stroke driver's crash rates compared to counterparts with no experience of stroke. Four cohort and three case-controlled studies met the inclusion criteria and five of the seven studies found an increase in crash rates for post-stroke drivers compared to drivers who had not experienced stroke. Perrier et al. (2010b) concluded their findings indicated an increased crash rate for drivers with stroke compared to their counterparts without stroke and encouraged further research on the risk of crashes for stroke survivors with specific stroke sequelae.

The results from the Canadian study by Perrier et al. (2010b) are inconsistent with an Australian study by Pearce, Smead and Cameron (2012) which involved telephone interviews following up 45 post-stroke respondents who were aged 18-74 years, and who had successfully completed and passed a multidisciplinary driving assessment on average, 20

months previously. Twenty-five of the 45 participants reported driving habits that indicated confident driving. Driving confidence was measured by driving frequency and distance, the amount of night driving undertaken, frequency of driving on high traffic roads such as freeways and driving alone. The frequency of accidents and traffic incidents reported suggested that 95% of their respondents were safe drivers. Eight respondents reported accidents, only two of which the respondent was 'at fault'. The crash rate of respondents was calculated to be 222 per 100,000 drivers which were within the confidence interval for similar accidents in non-stroke aged-matched drivers in the State of New South Wales, Australia where the study was conducted. Findings of this study suggest that the pertinent factor to ensure safe driving post-stroke was a multidisciplinary driving assessment following stroke, which enables identification of stroke survivors who have the ability to drive safely and confidently (Pearce, Smead & Cameron, 2012).

Other studies have found that stroke survivors have greater deficiencies when driving than non-stroke drivers (Heikkila, Korpelaine, Turkka, Kallanrante & Summala, 1999, Lings & Jensen, 1991). Lings and Jensen (1991) compared 113 stroke survivor scores in a mock car assessment with 109 non stroke participants. Results showed that the stroke participants scored worse in all areas of assessment with reduced reaction times, poorer strength in their non-affected sides and some stroke participants completely failed to react to signals. Right hemiplegic participants were also found to have more directional errors (Lings & Jensen, 1991).

In general it appears that currently there is a trend towards higher crash rates for post-stroke drivers than their aged matched non-stroke peers (Lings & Jensen, 1991; Perrier et al., 2010b). This may at least be partly due to the lack of a stringent post-stroke driving assessment process as reflected in the outcome of the study by Pearce et al. (2012) their families had received about returning to driving, focusing on the post-stroke evaluation process, and usually from the health professional's perspective. Currently, there is a lack of research considering attitudes and perceptions of all stakeholders, and more specifically those of stroke survivor's themselves about the decision to return to driving post-stroke. However such information is vital to facilitate informed decisions about best practice treatment interventions and assessment processes that are more patient-centred.

Given this gap in research on driving habits post-stroke has been discovered, a study was conducted on driving habits post-stroke as part of this thesis and crash rates were documented.

2.11 Summary

The findings from the comprehensive literature review presented in this chapter indicate that more research is required to understand the best practice approach to returning to driving post-stroke in Australia and worldwide. It is important to determine those factors that contribute to individual drivers failing driver assessments post-stroke or choosing to relinquish their driver's licence so that health care professionals can address these issues. Post-stroke drivers are a growing population. Current evidence indicates that this cohort is more likely to limit or relinquish their driving and have higher crash rates than the non-stroke population (Lings & Jensen, 1991; Pearce et al., 2012; Perrier et al., 2010b; Sagberg, 2006). As the population ages and there is a growing number of stroke survivors facing the decision to return to driving, health care professionals need to have best practise interventions in place.

Limiting or driving cessation post-stroke can lead to poor community interaction and social isolation. Thus post-stroke driving education needs to include alternative transport methods, repeated practice of outdoor mobility (other than driving) and appropriate timing and content of post-stroke driving education including verbal and written advice to help allay fears, build confidence and encourage insight into actual driving skills (Logan, Gladman & Radford, 2001; McCluskey et al., 2013). This is especially important as post-stroke non-drivers are more likely to become socially isolated and suffer from depression, which in turn affects physical health and may result in an increasing burden of care (White et al., 2012a).

Current research suggests there is limited information on attitudes and perceptions about driving post-stroke and how older people generally decide to relinquish their driver's licence. Research shows some pre-driving screening assessments are predictive of driving performance (Akinwuntan et al., 2010; Devos et al., 2011; George & Crotty, 2010); but few

studies have considered their ability to record the recovery process to see the best time to participate in on-road assessment when the stroke survivor is most likely to pass. What is also not fully understood are the psychometric properties of these assessments and their influence on scores.

This thesis therefore endeavours to rectify some of the gaps identified in this literature review in regards to knowledge of the process involved in attempting to resume driving or deciding to relinquish a driver's licence post-stroke. The first study (see Chapter Three) aims to address the lack of literature exploring older people's views of returning to driving in the acute post-stroke phase.

Chapter Three: Acute Phase – A Qualitative Study to explore perceptions of older people towards driving in the early stages of stroke recovery

Chapters one and two have highlighted the need to understand the process of returning to driving post-stroke from all stakeholder perspectives to enable informed, timely and best practice health care service delivery. In focusing on the acute phase, this chapter therefore focuses on the first of the stroke recovery trajectory's three main phases of recovery (acute, rehabilitation and community care) which act as a framework for the thesis. Importantly, Chapter two identified a gap in current research in considering the issue of driving post-stroke from the patient's perspective in the acute phase: a critical point in time in which the issue of returning to driving in Australia is often first considered. As current Australian driving legislation makes it possible for some stroke survivors to return to driving at one month post-stroke, which is within the acute stage of recovery, and most return to driving in the first few months post-stroke; it is important to understand the stroke survivor's perspectives related to driving at this early time in their recovery.

The aim of this chapter is to address this gap in current research and to further explore the perceptions and attitudes about driving post-stroke that currently exist in stroke survivors during the acute phase of their recovery trajectory. Also to be examined is post-stroke driving education including content and timing of information given to stroke survivors in the acute phase of recovery. The stated objective of the study here is to answer the first research question:

RQ1: What are the perceptions of older people toward driving post-stroke in the early stages of stroke recovery, and how might this inform content and timing of post-stroke driving education?

In this chapter, therefore a study is presented which examines the stroke survivor's attitudes and perspectives about driving post-stroke in the acute phase of their recovery trajectory.

Structurally this chapter consists of an introduction, methods, results, discussion, limitations and overall conclusions drawn from the findings.

This chapter contains material from:

McNamara, A., George, S., Ratcliffe, J. & Walker, R. (2015). Older people's attitudes towards resuming driving in the first 4 months post-stroke. Australas J Ageing, 34:1:E13-8. doi:10.1111/ajag.12135.

3.1 Introduction

Arguably, one of the most important factors in relation to independence following a stroke is retaining the ability to drive a motor vehicle (Ragland, Satariano & MacLeod, 2005). Nevertheless, the issue of legalities and procedures around assessment of fitness to drive a motor vehicle post-stroke, and how and when these are discussed with the stroke patient, are somewhat arbitrary. The NSF Clinical Guidelines (NSF, 2010, see Appendix I) recommend stroke patients receive information about driving post-stroke and report their conditions to the relevant driver's licence authority and car insurance company (NSF, 2010, see Appendix I). The NSF guideline (2010, see Appendix I) currently does not provide guidelines around the content or timing of information on post-stroke driving education that should be offered to stroke survivors. Current practice may thus include information on driving, in the form of written brochures, verbal information from doctors, occupational therapists, and nurses in both a formal and informal manner. Depending on duration of recovery, this information tends to be provided to inpatients at the acute and rehabilitation hospital from the first weeks post-stroke. In Australia, stroke survivors are recommended not to drive for at least one month (Austroads, 2012, see Appendix II). If there is any concern about their ability to drive, stroke patients are then required to obtain a certificate of fitness to drive, completed by a GP. A stroke survivor is required by law to meet the vision guidelines, which are 6/12 visual acuity and 120° of binocular vision. If the GP has any concerns about the stroke patient's driving ability, s/he can then refer them to an occupational therapist for a driving assessment (Austroads, 2012, see Appendix II).

Little is known about the individual's perceptions and attitudes toward driving post-stroke, particularly in the first month immediately following stroke. The objectives of this study were: (i) to explore perceptions and attitudes of older people towards driving post-stroke in the early stages of stroke recovery; and (ii) to assist in informing guidelines around the appropriateness of timing and content of driving information within the acute phase of the stroke recovery trajectory.

3.2 Methods

3.2.1 Recruitment

Participants were recruited over three separate days from one acute hospital stroke ward and two rehabilitation wards in Adelaide, South Australia, locations where stroke patients are typically moved to following acute treatment. All patients on these three wards during this time who met the eligibility criteria of: driving prior to stroke, older than 18 years, between one and 16 weeks post-stroke, had sufficient English to contribute to an interview, had none or only mild dysphasia and a mini-mental state exam (MMSE) score of 21 or more (Folstein et al., 1975), were approached to participate in the study. At the time of interview, none of the participants had received clearance from their doctors to return to driving. Of the 106 stroke patients, 32 were eligible and 24 consented (see Table 3.1). One person subsequently withdrew due to a desire not to have their interview recorded, and two consenting individuals were withdrawn, as it was found they were more than 16 weeks post-stroke.

Table 3.1: Qualitative study: Eligibility and consent

Hospital	No. patients	No. with stroke	No. eligible	No. consented
14 October 2010				
Flinders Medical Centre	29	11	1	1
Repatriation General Hospital	40	19	9	6
2 December 2010				
Flinders Medical Centre	28	24	3	2
Repatriation General Hospital	38	19	10	7
3 February 2011				
Flinders Medical Centre	26	12	4	1
Repatriation General Hospital	40	21	9	7
				Total 24

Table 3.2: Qualitative study: Participant's characteristics

Characteristics	Frequency
Gender	
Male	10
Female	11
Mean (range) years	74.5 (47-92)
Range of time since stroke (weeks)	1-16
Marital status	
Single	2
Divorced	2
Widowed	3
Married	14
Living alone or with others	
Live alone	6
Live with spouse or other family member	15
Type of accommodation	
Own home	12
Own unit	3
Renting (housing trust or private rental)	3
Unit in retirement village	2
Living with family	1
Mean MMSE scores (range)	27 (22-30)
Mean NHSS scores (range)	4.45 (1-9)

MMSE: Mini-mental State Exam, NHSS: National Institute for Health Stroke Scale.

3.2.2 Data collection

Approval to conduct the study was granted by the Southern Adelaide Clinical Human Research Ethics Committee (SACHREC), approval number: 203/10. Data were collected from 21 participants (Participant's characteristics are shown in Table 3.2.). Four (19.1%) were inpatients in the acute stroke ward at an acute hospital and 17 (80.9%) in the rehabilitation wards at a rehabilitation facility. After scanning the ward lists for eligible patients and completing an MMSE, informed written consent was obtained. The National Institute for Health Stroke Scale (NIHSS) (Brott et al., 1989; Goldstein & Samsa, 1997) was administered to assess the physical and cognitive impact of stroke. The assessments and interviews were completed by one interviewer. Interviews lasted between 45 and 75 minutes and took place at the participant's bedside (Domains covered in the semi-structured interview are outlined in Table 3.3). Interview questions were developed after a review of current literature on the topic of driving post-stroke and from discussions with a rehabilitation consultant and a driver trained occupational therapist (Murray, Kendall, Carduff, Worth, Harris, Lloyd et al., 2009).

Table 3.3: Qualitative study: Structured interview questions

Preliminary questions – demographics and health

1. What is your age?
2. What is your gender?
3. What is your current marital status?
4. Do you live alone or with another person?
5. How would you describe the type of housing you currently live in? How long have you lived there?
6. What type of stroke have you had and when did you have it?

Driving – general questions

7. Do you own a car?
8. How important is driving to you? Why is driving important to you?
9. What do you think influences people deciding to give up their driver's licence?

Driving – personal experience

Before your stroke

10. Tell me about your driving before you had your stroke?
11. How do you think your driving has changed over the last 5-10 years?
12. Are you usually the one to drive your car?
13. When do you usually drive? That is, do you only drive during the day?
14. Where do you usually drive? That is, only locally?
15. What day-to-day activities require you to drive?
16. How would you describe your driving ability?

After your stroke

17. How would you describe your ability to drive now?
18. What factors influence your ability to drive now?
19. For what reasons would you be likely to consider giving up your driver's licence?
20. What reasons would make you reluctant to give up driving?
21. What sorts of things worry you about driving now that you have had a stroke?

Strategies

22. What would you do if you could no longer drive?
23. Have you ever discussed giving up your driver's licence with anyone?
24. Would you consider doing a driver refresher course?
25. What else could you do to improve your driving?
26. What changes to your lifestyle would you have to make if you gave up driving?
27. Do you know what the legal procedure is now that you have had a stroke in regard to your driver's licence?

All interviews were audio recorded and transcribed. NVIVO (NVIVO Qualitative Data Analysis Software, 2008) was used to organise data and assist in data storage, coding and data retrieval.

3.2.3 Data analysis

Interview data were analysed using a 'direct' form of content analysis whereby the researcher was guided in her data coding by existing literature (Ezzy, 2002; Hsich & Shannon, 2005). Sections of text within responses to individual questions were checked as to whether they fit the main categories identified in the existing literature such as independence, confidence, driving habits and lifestyle. Patterns and responses across participants were examined and tallied to obtain an idea of the 'magnitude' of each response. From this initial coding, major themes were identified by examining the frequency certain themes were mentioned and reported importance. Findings were then discussed with colleagues, peers and specialists in driving rehabilitation to concur on emerging themes.

3.3 Results

3.3.1 Driving as independence

Prior to discussing their outlook on driving post-stroke, participants were asked to describe what driving meant to them more broadly. A strong primary theme to emerge was how participants described driving as pivotal to independence and their decision to return to driving post-stroke. Participants recognised that driving allowed continuation of social connections and also defined a sense of life satisfaction and self-determination, as the following quotes highlight:

'[Driving] is one of the most important things because it gives me my freedom. I like to get up in the mornings and do what I want to do.' (female, 63 years)

'Driving is one of the most important activities of my life; it sets me free and takes my mind off my worries.' (female,76 years)

'[Driving] is very important; I need to drive so I can visit my grandchildren. I like to go and take them wherever.' (male, 80 years)

Driving was seen as particularly important for retaining independence where participants were the main carers for their frail spouses. This was largely in order for them to be able to undertake important activities of daily living such as shopping. Interestingly, all male participants were also primary drivers, in line with gender role expectations of this age cohort. However, most women (84%) who were the primary drivers reportedly did so because their spouses could no longer drive due to ill health or disability.

3.3.2 Emphasis on physical recovery

At the time of interview (between one and 16 weeks post-stroke), most participants (95.2%) had not considered the question of driving post-stroke, or felt it was too soon for them to be certain of their ability to drive. When asked how they would describe their ability to drive, they stated:

'Well I wouldn't know till I got into the car would I?' (female, 79 years)

'I don't know because I haven't driven yet.' (male, 68 years)

Overwhelmingly, participants reported that they felt the need to focus on their physical and cognitive recovery and return home before addressing the issue of driving. However, when prompted to comment on their perceptions toward driving post-stroke, most (90.4%) discussed at least one physical factor hindering their ability to resume driving, as the following quote describes:

'Well, at the moment the use of one arm that would stop me, and I don't tend to look to the left which would obviously be tragic.' (female, 77 years)

Interestingly, male participants stated physical restrictions as the main reason they might not return to driving, with none mentioning a lack of confidence as an issue. All of the women discuss issues such as lack of confidence and safety. As one male participant stated:

'[My] ankle, it doesn't move, I can't get it to go up and down. I'll need that to drive.' (male, 80 years)

When prompted by the interviewer, the majority of male participants (80%) believed they could potentially return to driving, whereas only one of the 11 women (9%) reported she definitely would. One woman described her fear of driving by explaining how she felt when she went on a home visit from hospital and sat as a passenger in the front seat of her son's car:

'Well, I don't think I have any ability to drive now because just sitting in the car now bothers me in the traffic.' (female, 77 years)

Another woman described her lack of confidence by saying:

'I would, I'd no doubt I have to drive with a bit more care just till I got used to it again. I might just go down to the shops first and yes, just drive locally at first till I got used to it again.' (female, 79 years)

These attitudes and perceptions about physical limitations or abilities for driving were not influenced by participant's functional status as reflected in their NIHSS (Brott et al., 1989; Goldstein & Samsa, 1997) scores. An example of this was one participant whose NIHSS score was 9 and who had a dense left hemiplegia stating she could return to driving a manual car by reaching across to the gear stick with her right hand to drive. This woman went on to be discharged to a nursing home and never drove again. None of

the participants who scored a 4 or higher on the NIHSS stated that they might not drive again.

3.3.3 Imposing limits on driving pre-stroke and likelihood of return to driving

It was evident that some participants had already begun to make changes to their driving habits prior to their stroke. While just over half (52.3%) of the participants (mostly men) had reportedly not overtly altered their driving habits (i.e. driving day and night, locally and interstate), most (72.7%) of the women reported they had become more cautious. One woman spoke of how she was driving less and was considering ceasing driving altogether after moving into a retirement village. This was because she was no longer required to do any regular food shopping, and had access to a private bus service and local shops that were now within walking distance. Several other women similarly stated:

'I don't drive as much now, not into the city, just locally.' (female, 79 years)

'I am more cautious of speed. I realise I'm more comfortable driving at slower speed.' (female, 63 years)

Placing limits on driving pre-stroke tended to relate to the number of day-to-day community-based activities attended. Those participants who limited their driving pre-stroke reported they drove to fewer activities and destinations. Participants who limited their driving reported they tended to drive only during the day and locally to access necessities such as food shopping, banking and the post office. Those participants who had not limited their driving pre-stroke drove more often and to a larger scope of activities, such as community groups, the library, and visiting friends and relatives. Although age did not appear to influence overall attitudes toward driving pre-stroke, reports suggest it did have limited influence, as none of the four people younger than 63 years recounted limiting their driving. When examined in light of their current perceptions toward driving post-stroke, limiting driving pre-stroke did appear to be related to considerations of returning to driving post-stroke. Of the nine participants who

had reported limiting their driving pre-stroke (such as only driving in their local area and during day time), only 2 (22.2%) reported they would definitely be returning to driving. For those who had not begun limiting their driving prior to their stroke, around half (54.5%) reported they would definitely be returning to driving post-stroke.

3.3.4 Legalities and Australian return to driving processes post-stroke

In closing the interview, participants were briefly asked about their knowledge of driving regulations post-stroke. Despite all participants being given brochures and most attending ward seminars about driving post-stroke, 18 of the 21 participants (85.7%) reported they had never discussed relinquishing their driver's licence with anyone, and only three (14.3%) stated they had talked to their GP about this issue reportedly pre-stroke. Attitudes and perceptions were not influenced by the time since stroke.

3.4 Discussion

The finding that men seemed to express more confidence about returning to driving post-stroke may be due to the fact that they tend to have also reported driving more frequently than women pre-stroke. All of the men interviewed were the primary person in their households responsible for driving pre-stroke. This is consistent with research which found that individuals who drove greater distances and more frequently were more likely to rate themselves as better drivers and have more confidence about their driving ability (Marottoli & Richardson, 1998). The related finding that male participants tended to emphasise physical limitations, rather than psychological factors, such as confidence levels, as the predominant reason for not returning to driving post-stroke suggests it may be beneficial for health care professionals to address returning to driving with a different focus for men and women, outlining physical considerations with men and working to build confidence in women.

Limiting driving pre-stroke did appear to influence considerations over whether to return to driving post-stroke. Those people who had already limited their driving were more

likely to indicate they would be unlikely to return to driving post-stroke. However, several people indicated they were unsure about their driving ability and were undecided about returning to driving. Understanding why and when people limit their driving is important, as research has shown that limiting driving can lead to a reduced quality of life as a result of lower community participation (Myers, Paradis & Blanchard, 2008). Negative feelings post-stroke have also been found to be enhanced by loss of ability to participate in valued activities that were linked to pre-stroke identity (White et al., 2008). Consistent with previous research (Liddle & McKenna, 2003; Stav, Pierce, Wheatley & Schold-Davis, 2005), participants equated driving with independence and life satisfaction.

However, when discussing attitudes and perceptions toward driving post-stroke, the majority of participants stated they had not even begun to consider driving, and were primarily focused on their physical and cognitive recovery. These findings highlight the importance of appropriately timing discussions with stroke survivors about returning to driving, and that information delivered while the stroke survivor is still in hospital may not be retained. This lack of knowledge seems to support the general sentiment arising from the interviews that participants do not appear ready to consider or discuss driving post-stroke at this early stage of recovery. It may also reflect the reluctance of most people to discuss the possibility of relinquishing their driver's licence at this stage.

This lack of knowledge on post-stroke driving education and legislation further reinforces the notion that health care professionals may need to revisit the timing of discussions about returning to driving post-stroke with stroke survivors. They may need repetition of information on returning to driving post-stroke once they return to the community where they are likely to be more receptive to this information. It may be more effective within the early stages of recovery to focus instead on enhancing self-awareness, which could improve decision making and reinforce appropriate confidence levels in regard to likelihood of resuming driving. This process could also be of more benefit if discussions about alternative transport options are introduced at this early stage of recovery, as currently the majority of stroke patients in Australia will not return to driving (Allen et

al., 2007). It has been demonstrated that early discussions and interventions that address alternative transport options can improve confidence in participation in community outings (Barnsley et al., 2012).

3.5 Limitations and conclusions

Several limitations of this study need to be acknowledged. The use of a less structured interview format could have allowed participants to build upon some of the themes in more detail. It may also have been useful to capture changes over time and to re-interview participants further along the continuum of their recovery, as their views and needs may change. Future studies could determine whether or not initial attitudes and perceptions to driving post-stroke influenced whether someone returned to driving post-stroke. The opinions of other stakeholders, such as family and friends and staff working with stroke individuals, may also be of interest in future studies in order to gain information about attitudes and perceptions of those around the stroke patient who may have influenced decisions about driving post-stroke. Four participants in this study were under 65 years due to convenience sampling. Future studies should focus on people aged over 65 years to make it possible to compare results with other studies on older post-stroke survivors. NIHSS scores (Brott et al., 1989; Goldstein & Samsa, 1997) for all participants were compared with their statement on whether or not they would consider returning to driving post-stroke. No relationship was found between NIHSS (Brott et al., 1989; Goldstein & Samsa, 1997) scores and stated likelihood of returning to driving post-stroke. However, future studies might consider looking at specific functional and cognitive deficits that might influence post-stroke driving decision making, such as visual loss and whether returning to driving was realistic.

This study suggests that stroke survivors who are in the first four months of recovery may not retain information given to them about driving post-stroke. This could be due to a number of factors, predominantly that they are not considering returning to driving at this time, but they are more focused on physical and cognitive recovery.

Chapter Four: Rehabilitation Phase – A pilot study: Can the UFOV Assessment be used as a Repeated Measure to Determine Timing of On-road Assessment in Stroke?

Chapter three has highlighted the importance of understanding the process of returning to driving post-stroke from all stakeholder perspectives during the acute phase of the recovery trajectory. By understanding stakeholders' perspectives health care professionals are able to tailor services in a more patient-centred way, which could ultimately ensure better outcomes. Moving along the stroke recovery trajectory into the rehabilitation phase in this chapter, one aspect stroke survivors and their families encounter during this phase, that of assessment, is examined. Standardised assessments such as the UFOV assessment (Ball et al., 1988) are used by GPs and occupational therapists as a tool and an objective measure to guide decision making related to optimal timing to ensure the best chance of passing on-road driving assessment post-stroke (George, 2012). Findings in chapter two discovered that a gap in current research exists in understanding the influence of psychometric properties of the standardised assessments currently used as pre-driving screening tools. It is important to understand the influence psychometric properties have on standardised assessments, such as the UFOV assessment, in order to understand how they might influence scores and to enable interpretation of results correctly.

The aim of this chapter is to address this gap in current research and to provide evidence as to whether the UFOV assessment has a psychometric advantage as a clinical assessment, training tool and outcome measure. The study documented in this chapter examines the specific psychometric property of practice effect when repeating the UFOV assessment once a month for three months post-stroke. A time frame of one to three months was chosen to examine in this study in response to the change in Australian guidelines when the minimum time of returning to driving post-stroke was decreased

from three months to one month to align with overseas legislation (Austroads, 2012, see Appendix II).

In the absence of practice effect, any positive change in UFOV assessment scores will be clinical improvement and not due to familiarity of the UFOV assessment. It is hoped that the results of the study highlighted in this chapter will inform decisions about the best use of the UFOV assessment as a pre-driving screening tool post-stroke that could assist GPs in decisions about fitness to drive as well as contributing to the UFOV assessment's use as a retraining tool and outcome measure. If no practice effect is found this would suggest that the UFOV assessment can be used to measure change in cognitive and visual processing ability and assist in deciding optimal timing for referral to perform on-road assessment post-stroke. Therefore the objective of this chapter is to answer the second research question:

RQ 2: Is there a practice effect at one month intervals, for three months, for the UFOV assessment (Ball et al., 1988) in an older Australian, post-stroke population?

In this chapter, a study was presented to examine if there is a practice effect when conducting the UFOV assessment post-stroke, once a month for three months. A time frame of three months has been chosen to examine changes to Australian legislation, which enables stroke survivors to return to driving at one month, instead of three months post-stroke to align Australia with American and British guidelines. Structurally this chapter consists of an introduction, methods section, results, discussion, limitations and overall conclusions drawn from the findings.

4.1 Introduction

Following a stroke, survivors are often left with altered cognitive function and limitations likely to affect their ability to drive safely. Reduced cognitive function after stroke has been associated with decreased driving exposure and avoidance of complex driving situations such as driving in the rain, parallel parking and driving at night (Pound, Gompertz & Ebrahim, 1998). Difficulties with concentration, spatial issues, vision, attention and poor judgement also result from stroke and affect driving ability and safety (Edwards et al., 2008; Fisk et al., 2002b). Driving deficits have been found in acute mild stroke survivors in the first one to two months post-stroke (Hird et al., 2014). Hird et al. (2014) found that stroke survivors of acute mild ischemic stroke are able to perform basic driving tasks but deficits were found in their ability with more complex driving tasks such as turning left across oncoming traffic.

In Australia there is currently a lack of driver trained occupational therapists available to perform on-road assessments, so these need to occur when stroke survivors are most likely to pass or benefit from rehabilitation to avoid duplication and unnecessary use of an already overstretched resource. Pre-driving screening assessments, such as the UFOV assessments, help reduce the burden of inappropriately timed on-road assessments. The timing of on-road assessments needs to find a balance between the current legislation, which allows for a return to driving one month post-stroke for some stroke survivors and the need to ensure success for stroke survivors in order to build confidence rather than establish unrealistic expectations and experiences of failure. Therefore it is important to ensure appropriate timing of on-road assessment and the use of reliable pre-driving screening tools to aid in return to driving decision making and to reduce the likelihood of the need for further assessments. Appropriately timed pre-driving screening, such as completing a UFOV assessment, enables stroke survivors to avoid repeated and unnecessary experiences of failing on-road assessments, and to find the balance between the stroke survivor's independence, expectations of success and community safety.

Currently in Australia inequities still exist in accessing health care services (including rehabilitation and OT) to facilitate returning to driving (Fisk et al., 1997; NSF Stroke Audit Acute Services, 2013; NSF National Stroke Audit Rehabilitation Services, 2014). Despite existing guidelines (NSF, 2010, see Appendix I), stroke survivors and their families often experience different assessment processes, and are given inconsistent and inadequate advice about returning to driving post-stroke (Fisk et al., 1997). There are notable gaps in advice and experience of stroke survivors with regards to assessment for decisions on fitness to drive.

Variation exists in off-road driving assessments used by Australian occupational therapists as pre-driving screening tools prior to on-road assessments (Devos et al., 2011). Decisions about fitness to drive are complicated by the diversity of assessments used and the lack of agreement between occupational therapists about the 'best' (most reliable or valid) assessment prior to on-road testing (Unsworth et al., 2010). It is therefore crucial to ensure best practice where valid standardised pre-driving screening assessments are chosen with a full understanding of any influence from psychometric properties such as practice effect.

The UFOV assessment has been used for screening assessments, retraining and as an outcome measure following stroke (Mazer, Sofer, Korner-Bitensky & Gelinas, 2001). Design of the UFOV assessment enables it to assess visual processing and attention by measuring the speed a person can cognitively process visual information within a visual field radius of 30o, in a single glance (O'Connor et al., 2011). The UFOV assessment requires both the identification and localisation of supra threshold targets through subtests that tap the speed of visual information processing, ability to divide attention, and ability to ignore irrelevant information. The UFOV assessment is divided into three subtests. Subtest one: Processing speed: the examinee is asked to remember which of two objects, either a car or a truck, was presented in the previous screen. Accuracy and speed of response is measured. Subtest two: Divided attention: the examinee is asked to

identify the centrally presented object and locate a simultaneously presented car displayed in the periphery. The object displayed in the centre of the screen could be either a car or a truck. Subtest three: Selective attention: is the same as subtest two, except that the object displayed in the periphery is embedded in a field of 47 triangles or distracters (UFOV Users Guide, 2009).

Figure 4.1: UFOV assessment: Subtest one: Processing speed

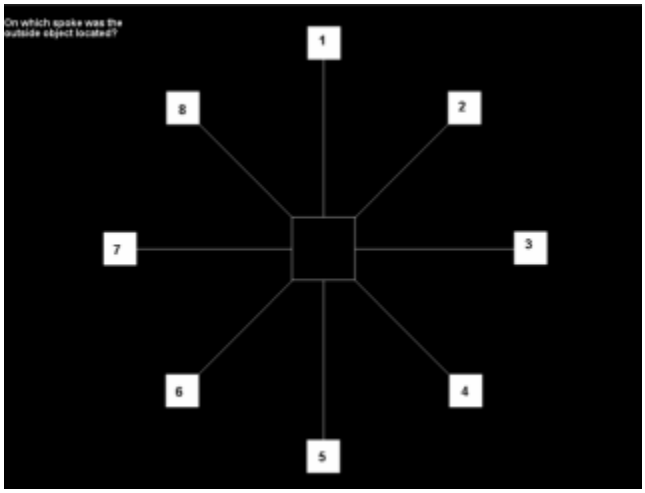

Figure 4.2: UFOV assessment: Subtest two: Divided attention

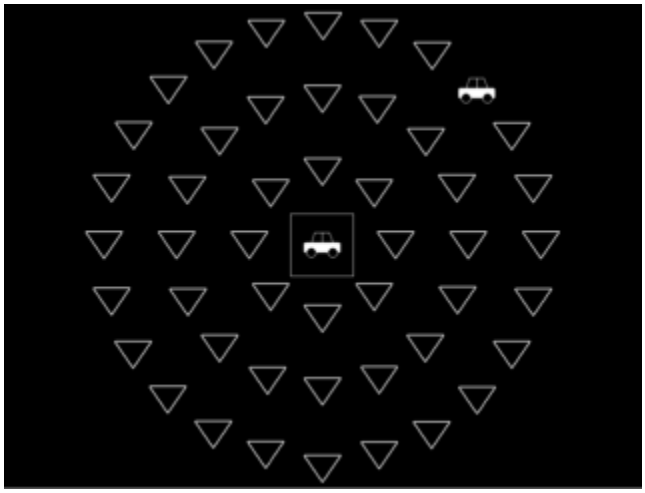

Figure 4.3: UFOV assessment: Subtest three: Selective attention

(Source: www.biopticodrivingusa.com/ufov-useful-field-of-vision/)

Results from UFOV assessment screening have been found to be associated with on-road driving performance post-stroke, demonstrating both high values of: specificity (prediction of pass on the on-road assessment) at 88.9% on subtest three: selective attention; and sensitivity of 85.7% (correct prediction of fail on the on-road assessment) on subtest two: divided attention (George & Crotty, 2010). The high sensitivity values point to the UFOV assessment's use in identifying those people requiring further training and delayed assessment, as they would currently pose a road safety risk and have a high likelihood of failing on-road assessment. The high specificity value relates to the UFOV assessment's ability to indicate it may be clinically useful in determining the timing of participating in on-road assessment to ensure the greatest likelihood for stroke survivors of passing (George & Crotty, 2010).

A further investigation was performed by George (2012) on whether rehabilitation physician's recommendations on stroke survivors' ability to return to driving following stroke were associated with performance on two assessment tools, the UFOV assessment

and the Stroke Driver's Screening Assessment (SDSA, Lincoln, Radford & Nouri, 2004). Both the UFOV and the SDSA are portable, relatively quick and easy to administer and could be available for use by GPs to assist with fitness to drive decision making. The aim of the study was to identify tools that GPs could use in their rooms as reliable and valid pre-driving screening tools with stroke survivors when assessing fitness to drive. The UFOV assessment was completed by 123 stroke survivors, 98 men with a mean age of 67.3 years (SD 13.5 years) who had driven prior to their stroke. Results showed that UFOV assessment scores were significantly associated with rehabilitation physician's recommendations on driving (George, 2012). George (2012) concluded that the UFOV assessment is a valid tool for GPs to use in decision making about fitness to return to driving post-stroke.

However, the application of the predictive ability of the UFOV assessment in regards to driving post-stroke is hampered clinically due to limited current knowledge on the possible affects the psychometric properties of the UFOV assessment may be having on scores. Practice effect is one such psychometric property which could influence UFOV assessment scores. If practice effect has occurred when performing the UFOV assessment more than once, the participant's scores increase not as a result of improved visual processing skills but due to learning how to perform the UFOV assessment. The psychometric properties of an assessment tool therefore influence the validity of the assessment and the ability to use the results from an assessment reliably as a pre-driving screening assessment, retraining tool and as an outcome measure in research.

Previous research has found a practice effect to be evident when administering the UFOV assessment repeatedly in the space of one day, with half an hour break between assessments, in young, healthy subjects (Bentley et al., 2012). However, it is unknown if this is also the case when there is a longer wash-out period between testing sessions, or in the older post-stroke population. A longer wash-out period between testing is more likely to be reflective of what normally occurs in practice with the post-stroke population, in the

clinical setting. Repeated UFOV assessments completed over one day as demonstrated in the Bentley et al. (2012) study are unlikely to occur in the clinical setting, as the use of assessments such as the UFOV assessment is to show clinical improvement over time after specific interventions, and would therefore be spaced and not occur on the same day. As clinical improvement following the intervention would take some days or weeks post-stroke there would be no benefit in performing the UFOV assessment repeatedly in one day to assess improvement that might have occurred as a result of a rehabilitation program. There are also limited pre-driving assessment resources, considerable costs involved in off- and on-road driving assessments and issues specific to the post-stroke population, such as fatigue, that would make repeated UFOV assessments in one day unlikely to be appropriate clinically. One month intervals are considered a more likely clinical scenario.

Therefore, the aim of this study was to examine if there is a practice effect at one month intervals, for three months, for the UFOV assessment in an older Australian, post-stroke population. The objective is to determine the feasibility of the UFOV assessment being used repeatedly in a clinical setting over the stroke trajectory of recovery from one to three months to inform appropriate timing of on-road assessments.

4.2 Methods

4.2.1 Participants

Of the 193 stroke survivors approached to participate in this trial, 53 were recruited; however, 11 withdrew due to illness or work commitments, leaving 42 post-stroke participants (see Figure 4.1). Of these remaining 42 participants there were 17 men (40.5%), with a mean age of 71 years (SD 9.33) with 39 participants experiencing infarcts (93%) and three haemorrhages (7%). All 42 participants were recruited from the acute stroke ward at Flinders Medical Centre, the Day Rehabilitation service and Rehabilitation in the Home service at Repatriation General Hospital, Adelaide, Australia between 19 November 2010 and 20 July 2012.

Those that met the following selection criteria were approached to be part of the trial: post-stroke, 18 years and over, MMSE (Folstein et al., 1975) of 23 or more, no hemianopia present, no or only mild dysphasia, driving prior to their stroke and sufficient English language to complete the assessment (see Figure 4.4 and Table 4.1). This study was approved by the Southern Adelaide Health Service/Flinders University Human Research Ethics Committee (SAFUHREC), approval number: 374/10.

Figure 4.4: UFOV study: Practice effect RCT flow chart

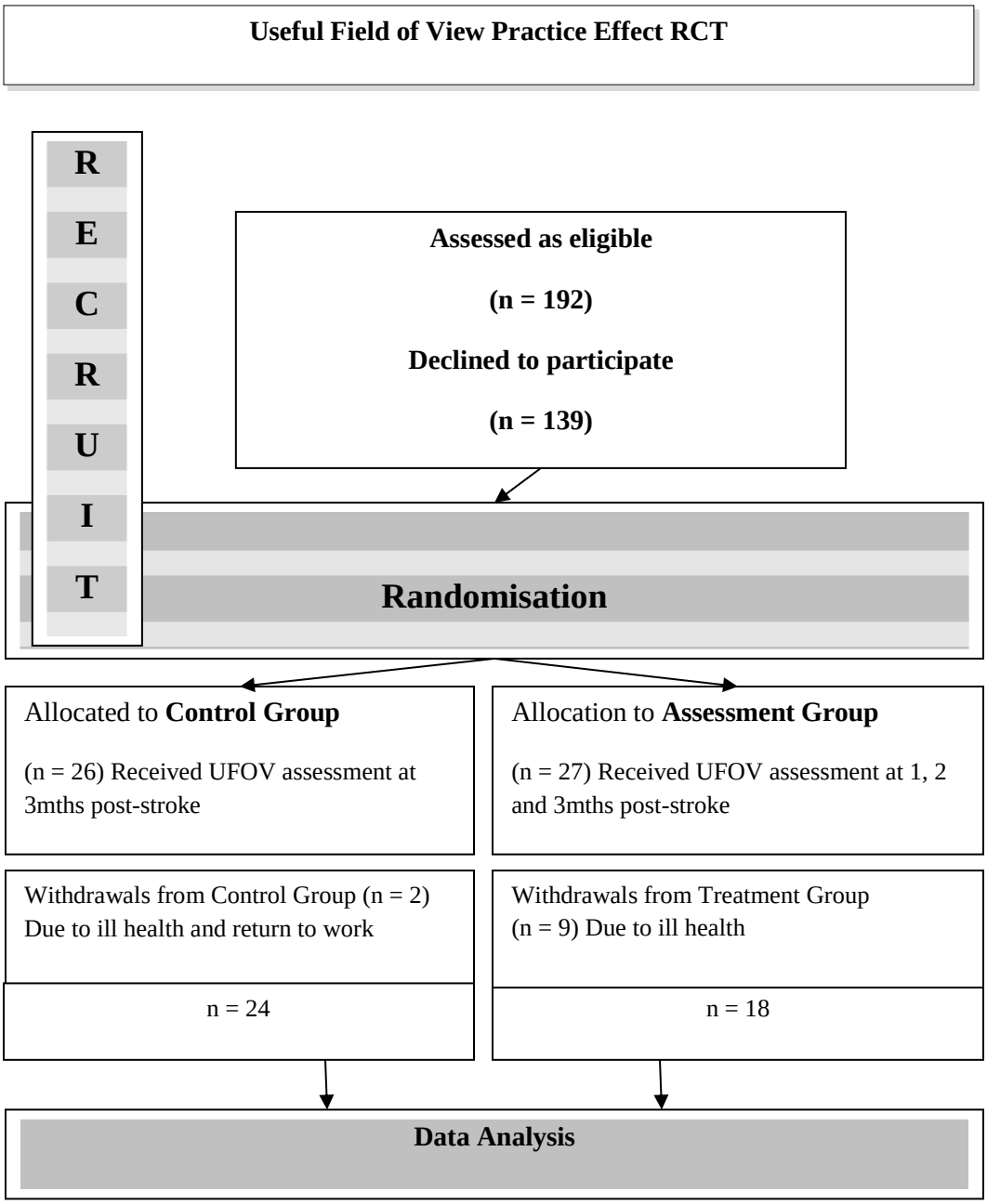

Table 4.1: UFOV study: Participants characteristics

	Assessment group (n=27)	Control group (n=26)	Total (n=53)
Age in years	72.8 (SD 9.0)	70.5 (SD 10.3)	71.7 (SD 9.7)
Gender (male/female)	15/12	15/11	30/23
Barthel scores	100.48 (SD22.14)	106.92 (SD 8.29)	103.57 (SD 17.11)

4.2.2 Procedure

Participants were randomised into either the control or assessment groups by sealed envelope allocation by an assessor blind to the study. The assessment group completed the UFOV assessment at one, two and three months post-stroke. A control group was utilised for a UFOV assessment at three months to evaluate the practice effect and was modelled on the post-test study design of Campbell and Stanley (1966). The data collector was not blind to group allocation.

At the initial assessment participants also completed a Modified Barthel Index (Shah, Vanclay & Cooper, 1989), a self-reported functional assessment on the participant's ability to perform personal hygiene, bathing, feeding, toileting, mobility and dressing tasks. The questionnaire and the UFOV assessments were administered in participant's homes during home visits.

4.2.3 Data analysis

The required sample size was calculated based on data reported in a published article validating the UFOV assessment with stroke survivors (George & Crotty, 2010). The minimum sample size of 50 was required assuming alpha = 0.05 and p = 0.20 (i.e. power = 0.80). Data was analysed using SPSS version 19 (SPSS Inc., 2009). Data was initially checked for skewness and kurtosis and non-parametric tests were used where appropriate. All results on the UFOV assessment scores were reported in milliseconds to allow for detailed analysis, and median to be more representative of the central tendency as the data was not normally distributed.

The Mann-Whitney-U test (Mann & Whitney, 1947) was used, as data was not normally distributed, to determine the differences between the UFOV assessment scores at three months between the control and assessment group for each of the three subtest scores. Friedman's ANOVA (Mack & Skillings, 1980) was used to compare UFOV assessment subtest scores for the assessment group at one, two and three months. The level of significance was set at $P<0.05$. Intention to treat analysis did not occur due to inherent bias of collecting missing data from participants who withdrew (Armijo-Olivo, Warren & Magee, 2009). Those participants who withdrew did not have their data collected and would not experience a practice effect, as they did not continue to perform the UFOV assessment at one month intervals (La Valley, 2003).

As no practice effect was found between control and assessment group data for the two groups, data was combined to examine UFOV assessment pass/fail for right versus left stroke at one and three months. Significance between age, MMSE or MBI scores for those participants who passed or failed the UFOV assessment at one or three months was also examined.

4.3 Results

The results for the three subtest scores for the UFOV assessment are presented in Table 4.2. There were no significant differences between any of the UFOV assessment scores between the assessment and control groups at three months post-stroke.

When analysing the monthly scores in the assessment group, no significant differences were found in the central processing subtest scores (subtest one) or divided attention subtest scores (subtest two); however, a significant difference was found in the selective attention (subtest three) subtest scores ($p = 0.025$). Post hoc analysis using a sign test (Dixon & Mood, 1946) revealed that this significant difference was between subtest three scores at months one and three ($p = 0.049$) in the assessment group.

As no practice effect was found with overall scores between the assessment and control groups at three months it was decided to combine group scores to examine pass/fail rates of UFOV assessment to indicate timing of referral to on-road assessments. Based on the UFOV validation study performed by George and Crotty (2010) where subtest two was found to have the highest sensitivity for prediction of failing the on-road assessment, subtest two scores were analysed. At one month, 16.9% stroke survivors passed the UFOV assessment subtest two and 79.2% failed the UFOV assessment subtest two. Of those stroke survivors who failed the UFOV assessment subtest two at one month, when reassessed at three months 69.1% passed and 28.6% again failed.

There was no significant difference found for type of stroke between assessment and control group, with the assessment group having RCVA n = 16 (59.2%) and the control group having RCVA n = 11 (42.3%) ($\chi^2(3) = 8.24$ $p = 0.41$). When data was combined there was no significant difference found between pass/fail of the UFOV assessment for right stroke versus left stroke at one month ($\chi^2(6) = 10.95$, $p>0.05$). There was also no

significance found between ages, MMSE or MBI scores for those participants who passed or failed the UFOV assessment at one or three months.

Table 4.2: UFOV study: Subtest scores analysis

	Central processing		Divided attention		Selective attention	
Month	**Assessment group median (quartiles) scores in millisecs**	**Control median (quartiles) scores in millisecs**	**Assessment group median (quartiles) scores in millisecs**	**Control group median (quartiles) scores in milisecs**	**Assessment group median (quartiles) scores in millisecs**	**Control group median (quartiles) scores in millisecs**
1	18.6 (16.0-123.1)		149.9 (18.6- 380.2)		153.4 (18.6-433.5)	
2	18.6 (16.0-143.1)		80.2 (16.7-383.0)		119.6 (18.6-400.0)	
3	18.6 (16.7-120.0)	18.6 (16.7-206.7)	20.1 (16.7-342.9)	22.6 (16.7-280.1)	56.0 (18.6-306.7)	80.0 (18.6-356.6)

+ All values are in milliseconds and expressed as median and quartiles scores. ǂ No scores for 1 and 2 months for control group as UFOV only done at 3 months.

4.4 Discussion

The results of this study demonstrate that the repeated use of the UFOV assessment as an outcome measure over a three month period with stroke survivors did not result in a practice effect overall. No significant practice effect was found between three month UFOV assessments scores for the control and assessment groups. The assessment group showed a significant difference in the selective attention subtest three scores between months one and three, which may suggest an improvement in selective attention skill, but this did not statistically significantly affect the overall results.

The finding of no practice effect found in this thesis study contributes to evidence that the UFOV assessment has a psychometric advantage as a tool to be utilised in clinical practice to prompt referral for an on-road assessment, but is by no means conclusive. Although this study results contribute to evidence that the UFOV assessment does not have a practice effect when performed at one month intervals for three months post-stroke; this was a pilot study with a small sample size and therefore this study would need to be repeated with larger numbers of participants to confirm a lack of practice effect.

As no practice effect was found the assessment and control group scores were combined and based on the validation study by George and Crotty (2010) showing that UFOV assessment subtest two scores had the highest sensitivity to failing on-road assessments, the subtest two scores were analysed. Results indicated that at one month 16.9% of stroke survivors passed the UFOV assessment subtest two. When UFOV assessment subtest two were completed at three months, of those that failed the UFOV assessment subtest two at one month 69.1% passed, indicating referral for on-road assessment at this time would increase the likelihood of passing. This suggests the UFOV can guide clinical decision making.

When the assessment and control groups were examined together, no significant differences were found between left or right hemisphere strokes pass/fail rates on the UFOV assessment. No significant difference between left or right hemisphere strokes pass/fail rates is important to note as stroke survivors experiencing a right hemisphere stroke would be expected to have more visual processing deficits (Vallar & Perani, 1986). There was also no significance

found between the pass/fail rates in groups in the combined data and MMSE scores, MBI results or age.

Results of this study also support the findings of previous research (Horswill, Anstey, Hatherly & Wood, 2010; Mazer et al., 2001; Richards, Bennett & Sekuler, 2006) relating to the applicability of the UFOV assessment as a training tool. As no practice effect for the UFOV assessment was found, these findings suggest that, within a three month time frame post-stroke, any improvements from repeating the UFOV assessment would be as a result of a training effect or natural recovery and not a practice effect.

The extent and impact of the post-stroke recovery trajectory must not be underestimated. The adjustment process gradually evolves over a prolonged period of time over most of the first 12 months post-stroke (Kirkevold, 2002). It has been argued there is a need for better targeted approaches which include valid standardised assessments to enable a more comprehensive understanding of the complexities of the adjustment processes post-stroke (Kirkevold, 2002). Progression along the stroke recovery trajectory can be supported and encouraged by facilitating independence and self-esteem (White et al., 2012a). This can be achieved through a comprehensive and consistent return to driving process based on best practice research. Good quality care can prevent further decline into subsequent disability (Szczerbriska et al., 2010).

4.5 Limitations and Conclusions

Limitations of this study include the small sample size and uneven attrition across groups, which may have restricted our ability to detect differences and thus results may be inconclusive. Intention to treat analysis did not occur. This was due to the inherent bias of collecting missing data from participants who withdrew (Armijo-Olivo, Warren & Magee, 2009). Those participants who withdrew did not have their data collected and would not experience a practice effect as they did not continue to perform the UFOV assessment (Ball, et al., 1988) at one month intervals (La Valley, 2003).

Future studies could examine the practice effect over longer periods of time post-stroke and could continue monthly UFOV assessments to consider the difference between one month and six month scores, which is when most spontaneous recovery is likely to occur (Silbeck et al., 1983). This information could inform timing of driving assessment for the post-stroke population in the future and avoid unnecessary use of post-stroke driving assessment resources, and the post-stroke trajectory of functional decline, disappointment and depression (Dhamoon, Moon, Paik, Sacco & Elkind, 2012).

Chapter Five: Community Phase – Confidence: Are Driving Confidence Levels Similar in Stroke Survivors Who Have Returned to Driving and Aged-matched Non-stroke Driving Peers?

Chapter Four has considered the aspect of psychometric properties of standardised assessment and their influence on scores, in particular, repeatability with the focus of considering the impact of practice effect. During the community phase of recovery post-stroke the ability to rebuild confidence in all aspects of life contributes to a positive attitude and experience during recovery. Driving, in particular, is influenced by confidence levels (Hogath et al., 2011) and has more impact on driving for female drivers (Marottoli et al., 1997). A lack of confidence can contribute to stroke survivors relinquishing their driver's licence prematurely or limiting their driving to daylight hours and to driving in their local area only. This limitation in driving scope reduces the sphere of social contact for the stroke survivor and their caregivers and can contribute to other resulting serious health challenges such as depression. Findings in Chapter Two identified a gap in current research in understanding the influence driving confidence has on driving post-stroke. It is important to understand what factors influence driving confidence post-stroke, as confidence or lack of confidence will contribute to decision making about driving such as limiting driving and driving habits.

The aim of this chapter is to address this gap in current research and to provide evidence upon the extent to which confidence levels influences driving post-stroke and to answer the third research question:

RQ3: Are self-perceived driving confidence levels lower in the post-stroke driving population compared to their aged-matched non-stroke driving peers?

In this chapter, I therefore present a study conducted to evaluate driving confidence in the post-stroke older driver in Adelaide, SA. Structurally this chapter consists of an introduction, methods, results, discussion, limitations and overall conclusions drawn from the findings.

This chapter contains material from:

McNamara, A., Ratcliffe, J, George, S. (2014). Evaluation of driving confidence in post-stroke older drivers in South Australia. Australas JAgeing, 33:3:205-207. doi:10.1111/ajag.12117.

5.1 Introduction

Fewer than half the post-stroke populations in Australia return to driving (AIHW, 2014). This may be due to poor health or lack of a uniform, evidence-based process in returning to driving post-stroke currently in Australia. As a result of this haphazard approach the influence of issues, such as a lack of driving confidence, are not being identified and opportunities for appropriate interventions are being missed.

A lack of driving confidence has been linked to self-limiting driving behaviours including reduced driving mileage, increased driving cessation, social isolation and declining health leading to poorer quality of life in older adults (Ackerman et al., 2011; Allen et al., 2007; Donorfio, D'Ambrosio, Couglin & Mohyde, 2008; La Grow, Neville, Alpass & Rodgers, 2012). Driving is essential for maintaining social interactions (Baldock, Mathias, McLean & Berndt, 2006). Driving difficulties may be caused by a lack of driving confidence. To understand why these limitations occur, it is important to investigate the impact of driving confidence and to determine its influence on limiting driving post-stroke. Currently, there is lack of evidence to indicate the extent to which lack of driving confidence post-stroke affects self-limiting of driving behaviours. Stroke survivors often have altered cognitive function and limitations that are likely to affect their ability to drive. Reduced cognitive function has been associated with a decreased driving exposure and avoidance of stressful driving situations such as driving in the rain, parallel parking and driving at night (Hoggarth et al., 2011; La Grow et al., 2012; White et al., 2012a). In addition, visual problems, spatial issues, difficulties with concentration and poor judgement may all result from stroke and potentially affect driving ability (Edwards et al., 2008; Hoggarth et al., 2011). The impact of poor judgement on self-awareness post-stroke may result in feelings of confidence that may not

match driving skills (Edwards et al., 2008). The relationship between cognitive ability, driving confidence and driving restriction is a complex one. However, in the absence of driving-related skill restrictions post-stroke, low confidence can be a concern as it may lead to premature self-limiting of driving and even driving cessation (Hoggarth et al., 2011).

The aim of this study therefore was to determine whether self-perceived driving confidence levels are lower in the post-stroke driving population compared to their aged-matched non-stroke driving peers.

5.2 Method

5.2.1 Instrument

The Adelaide Driving Self Efficacy Scale (ADSES) was developed in Adelaide, South Australia (SA) by George, Clark and Crotty (Wong, Smith & Sullivan, 2012), and is a set of 12 questions asking participants to rate their confidence levels from 0 (no confidence) to 10 (full confidence) about driving situations including driving around a roundabout, driving in high-speed areas and to a new destination. ADSES results are a reliable and valid measure of driving self-efficacy (Wong et al., 2012) and predicted on-road performance (George et al., 2007). Stapleton, Connolly and O'Neil (2012) found the ADSES reliably predicted those post-stroke drivers who received restricted and unrestricted driving recommendations following their on-road driving assessment. ADSES scores used in this study were collected in two previous studies on a post-stroke driving population (see DHQ study participants) and a non-stroke driving population of aged-matched peers (see DCE study participants) at the Repatriation General Hospital, Adelaide, SA and online across Australia respectively.

5.2.2 Participants

The post-stroke drivers were recruited via a retrospective file audit from the driving assessment clinic at the Repatriation General Hospital, Adelaide, SA over a three year period from June 2008 to the end of May 2011. All participants had returned to driving post-stroke after medical clearance, passing a battery of standardised off-road assessments, and completing a standard route on-road assessment with a driving instructor and a driving-trained occupational therapist. One hundred and ten stroke patient files were identified with 86 consenting to be contacted for future research. Participants were then selected, if they met

the following inclusion criteria: older than 18 years; drove prior to their stroke; diagnosis of stroke; and sufficient English language to perform a telephone interview. Seventy-five of the 86 patients met the criteria. When contacted, 40 of these 75 stroke survivors were willing to participate in the study. A telephone interview was performed which included the ADSES.

For the non-stroke population, a private online company was approached to recruit participants older than 65 years, current drivers and had never had a stroke. One hundred and fourteen participants were recruited from across Australia, four were excluded as they did not complete the data required. The ADSES was completed online. Gender ratios for both groups of participants were: stroke group 62% men and non-stroke 49% men, the majority of all participants lived in their own homes with a spouse and were all 65 years or older. Stroke group reported 25% used a walking aid, whereas only 10% of the non-stroke group did. However, only 15% of the stroke group, but 35% of the non-stroke group received community services.

5.2.3 Data analysis

All analyses were performed using SPSS statistical package, version 19 (2009) (Owsley et al., 1999). Differences between ADSES scores for stroke and non-stroke groups for age and gender were analysed using the Mann-Whitney U-test (Mann & Whitney, 1947) for independent samples, as data were not normally distributed. Categorical variables of age (older and younger than 75 years) and kilometres driven were analysed using the Kruskal-Wallis test (Kruskal, 1952) for age in years and driving habits. All analyses were two tailed, and P-values were considered significant if they were lower than $P = 0.05$.

5.3 Results

Mean ADSES scores for non-stroke driving population (n=114, 56 men) with a mean age of 65 years (SD=12.17) was 99.34. For the stroke driving population (n=40, 25 men) with a mean age of 72 years (SD=5.2) the mean ADSES score was 110.4. Results indicate that the relationship between overall ADSES scores for the non-stroke driving population compared with the stroke driving population was not significant ($z = -0.1408$, $P = 0.159$, $r = -0.133$, indicating a small effect size using Cohen criteria) (Pallant, 2011). There was no significant impact of age upon ADSES scores across the two groups. Nor did men and women differ

significantly in terms of their ADSES scores. Finally, age was not associated with the number of kilometres driven per week (P = 0.157).

5.4 Discussion

Results indicate that stroke survivors in this study returned to driving with no significant difference in their driving confidence compared to the aged-matched non-stroke driving group. These results show that once stroke survivors returned to driving in this study they appeared to have had no significant issues with driving confidence compared to their non-stroke aged-matched driving peers. Stroke survivors returning to driving may be those who have driving confidence and it is highly plausible that a lack of driving confidence might be the reason for not returning to driving post-stroke. The next step in determining the influence of driving confidence post-stroke (in the absence of other driving-related skill restrictions) is to study whether the ADSES could be a useful tool in identifying stroke survivors with low driving confidence during the acute phase, earlier on in their recovery, who might be at risk of not returning to driving. Timely recognition of a lack of driving confidence might allow for appropriately targeted early treatment strategies to prevent driving cessation prematurely post-stroke (Donorfio et al., 2008). The results highlighted in this study provide further evidence of the influence that driving confidence has post-stroke on the process of returning to driving. It would appear from this study that general driving confidence was not adversely affected significantly, once post-stroke drivers returned to driving.

5.5 Limitations

This study was limited by small sample sizes, especially the stroke group, which lowered its explanatory powers in detecting statistical interactions supported by the low effect size. Different modes of data collection and analysis were utilised with the two groups of participants, which may have influenced the comparisons and resultant findings from this study. Furthermore, in contrast to the stroke group, the non-stroke group had experienced no interruption to their driving, which could have influenced confidence levels. Future studies considering further the incongruence between self-perceived driving ability and lack of actual driving ability are important, as there is evidence to indicate that driving confidence does not always equate to safe driving, especially in older drivers (Cohen, 1988).

5.6 Conclusion

Returning to driving post-stroke is important, as not returning to driving has been linked with social isolation, reduced quality of life, depression and a higher need for medical interventions (Holland & Rabbits, 1992). Studies that examine early detection of driving confidence issues using tools such as the ADSES may help stroke survivors in decision making about returning to driving post-stroke, development of appropriately targeted interventions and avoid premature driving cessation. Those stroke survivors who were deemed both medically fit to drive and returned to driving reported comparable driving confidence to the non-stroke drivers. It was found in this study that gender did not appear to be a factor in determining driving confidence levels in these stroke and non-stroke older drivers. Other previous research that has found gender to be an influencing factor with women to be more likely than men to lack driving confidence (Marottoli et al., 1997). The lack of influence of gender in the findings from this study may be due to other salient characteristics of the study participants, particularly that they were all current drivers, the majority of whom drove for more than 100 km/week.

Findings from this study suggest that once stroke survivors of both genders return to driving post-stroke they have the same levels of driving confidence as their aged-matched non-stroke driving peers. The influence of confidence earlier in the stroke recovery trajectory should be considered in future research, and may be identified by using the ADSES to determine those stroke survivors who lack confidence about returning to driving post-stroke.

Chapter Six: Community Phase –Does Driving Confidence Influence Driving Habits in Stroke Survivors?

Chapter Five explored whether a lack of confidence was present for stroke survivors who had returned to driving post-stroke and whether or not it differed from non-stroke driving peers. Confidence was not found to differ significantly between post-stroke drivers and older drivers of similar ages. Conclusions drawn were that those stroke survivors who had returned to driving may be those who did not have confidence issues during the acute phase of their recovery trajectory. To further understand the issue of driving confidence post-stroke, another study was undertaken to examine whether or not levels of confidence affect driving habits once stroke survivors have returned to driving. The study documented in this chapter explores whether driving confidence levels affect post-stroke drivers driving habits. Findings from the literature review in Chapter Two discovered a gap in current research in understanding the influence driving confidence has on driving habits post-stroke. It is important to understand what factors influence driving confidence post-stroke as level of confidence will contribute to decision making about driving, such as limiting driving and driving habits. The aim of this chapter is to address this gap in current research and to provide evidence of how confidence influences driving habits post-stroke as well as to answer the fourth research question:

RQ4: Are self-perceived confidence levels associated with self-regulation of driving in the post-stroke population?

The objective of this study is to better understand those driving habits influenced by confidence in driving post-stroke. Limiting driving can lead to driving less often to fewer destinations which reduces social connectedness and contributes to social isolation. Social isolation post-stroke has been found to have negative consequences for recovery and can lead to depression (White et al., 2008). If we can understand how confidence can influence driving habits, such as limiting driving behaviours, we can find a solution to stop negative outcomes such as depression.

In this chapter, therefore a study is presented which was conducted to examine perceived confidence and how it relates to driving habits post-stroke. Structurally this chapter consists of an introduction, methods, results, discussion, limitations and overall conclusions drawn from the findings.

This chapter contains material from:

McNamara, A., Walker, R., Ratcliffe, J, George, S. (2015). Perceived confidence relates to driving habits post-stroke. Dis Rehabil, 37:14:1228-33. doi:10.3109/09638288.2014.958619.

6.1 Introduction

The return to driving trajectory post-stroke usually involves a period of non-driving, with the length of interruption depending on the impact of stroke, local medical guidelines and assessment by doctors. For most stroke survivors, there is an interruption to their driving for some months post-stroke which contributes to lack of returning to driving confidence and many do not return to driving at all. Driving difficulties post-stroke may be caused by a lack of driving confidence which interferes with driving performance including distractibility, inadequate scanning of the environment, poor lane positioning, judgement problems and slow response to emergency situations (Fisk et al., 2002b). In one study to compare stroke survivors, at least 6 months post-stroke and non-stroke older adults in the community; vision and attention were found to be impaired in stroke survivors, with the severity of visual problems influencing driving status, confidence and driving behaviours (Fisk et al., 2002b). These limitations may also contribute to a higher risk ratio for crashes in post-stroke drivers (Perrier et al., 2010b).

6.1.1 Confidence

A number of previous studies have indicated that confidence in driving affects self-limiting driving behaviour in older adults in the general community (Anstey & Smith, 2003; Marottoli

& Richardson, 1998; Myers, Paradis & Blanchard, 2008). A study of 125 current drivers aged 77 years and over by Marottoli and Richardson (1998) in Connecticut, USA, found driving confidence was related to driving frequency and mileage, but that there was no relationship to adverse driving events or driving performance. Participants drove further and more often if they were confident but did not have fewer crashes. Driving confidence has also been found to be linked to driving frequency, less limiting driving behaviours and better perceived driving ability (Fisk et al., 2002b; Tan et al., 2011). Macdonald, Myers and Blanchard (2008) used the Driving Comfort Scale with 71 current drivers aged between 63 and 93 years recruited from retirement complexes and senior centres. Participants received a number of tests which assessed visual acuity, sensitivity and speed of visual processing, reaction time tests, walking tests, cognitive testing, brake reaction timing plus a background questionnaire. Driving patterns were found to be more strongly related to perceived comfort and perceived driving abilities than to objective actual driving performance.

In a joint Canadian, Australian and NZ study by Langford et al. (2013) of current drivers, associations between low-mileage drivers and a heightened crash risk were found. Low-mileage drivers in the Langford et al. (2013) study were more likely to be women over 80 years but were found to be only 15% of the total sample of participants (n=1222). Low-mileage drivers "performed relatively poorly on a wide range of performance measures, perceived their own driving ability as lower, and reported lower comfort levels when driving in challenging situations compared to the higher mileage drivers and in most instances these differences were statistically significant" (Langford et al., 2013, p. 304). Confidence has also been associated with on-road performance in post-stroke drivers (George & Crotty, 2010; Stapleton et al., 2012). Both of these post-stroke studies used the ADSES to assess self-perceived driving confidence. Firstly, in Stapleton et al. (2012), the participant and a proxy (significant other) were asked to complete the ADSES and participant also completed an on-road driving assessment. Both assessments were repeated again at six months post-baseline measures with those participants who had successfully passed the initial testing. ADSES scores for both participants and proxy were statistically significantly related to on-road driving scores and performance. Those participants with low driving confidence, as measured by the ADSES, were recommended by the researchers to restrict their driving and those with high ADSES scores received unrestricted driving recommendations. Thus, ADSES scores are shown in the Langford et al. (2013) study to be predictive of on-road driving performance.

The impact of poor judgement on self-awareness post-stroke also needs to be considered, as it can result in feelings of confidence that may not match driving skills (Wong et al., 2012). The relationship between cognitive ability, driving confidence and driving restriction is a complex one. However, in the absence of any cognitive impairment that may affect judgement and driving-related skill restrictions post-stroke, low-confidence can be a concern as it may lead to premature driving limiting and cessation (Edwards et al., 2008). The potential complexities between driving safety, confidence issues and driving behaviours relating to stroke warrant further investigation. Lower mileage and lower confidence levels may indicate a higher risk driver group. This may mean they need closer monitoring or intervention to improve their confidence and driving ability. As therapists, we are able to identify those stroke survivors most likely to limit their driving and those who are at risk of driving cessation altogether. This will allow us to intervene to increase driving confidence and skill, and thus assisting with returning to full driving potential post-stroke, reducing the likelihood of self-limiting driving behaviours and crash risk. If appropriate, after assessment it may also become apparent that intervention needs to assist the driver to come to terms with the need to further limit or cease driving and explore the alternatives available to them (White et al., 2008). The impact of driving cessation can result in reduced community access and social isolation which can also be managed by the exploration of the role of the carers as well as alternative methods of transport (Liddle et al., 2012). The aim of this study was to determine whether self-perceived confidence levels are associated with self-regulation of driving in the post-stroke population.

6.2 Methods

6.2.1 Participants

Ethics approval was given by the SAFUHREC, project number: 374/10, to recruit participants through a retrospective audit conducted on client files over a three year time period from June 2008 to the end of May 2011, at the Driving Assessment Clinic at the Repatriation General Hospital, Adelaide, SA. The Occupational Therapy Driver Assessment and Rehabilitation Clinic is a specialist service for people whose driving is impacted upon by injury, illness, stroke or age-related functional decline. All participants had returned to driving post-stroke after medical clearance, passing a battery of standardised off-road assessments and completing a standard route on-road assessment with a driving instructor and

a driving trained occupational therapist at the Occupational Therapy Driver Assessment Rehabilitation Clinic at the Repatriation General Hospital, Adelaide, SA (Table 6.1).

Table 6.1: DHQ study: Participants characteristics (n = 40)

Characteristics	**Frequency**
Gender	
Male	25
Female	15
Age range	
29 to 88 years (Mean: 65.5 years, SD= 12.17 years)	
Range of time since stroke (in months)	
2mths to 36mths (Mean: 16.9 months, SD= 9.83 months)	
Type of stroke	
Haemorrhagic	9
Infarct	31 (77.5%)
Living alone or with others	
Lives alone	19
Lives with spouse or other family members	21
Type of accommodation	
Own home	33
Renting (Housing Trust or private rental)	5
Retirement village	2
Community services	
Domiciliary care	0
RDNS	1 (bloods)
Council for cleaning services	5
None	34
Walking aids use	
Indoor	
SPS	2
Rollator	1
Outdoor	
SPS	8
Frame	1
None	30

NB: some participants reported using more than one walking aid.

6.2.2 Procedure

One hundred and ten patients were identified as having had stroke from the driving assessment clinic files during the allocated time frame. Of the 110 stroke patients, 24 (26%) stated on their files that they did not wish further contact, leaving 86 possible recruits. From these, participants were sought who met the following inclusion criteria: diagnosis of stroke; aged 18 years or over; driven pre-stroke; returned to driving after the driving assessment; and sufficient English language to perform a telephone interview. Seventy five of the 86 potential recruits matched the selection criteria. Those that were not eligible had either stopped driving (n=6), were deceased (n=1) or no longer contactable (n=4). Of these 75 people contacted, 40 agreed to take part in the telephone interviews. The interviews comprised two main components. Firstly, basic socio-demographic information including age, gender, details of when the participant had their stroke and type of stroke were recorded. Secondly, the two questionnaires, ADSES (George et al., 2007; George & Crotty, 2010) and the Driving Habits Questionnaire (DHQ, Owsley et al., 1999) were completed.

6.2.3 Instruments

The instruments used in this study to determine confidence in driving and driving habits were the ADSES and the DHQ. Both of these questionnaires have previously been validated in populations of older people examining confidence and driving habits, respectively (Fisk et al., 2002b; George et al., 2007; Owsley et al., 1999). The ADSES comprises 12 questions about specific driving tasks, such as parallel parking and driving at night, and asks the participant to self-rate their level of confidence in performing each of these tasks on a Likert scale ranging from 0 (not confident) to 10 (completely confident), with a maximum score of 120 indicating the highest level of confidence (Table 6.2 includes the specific questions asked in this scale and a summary of the results). ADSES has demonstrated internal consistency and construct validity with stroke and non-stroke populations. Criterion validity has also been demonstrated in relationship to outcomes of on-road driving assessment, and it was found to be a reliable and valid measure of driving self-efficacy (George et al., 2007; George & Crotty, 2010). Recently, the ADSES was also validated for application with stroke populations (Stapleton et al., 2012). The ADSES was chosen for this study because George and Crotty (2010) found self-perceived driving confidence levels, as assessed by the ADSES, have a statistically significant association with on-road driving assessment results. In this way, the impact of the incongruence that can be found between self-perceived driving ability

reported and actual driving ability was reduced. The DHQ is designed to be interviewer administered and addresses six domains:

(a) Current Driving Status and Miscellaneous Issues: current driving states and self-assessed driving quality.
(b) Driving Exposure: number of days driven, where and how often drive in an average week.
(c) Dependence on Others: allows for a 'dependency' score to be calculated that evaluates how much participants depend on others to drive them.
(d) Driving Difficulties: degree of difficulty experienced with specific driving tasks and whether this is due to visual problems.
(e) Self-Reported Crashes and Citations.
(f) Driving Space: how far participants have driven from their home over the last year.

The DHQ is a valid and reliable indicator of self-reported driving habits (Baldock et al., 2006; MacDonald, Myers & Blanchard, 2008). Owsley, Stalvey, Wells and Sloane (1999) studied people with and without cataracts and found through the use of the DHQ, that those with cataracts were more likely to have been told to limit their driving and to have had higher crash rates in the last year. Another study performed using the DHQ by Baldock, Mathias, McLean and Berndt (2006) looked for risk factors for inadequate self-regulation in older drivers. Participants completed a DHQ, functional tests and an on-road test. The DHQ was used in this study to identify self-regulation of driving. Results compared driving assessment and function tests with reported self-regulation from the DHQ, and suggested poor self-regulation was likely for those people with reduced sensitivity levels, information processing speeds and visio-spatial ability. Although this study was not specifically targeting stroke survivors, reduced sensitivity levels, information processing speeds and visio-spatial ability could result from stroke, indicating that the results of this study support findings that post-stroke drivers are more likely to self-regulate their driving (Fisk et al., 2002b). Both the ADSES and the DHQ are easy to administer and designed to be used in an interview style format, an appropriate mode of administration for post-stroke participants.

6.2.4 Data analysis

The data were analysed using the Statistical Package for Social Sciences (SPSS Inc., Version 19.0, 2009). Associations between self-reported confidence in driving tasks, as recorded in

the ADSES, and driving habits post-stroke, as recorded in the DHQ, were analysed using one-way analysis of variance (ANOVA). Associations between ADSES and DHQ descriptive categories were also assessed using Pearson's correlation coefficient (r value). P was set at less than 0.05. Alpha was not adjusted as the study was exploratory in nature and we did not want to increase the chances of a type 2 error (Perneger, 1998).

6.3 Results

All participants (n = 40) were post-stroke, with 77.5% participants suffering an infarct (n = 31) and 22.5% (n = 9) a haemorrhage stroke. The mean age of participants was 65 years (SD 12.17), and mean time since stroke was 16.9 months (SD 9.83). (Participant's characteristics are described in Table 6.1.) The mean ADSES score was 103.50, (SD 19.11) with a maximum score of 120 indicating highest possible levels of confidence. Overall, men scored an ADSES mean score of 105 (SD 4.08) and women 103 (SD 19.46). Participants under 65 years had a mean ADSES score of 110 (SD 7.07) and participants 65 years and older had an ADSES mean score of 100 (SD 13.17). The correlation between ADSES and the duration of time since stroke was not found to be significant ($r = -0.076$, $p = 0.643$). Driving at night followed by planning to travel to a new destination were the two driving activities stroke survivors felt least confident in. This was followed by driving in unfamiliar areas, to new destinations and parallel parking.

Participants reported being most confident driving in their local area (see Table 6.2). It was apparent from the files audit that male stroke survivors (62.5%, n = 25) were more likely to be assessed for returning to driving post-stroke than female stroke survivors (37.5%, n = 15). Completion of the DHQ revealed noticeable gender and age differences, with male stroke survivors indicating that, in general, they tended to drive further and more often in an average week than women. Younger stroke survivors (aged under 65 years) drove further and more often in an average week compared to older participants and were less likely to self-limit their driving. There were three aspects in the DHQ which were significantly associated with self-reported confidence as recorded in the ADSES. Firstly, driving space, which asked questions about how far participants drove from their own neighbourhood and how much participants limited their driving to their local area, was significantly associated with the self-reported confidence levels in the ADSES ($r = 0.35$, $p = 0.027$). The further individuals drove from home, the more confident they reported themselves to be at driving and the less likely

they were to depend on others to drive them. Secondly, the number of kilometres driven by participants per week was significantly associated with self-reported confidence levels ($r = 0.43$, $p = 0.006$). The more kilometres participants reportedly drove, the more confident they reported themselves to be in their own driving abilities and they were less likely to depend on others to drive them.

Finally, self-limiting driving, which included aspects of driving participants found difficult or avoided, such as driving in the rain, driving on high-traffic roads and parallel parking, occurred more often in women and was significantly associated with lower self-reported driving confidence levels ($r = 0.63$, $p = 0.000$ significant at 0.01). No significant associations were found during analysis between participant's self-reported driving confidence as recorded on the ADSES and the DHQ categories of: how participants preferred to get around ($p = 0.061$); how fast participants drove in relation to the rest of the traffic ($p = 1.00$); whether or not someone had suggested participants limit their driving in the last year ($p = 0.924$); how participants rated their own driving overall ($p = 0.462$); if they did not want to drive what alternative would they use ($p = 0.640$); the number of days a week they drove ($p = 0.126$); and the number of places they drove to in a week ($p = 0.575$). This suggests that these aspects of driving as reported in the DHQ were not influenced by participant's self-reported confidence in their own driving abilities. There were no crashes reported and only two citations (tickets given by police for speeding) for the one driver who was working as a truck driver and on the roads every day for many hours. Thus, due to the infrequency of these events they were not included in the statistical analysis.

Table 6.2: DHQ study: Adelaide driving self-efficacy scale (ADSES) summary of results (n = 40)

How confident do you feel:	Not at all (0-2)	Not very (3-4)	Reasonable (5-6)	Very (7-8)	Completely (9-10)
Driving in your local area	0	0	0	10%	90%
Driving in heavy traffic	5%	0	10%	17.5%	67.5%
Driving in unfamiliar areas	10%	0	12.5%	27.5%	50%
Driving at night	25%	0	5%	17.5%	52.5%
Driving with people in the car	5%	0	2.5%	12.5%	80%
Responding to road signs and traffic signals	0	0	0	5%	95%
Driving around a roundabout	2.5%	0	2.5%	7.5%	87.5%
Attempting to merge with traffic	0	0	5%	22.5%	72.5%
Turning right across oncoming traffic	2.5%	0	7.5%	12.5%	77.5%
Planning travel to a new destination	12.5%	0	7.5%	12.5%	67.5%
Driving in high speed areas	7.5%	0	0	22.5%	70%
Parallel parking	10%	0	5%	17.5%	67.5%

6.4 Discussion

The results from this study indicate a significant association between post-stroke survivor's levels of confidence in their own driving ability and choosing to self-limit their driving. Lower confidence levels were associated with a preference to drive closer to home, driving fewer kilometres a week, and avoidance of driving situations that challenged driving confidence such as driving in the rain, in unfamiliar areas and in high-traffic areas. On review of the stroke driver assessor's files, male stroke survivors were more likely to be assessed to return to driving post-stroke than their female counterparts. This is also

consistent with a previous study by Perrier et al. (2010a) which found that women were less likely to return to driving post-stroke than men. It may be the case that women are not only less likely to return to driving post-stroke but they are less likely to volunteer for a driving assessment in an attempt to return to driving. As this study examined self-reported confidence, we portioned the ADSES scores by gender to assess whether confidence levels could play a part in more men returning to driving post-stroke than women. There was little difference between men and women in this study in regards to their driving confidence levels. However, it is important to note that our sample comprised stroke survivors who had already returned to driving. It would be beneficial to determine confidence with stroke survivors immediately post-stroke prior to making the decision to return to driving. We could then determine these ADSES scores later post-stroke to examine if there are any discrepancies between ADSES scores for those who go on to return to driving and those who do not. If gender differences were apparent and women on average score lower than men, it may indicate that confidence levels are a primary reason why fewer women tend to complete the driving assessment and ultimately return to driving post-stroke.

Studies on the older population generally have found that older women are more likely to have less confidence about their driving and therefore self-limit by reducing their mileage driven or cease driving more often than men (Langford et al., 2013; Marottoli et al., 1993; Myers et al., 2008). As with post-stroke drivers, women were more likely to self-regulate and avoid driving situations they found risky or difficult such as driving at night, in the rain or parallel parking (Myers et al., 2008). Langford et al. (2013) studied 1222 Canadian, Australian and NZ older drivers in the Candrive/ Ozcandrive older drivers study and also found women over 80 years to be more likely to be low-mileage drivers. They assessed physical, sensory (e.g. time held right leg stance, rapid pace walk time taken, ruler drop test, Snellen visual acuity in both eyes) and cognitive (e.g. MMSE, Montreal cognitive assessment and TMT A and B) ability along with demographic details. Self-reported crash rates, driving comfort scales and self-perceived driving ability were also collected. Low-mileage drivers were found to have a significantly lower performance on most of the physical, sensory and cognitive assessments, lower self-perceived driving ability and comfort, and a higher self-reported crash rate than higher mileage drivers. These results indicate safety implications for lower mileage drivers and identify them as needing more input from health care professionals and driving authorities.

Age of participants also appears to influence confidence levels and driving habits in this post-stroke driving population. ADSES and DHQ scores indicated that post-stroke drivers who were 65 years and over were more likely to have less driving confidence and to self-limit their driving behaviours. Participants under 65 years drove further and more often and were less likely to limit their driving. This research suggests some important future directions for health care professionals and policy makers in the provision of interventions that support resuming driving post-stroke and the continuation of safe driving to avoid or limit the negative impact of driving cessation (White et al., 2008).

Berges, Seal and Ostir (2012) found at 3 months post-stroke the importance of increased social participation, as it was linked to a positive effect and psychological wellbeing. The results of this study suggest it is imperative to develop targeted interventions for the promotion of driving confidence. Improving driving confidence in turn would increase mileage, frequency of driving and potentially decrease social isolation in post-stroke populations. Alternatively, they may require provision of other transport options to help maintain quality of life if limiting driving or considering driving cessation.

This study illustrates the future potential of the ADSES to be usefully applied by health care professionals with stroke survivors to help predict returning to driving, driving behaviours and, in particular, the likelihood of self-limiting driving. This information, where appropriate, could assist in the introduction of strategies to help stroke survivors return to driving and expand driving beyond self-limiting situations. This could in turn increase the number of post-stroke drivers, and keep them safer and on the roads for longer. Targeted pre-driving training and on-road lessons with trained driving instructors and occupational therapists could be funded to ensure safe and appropriate return to driving. Continuing to drive safely would help reduce the likelihood of depression and social isolation post-stroke, and the need for costly medical interventions, alternative transport options and lower carer burden.

6.5 Limitations

Limitations of this study include the relatively small sample size due to practical and budgetary considerations which allowed recruitment from a single driving assessment unit. At the time of this study, this unit was funded for one trained driving assessor working two

days a week, therefore patient numbers were limited. Further studies should consider seeking ethics approval to recruit from more than one driving assessment unit to increase sample size, statistical power and offers the opportunity to further substantiate the preliminary findings from this exploratory study.

Another limitation of this study is that the DHQ relies on self-reported driving habits. The incongruence between self-perceived driving ability and lack of actual driving ability was not assessed and so actual driving habits cannot be confirmed. Future studies could consider the importance of assessing the difference between self-perceived driving ability and actual driving ability, to see which one self-perceived driving confidence is most associated with, as driving confidence does not always reflect safe driving, especially in older drivers (Holland & Rabbit, 1992). All participants in the current study had completed and passed an on-road driving test; further research is required to compare reported driving behaviours with observed driving behaviours at the time of assessment. To that end, it would be helpful for future studies to include an on-road driving assessment immediately following completion of the ADSES and DHQ when researching people who had already returned to driving post-stroke and include linkage to government data on crash rates. This would allow for comparison of self-perceived driving abilities and habits, with actual observed behaviours in the on-road driving assessment along with any reported crashes. It was considered in this study that in order to pass the on-road driving assessment, the participants must have had reasonable cognitive abilities and awareness. Given this assumption, choosing the ADSES to assess self-perceived confidence was thought to reflect driving ability, as it has been shown to be statistically significantly associated with on-road driving performance (George & Crotty, 2010). Finally, functional data were not collected and compared to reported driving habits or driving confidence as all participants had already been screened medically and deemed fit to return to driving. All participants were reported as independent in activities of daily living by the driving assessor notes; however, no formal functional assessments were collected or recorded by the driving assessor as he was only assessing driving ability and this is a limitation of this study.

6.6 Conclusion

Results of this study indicate that lower confidence reflects an association with self-limiting driving behaviours once stroke survivors return to driving. It would be of clinical benefit to

identify this group early in their recovery process to ensure they are given appropriate support (Yassuda, Wilson & von Mering, 1997). Future use of the ADSES prior to deciding to return to driving could identify those stroke survivors who lack driving confidence. Early recognition will allow for appropriately targeted treatment strategies to be developed and applied to build confidence levels and to encourage more stroke survivors to return to their full driving potential.

Chapter Seven: The Community Phase – What Factors Influence the Decision to Relinquish a Driver's Licence in Older Australian Drivers?

Findings from the literature review in Chapter Two discovered a gap in current research in understanding the decision making process that occurs when older drivers face the decision to relinquish their driver's licence or choose to work towards recovering their driving skills and driver's licence. It is important to understand what factors influence decision making when considering relinquishing a driver's licence and who may be included in the sphere of influence on this decision.

The aim of this chapter is to address this gap in current research and to provide evidence of what factors influence decision making about relinquishing a driver's licence in an older Australian population of drivers. As the majority of stroke survivors are older (AIHW, 2014), understanding how older people make the decision to relinquish their driver's licence will help gain knowledge about what factors may be particular to older people and identify factors that may be specific to health conditions such as stroke. The following study aims to contribute to understanding how to provide sufficient services to avoid premature driving cessation and safe return to driving after experiencing chronic health conditions such as stroke by endeavouring to answer the fifth research question:

RQ5: What is the relative importance of key factors (driving confidence, crash risk, age, general practitioners' or family and friend's recommendations to cease driving, and the cost and availability of other transport options) to an older Australian's decision to relinquish their driver's licence?

In this chapter, therefore I present a study conducted to examine what factors influence older drivers when considering relinquishing their driver's licence. Structurally this chapter consists of an introduction, methods, results, discussion, limitations and overall conclusions drawn from the findings.

This chapter contains material from:

McNamara, A., Chen, G., George, S., Walker, R, Ratcliffe, J. (2013). What factors influence older people in the decision to relinquish their driver's licence? : A discrete choice experiment. Acc Anal Prev, 55:178-84. doi:10.1016/j.aap.2013.02.034.

7.1 Introduction

The decision to relinquish one's driver's licence can be a difficult one (Adler & Rottunda, 2006). Driving is one of the most important tools to enhance activities of daily living and a driver's licence can symbolise independence, autonomy and competence (Persson, 1993). Deteriorating health and medical issues are often cited as reasons for relinquishing one's driver's licence. In a Southern Californian study conducted by Dellinger, Sehgal, Sleet & Barrett-Connor (2001) 1950 participants aged 55 years and older who had ever been licenced drivers responded to a mail-out survey. Forty-one percent stated their main reason for ceasing driving was due to a medical condition whilst just over 19% cited age related issues. A Finnish study by Hakamies-Blomqvist and Wahlstrom (1998) surveyed a sample of current drivers aged 70 years and over and drivers 70 years and over who had recently not renewed their driver's licence. For those who had recently relinquished their licence, the main reasons were found to be different for men and women. Male drivers most frequently cited deteriorating health as the deciding issue to relinquish their licence whereas women most frequently cited a loss in driving confidence.

A study conducted in Australia by Unsworth, Wells, Browning, Thomas and Kendig (2007) found that few older drivers indicated they had voluntarily relinquished their driver's licence. However, a majority indicated they did limit their driving and avoided certain driving situations (e.g. driving long distances, driving in bad weather, driving at night). Gender was found to be an important influencing factor in that women were three times more likely than men to indicate they had relinquished their driver's licence. Fillenbaum (1988) found that, in general, self-reported driving cessation was more likely for respondents who were older, female, with a higher income, more dependent according to the instrumental activities of daily living (IADL) instrument and who rated their own eyesight as poor. The impact of

relinquishing a driver's licence and driving cessation can have devastating effects for an older person including reduced community interaction, isolation and depression (Marottoli et al., 1997). Hence the decision to relinquish driving needs to be carefully considered. Understanding key factors that affect an older driver's decision to relinquish their driver's licence has been previously identified as important to assist health care professionals in communicating with older people about their driving ability, and to help older people to respond positively to the consequences of driving reduction or even cessation (Ragland, Satariano & MacLeod, 2004). The findings from previous studies point to potentially significant differences between men and women, with older women being more likely to admit to their own declining driving abilities than older men. Men may be more likely to externalise the decision to relinquish their driver's licence as primarily due to medical reasons, as opposed to their own innate declining driving abilities or an increased crash risk (Hakamies-Blomqvist & Siren, 2003; Hakamies-Blomqvist & Wahlstrom, 1998).

Discrete choice experiment (DCE) is a quantitative methodology which has been widely utilised to study how people make decisions (Lancsar & Louviere, 2008). DCE has its origins in mathematical psychology and has been widely applied in marketing, transport and environmental economics and more recently within health economics (Louviere, Hensher & Swait, 2000). DCE is based upon stated preferences and was designed to establish the relative importance or weight attached to salient characteristics (or attributes) in formulating a decision about a particular course of action (e.g. to choose a particular product or service) (Louviere et al., 2000).

The main objective of this study was to apply DCE methodology to investigate the relative importance of a number of key factors (relating to driving confidence, crash risk, age, GP's recommendation to cease driving, and the cost and availability of other transport options) to an individual's decision to relinquish their driver's licence. Specifically we sought to investigate the extent to which the relative importance of key factors related to this decision varied according to the characteristics of the older person including age (youngest vs oldest) and gender.

7.2 Materials and methods

7.2.1 Establishing attributes and their levels

Key factors that were likely to be important to older people when making decisions about relinquishing their driver's licence were identified through a literature search comprising Flinders University library databases, including PubMed and Scopus, and through consultation with rehabilitation clinicians and occupational therapists involved in the care of older people. The researcher then summarised these characteristics and developed them into five attributes with a range of three corresponding levels for presentation. The five attributes and their associated levels where then included within the DCE study (Table 7.1).

Table 7.1: DCE study: Attributes and attribute levels

Attributes	Attribute level	Variable name
Percentage risk of car crash in the next year	5% 30% 60%	risk5 risk30 risk60
Age	70 80 90	age70 age80 age90
Confidence levels in your own driving ability	Highly confident Medium confident Low confident	confidhigh confidmed confidlow
Recommendations by others about your fitness to drive	Your local doctor recommends you stop driving Your local doctor says you are fit to drive but your family and friends recommend that you stop driving Both your local doctor and your family and friends recommend that you are fit to drive	recommone recomg recomboth
Availability of other transport options	Available to you all of the time Available to you some of the time Hardly ever available to you	othtranall othtransome othtrannone
Cost of public transport for older people	Free public transport at all times Free public transport 9am to 3pm week days only 25% concession off the full fare at all times	costfree cost93 cost25off

7.2.2 Crash risk (%)

Previous research has indicated that an individual's concern about the likelihood of being involved in an accident is an important factor in driving cessation (La Font, Laumon, Helmer, Dartigues & Fabrigoule, 2008). We included a low (5%), moderate (30%) and high (60%) level of crash risk in the next year to ascertain the extent to which the decision to relinquish a driver's licence was affected by differential rates of crash risk.

7.2.3 Age groups

Age was included to ascertain the extent to which age per se may or may not influence the decision to relinquish a driver's licence. Previous research has indicated there may be a threshold level of age beyond which the decision to relinquish a driver's licence is more easily reached (Burkhard & McGarock, 1999).

7.2.4 Confidence in your own driving ability

This factor has been previously identified as important to the decision to relinquish a driver's licence in previous surveys of older people (Ackerman et al., 2008; Meng & Siren, 2012; Ross, Dodson, Edwards, Ackerman & Ball, 2012). We included a low, moderate and high level of confidence to ascertain the extent to which the decision to relinquish a driver's licence was affected by differential rates of confidence in driving ability.

7.2.5 Recommendation by others about fitness to drive

Previous research has indicated that the recommendations of GPs, family and friends may all be influential in an older person's decision to relinquish their driver's licence (Barnsley et al., 2012; Hakamies-Blomqvist & Wahlstrom, 1998; Stapleton et al., 2012). We sought to investigate the relative importance of the source of this recommendation (GP or family and friends or both sources) in influencing the decision to relinquish a driver's licence.

7.2.6 Availability of other transport options

This factor has been identified as important in a number of studies (Couglin, 2001; Stacey & Kendig, 1997). If other transport options are more readily available, it is possible that the decision to relinquish a driver's licence is more easily reached.

7.2.7 Cost of public transport options for older people

Similarly the cost of public transport has been found to be influential previously in the decision to relinquish a driver's licence (Corpuz, 2007). We included levels for this attribute based upon varying cost options which are currently available for older people within Australia (ACT Government Road Transport Authority, 2015b; Government of South Australia, Department of Transport, Travel and Motoring, 2015c; Northern Territory Government, Department of Transport, 2015b; NSW Roads and Maritime, 2015b; Queensland Government, Department of Transport and Main Roads, 2015b; Tasmanian Government, Department of State Growth Transport, 2015b; Vicroads, 2015b; Western Australian Government, Department of Transport, 2015b). A small pilot study was conducted in advance of the main study with a separate group of older adults (n = 10) aged 65 years and above, who were current drivers and who had not had a stroke. The main purpose of the pilot study was to ensure that the DCE question format and instructions were easily understood and interpreted, and that the attributes and levels included were important, realistic and plausible to respondents and able to be traded. Positive feedback about the topic and questions was received. A slight rewording of elements of the survey instructions were carried out as a result of the findings of the pilot study in order to promote participants understanding and completion rates.

7.2.8 Producing scenarios

Three levels for each of the five attributes results in 243 possible scenarios ($3^5 = 243$). We used a fractional factorial design by applying the techniques described in Burgess and Street (2005) to reduce the full factorial for the DCE into a more practical eighteen binary choice sets, which were 100% efficient for the estimation of main effects. The DCE design was divided into three versions, each containing six binary choice sets. The second of the binary choice sets was repeated as a seventh binary choice set to form a test of internal consistency for individual respondents to the DCE survey. The three survey versions were then randomly

administered to eligible consenting participants via an online mode of survey administration. For each choice set, participants were asked to indicate in which situation they would be more likely to relinquish their driver's licence (See Fig. 7.1 for an example of a scenario in the DCE survey).

Figure 7.1: DCE study: Scenario example

Pair 1

Scenario 1	**Scenario 2**
60% risk of having a crash in the next year.	5% risk of having a crash in the next year.
70 years of age.	90 years of age.
Medium confidence in your own driving ability.	Low confidence in your own driving ability.
Both your local doctor and your family and friends recommend that you are fit to drive.	Your local doctor says you are fit to drive but your family and friends recommend that you stop driving.
Other transport options are available to you all of the time.	Other transport options are available to you some of the time.
Free public transport for older people 9am to 3pm week days only.	Free public transport for older people at all times.

In which scenario would you be more likely to give up driving?

□ Scenario 1

□ Scenario 2

7.2.9 Survey design

The online survey contained three main sections. (A) Comprised a series of questions about participant's confidence in their driving ability, distances and frequency of driving each week along with questions about the participant's views on mandatory driving assessments for older people. (B) Comprised the DCE in which participants were presented with a series of hypothetical binary choice sets comprising alternative levels of a number of key attributes

potentially influencing an individual's decision to relinquish their driver's licence. (C) Comprised a series of demographic and health status questions. The study was approved by the Flinders Clinical Research Ethics Committee (Approval number: 5468, granted March 2012). Participants were recruited and consented in April 2012 by Pureprofile an online panel company with a wide representation of consenting adults throughout Australia, who have agreed to be approached to participate in research studies. The inclusion criteria for the study were older people (aged 65 years and above), currently driving with no history of a prior stroke. All online surveys were completed within a three week period in April 2012.

7.2.10 Data analysis

The data from the DCE was analysed based upon random utility theory, using a conditional logit model (Ryan, 2008). The function to be estimated was specified as:

$$U=\check{}1\ risk30+\check{}2\ risk60+\check{}3\ confidmed+\check{}4\ confidlow+\check{}5\ recomnone+\check{}6\ recomgp+\check{}7$$

$$othtransome+\check{}8\ othtrannone+\check{}9\ cos\ t93+\check{}10\ cos\ t25off+\varepsilon$$

where U is the utility individual derives from choosing alternative in each choice scenario, ˇi is a vector of coefficients reflecting the desirability of the attributes, and the unobserved term ε is a random term, independent and identically distributed (IID) with Gumbel distribution. The analyses were conducted in Stata version 12.1 (StataCorp LP, College Station, Texas, USA).

7.3 Results

A total of 114 older people (n = 56 male, 49%) who were current drivers were invited to take part in this study; all consented and completed the online survey. A total of three respondents were excluded from the data analysis because they did not fully complete the DCE. One additional respondent was excluded from the descriptive analysis due to incomplete information. Socio-demographic information for the total sample of useable respondents (n = 110) is presented in Table 7.2.

Table 7.2: DCE study: Participant characteristics (n = 110)

Mean age years	70.3
Male	56
Live alone	16
Live with spouse	87
Live with other family/friend	7
Live in own home	91
Live in rental accommodation	15
Live in housing rental	0
Live in residential care	4
Lives in South Australia, Australia	21
Lives in Victoria, Australia	17
Lives in Tasmania, Australia	10
Lives in New South Wales & Australian Capital Territory	23
Lives in Queensland, Australia	18
Lives in Northern Territory	2
Lives in Western Australia	19
Receives Meals on Wheels	0
Receives Royal District Nursing Service	2
Has Care Package	3
Receives DVA services	6
Receives Domiciliary Care Package	5
Receives Council services	31
Uses walking aid of some kind	13
Has a long-term disability, illness or medical condition	33 (30%)

Age ranged from 66 years to 85 years, with five people (5.7%) reporting having had one accident each within the preceding 12 months. Most participants did not think older drivers had more accidents than younger drivers and the vast majority thought mandatory driving tests would be more appropriate at 85 years (rather than the current situation in some states of Australia, at 75 years of age). Most respondents agreed that their GP should be responsible for mandatory reporting (see Table 7.3).

Table 7.3: DCE study: Driving information

	Total sample n = 110 (%)
No. of kilometres driven per week‡	
≤ 50	26 (23.6%)
51-100	18 (17.8%)
101-200	31 (27.9%)
> 200	35(30.7%)
No. of days driven per week	Av. 5.03 days/wk
No. of places driven per week	Av. 4.05 places/wk
No. of accidents last year	5 people, 1 accident each
Has been suggested to give up driver's licence last year	6 yes, 104 no
Agree with the statement: older drivers have a higher incidence of crashes than younger driver	8 yes, 102 no
Agree with the statement: compulsory driving tests over the age of 70 years	57 yes, 53 no
Agree with the statement: compulsory driving tests over the age of 85 years	101 yes, 9 no
Agree with the statement: mandatory reporting for your GP	106 yes, 4 no

Analysis occurred for the extent of dominant choice behaviour (summarised in Table 7.4).

Table 7.4: DCE study: Dominant choice behaviour

	% of respondents (n = 110†)
Higher risk was always chosen	5.45
Higher age was always chosen	4.55
Lower confidence was always chosen	4.55
Less recommendation by friends and/or GP was always chosen	5.45
Better availability of other transport was always chosen	0.91
Lower cost of public transport was always chosen	1.82

Note: † Only individual who has answered all 6 pairs of choice questions is included

A dominant response implies that the scenario with the preferred direction of preference for one particular attribute is always chosen, irrespective of the levels of the remaining attributes presented (Lancsar & Louviere, 2008). Respondents with dominant preferences consistently choose the scenario with the higher level of a particular attribute and do not 'trade-off' between this attribute and others (Laver et al., 2011). For example, a respondent who always indicated they would be more likely to relinquish their driver's licence in situations where the age of the driver was older is assumed to exhibit a dominant response pattern for old age. Overall, 22% of participants were found to exhibit dominant preferences for one of the attributes presented. Lancsar and Louviere (2008) suggest that dominant responses are valid and omitting them from DCE data analysis may result in bias and reduced statistical efficiency. Thus in this study participants with dominant choices were not omitted from statistical analysis. The conditional logit estimates are reported in Table 7.5.

Table 7.5: DCE study: Conditional logit estimates for driving decision making of older people

Attribute levels	Full sample	Ages 65-69	Ages 70-89	Male	Female	≤ 50 KM	> 50 KM	ADSES ≤ 105	ADSES > 105
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
risk30	0.387***	0.230	0.473**	0.526***	0.296	0.093	0.475***	0.461**	0.467**
	[0.135]	[0.209]	[0.190]	[0.195]	[0.210]	[0.270]	[0.164]	[0.216]	[0.190]
risk60	0.554***	0.560***	0.546***	0.419**	0.751***	0.209	0.835***	0.649***	0.459**
	[0.133]	[0.194]	[0.189]	[0.181]	[0.207]	[0.249]	[0.199]	[0.189]	[0.200]
age80	0.254*	0.321	0.238	0.258	0.275	0.198	0.396*	0.503**	0.031
	[0.141]	[0.211]	[0.203]	[0.206]	[0.208]	[0.254]	[0.204]	[0.214]	[0.206]
age90	0.447***	0.449**	0.461**	0.606***	0.336	0.493*	0.504**	0.803***	0.158
	[0.142]	[0.202]	[0.206]	[0.207]	[0.209]	[0.255]	[0.209]	[0.216]	[0.210]
confidmed	0.133	0.388*	-0.085	-0.254	0.531**	0.303	-0.051	0.264	0.110
	[0.137]	[0.206]	[0.196]	[0.200]	[0.209]	[0.253]	[0.179]	[0.214]	[0.194]
confidlow	0.578***	0.847***	0.396**	0.315	0.850***	0.585**	0.631***	0.363*	0.852***
	[0.141]	[0.212]	[0.202]	[0.204]	[0.213]	[0.253]	[0.207]	[0.204]	[0.211]
recomgp	0.262*	0.341*	0.191	0.065	0.424**	0.377	0.141	0.443**	0.138
	[0.137]	[0.196]	[0.198]	[0.197]	[0.206]	[0.249]	[0.200]	[0.208]	[0.200]
recomnone	0.850***	1.048***	0.705***	0.660***	1.003***	1.130***	0.725***	1.026***	0.817***
	[0.137]	[0.208]	[0.191]	[0.190]	[0.209]	[0.263]	[0.176]	[0.210]	[0.199]
othtransome	0.070	0.040	0.124	0.155	0.060	0.049	0.159	0.012	0.079
	[0.132]	[0.189]	[0.190]	[0.195]	[0.193]	[0.252]	[0.172]	[0.205]	[0.191]
othtrannone	0.068	-0.213	0.302	0.201	-0.067	-0.137	0.306	-0.041	0.133
	[0.140]	[0.211]	[0.199]	[0.196]	[0.217]	[0.257]	[0.201]	[0.215]	[0.207]
cost93	0.004	0.025	-0.032	-0.052	0.157	0.093	-0.012	0.078	-0.039
	[0.128]	[0.189]	[0.177]	[0.177]	[0.202]	[0.257]	[0.159]	[0.184]	[0.191]
cost25poff	0.019	0.222	-0.140	0.039	0.109	0.066	-0.163	-0.055	0.072
	[0.141]	[0.207]	[0.205]	[0.208]	[0.208]	[0.248]	[0.206]	[0.217]	[0.203]
Log likelihood	-324.555	-151.747	-166.002	-174.258	-140.425	-96.137	-205.902	-157.406	-160.468
N	90	44	45	48	41	27	58	45	45
Obs.	537	264	270	288	246	162	345	267	270

Notes: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

The internal consistency was checked by comparing whether the respondents have answered a repeated choice scenario (choices two and seven in the experiment) with the same answer. Those participants who did not pass the test of internal consistency (18.4% n = 21) were excluded from the final regression analysis, giving a total final sample size for the DCE of n = 93. As can be seen in Column one in Table 7.5, amongst the six salient attributes included in the DCE, four of the attributes were found to be statistically significant at the 10% level, these were: crash risk, age, confidence levels and local GP recommendations. The availability of other transport options and the cost of public transport for older people were found to be non-significant in determining older people's preference to relinquish their driver's licence.

Since dummy coding is used, the coefficient (ˇi) indicates the difference between a specific attribute level and the reference level within each attribute. For all statistically significant attributes and levels, the sign and the staging of the impact of attribute levels are consistent as expected. For example, for the risk attribute the coefficients of risk30 and risk60 variables (0.387 and 0.554, respectively) indicate that compared to the reference level (i.e. percentage risk of car crash in the next year is five percent), the higher the risk level, the more likely participants would be to express a preference to relinquish their driver's licence. The next two statistically significant attributes (age and confidence) suggest that the likelihood of relinquishing a driver's licence increased with old age and a low confidence level in participant's own driving ability. Among all attributes, the GP, family and friends' recommendations attribute was found to have a very significant impact on participant's decision making, with the magnitude of the beta coefficient attached to the variable recomnone (local doctor recommends stop driving) representing the largest significant indicator of the decision to relinquish the driver's licence across all included attribute levels. Columns two to nine in Table 7.5 show the sub-sample analysis results. Consistent to the full sample results, both the availability of other transport options and the cost of public transport for older people attributes were found to be non-significant.

When dividing the full sample into two age groups (65-69 and 70-89 years), the main conclusions are consistent with what has been discussed above for the full sample (see columns two and three in Table 7.5 for details). The key difference in results between the

two age groups are (a) that the younger participants appear to be greater risk takers in that the medium risk level (30% risk of car crash in the next year) was non-significant in the decision to relinquish their driver's licence for the younger age group, but statistically significant for the older age group ($p < 0.05$).

When separating the full sample by participant's gender, presented in columns four and five in Table 7.5, the two distinguishing features were (a) that the age attribute became statistically non-significant in the decision to relinquish their driver's licence for females ($p > 0.10$) and (b) that the lowest confidence level attribute became statistically non-significant for males ($p > 0.10$) whereas the lowest confidence level is highly statistically significant in the decision to relinquish their driver's licence for females ($p < 0.01$). In columns six and seven of Table 7.5, the participants were divided by the kilometres driven per week (equal or less than 50 km per week, or more than 50 km per week). The key difference relative to the results for the total sample is that risk attribute became statistically non-significant in the decision to relinquish their driver's licence for those who usually drive equal or less than 50 km per week ($p > 0.10$). Finally, in the last two columns of Table 7.5, the participants were divided into two groups by their ADSES score (≤ 105 and >105). For those participants who were classified at higher driving self-efficacy levels (ADSES > 105) the age attribute became non-significant ($p > 0.10$).

7.4 Discussion

To our knowledge this is the first study to apply DCE methods to examine older people's preferences when considering relinquishing their driver's licence. DCE is a quantitative methodology which has been widely utilised to study how people make decisions and therefore its application to this context represents a natural, yet novel extension of the approach. Amongst the six key attributes included within the DCE (i.e. percentage risk of car crash in the next year, driver's age, confidence levels in your own driving ability, recommendations by others about your fitness to drive, availability of other transport options, and cost of public transport for older people), the last two attributes (transport options and cost) were found to be non-significant in the determination of older people's preference in the decision to relinquish their driver's licence. The high rate of completion and participant's understanding throughout this study provides support for the face validity of the DCE

approach in an older population. Dominant choice behaviour in this study was not strong and the results of the DCE analysis reveal participants were prepared to make trade-offs between the attribute levels presented in making these decisions. The results of this study indicate that age and confidence in driving ability are two factors highly relevant for older people in their decision making relating to relinquishing their driver's licence. These findings are consistent with other studies which have also found these factors to be highly influential (Ackerman et al., 2011; Burkhard & McGarock, 1999; Meng & Siren, 2012; Ross et al., 2012). The findings also indicate some important differences between males and females, with females more readily attributing a lack of confidence in their own driving ability to the decision to relinquish their driver's licence than males.

Overall, respondents found the advice of their local GP very important in their decision making about relinquishing their driver's licence. However, advice from relatives or friends was not found to be as influential as the recommendation of a GP in this decision making process. This finding contrasts with the few studies in the literature which suggest family and friends were much more likely to be considered in this decision making process than the GP or health care professional (Hakamies-Blomqvist & Wahlstrom, 1998; Johnson, 1998; Persson, 1993). The potential reasons for this discrepancy may be related to the Australian context of our study. The current situation within Australia emphasises the central importance of the GP's decision about an older person's ability to drive as an integral part of the driving regulations in Australia. Other studies were conducted overseas where the GP's decision is not such an integral component of driving regulations.

There are some limitations to our study which are important to highlight. Firstly, the study was essentially exploratory and conducted with limited resources and consequently the sample size was constrained; hence the results presented above should be explained with caution. Further research is required with larger numbers of older people to verify the findings from this small scale exploratory study. Secondly, the study was based upon DCE, a methodology which is based upon people's 'stated' preferences about how they would make decisions as opposed to their 'revealed' preferences about how decisions are actually made in practice. Future research should investigate more fully the extent to which older people's stated preferences about the decision to relinquish their driver's licence correspond with their

actual decision making in this context. The survey respondents within our study were all current drivers and the majority had not yet been mandatory tested for their driving ability. We obtained a 'snapshot' of current decision making preferences; and it is possible that the relative importance of key factors to the decision to relinquish a driver's licence may change in accordance with changes in the regulatory environment and as the respondent ages. Alternative methods of transport and the costs of public transport may also become more relevant attributes as participant's age and face the reality of mandatory testing and the possibility of the loss of licence.

7.5 Conclusions

This study has demonstrated the feasibility of the application of the DCE approach with older people to assess their attitudes and preferences when considering the question of relinquishing one's driver's licence. The results from this DCE study suggest that advanced old age and low confidence in driving ability may be more influential than environmental factors such as availability of other transport options and the cost of public transport in the decision to relinquish a driver's licence. Specifically, this study has highlighted the central importance of the local GP's advice regarding older drivers relinquishing a driver's licence. Further research should be conducted to assess the relevant time-point for this decision (e.g. by identifying factors that may indicate to the GP that older people are ready for discussions about relinquishing their driver's licence). As Foley, Harley, Heimovitz, Guralnik and Brock (2002) state "Failure to recognise the magnitude and importance of this transition among elderly adult drivers will compromise goals of improving the quality of life in old age, now and in the future" (p.1285).

Chapter Eight: Discussion

8.1 Overview summary

This thesis has endeavoured to focus on older stroke survivors in Adelaide, Australia and the process of returning to driving post-stroke. Five studies have been undertaken spanning over the three phases of stroke recovery; acute, rehabilitation and community. During the acute phase a study was completed to examine stroke survivor attitudes and perceptions about the likelihood of returning to driving. The second study undertaken looked at issues which arise in the rehabilitation phase of post-stroke recovery with the use of standardised assessments. Standardised assessments are used to assess fitness to drive without sufficient knowledge of the influence of psychometric properties of assessments. The UFOV study in Chapter Four examined the issue of practise effect, one example of a psychometric property of an off-road standardise assessment and the possible effects it might have on scores. Understanding the influences of psychometric properties is important as scores from standardised assessments are used in decision making about fitness to drive and so need to be valid and reliable. Returning to the community is the third phase of the stroke survivor recovery. The first two studies presented in the community phase were to examine the issue of confidence and its influence on driving habits. The final study presented in the community phase was designed using a DCE methodology to examine how the decision is made by older Australians when considering relinquishing their driver's license. The population of older Australians was studied as there was no previous research using the DCE methodology on the topic of the decision to relinquish a driver's licence, so it was necessary to establish an Australian 'norm'. In this discussion chapter findings of the five studies presented in this thesis are discussed and set out in order of stroke trajectory recovery phases (acute, rehabilitation and community phases) along with future research directions. Limitations are also acknowledged and clinical practice implications are presented.

8.2 Acute phase of recovery post-stroke

In answer to RQ1: What are the perceptions of older people toward driving post-stroke in the early stages of stroke recovery, and how might this inform content and timing of post-stroke driving education?

8.2.1 Driving as independence

The qualitative study presented in Chapter Three undertaken during the acute phase of recovery examined attitudes and perceptions of a sample of older Australians post-stroke. Findings from this study concurred with international research findings that driving equates with independence (Lister, 1999; Pearce et al., 2012; Persson, 1993). The qualitative study in Chapter Three uncovered the concept that driving is perceived by stroke survivors as pivotal to independence and found that the need for independence was a primary motivation for the desire to return to driving post-stroke. When asked to consider the decision of whether or not to return to driving post-stroke, participants reported that driving equated to independence and enabled continued social connectedness and was a primary factor in their decision to return to driving. So, in addition to previous findings, the qualitative study presented in Chapter Three demonstrated that wanting to maintain independence is a primary factor in decision making about returning to driving post-stroke.

Future research directions, as a result of the qualitative study completed in this thesis, may include consideration of whether initial attitudes and perceptions about driving in the acute phase of recovery influenced decision making about returning to driving in later stages of the stroke survivor's recovery trajectory. Future studies could include a longer term follow up, for example, one year and assess the degree of convergence (or otherwise) between stated preferences and revealed preferences. By examining whether those people who initially stated they would (would not) return to driving post-stroke did actually return (not return) to driving in the longer term the importance of acute phase attitudes could be discovered.

Future qualitative studies may also extract valuable information though a longitudinal assessment whereby, instead of focusing upon a snapshot of stroke survivor's attitudes and perceptions, data was collected throughout the stroke survivor's recovery trajectory in order to capture how attitudes changed over time and when these changes occurred. If future studies examine change over time in attitudes and perceptions, this might also be helpful information to inform the optimal timing and content of post-stroke driving education. Such education could focus on different aspects of the recovery process throughout the acute, rehabilitation and community phases of the recovery trajectory in order to be more patient-

centred, and as a method of ensuring more targeted intervention strategies, retention of information and engagement by stroke survivors.

The findings from the qualitative study reported upon in this thesis indicate that stroke survivors have been found to be more focused on their physical recovery during the acute phase and are more likely to be receptive about information on physical recovery post-stroke. At the same time participants demonstrated that they were less likely to be influenced during the acute stage by how their physical recovery may affect specific driving skills as no connection was found between NIHSS (Brott et al., 1989; Goldstein & Samsa, 1997) scores and attitudes and perceptions of participants about driving post-stroke. Future studies may also consider focusing more upon specific functional and cognitive deficits that could potentially influence factors such as insight in post-stroke driving decision making. Other specific physical and cognitive factors, such as visual loss, may make returning to driving post-stroke unrealistic, and future studies could also consider specifically targeted education and rehabilitation interventions for this group of stroke survivors.

Gender differences found in the qualitative study in Chapter Three could also influence the design of future studies related to post-stroke driving education by considering the potential benefits of tailoring information with the provision of gender specific driving education sessions. Female stroke survivors could be given more information and support to help build their confidence in engaging in the return to driving process post-stroke, and male stroke survivors given support to understand their limitations and the consequences of decreased driving skills on driving ability. The extent to which such tailored information may or may not be helpful in generating positive outcomes post-stroke could also be examined.

A potential limitation of the qualitative study presented in Chapter Three is that a semi-structured interview technique was utilised with prearranged, set questions relating to defined topics identified as important a priori by the candidate and the wider research team. It is possible that an unstructured interview approach might have gleaned valuable information outside of the topics identified, and enabled the stroke survivor to feel free to converse more on other potentially important issues related to the subject of driving post-stroke.

An additional limitation was that a minority (n = 4) of participants included in the qualitative study in Chapter Three were younger than 65 years of age. These participants were included in the study for practical reasons in order to reach a sufficient number of participants to facilitate data analysis, given the necessary time constraints for recruitment and reporting. Future studies should focus exclusively upon participants over 65 years to facilitate more direct comparisons with findings from other studies conducted with older populations.

As found in previous research (Fisk et al., 2002b; White et al., 2012b) stroke survivors in the qualitative study in Chapter Three were not receptive to traditional forms of post-stroke driving education at this acute stage of their recovery trajectory; therefore it would probably not influence their decision making about fitness to drive. These findings suggest that health care professionals need to revisit the timing and, more importantly, the content and method of delivery of driving education post-stroke to ensure the information is being understood and retained. Support by health care professionals for discussion on considering relinquishing a driver's licence with the resulting question of transport options if driving ceased, needs to occur in the acute phase because of the current Australian legislation and the possibility of returning to driving at one month post-stroke. So as timing of return to driving post-stroke education is linked to current legislation, we need to consider what information stroke survivors are able to comprehend at this stage, and reconfigure the type and method of how information is delivered to ensure it informs stroke survivors. Post-stroke driving education needs to act as a base during the acute phase, on which to develop an understanding of abilities, formal processes and legislation throughout stroke recovery and the return to driving process post-stroke.

Findings in the qualitative study in Chapter Three, that even in this optimal environment for post-stroke driving education, participants had not retained information on current Australian post-stroke driving legislation clearly demonstrates a need to understand better how to engage stroke survivors at this early stage of recovery. Further research needs to occur to examine this phenomenon and explore education methods of delivery to ensure stroke survivors and their carer's needs are met in regards to driving education post-stroke. Results from the

qualitative study demonstrated that stroke survivors found that facing the decision to relinquish a driver's licence in the acute phase of recovery was overwhelming. Instead, stroke survivors may be more receptive to education that involves practical problem solving which may be less confronting. In order to deliver patient-centred post-stroke driving education during the acute phase of the recovery trajectory, the qualitative study results in Chapter Three suggested it would be pertinent to consider transport options which include: practical retraining in alternative transport options. Training in the use of public transport which includes practise trips with supervision can facilitate confidence and consideration of public transport as an alternative to driving or relying on family and friends (McCluskey & Middleton, 2010; McCluskey et al., 2013). Education about how to access information on bus routes and when buses with adapted access options are available could be included in post-stroke driving education along with training in the use of options, such as scooters, including support to purchase the correct scooter (McCluskey & Middleton, 2010, McCluskey et al., 2013). Future studies could build on previous research (McCluskey & Middleton, 2010; McCluskey et al., 2013) in understanding further the specific barriers in decisions about choosing alternative transport options post-stroke, and how best to educate and support such decisions throughout the stroke recovery trajectory so the interventions developed are patient-centred.

Established timing of post-stroke driving education needs to occur within one month post-stroke to be consistent with current legislation; but the qualitative study results in Chapter Three shows that at this early stage there is a limit to the amount and type of information stroke survivors are able to understand and retain. Qualitative study participants in Chapter Three demonstrated that up to 16 weeks post-stroke they are not yet ready to address the issue of returning to driving, and are instead focused on their physical and cognitive recovery. Timing of post-stroke driving education needs to occur within one month post-stroke, but also needs to be revisited at other times throughout the recovery trajectory, as the stroke survivor becomes more able to focus on the question of their fitness to drive and to absorb patient-centred post-stroke driving education that is specific to their gender and the stage of the stroke survivor's recovery trajectory. Education is needed during this acute phase to help stroke survivors grieve and come to terms with their disability, and to encourage a practical understanding of current limitations and abilities along with the potential for recovery and

implications for driving. This will encourage a more realistic approach to decision making about fitness to drive post-stroke.

8.2.2 Limiting driving

Results from the qualitative study in Chapter Three indicate that during the acute phase of recovery, stroke survivors decisions about returning to driving and self-limiting their driving was influenced by whether or not they were self-limiting their driving exposure pre-stroke. Only two of the nine participants who reported they had limited their driving pre-stroke stated they would consider returning to driving post-stroke and over half (54.5%) of those participants who did not limit their driving pre-stroke reported they would return to driving post-stroke. Those participants who did self-limit their driving pre-stroke reported that they were most comfortable driving during the day in their local area only. This was closely followed by driving in the rain. Limiting driving pre-stroke also meant that qualitative study participants in Chapter Three drove to fewer destinations and attended fewer activities in their communities than those participants who did not limit their driving pre-stroke. Age did not appear to influence whether the qualitative study participants considered returning to driving post-stroke.

Gender differences existed in regards to self-limiting driving behaviours both pre- and post-stroke in the qualitative study presented in Chapter Three, with men found to drive more often and further and to be less likely to self-limit their driving behaviour than women. Findings showed that men were more likely to consider returning to driving post-stroke and were more likely to have driven pre-stroke than women. Men were also more likely to have driven further and more often pre-stroke, being less likely to limit their driving pre-stroke and to be the primary driver whenever they were travelling in a car. Post-stroke men reported that they were more likely to have confidence about returning to driving compared to women post-stroke. Despite men tending to focus more on physical barriers to returning to driving post-stroke, they seemed to lack insight to the actual physical impact of their stroke which was reflected in the lack of association between their NIHSS scores and their returning to driving post-stroke confidence. Consequently, it is important to include in post-stroke driving education discussions for men about strategies to facilitate awareness of the implications for driving on the physical impact of their stroke, and to help with recalibrating

their confidence levels appropriately to their actual skill levels. Given that a major contributor for stroke survivor independence is their ability to drive (Chaudry et al., 2008), addressing a lack of driving confidence early will enable more stroke survivors to return to driving and will likely reduce the degree of self-limiting driving behaviours in both genders.

Women's self-perceived post-stroke driving confidence levels were also found to be unrelated to NIHSS scores but were pre-eminent when discussing reluctance to return to driving post-stroke. Reported driving confidence was found to be statistically significant in relation to projected self-limiting driving behaviours post-stroke in the qualitative study in Chapter Three and was only reported by female participants. None of the male participants reported a lack of confidence in their ability to return to driving. A lack of driving confidence both pre- and post-stroke in the female participants is at least partly due to the majority of women indicating they were not the primary driver when they were in a car pre-stroke. Most of the women in the qualitative study had not had significant driving experience pre-stroke, whereas all male participants were the primary drivers and drove whenever they were in the car. Eighty-four percent of female participants in the qualitative study in Chapter Three, who were current primary drivers of their cars, only did so because their husbands had either died or become too ill to drive. Only 16% of female participants in the qualitative study had been primary drivers of their cars pre-stroke for many years.

8.2.3 Key findings of the acute phase study:

- Driving equated to independence with the need to retain independence as pivotal to the decision to return to driving post-stroke.
- Post-stroke driving education does not appear to be absorbed in the acute phase of the stroke recovery trajectory and therefore timing and content need to be revisited.
- Chapter Three qualitative study participants were focused on their physical and cognitive recovery in the acute phase of the stroke recovery trajectory and not on returning to driving.
- All of the men were the primary driver when in the car and 84% of women who were primary drivers only did so because their husbands had died or no longer drove due to illness or frailty.

- A lack of confidence tended to be the main reason, in particular, women chose to limit or cease driving post-stroke. Physical barriers were the reason men gave when considering returning to driving post-stroke.
- Qualitative study participants who had limited their driving pre-stroke had a higher chance of limiting or ceasing their driving post-stroke.

8.3 Rehabilitation phase of recovery post-stroke

In answer to RQ2: Is there a practice effect at one month intervals, for three months, for the UFOV assessment (Ball et al., 1988) in an older Australian, post-stroke population?

8.3.1 Post-stroke Driving Assessment

Currently in Australia there is no formalised decision tree for assessing fitness to drive post-stroke and there is significant heterogeneity in approaches adopted across geographical areas, and states and territories. For some stroke survivors the issue of driving is not raised during their acute and rehabilitation phases of recovery. Some stroke survivors are only medically assessed by their GPs (which includes an eye test) whilst others go on to have more complex pre-driving and on-road driving assessments by occupational therapists and driving instructors. The NSF guidelines (2010, see Appendix I) state that stroke survivors should legally notify the driving authority that they have had a stroke. Fitness to drive should be determined by the GP and both pre-driving and on-road driving assessments should occur (NSF, 2010, see Appendix I). However, there is no consensus on which pre-driving and on-road assessments should be used or what driving skills should be assessed (NSF guidelines, 2010, see Appendix I; Unsworth & Baker, 2014). On-road assessment is also not standardised in Australia, with no specific skills required to be tested and no consistency in which health care professionals are involved in the assessment process, or what level of specialised training they require. If a nationally utilised decision tree was developed it could outline a process for stroke survivors to return to driving post-stroke. Such a decision tree should include approved standardised assessments by a specially trained multidisciplinary team of health care professionals with a protocol as to the specific skills required for driving

and the appropriate timing of such assessment. Gender and possibly age specific targeted interventions should also be developed and utilised, where and when appropriate.

When developing the decision tree we need to make informed decisions about which standardised assessments to use consistently in deciding fitness to drive post-stroke, and it is imperative we understand the influences that psychometric properties have on scores. Decisions on which standardised assessments are to be used need to ensure improvement in scores are as a result of an improvement in skills and not just an improvement in the ability to perform the assessment, because of psychometric influences such as practice effect. The most research proven assessments need to be chosen for our national decision tree to ensure best practice assessment procedures.

8.3.2 Psychometric properties of UFOV assessment

As an outcome of measures in research, assessment and retraining tool, the UFOV assessment assists in making clinical decisions about which interventions to use and in which population groups, helping to determine treatment plans. However, the quality of information which may be measured using the UFOV assessment is determined by its psychometric properties. These properties of standardised assessments include levels of measurement, reliability, validity, repeatability and responsiveness (Roach, 2006). It is imperative that fitness to drive assessment is psychometrically robust and reliable in order to sensitively measure and predict changes in driving ability.

The UFOV assessment study documented in this thesis assessed the psychometric property of repeatability with the particular aspect of the influence of practice effect on repeatability of the UFOV assessment examined. No practice effect was found, suggesting that when the UFOV assessment is completed at one month intervals for three months post-stroke there is no influence of practice effect upon the results. Finding no practice effect provides support for the potential for the UFOV assessment to provide a valid and reliable pre-driving assessment to use post-stroke to determine fitness to drive and help indicate when stroke survivor's skills have an increased likelihood of success in an on-road fitness to drive assessments. As an outcome measure, the UFOV assessment's psychometric property of

repeatability without practice effect indicates strength in its use. These results suggest that an increase in scores would be indicating improvement in the speed and accuracy of visual processing skills and not be as a result of familiarity with the assessment.

Larger numbers of participants, from a number of health care facilities who performed the UFOV assessment over a longer period of time, would confirm current findings. UFOV assessment at one month intervals was chosen as it was deemed reflective of clinical practice and availability of current clinical resources for assessment post-stroke. However, future studies might also consider completing the UFOV assessment more frequently and to confirm a lack of practice effect over a longer period, for example, six months when most post-stroke functional and neurological recovery occurs (Bonita & Beaglehole, 1988; Duncan et al., 1992; Hendricks et al., 2002).

8.3.3 Timing of post-stroke driving assessment

As UFOV assessment subtest two was found to have the highest sensitivity to failing the on-road assessment in the study performed by George and Crotty (2010), subtest two results were analysed. Results showed that for those 79.2% of stroke survivors who failed the UFOV assessment at one month, 69.1% passed when reassessed at three months post-stroke. These results suggest that reassessment at three months post-stroke is appropriate as approximately two thirds of those stroke survivors reassessed at three months will have a high probability of going on to pass the on-road assessment. This information could inform procedures about when to retest stroke survivors, saving resources and reducing the number of times stroke survivors experience failing both pre-driving and on-road assessments. By helping to reduce the number of times a stroke survivor fails pre-driving and on-road assessment, resources are maximised and driving confidence and cooperation with the post-stroke fitness to drive assessment process is maintained.

White et al. (2012a) found that those stroke survivors that persisted with follow-up rehabilitation after discharge, including driving assessment, were more likely to have higher levels of independence, participation and self-efficacy. One limitation of the UFOV study was there were no records taken of whether participants experienced rehabilitation post-

stroke or, if they did, what types of rehabilitation program participants were involved in. Future studies might record rehabilitation programs being undertaken by study participants in order to examine whether types, intensity or timing of rehabilitation programs influence stroke survivor's abilities in performing pre-driving screening assessments such as the UFOV assessment.

8.3.4 Key findings of the rehabilitation phase:

- There is no consensus in Australia about which is the best standardised pre-driving and on-road driving assessment to use. A national decision tree is proposed to standardise decision making by health care professionals.
- When deciding on which standardised assessments to recommend for the decision tree there needs to be more understanding of the influences of the psychometric properties on assessment scores.
- No practice effect was found when performing the UFOV assessment at one, two and three months post-stroke in an older Australian population.
- Timing for reassessment using the UFOV assessment at three months post-stroke is appropriate as 69.1% of those stroke survivors who failed subtest two of the UFOV assessment at one month passed at three months. This result is significant as subtest two scores have high sensitivity to failing the on-road assessment (George & Crotty, 2010).
- Future research should consider performing the UFOV assessment up to six months for improvement in scores when most functional recovery occurs post-stroke. This would then inform timing of reassessment.
- Future research could examine the influence of frequency and types of rehabilitation programs and how they might influence ability to perform on the UFOV assessment.

8.4 Community phase of recovery post-stroke

In answer to RQ3: Are self-perceived driving confidence levels lower in the post-stroke driving population compared to their aged-matched non-stroke driving peers?

8.4.1 Driving Confidence and its Influences

Findings from the ADSES study demonstrated that once stroke survivors return to driving, both genders have the same driving confidence levels as aged-matched non-stroke driving peers. However, it may be that a lack of driving confidence influences the decision to engage in the assessment process to return to driving post-stroke. Confidence may be a significant factor in deciding to return to driving post-stroke but both the ADSES and the DHQ study results in this thesis show that once stroke survivors of both genders have returned to driving their confidence levels do not significantly differ from their non-stroke aged-matched driving peers. However, driving confidence for both non-stroke drivers in the DCE study and post-stroke drivers in the qualitative study, DHQ and ADSES studies was found to influence limiting driving behaviour. As driving confidence decreases, limiting driving behaviour increases.

Results from the qualitative study in Chapter Three demonstrated that men did not lack confidence when asked to consider the question of returning to driving post-stroke in the acute phase of their recovery trajectory as none of the men cited confidence as a consideration in returning to driving. However, women reported a lack of driving confidence to be the main issue when they considered returning to driving post-stroke. Results from the general, non-stroke older driving population in Australia extracted from the DCE study also found that driving confidence was more of an issue in the decision to relinquish a driver's licence for women than for men.

However, gender was not found to influence confidence levels in post-stroke drivers, as female post-stroke drivers were found to be as confident in their driving skills as their male counterparts when examining ADSES scores reflective of self-reported confidence levels in

the DHQ study. These results suggest that once women return to driving post-stroke they are just as confident as their male counterparts and their non-stroke driving peers.

In answer to RQ4: Are self-perceived confidence levels associated with self-regulation of driving in the post-stroke population?

8.4.2 Limiting Driving Post-stroke

In the DHQ study when assessing actual driving habits once stroke survivors had returned to driving, it was found that those participants, who self-rated their driving confidence as high, drove further, drove more kilometres and to more destinations each week. Self-perceived driving confidence as measured by the ADSES was found to be a significant factor in both the decision to return to driving post-stroke and self-limiting driving behaviour once stroke survivors had returned to driving.

When examining confidence levels in stroke survivors of both genders who have returned to driving from the DHQ study, confidence levels were not found to differ between men and women. These results show that once female stroke survivors have returned to driving post-stroke, they have the same possibility of high confidence levels as male stroke survivors and consequent driving scope. Women who had returned to driving post-stroke in the DHQ study tended to have had confidence in their post-stroke driving ability prior to returning to driving, or had managed to overcome their poor driving confidence issues. Hence it would appear that a lack of driving confidence for women post-stroke is more likely to influence ceasing driving altogether in the early stages of the recovery trajectory; but once they return to driving women have the same levels of driving confidence as men and therefore the same potential driving scope. The results from the DHQ study will be helpful in informing health care professionals and shaping future best practice in supporting decision making about returning to driving post-stroke. It appears that driving confidence is an issue for women in the first four months post-stroke and lack of driving confidence has the potential for a devastating impact on the decision not to return to driving. Driving confidence does appear to be an important influence in self-limiting driving behaviour for both men and women pre- and post-stroke. Support for decision making about returning to driving in the first four

months post-stroke for women should target driving confidence and consequently reduce the likelihood of premature driving cessation.

Future studies could consider performing an ADSES on all stroke survivors in the acute phase of recovery. Follow-up studies could then be performed that examine whether ADSES scores are associated with actual driving outcomes post-stroke and influence future return to driving decisions and self-limiting driving behaviours. In particular, women's levels of driving confidence post-stroke could be monitored using the ADSES and interventions tailored to help improve driving confidence. In addition to this, future studies could interview women who had returned to driving post-stroke (as the DHQ study found they had the same confidence levels as their male counterparts) and investigate whether they had driving confidence issues in their acute phase of recovery, which they managed to overcome. If these women did overcome driving confidence issues, future studies could reveal what factors helped them to overcome such issues and return to driving post-stroke which in turn could be applied in targeted interventions in order to support other women. Gender differences in the rate of returning to driving were found in the DHQ study. There were twice as many men than women being assessed for returning to driving post-stroke; however, this was only a small study of one driving assessment facility. It would be beneficial in future studies to examine whether this gender disparity in the assessment process is the case more generally or only specific to this one facility. Potential gender disparity in assessment results could be mediated by targeted attempts by health care professionals to encourage more women to consider returning to driving, if they are deemed medically well enough to do so. By doing so it may help avoid the downward spiral of depression and social isolation often associated with ceasing driving post-stroke (White, 2012b).

It is important to remember, however, that driving confidence levels do not always reflect actual driving ability. The DHQ study performed for this thesis examined reported driving habits; future studies could examination self-perceived driving confidence compared with actual driving ability post-stroke and include data linkage to government data bases with records of citations and crash rates to contribute to the overall picture of actual performance.

Future studies could also examine the degree to which self-limiting driving behaviours pre-stroke contribute to self-limiting driving behaviours post-stroke and the extent to which it influences decisions about fitness to drive or ceasing driving altogether. Factors contributing to self-limiting driving behaviours generally, and specifically for stroke survivors, are complex and not yet well understood. Whilst confidence is one of the main contributing factors to self-limiting driving behaviours post-stroke (White et al., 2012a), research has also shown that executive dysfunction (Motta et al., 2014), advancing age (Dugan & Lee, 2013; Finestone et al., 2009), reduced visual ability (Fisk et al., 2002b; Sandlin, McGwin & Owsley, 2014; Sengupta et al., 2014) and other physical limitations (Alguren, Fridlund, Cieza, Sunnerhagen & Christensson, 2012; Perrier et al., 2010a) significantly contribute to reduced driving ability post-stroke.

During the DHQ study the period post-stroke was also examined to see if driving confidence increased with more time and more post-stroke driving experience. The variable of time since stroke (two months to 36 months, mean: 16.9 months) was compared to driving confidence levels as measured by the ADSES. ADSES scores, reflecting participant self-perceived driving confidence post-stroke, were not found to be significantly associated with time since stroke. So once stroke survivor's return to driving they are as confident about their driving as non-stroke aged-matched peers and this did not change over the first 36 months post-stroke.

There were some limitations in regards to the studies in this thesis that examined limiting driving that it is important to acknowledge. In the ADSES study there were comparisons made between the ADSES scores collected during the DCE study, an online survey of older Australian drivers who had not experienced stroke and the DHQ study where ADSES scores were collected during phone interviews with stroke survivors. So data collection methods were different in these two studies. Another consideration is that in both studies the data collected on driving habits were self-reported and not observed, thus it is not possible to verify self-reported with actual observed driving behaviours. It is also important to highlight that in the DCE study the participants had not had disruption to their driving prior to data collection whereas in the DHQ study stroke survivors had a period of time where they were

not driving during their recovery trajectory. This may have had an effect on driving habits and confidence levels in addition to the results of the effects of stroke in participants.

In answer to RQ5: What is the relative importance of key factors (driving confidence, crash risk, age, GP's recommendation to cease driving, and the cost and availability of other transport options) to an older Australian's decision to relinquish their driver's licence?

8.4.3 Crash risk

As with previous Australian research (Pearce et al., 2012) findings from the DCE and DHQ studies did not demonstrate a high crash rate in older non-stroke and post-stroke participants. Only five of the 110 older non-stroke Australian drivers who participated in the DCE study reported minor accidents (one each) in the last year (4.5%); this result is well below the Australian average for older Australian drivers (Baldock & McLean, 2012). There were no crashes reported by the 40 DHQ study post-stroke driving participants and only two speeding tickets were received by one participant who had returned to truck driving and drove many kilometres a day.

When questioned if they had been asked to cease or limit their driving by anyone in the last year, only six out of the 40 post-stroke participants in the DHQ study reported they had discussed this with anyone else, but none had stopped driving. ADSES scores of the DHQ study participants showed that self-reported driving confidence levels were not statistically significantly associated with having a discussion with someone who suggested they cease or limit their driving in the previous year. These conversations took place with the participant's GP or family and friends and were unsuccessful in changing driving behaviour. This finding, that GPs who spoke to the DHQ post-stroke study participants were unable or unwilling to address the issue of concerns about driving ability with their patients to the extent they ensured a change in driving behaviour, is of considerable concern. Interestingly five out of these six DHQ post-stroke study participants who had spoken to their GPs about considering relinquishing their driver's licence were men, and when these men had been asked to rate their own driving skills during the DHQ study interview they had reported they were good or excellent drivers. The only female participant, who had discussed limiting or ceasing driving in the last year with her GP, had reported her driving skills as average. This suggests

possible gender differences in self-rating driving ability, insight and driving confidence levels. These findings support those of the qualitative study in chapter three, suggesting that male drivers, in particular, tend to lack insight into their driving skills. So in both studies findings suggest gender differences in regard to insight of driving skills with men, more likely than women to lack such insight.

When the DCE study examined two age groups (65-69 years and 70-89 years) younger participants appeared to be higher risk takers. For younger participants the low (5%) and medium (30%) risk of crash levels were non-significant in the decision to relinquish a driver's licence. Thus it was not until they were presented with a 60% risk of crash in the next year that their decision to relinquish their driver's licence was influenced. For the older aged group, overall crash risk was significant in their decision to relinquish a driver's licence.

Age and confidence levels were significantly associated with the decision to relinquish a driver's licence in older Australian drivers who were participants in the DCE study. This was also found to be the case in stroke survivors in the DHQ study, as younger drivers reported they were less likely to limit their driving and to drive further than older drivers. Therefore results of both the DHQ and DCE study show that the older stroke and non-stroke drivers become, the less confident they are and more likely to be influenced in their decision to relinquish their driver's licence by information on crash risk in the following year.

Low mileage drivers were statistically significantly associated with reduced scope of driving drove fewer kilometres each week and were more likely to self-limit their driving in the results of both the DHQ and the ADSES study. As previous research (Langford et al., 2013) has shown that low mileage older drivers have a self-reported higher crash rate, it is of concern that older Australian drivers aged between 65 and 69 years who participated in the DCE study, including those who were low mileage drivers, found that the low to medium potential crash risk for the next year was non-significant in their decision to relinquish their driver's licence.

These are important findings as they help to inform targeted driver education sessions and enable them to become more patient-centred, enabling us to understand what is most likely to influence decisions about fitness to drive. Results from the DCE and DHQ studies presented in this thesis show that younger, male and low mileage drivers need help with more understanding of their actual driving skills and potential crash risk and female drivers require more support with their driving confidence when considering the decision to relinquish their driver's licence.

Future studies could examine the differences between gender and perceptions of crash risk throughout different age groups of stroke survivors. Younger generations of post-stroke drivers may have less gender differences in regards to insight into driving skills and potential crash risks, as younger women are more likely to be primary drivers and have more driving experience than their older counterparts. Data linkage could be used to consider differences in reported and actually recorded crash rates, and link with reported self-perceived driving ability, gender and age to better inform driver education interventions post-stroke.

8.4.4 Preferences for Retaining a Drivers Licence

One aim of this thesis was to examine more generally, from a community perspective, older Australian's preferences in relation to several key factors which may influence their decision making about relinquishing their driver's licence. By better understanding the views and preferences of older people in the general community, insights can be gained about what factors associated with ageing, more generally, may be contributing to decisions about returning to driving, in addition to those factors which arise following a significant health event such as experiencing a stroke. In keeping with the scope of this thesis, a study was carried out to examine the factors that influenced decision making when considering relinquishing a driver's licence in older Australians aged over 65 years. This is the age group that best matches the current post-stroke population as approximately 75% of strokes occur in people over the age of 65 years (Stroke Centre statistics, 2015).

A novel DCE methodological approach was employed to consider this issue in more detail; and scenarios were designed based upon several key factors identified by previous research

as pivotal in the decision to relinquish or retain one's driver's licence including: age; risk of crash in the succeeding year; driving confidence levels; influence of others about whether to relinquish a driver's licence; availability of alternative transport options; and the cost of public transport influencing decision making (Barnsley et al., 2012; Dugan & Lee, 2013; Hakamies-Blomqvist & Siren, 2003; Pearce et al., 2012). The results of the DCE study outlined in this thesis concur with the findings of other studies, that is, with increased age and less driving confidence there is a higher likelihood of deciding to relinquish a driver's licence (Anstey & Smith, 2003; Dugan & Lee, 2013; Finestone et al., 2009; George et al., 2007; Marottoli & Richardson, 1998; Myers et al., 2008).

The statistically significant finding that the advice of the local GP was overwhelmingly important in decision making about relinquishing a driver's licence in the over 65 year age group contributes to research in this area. It also reinforces the need for GPs to have confidence in their abilities and a clear understanding of their responsibilities in regards to the issue of driver licences and assessing fitness to drive post-stroke. An Australian study (Jones et al., 2012) found GPs were unsure about whether they should be responsible for assessing fitness to drive and were concerned about a lack of alternative transport options. Other overseas studies have found that GPs are reluctant to discuss the issue of driving and licence regulations with their patients for fear it may negatively impact their relationship (Jang et al., 2007). Findings from the DCE study in this thesis suggest this is also the case in Australia, as none of the 110 participants who completed the survey reported having had a discussion on needing to consider the possibility of relinquishing their driver's licence with anybody over the last year including with their GP. Despite findings in previous research that GPs have concerns about damaging their relationships with patients if they discuss fitness to drive (Jang et al., 2007), results from the DCE study suggest that Australian participants displayed their greatest trust in their GP's opinion and advice about fitness to drive. Participants in the DCE study reported that they saw their GP as being the most appropriate person to discuss relinquishing a driver's licence, and the most acceptable health care professional to be responsible for the issue of mandatory testing and reporting when it was deemed necessary to consider relinquishing a driver's licence. Results of the DCE study showed that the GP's opinion about fitness to drive had the most significant impact on older Australian's decision making about relinquishing a driver's licence, more so than the opinions of family and friends. Cost and availability of alternative transport options, crash rates, driving confidence

levels and age were also found to affect this decision, although not to the same extent as the local GP's opinion and recommendation. It is therefore critical that GPs are supported to provide the right advice in relation to the decision to retain or relinquish a driver's licence for individuals in their care, and that they have the training and access to the multidisciplinary input needed to support such decisions and advice.

Further studies could also assess the benefits of GPs having other health care professionals input in helping to assess fitness to drive. A multidisciplinary approach may help deflect perceived blame on the GP and thereby maintaining the patient–doctor relationship. Such input could also contribute to the GP feeling more confident in the decision making process and contribute to a best practice approach to post-stroke return to driving interventions.

Further results from the DCE study of significance were that participants did not appear to consider the availability of alternative transport options or the cost of public transport important key elements in their decision to relinquish their driver's licence. This may be at least partly reflective of the fact that all of the study participants indicated they were current drivers. Thoughts of finding alternative transport options or using public transport for the first time in many years had not yet been actual considerations for them. Alternative transport options may only be issues that become important once an individual relinquishes their driver's licence and they are actually faced with the practicality of how to get around. This may not occur for some time after the driver's licence is relinquished as the reality of relying on others for transport becomes apparent. These results are contrary to findings from overseas studies (Logan, Dyas & Gladman, 2004). Logan, Dyas and Gladman (2004) interviewed 24 community dwelling stroke survivors about their experiences with transport since their stroke. Findings included reports from stroke survivors that they had inadequate information on transport services available to them and were concerned about the costs associated with taxis and scooters. Relying on family and friends for transport was only used for health related appointments. Logan, Dyas and Gladman (2004) did conclude, however, that many transport barriers reported by the stroke survivors in their study could be overcome by targeted interventions.

It is important to reiterate that the DCE study in this thesis elicited stated rather than actual preferences. Further research should assess the extent to which individual's stated preferences concur (or diverge) from their actual revealed preferences when faced with the decision to retain or relinquish their driver's licence. If stated preferences in given hypothetical scenarios are in agreement with what actually occurs in practice (in similar scenarios) this would then provide further support for the validity of preferences obtained using the DCE approach with people such as stroke survivors. If actual preferences differed from stated preferences, research on why and when this occurred may assist in informing the design and timing of future DCE studies on post-stroke driving education interventions.

The DCE study results highlighted the importance that older Australians place in advice given to them about driving and, more specifically, decisions about relinquishing their driver's licence by their GP. Future studies could consider comparing retention by stroke survivors of driving information given to them by different, significant others including their GP, partners, family or friends throughout the recovery trajectory. In this way such a study could identify key individuals who are most likely to influence decisions about driving post-stroke overall and at different phases throughout recovery.

8.4.5 Decision to return to driving post-stroke

Current research indicates that many stroke survivors and their families have made decisions about returning to driving or ceasing driving post-stroke without professional advice being available to them (Chua et al., 2012; Fisk et al., 1997) resulting in many stroke survivors and their families overestimating the stroke survivors return to driving abilities (Heikkila et al., 1999). Indeed, a lack of insight has been demonstrated by stroke survivors and their families into the intricacies of skills required performing driving tasks post-stroke, which leads to poor decision making about fitness to drive and increases crash risk (Heikkila et al., 1999). When faced with the decision to return to driving post-stroke, stroke survivors need to be well informed of the return to driving process and support mechanisms, the current legislation and alternative transport options available to them to support their decision making.

In Australia stroke survivors are able to return to driving as soon as 1 month post-stroke if their doctors assess them as fit to drive (Austroads, 2012, see Appendix II). It is important to know what the attitudes and perceptions of stroke survivors are at this stage of their recovery trajectory and what information they will be receptive to, in order to inform their fitness to drive decision making. During the qualitative study conducted as part of this thesis, participants were interviewed from one to 16 weeks post-stroke and were currently still being treated in an acute or rehabilitation health care facility at the time of the study interviews. All qualitative study participants had received information on post-stroke driving legislation and procedures. The four (19.1%) participants at the acute hospital and the 17 participants at the rehabilitation facility were given information brochures that explained current Australian post-stroke driving legislation and procedures. The 17 (80.9%) participants at the rehabilitation facility also attended post-stroke driving education information sessions conducted by a driver trained occupational therapist. Despite this optimum level of formal post-stroke driving education, the majority (85.7%) of qualitative study participants were unable to state what the current legislation involved in regards to returning to driving post-stroke when interviewed by the researcher. Eighteen (85.7%) of the 21 qualitative study participants reported never having discussed relinquishing their driver's licence with anyone, either pre or post-stroke and the other three (14.3%) participants reported they had only discussed driving briefly with their GP pre-stroke. Those three participants who had discussed driving with their GP pre-stroke were only starting to think about relinquishing their driver's licence and had not brought the subject up with family and friends, with none specifically recalling discussing the legislation. Three participants could recall fragmented details of the post-stroke driving legislation, remembering only that they needed to talk to their GP about it and recalled they could start driving again at one month post-stroke. Most (95.2%) qualitative study participants in Chapter Three of this thesis reported they were more focused on their physical and cognitive recovery and had not yet focused on thinking about returning to driving, stating they would probably consider the issue of returning to driving once they got home.

Findings from the DCE study in this thesis demonstrated importance that older Australians place on their local GP's post-stroke driving advice when faced with the decision to relinquish their driver's licence. These findings may suggest that as two thirds of post-stroke drivers are over the age of 65 year (AIHW, 2014) then in order for post-stroke driving

education to be patient-centred the GP is the most appropriate person to provide post-stroke driving education in the Australian community. However, GPs have been shown to feel reluctant to discuss relinquishing a driver's licence with their patients in previous research, suggesting that GPs need more training in this area (Jang et al, 2007; Jones, Rouse-Watson, Beveridge, Sims & Schattner, 2012). An Australian study by Jones, Rouse-Watson, Beveridge, Sims and Schattner (2012) documented the findings from a series of face-to-face interviews performed with seven urban and nine rural GPs. It was found they were unsure whether they should be responsible for assessing fitness to drive and displayed a lack of knowledge on alternative transport options. In a Canadian study, Jang et al. (2007) sent surveys asking 1000 randomly selected Canadian GPs to self-report their attitudes toward driving assessments and the process of reporting medically unsafe drivers. Over 45% of the 486 respondents reported they were not confident in assessing fitness to drive and didn't consider themselves the most qualified professional to do so (Jang et al., 2007). Most (88.6%) reported they felt they would benefit from further education in this area, and 75% felt reporting unsafe drivers to the authorities was a conflict of interest and negatively affected their patient–doctor relationship. However, 72.4% agreed that as GPs they should be legally responsible for reporting unsafe drivers to the authorities. GPs appear to be conflicted about maintaining a positive relationship with their patients whilst at the same time, fulfilling their responsibilities in regards to assessing and reporting fitness to drive.

Further research should be conducted to examine how confident Australian GPs are in assessing and making decisions about fitness to drive and their involvement in the mandatory assessment process for older drivers. Doctors both in Australia and overseas clearly need more training and support in addressing the issue of assessing and deciding on fitness to drive (Coopersmith, Korner-Bitensky & Mayo, 1989; Jang et al., 2007). Further support services at local GP's surgeries by other health care professionals, such as occupational therapists, would assist in formal, standardised assessment and decisions on fitness to drive. Such support would conform to current research that suggests best practice for assessing fitness to drive should include a multidisciplinary team approach using standardised assessments that are reliable and valid measures. Driver trained occupational therapists based in the community would be best suited to conduct pre-driving screening assessments after referral from GP's surgeries in the community, and could then also be available to offer ongoing driver

retraining, on-road assessment and informed advice to GPs assessing fitness to drive in stroke survivors.

The DCE study included non-stroke participants to enable results to show the norm for older Australian drivers who had not experienced stroke as DCE methodology has not been used for either non-stroke or stroke drivers previously. Future studies should be carried out using the DCE methodology to determine how stroke survivors specifically make decisions about returning to driving post-stroke. By completing the DCE study on a non-stroke population, comparisons can be made by future studies on stroke survivors in order to understand how they differ from their non-stroke peers. Utilising DCE methodology would determine which factors contribute to decision making about returning to driving or relinquishing a driver's licence post-stroke, which may in turn indicate optimal timing and content for discussions between stroke survivors and their GPs about relinquishing their driver's licence.

The novel DCE approach used to investigate factors that influence people in their choice to relinquish their driver's licence represents the first study internationally to apply DCE technique in this area. In this study, the conditional logit model which is one of the most widely used methods for analysing DCE data in the literature has been used. Recent methodology development further relaxes the restrictions of the conditional logit model and allows for scale and preference (or taste) heterogeneity of respondents. One example is the recently developed generalised multinomial logit model (GMNL) (Fiebig et al., 2010) which can take account of both scale and taste heterogeneity simultaneously. In this thesis DCE study, since the sample size was relatively small, more advanced econometric methods such as GMNL were not utilised to analyse the DCE data. However, more advanced econometric methods should be considered for the analysis of data where larger sample sizes are attained in future DCE studies.

8.4.6 Driving assessments

The idea of mandatory testing was rejected by the majority of participants during the DCE study within this thesis and, if required by government, most participants preferred mandatory testing to occur from 85 years of age and by their GP. Interestingly this cut off

age coincided with the statistics on risk of crashes with the customary risk curves based on crashes per distance travelled showing that increases in crash risk become apparent only from around age 75 years onwards, with the most noticeable increases being shown by the relatively small proportions of drivers aged 85 years and older (OECD, 2001). Previous research also suggests that GPs concur with the preferences expressed by the DCE study participants, that is, GPs are the most appropriate health care professionals to be involved in the mandatory reporting of unsafe drivers to the authorities (Jang et al., 2007). These findings from the DCE study on an older Australian population helps inform how stroke survivors may respond to advice by a GP when considering returning to driving or relinquishing their driver's license as two thirds of the stroke population are over 65 years old (AIHW, 2014).

When considering post-stroke drivers, results from the DHQ study suggest that twice as many men are being assessed for fitness to drive post-stroke than women. This finding suggests that women's needs for support and encouragement to consider being assessed to return to driving post-stroke may not have been met. A consistent approach in Australia for assessing fitness to drive may lead to more confidence in stroke survivors to more fully engage in the assessment process and enable them to return to driving and independence. In particular women post-stroke may be more confident in the return to driving process if they had a clearer understanding of a formal, national decision tree that ensured a standardised, multidisciplinary assessment process that was patient-centred, and of little or no cost to the stroke survivor with retraining options available that met their needs. Encouraging returning to driving post-stroke, if safe to do so, helps reduce the likelihood of depression and social isolation (White, 2012b).

8.4.7 Key Findings of Community Phase of Recovery Post-stroke

- Once stroke survivors returned to driving they had the same level of self-perceived driving confidence as their non-stroke aged-matched driving peers.

- Gender differences were found in the consideration of relinquishing a driver's licence. Men were most influenced by physical limitations and women by lack of driving

confidence. These findings should influence future gender targeted intervention strategies in order to have a more patient-centred approach.

- Age influences how crash risk influences the decision to relinquish a driver's licence in the older Australian driving population.
- Self-perceived driving confidence was not associated with time since stroke in those stroke survivors in the DHQ study who had returned to driving.
- Five minor not-at-fault crashes were reported for non-stroke older drivers in the DCE study and none for stroke drivers in the DHQ study. This was well below state averages.
- Results from the DCE study showed that age, driving confidence, crash rates and recommendations by GPs were statistically significantly associated with the decision to relinquish a driver's licence. Not significant were cost and availability of alternative transport options.
- Preferences expressed in the DCE study concur with previous research that the GP is the most appropriate health care professional to be involved in mandatory reporting of unsafe drivers.
- GP recommendations were overall the most significant factor in the decision to relinquish a driver's licence in the DCE study.
- GPs are reluctant to discuss relinquishing a driver's licence with patients but they agree they are the most appropriate health care professional to do so. DCE study participants agreed GPs are the most appropriate health care professional to discuss relinquishing a driver's licence.
- More men than women are assessed for fitness to drive post-stroke.

8.5 Limitations

Limitations have been discussed in each study chapter and throughout this Discussion Chapter. A common limitation of each study is that of small sample size, except for the qualitative study in Chapter Three sample size which was sufficient for a qualitative study.

Future research on the topics examined in this thesis should be repeated with larger sample sizes collected across multiple sites to increase the strength of findings.

8.6 Future directions

Future directions have also been briefly mentioned in the discussion section of each study chapter and elaborated on at the end of each phase of recovery in this Discussion Chapter. Overall, further studies in Australia should initially include more systematic data collection to facilitate accurate reporting of statistics on the numbers and key socio-demographic characteristics of stroke survivors who return to driving post-stroke, including gender differences.

There needs to be more research on what factors influence decisions by stroke survivors to return to driving. As a gap in research on DCE methodology being used to research decisions to relinquish a driver's licence in older people was identified the decision was made to complete a DCE study on older people in general. This thesis DCE study can now be used as a comparison with DCE studies on stroke survivors. DCE methodology could be used, as demonstrated in the DCE study of this thesis, with stroke survivors and then stated preferences compared later with actual decision making outcomes. In this way the influence of confidence and insight regarding decision making could be better understood and the focus of stroke survivors in their recovery phases examined. These future studies could then inform timing of post-stroke driving education including content requirements for such interventions. Along with DCE methodology, the ADSES should be considered in future research to assist in determining self-perceived confidence levels in the acute phase, prior to the decision about fitness to drive and then followed up to examine whether it influenced returning to driving outcomes.

During the rehabilitation stage post-stroke, this thesis reported upon a study to examine practice effect as one psychometric property of a standardised assessment. Future research needs to be undertaken to assess psychometric properties and their influence on scores of any standardised assessments considered to be included in a proposed nationally utilised decision tree and optimal stage/s of recovery to apply these standardised instruments post-stroke.

Understanding the influence of psychometric properties on standardised assessments used to assess fitness to drive post-stroke would inform the development of evidence based guidelines such as a nationally utilised decision tree.

The findings from this thesis indicate that there needs to be further research on how decisions are made on relinquishing a driver's licence in specific groups of people experiencing chronic conditions such as stroke. Further research needs to focus more on self-perception of driving skills and its influences at different stages of recovery. By understanding what stroke survivors are focusing on and believe about their driving ability, we can better target intervention strategies throughout the recovery process, which may include being more gender, age and phase of recovery specific. Findings from this thesis that GPs are considered by older Australian drivers to be the most appropriate health care professionals to discuss fitness to drive and to give advice on relinquishing a driver's licence can inform future studies. It would be insightful to repeat the DCE study with a sample of stroke survivors to determine if this specific population also view GPs as the most appropriate health care professionals to discuss fitness to drive and help with decisions about relinquishing a driver's licence. It will also enable a more general comparison of the extent to which their preferences are in agreement with those of older Australians from the general non-stroke community. Also, as past research has demonstrated that Australian GPs are not comfortable or confident in discussing fitness to drive with their patients, further studies could consider factors that would facilitate better communication and decision making between doctors and patients (Jones et al., 2012).

8.7 Clinical implications

A nationally utilised decision tree for the process of fitness to drive post-stroke is suggested, similar to the decision pathway that has been developed elsewhere for dementia patients who drive (Carter et al., 2015). A decision tree utilised by clinicians would reduce the current inconsistencies in the return to driving process post-stroke in Australia and be a best practice approach based on current research. This proposed decision tree could be utilised across Australia to guide clinical practice as well as fitness to drive decision making. The following are clinical implications as a result of the findings from the five studies contained in this

thesis that could be included in a national decision tree to ensure a consistent approach to fitness to drive post-stroke.

Results for the qualitative study in Chapter Three of this thesis demonstrate that stroke survivors are not focused on returning to driving in the acute phase of their recovery and are therefore not receptive to current methods of post-stroke driving education. Timing and content of post-stroke driving education in the acute phase of the stroke recovery trajectory needs to be revisited in order to become more patient-centred. Post-stroke driving education may be more likely to be absorbed during the acute phase, if the focus is on increasing insight into impact of stroke on driving skills, alternative transport options such as arrangements for getting a lift from family or friends (either temporary or permanent) and more gender specific interventions to focus on confidence building in women and insight into physical limitations in men. Qualitative study findings in Chapter Three suggest the use of the ADSES during the first few months post-stroke may act as a guide to intervention to help identify and address a lack of driving confidence, especially in women, and reduce unnecessary driving cessation. ADSES scores during the acute phase may also identify a lack of insight and a mismatch between the functional impacts of stroke and self-perceived driving confidence. A better understanding of gender specific issues will enable targeted intervention strategies. Confidence was found in the qualitative, DHQ, ADSES and DCE studies to influence decisions about limiting driving and relinquishing a driver's licence. Clinicians therefore need to address the issue of lack of driving confidence for all stroke survivors to help reduce the impact on limiting driving and reduced driving scope.

During the rehabilitation phase of the stroke recovery trajectory many stroke survivors are experiencing assessment to determine fitness to drive. A nationally utilised decision tree is proposed to act as a standardised approach by clinicians on decisions about fitness to drive. To aid in informing a national decision tree, further research needs to be undertaken to understand the influence of psychometric properties on standardised assessments, to ensure the most valid and reliable standardised assessments are recommended.

During the community phase DHQ study findings demonstrated that fewer women engage in the return to driving process post-stroke. Such findings indicate that clinical interventions need to focus on issues of confidence and to encourage women to engage in the returning to driving process post-stroke to avoid unnecessary premature driving cessation and possible associated health implications of social isolation and depression.

Clinically more work needs to be done to offer stroke survivors acceptable patient-centred alternatives to driving both temporarily and if ceasing driving, permanently. More resources need to be available to enable therapists to train stroke survivors in the use of accessible public transport, scooter purchase and use, and to explore other transport options available such as community buses and volunteer transport services in their communities.

Finally, as the DCE study discovered that the GP was seen by older Australian drivers as the most appropriate health care professional to give advice on relinquishing a driver's licence. Future research, using DCE methodology, to examine if stroke survivors are also most influenced by their GP when considering fitness to drive needs to occur to help inform future practice. Currently in Australia it is the GP's role to determine fitness to driver, so GP's do need to be included in a national approach as described in the proposed decision tree. Development of a national decision tree that includes a multidisciplinary team approach in the community to support a GP's fitness to drive decision making using standardised assessments is required for a best practice approach. A future best practice approach needs to include research on which tools GPs can use as objective measures of fitness to drive. A standardised approach by GP's would then complement a multidisciplinary input, to determine the best timing for referral for on-road assessments, ensuring maximum likelihood of passing assessments to avoid unnecessary use of resources and reduce experiences of failure for stroke survivors.

8.8 A Decision Tree

Currently the Australian return to driving process post-stroke is not a uniform one for stroke survivors with different pathways taken to come to the decision about fitness to drive. Inconsistencies exist, leading to a fragmented approach which is compounded by inadequate

funding and resources for fitness to drive assessment, education and retraining. A decision tree that could be used nationally across Australia is suggested in order to reduce inconsistencies and to refine and standardise the return to driving process within Australia by setting out a standardised approach. The five studies presented aim to add to knowledge about the return to driving process and factors influencing the decision of fitness to drive post-stroke and inform the development of the proposed decision tree.

References

1. Ackerman, M. L., Edwards, J. D., Ross, L. A., Ball, K. K. & Lunsman, M. (2008). Examination of cognitive and instrumental functional performance as indicators for driving cessation risk across 3 years. Gerontologist, 48, 802-810.

2. Ackerman, M., Crowe, M., Vance, D., Wadley, V., Owsley, C. & Ball, K. (2011). The impact and feedback on self-rated driving ability and driving self-regulation among older adults. Gerontologist, 51, 367-378. doi:10.1093/geront/gnq082.

3. ACT Government Road Transport Authority. (2015a). Licence General ACT Licence Information, Medical Conditions and Requirements. Retrieved from: www.rego.act.gov.au/licence/general-act-licence-information/medical-conditions

4. ACT Government Road Transport Authority. (2025b). Older Drivers' Information Brochure – Road Transport Authority. Retrieved from: www.rego.act.gov.au

5. Adler, G. & Rottunda, S. (2006). Older adults' perspectives on driving cessation. J Aging Stud, 20, 227-235. doi:10.1016/j.jaging.2005.09.003.

6. Akinwuntan, A. E., Feys, H. & De Weerdt, W. (2002). Determinants of driving after stroke. Arch Phys Med Rehabil, 83, 334-341.

7. Akinwuntan, A., E., DeWeerdt, W., Feys, H., Baten, G., Arno, P. & Kiekens, C. (2003). Reliability of a road test after stroke. Arch Phys Med Rehabil, 84, 1792-1796.

8. Akinwuntan, A.E., Arno, P., De Weerdt, W., Feys, H. & Kiekens, C. (2006). Prediction of driving after stroke: A prospective study. Neurorehabil Neural Repair, 20, 417-423. doi:10.1177/1545968306287157.

9. Akinwuntan, A., Devos, H., Verheyden, G., Baten, G., Kiekens, C., Feys, H. et al. (2010). Retraining moderately impaired stroke survivors in driving related visual attention skills. Top Stroke Rehabil, 17, 328-336. doi:10.1310/tsr1705-328.

10. Alguren, B., Fridlund, B., Cieza, A., Sunnerhagen, K. S. & Christensson, L. (2012). Factors associated with health-related quality of life after stroke: A 1-year prospective cohort study. Neurorehabil Neural Repair, 26, 266-274 doi:10.1177/1545968311414204.

11. Allen, Z. A., Halbert, J. & Huang, L. (2007). Driving assessment and rehabilitation after stroke. MJA, 187, 599.

12. Anstey, K. J. & Smith, G. A. (2003). Associations of biomarkers, cognition and self-reports of sensory function with self-reported driving behaviour and confidence. Gerontology, 49, 196-202. doi:10.1159/000069177.

13. Anstey, K. J., Windsor, T. D., Luszcz, M. A. & Andrews, G. R. (2006). Predicting driving cessation over 5 years in older adults: Psychological well-being and cognitive competence are stronger predictors than physical health. J Am Geriatr Soc, 54, 121-126.

14. Armijo-Olivo, S., Warren, S. & Magee, D. (2009). Intention to treat analysis, compliance, drop-out and how to deal with missing data in clinical research: A review. Phys Ther Rev, 14, 36-49. doi:10.1179/174328809X405928.

15. Aslaksen, P. M., Orbo, M., Elvestad, R., Schafer, C. & Anke, A. (2013). Prediction of on-road driving ability after traumatic brain injury and stroke. Eur J Neurol, 20, 1227-1233. doi:10.1111/ene.12172.

16. Australian Institute of Health and Welfare. (2014). The fourteenth biennial health report of the Australian Institute of Health and Welfare. Australia's Health. Cat. no. AUS 178. Canberra. AIHW. ISSN 1032-6138. ISBN 978-1-74249-544-6.

17. Australian Standards for Editing Practice (2013). Second Edition. Institute of Professional Editors Limited (IPed) from: www.iped-editors.org

18. Austroads. Assessing fitness to drive – for commercial and private vehicles (2012) Sydney. Australia. Accessed December, 2014 from: www.austroads.com.au

19. Baldock, M. R., Mathias, J. L., McLean, A. J. & Berndt, A. (2006). Self-regulation of driving and its relationship to driving ability among older adults. Accid Anal Prev, 38, 1038-1045.

20. Baldock, M. R. J. & McLean, A. J. (2012). Older drivers: Crash involvement rates and causes. Centre for Automotive Safety Research. Available from: www.casr.adelaide.edu.au/reports

21. Ball, K.K., Beard, B.L., Roenker, D.L., Miller, R.L. & Griggs, D.S. (1988). Age and visual search: Expanding the useful field of view. JOSA A, 12, 2210-2219. doi:10.1364/JOSSA.5.002210.

22. Ball, K. & Owsley, C. (1993). The Useful Field of View test: A new technique for evaluating age-related declines in visual function. J Am Optom Assoc, 64, 71-79.

23. Ball, K., Owsley, C., Stalvey, B., Roenker, D. L., Sloane, M. E. & Graves, M. (1998). Driving avoidance and functional impairment in older drivers. Accid Anal Prev, 30, 3, 313-322. doi:10.1016/S0001-4575(97)00102-4.

24. Barber, A. P., Davis, S. M., Infeld, B., Baird, A. E., Donnan, G. A., Jolley, D. et al. (1998). Spontaneous reperfusion after ischemic stroke is associated with improved outcome. Stroke, 29, 2522-2528. doi:10.1161/01.STR.29.12.2522.

25. Barnsley, L., McCluskey, A. & Middleton, S. (2012). What people say about travelling outdoors after their stroke: A qualitative study. Aust Occup Ther J, 59, 71-78. doi:101111/j.1440-1630.2011.00935.x.

26. Bentley, S. A., LeBlanc, R. P., Nicolela, M. T. & Chauban, B. C. (2012). Validity, reliability, and repeatability of the useful field of view test in persons with normal vision and patients with glaucoma. Investigative Opthalmology and Visual Science, 53, 6763-6769. doi:10.1167/iovs.12-9718.

27. Berges, I. M., Seale, G. S. & Ostir, G. V. (2012). The role of positive effect on social participation following stroke. Disabil Rehabil, 34, 2119-23.

28. Bonita, R. & Beaglehole, R. (1988). Recovery of motor function after stroke. Stroke, 19, 1497-1500. doi:10.1161/01.STR.10.12.1497.

29. Bouillon, L., Mazer, B. & Gelinas, I. (2006). Validity of the cognitive behavioural driving inventory in predicting driving outcome. Am J Occup Ther, 60, 420-427. doi:10.5014/ajot.60.4.420.

30. Brott, T., Adams, H., Olinger, C., Marler, J., Barson, W., Biller, J. et al. (1989). Measurements of acute cerebral infarction: A clinical examination scale. Stroke, 20, 864-870. doi:10.1161/01.STR.20.7.864.

31. Burgess, L. & Street, D. (2005). Optimal design for choice experiments with asymmetrical attributes. J Stat Plann and Inference, 134, 288-301. doi:10.1016/j.jspi.2004.03.021.

32. Burkhard, J.E. & McGarock, A.T. (1999). Tomorrow's older drivers. Who? How many? Transport Research Record, 99:1501. doi:http://dx.doi.org/10.3141/1693-10.

33. Campbell, D. T. & Stanley, J. C. (1966). Experimental and quasi-experimental designs for research. Chicago: Rand McNally.

34. Carr, D. B. (2000). The older adult driver. Am Fam Phys, 61, 141-146.

35. Carter, T. & Major, H. (2003). Driving restrictions after stroke: Doctor's awareness of DVLA guidelines and advice given to patients. Clin Med, 3, 187.

36. Carter, K., Monaghan, S., O'Brien, J., Teodorczuk, A., Mosimann, U. & Taylor, J-P. (2015). Driving and dementia: A clinical decision pathway. Int. J Ger Psych, 30, 210-16. doi:10.1002/gps.4132.

37. Charlton, J. L, Oxley, J., Fildes, B., Oxley, P. & Newstead, S. (2006). Characteristics of older drivers who adopt self-regulatory driving behaviours. Trans Res, Part F, 9, 363-373.

38. Chaudry, F., Jay, W. M. & Poole, D. (2008). Stroke and driving. Top Str Rehabil, 15, 37-40. doi:10.1310/tsr1501-37.

39. Chua, M., McCluskey, A. & Smead, J. M. (2012). Retrospective analysis of factors that affect driving assessment outcomes after stroke. Aust Occup Ther J, 59, 121-130, doi:10.1111/j1440-1630.2012.01005.x.

40. Cohen, J. W. (1988). Statistical power analysis for the behavioural sciences (2nd edn). Hillsdale, NJ: Lawrence Erlbaum Associates.

41. Coopersmith, H. G., Korner-Bitensky, N. A. & Mayo, N. E. (1989). Determining medical fitness to drive: Physicians' responsibilities in Canada. CMAJ, 140, 375-378.

42. Corpuz, G. (2007). Public transport or private vehicle: Factors that impact on mode Choice. 30th Australasian Transport Research Forum, 1, 11.

43. Couglin, J. (2001). Transportation and older persons: Perceptions and preferences. A report on focus groups. Washington, DC: Centre for Transportation Studies, and Age Lab.

44. Dahmoon, M. S., Moon, Y. P., Paik, M. C., Sacco, R. L. & Elkind, M. S. V. (2012). Trajectory of functional decline before and after ischemic stroke: The northern Manhattan study. Stroke, 43, 2180-2184. doi:10.1161/STROKEAHA.112.688922.

45. Dellinger, A.M., Sehgal, M., Sleet, D.A. & Barrett-Connor, E. (2001). Driving cessation: What older former drivers tell us. J Am Ger Soc, 49, 431-435. doi:10.1046/j.1532.5415.2001.49087.x.

46. Desapriya, E., Brubacher, J., Chan, H., Hewapathirane, D., Subzwari, S. & Pike, I. (2014). Vision screening of older drivers for preventing road traffic injuries and fatalities. The Cochrane Collaboration, The Cochrane Library, Issue 2.

47. Devos, H., Akinwuntan, A. E., Nieuwboer, A., Truijen, S., Tant, M., & De Weerdt, W. (2011). Screening for fitness to drive after stroke. Neurology, 76, 747-756. doi:10.1212/WNL.0b013e31820d6300.

48. Dickerson, A. E., Brown Mueul, D., Ridenour, C. D. & Cooper, K. (2014). Assessment tools predicting fitness to drive in older adults: A systematic review. Am J Occup Ther, 68, 670-680. doi:10.5014/ajot.2014.011833.

49. Dixon, W.J. & Mood, A.M. (1946). The statistical sign test. J Am Stat Assoc, 41, 236:557-566. doi:10.2307/2280577.

50. Dombovy, M. L. (1991). Stroke: Clinical course and neurophysiologic mechanisms of recovery. Critical reviews in physical and rehabilitation medicine, 2, 171-188.

51. Donorfio, L. K., D'Ambrosio, L. A., Couglin, J. F. & Mohyde, M. (2008). Health, safety, self-regulation and the older driver: It's not just a matter of age. J Safety Res, 39, 555-561. doi:10.1016/j.jsr.2008.09.003.

52. Drickamer, M. A. & Marottoli, R. A. (1993). Physician responsibility in driver assessment. The Am J Med Sci, 306, 277-281.

53. Dugan, E. & Lee, C. M. (2013). Biopsychosocial risk factors for driving cessation? Findings from health and retirement study. J Ageing Health, 25, 1313-1328. doi:10.1177/0898264313503493.

54. Duncan, P. W., Goldstein, L. B., Matchar, D., Divine, G. W. & Feussner, J. (1992). Measurement of motor recovery after stroke: Outcome assessment and sample size requirements. Stroke, 23, 1084-1089. doi:10.1161/01.STR.23.8.1084.

55. Edwards, J., Ross, L., Ackerman, M., Small, B., Ball, K., Bradley, S. et al. (2008). Longitudinal predictors of driving cessation among older adults from the ACTIVE clinical trial. J Geront Psychol Sci, 63B, 6-12.

56. Edwards, J. D., Myers, C., Ross, L., Roenker, D., Cissell, G., McLaughlin, A. et al. (2009). The longitudinal impact of cognitive speed of processing training on driving mobility. Gerontologist, 49, 485-494. doi:10.1093/geront/gnp042.

57. Evans, L. (1988). Older drivers involvement in fatal and severe crashes. J Gerontol, 43, 5186-5193. doi:10.1093/geronj/43.6.S186.

58. Ezzy, D. (2002). Qualitative analysis: Practice and innovation. Crows Nest, NSW: Allen & Unwin.

59. Fiebig, D.G., M. P. Keane, J. Louviere, & N. Wasi. (2010). The Generalized Multinomial Logit Model: Accounting for Scale and Coefficient Heterogeneity, Marketing Science, 29 (3) 393-421. doi:10.1016/S1755-5345(13)70014-9.

60. Fillenbaum, G.G. (1988). Multidimensional functional assessment of older adults Americans Resources and Services Procedures (OARS). New Jersey: Lawrence Erlbaum.

61. Finesilver, S. G. (1969). The older driver: Statistical evaluation of licensing and accident involvement in 30 states. Denver: University of Denver College of Law.

62. Finestone, H. M., Marshall, S. C., Rozenberg, D., Moussa, R. C., Hunt, L. & Greene-Finestone, L.S. (2009). Differences between post-stroke drivers and non-drivers. Am J Phys Med Rehabil, 88, 904-923. doi:10.1097/PHM.0b013e3181aa001e.

63. Finestone, H. M., Guo, M., O'Hara, P., Greene-Finestone, L., Marshall, S. C., Hunt, L. et al. (2010). Driving and reintegration into the community in patients after stroke. PMR 2, 497-503. doi:10.1016/j.pmrj.2010.03.030.

64. Fisk, G., Owsley, C. & Pulley, L. (1997). Driving after stroke: Driving exposure, advice, and evaluations. Arch Phys Med Rehabil, 78, 1338-1345. doi:10.1016/S0003-9993(97)90307-5.

65. Fisk, G. D., Novack, T., Mennemeier, M. & Roenker, D. (2002a). Useful field of view after traumatic brain injury. J Head Trauma Rehabil, 17, 16-25.

66. Fisk, G. D., Owsley, C. & Mennemeier, M. (2002b). Vision, attention and self-reported driving behaviours in community-dwelling stroke survivors. Arch Phys Med Rehabil, 83, 469-77. doi:10.1053/apmr.2002.31179.

67. Foley, D., Harley, M.S., Heimovitz, K., Guralnik, J.M. & Brock, D.B. (2002). Driving life expectancy of persons aged 70 years and older in the United States. Am J Public Health, 92, 1284-1289.

68. Folstein, M. F., Folstein, E. & McHugh, P. R. (1975). "Mini-Mental State": A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res, 12, 189-198. doi:10.1016/0022-3956(75)90026-6.

69. Freeman, E. E., Gange, S. J., Munoz, B. & West, S. K. (2006). Driving status and risk of entry into long-term care in older adults. Am J Public Health, 96, 1254-1259. doi:10.2105/AJPH.2005.069146.

70. Gadidi, V., Katz-Leurer, M, Carmeli, E. & Bornstein, N. M. (2011). Long-term outcome post-stroke: Predictors of activity limitations and participation restriction. Arch Phys Med Rehabil, 92, 1802-1808. doi:10.1016/j.apmr.2011.06.014.

71. George, S. (2012). Tools to inform general practitioners' decision making on driving following a stroke. MJA, 196, 37-38. doi:10.5694/mja11.10160.

72. George, S., Clark, M. S. & Crotty, M. (2007). The development of the Adelaide driving self-efficacy scale. Clin Rehabil, 21, 56–61. doi:10.1177/0269215506071284.

73. George, S. & Crotty, M. (2010). Establishing criterion validity of the Useful Field Of View assessment and Stroke Drivers' Screening Assessment: Comparison to the results of on-road assessment. Am J Occup Ther, 64, 114-122. doi:10.5014/ajot.64.1.114.

74. Goldstein, L. & Samsa, G. (1997). Reliability of the NIHSS: Extension to non-neurologists in the context of a clinical trial. Stroke, 8, 307-310. doi:10.1161/01.STR.28.2.307.

75. Good, K. T., Ball, K. K., Sloane, M., Roenker, D. L., Roth, D., Myers, R. S. et al. (1998). Useful field of view and other neurocognitive indicators of crash risk in older adults. J Clin Psychol Med Set, 5, 425-440.

76. Government of South Australia, Department of Transport, Travel and Motoring. (2015a). Medical Fitness to Drive. Retrieved from: www.sa.gov.au/topics/tranport-travel-and-motoring/motoring/drivers-and-licences/medical-fitness-to-drive

77. Government of South Australia, Department of Transport, Travel and Motoring. (2015b). Licensing Seniors. Retrieved from: www.sa.gov.au/seniors/transport

78. Government of South Australia, Department of Transport, Travel and Motoring (2015c). Retrieved from: www.sa.gov.au

79. Griffen, J. A., Rapport, L. J., Coleman Bryer, R. & Scott, C. A. (2009). Driving status and community integration after stroke. Top Stroke Rehabil, 16, 212-221. doi:10.1310/tsr1603-212.

80. Hakamies-Blomqvist, L. & Wahlstrom, B. (1998). Why do older drivers give up driving? Accid Anal Prev 30, 305-312. doi:10.1016/S0001-4575(97)00106-1.

81. Hakamies-Blomqvist, L. & Siren, A. (2003). Deconstructing of gender difference: Driving cessation and personal driving history of older women. J Safety Res, 34, 383-388. doi:10.1016/j.jsr.2003.09.008.

82. Heikkila, V-M., Korpelainen, J., Turkka, J., Kallanrante, T. & Summala, H. (1999). Clinical evaluation of the driving ability in stroke patients. Acta Neurol Scand, 99:349-355. doi:10.1111/j.1600-0404.1999.tb07363.x.

83. Heiman, G. W. (2002). Research Methods in Psychology. 3rd Edition. Boston & New York. Houghton Mifflin Company.

84. Hendricks, H. T., van Limbeek, J. & Geurts, A. C. H. (2002). Motor recovery after stroke. Arch Phys Med Rehab, 83:11:1629-1637. doi:10.1053/apmr.2002.35473.

85. Hird, M. A., Vetivelu, A., Saposhik, G. & Schweizer, T. A. (2014). Cognitive on-road and simulator based driving assessment after stroke. J Str Cerebrovas Dis, 23, 2654-2670. doi:10.1016/j.jstrokecerebrovasdis.2014.06.010.

86. Hoggarth, P., Dalrymple-Alford, J., Croucher, M., Severinsen, J., Gray, J., Oxley, J. et al. (2011). Assessment of older drivers in New Zealand: The current system, research and recommendations. Australas J Ageing, 30, 148-155. doi:10.1111/j.1741-6612.2010.00478.x.

87. Holland, C. & Rabbit, P. (1992). People's awareness of their age-related sensory and cognitive deficits and the implications for road safety. App Cog Psychol, 6, 217-231.

88. Horswill, M.S., Anstey, K., Hatherly, C.G., & Wood, J.M. (2010). The crash involvement of older drivers is associated with their hazard perception latencies. J. Int Neuropsychol Soc, 16, 939-944. doi:10.1017/S135561771000055X.

89. Hsich, H-F. & Shannon, S. (2005). Three types of content analysis. Qual Health Res, 15, 1277-1288.

90. Jang, R., Man-Son-Hing, M., Molnar, F., Hogan, D., Marshall, S., Auger, J. et al. (2007). Family physicians' attitudes and practices regarding assessments of medical fitness to drive in older persons. J Gen Int Med, 22, 531-543.

91. Johansson, B. B. (2000). Brain plasticity and stroke rehabilitation: The Willis lecture. Stroke 31, 223-230. doi:10.1161/01.STR.31.1.223.

92. Johnson, J.E. (1998). Older rural adults and the decision to stop driving: The influence of family and friends. J Community Health Nurs, 15, 205-216. doi:10.1207/s15327655jchn1504_2.

93. Jones, K., Rouse-Watson, S., Beveridge, A., Sims, J. & Schattner, P. (2012). Fitness to drive: GP perspectives of assessing older patients. Aust Fam Phys, 41, 235-239.

94. Karceski, S. & Gold, C. A. (2011). Driving after a stroke. Neurology, 76, e35-e36. doi:10.1212/WNL.0bD13e3182104170.

95. Kiran, S. (2012). What is the nature of post-stroke language recovery and reorganisation? ISRN Neurology, 786872, 1-13. doi:10.5402/2012/786872.

96. Kirkevold, M. (2002). The unfolding illness trajectory of stroke. Dis Rehabil, 24, 887-898. doi:10.1080/09638280210142239.

97. Kruskal, W. H. (1952). Use of ranks in one criterion variance analysis. J Am Stat Assoc. 47:260:583-621. doi:10.1080/01621459.10483441.

98. Lafont, S., Laumon, B., Helmer, C., Dartigues, J. F. & Fabrigoule, C. (2008). Driving cessation and car crashes in older drivers: The impact of cognitive impairment, dementia and future dementia in a population study. ICTTP 4, August 31–September 4, Washington, DC.

99. La Grow, S., Neville, S., Alpass, F. & Rodgers, V. (2012). Loneliness and self-reported health among older persons in New Zealand. Australas J Ageing, 31, 121-123. doi:10.1111/j.1741-6612.2011.00568.x.

100. Lancsar, E. & Louviere, J. (2008). Conducting discrete choice experiments to inform healthcare decision making: A user's guide. Pharmacoeconomics, 26, 661-677.

101. Langford, J., Fitzharris, M., Koppel, S. & Newstead, S. (2004a). Effectiveness of mandatory licence testing for older drivers in reducing crash risk among urban older Australian drivers. Traffic Inj Prev, 5, 326-335. doi:10.1080/15389580490509464..

102. Langford, J., Fitzharris, M., Newstead, S. & Koppel, S. (2004b). Some consequences of different older driver licensing procedures in Australia. Accid Anal Prev, 36, 993-1001. doi:10.1016/j.aap.2003.11.003

103. Langford, J., Bohensky, M., Koppel, S. & Newstead, S. (2008). Do age-based mandatory assessments reduce older drivers' risk to other road users? Accid Anal Prev, 40, 1913-1918. doi:10.1016/j.aap.2008.08.010.

104. Langford J., Charlton, J., Koppel, S., Myers, A., Tuokko, H., Marshall, S. et al. (2013). Findings from the Candrive/Ozcandrive study: Low mileage older drivers, crash risk and reduced fitness to drive. Accid Anal Prev, 61, 304-10. doi:10.1016/j.aap.2013.02.006.

105. LaValley, M. (2003). Intention-to-treat analysis of randomised controlled trials Boston University http://people.bu.edu/mlava/ ACR/ARHP Annual Scientific Meeting, Orlando 10.27.2003.

106. Laver, K., Ratcliffe, J., George, S., Lester, L., Walker, R., Burgess, L. et al. (2011). Determining patient preferences for rehabilitation following stroke: A discrete choice Experiment. J Rehab Med, 43, 354-358. doi:10.2340/16501977-0678.

107. Lee, N., Tracey, J., Bohannon, R. & Ahlquist, M. (2003). Driving resumption and its predictors after stroke. Conn Med, 67, 387-391.

108. Legh-Smith, J., Wade, D. & Hewer, R. (1986). Driving after a stroke. J R Soc Med, 79, 200-203.

109. Liddle, J. & McKenna, K. (2003). Older drivers and driving cessation. Br J Occup Ther, 66, 125-132. doi:10.1177/030802260306600307.

110. Liddle, J., Turpin, M., McKenna, K., Kubus, T., Lambley, S. & McCaffrey, K. (2009). The experiences and needs of people who cease driving after stroke. Brain Impairment, 10, 271-281.

111. Liddle, J., Flemming, J., McKenna, K., Turpin, M., Whitelaw, P. & Allen, S. (2012). Adjustment to loss of the driving role following traumatic brain injury: A qualitative exploration with key stakeholders. Aust Occup Therp J, 59, 79-88. doi:10.1111/j.1440-1630.2011.00978.x.

112. Lincoln, N. B., Radford, K. A. & Nouri, F. M. (2004). Stroke Drivers Screening Assessment. Revised manual. Nottingham: University of Nottingham.

113. Lings, S. & Jensen, P. B. (1991). Driving after stroke: A controlled laboratory investigation. Int Disabil Stud, 13, 74-82.

114. Lister, R. (1999). Loss of ability to drive following a stroke: The early experiences of three elderly people on discharge from hospital. BJOT, 62, 514-520.

115. Logan, P. A., Gladman, J. R. F. & Redford, K. A. (2001). The use of transport by stroke patients. BJOT, 64, 261-264.

116. Logan, P. A. & Dyas, J. (2004). Using an interview study of transport use by people who have had a stroke to inform rehabilitation. Clin Rehabil, 18, 703-708. doi:10.1191/026921550.4cr742oa.

117. Louvier, J. J., Hensher, D. A. & Swait, J. D. (2000). Stated choice methods: Analysis and Application. Cambridge University Press. UK.

118. MacDonald, L. M., Myers, A. M. & Blanchard, R. A. (2008). Correspondence among older drivers: Perceptions, abilities and behaviours. Top Geriatr Rehabil, 24, 239-52.

119. Mack, G. A. & Skillings, J. H. (1980). A Friedman-type rank test for main effects in a two factor ANOVA. J Am Statist Assoc, 75, 947-951. doi:10.1080/01621459.1980.10477577.

120. Mann, H. B. & Whitney, D. R. (1947). On a test of whether one of two random variables is stochastically larger than the other. Ann Maths Stat, 18, 50-60. doi:10.121/aoms/1177730491.

121. Marottoli, R. A., Ostfeld, A. M., Merrill, S. S., Perlman, G. D., Foley, D. J. & Cooney, L. M. (1993). Driving cessation and changes in mileage driven among elderly individuals. J Gerontol, 48, S255-S260. doi:10.1093/geronj/48.5.S255.

122. Marottoli, R. A., Cooney, L. M., Wagner, D. R., Doucette, J. & Tinetti, M. (1994). Predictors of automobile crashes and moving violations among elderly drivers. Ann Int Med, 121,11, 842-846.

123. Marottoli, R. A., Mendes de Leon, C. F., Glass, T. A., Williams, C.S., Cooney, L. M., Berkman, L. F., et al. (1997). Driving cessation and increased depressive symptoms: Prospective evidence from the New Haven EPESE Established Populations for Epidemiologic Studies of the Elderly. J Am Geriatr Soc, 45, 202-206.

124. Marottoli, R. A. & Richardson, E. D. (1998). Confidence in, and self-rating of, driving ability among older drivers. Accid Anal Prev, 30, 331-336. doi:10.1016/S0001-4575(97)00100-0.

125. Marottoli, R. A., Mendes de Leon, C. F., Glass, T. A., Williams, C. A., Cooney, L. M. & Berkman, L. F. (2000). Consequences of driving cessation: Decreased out-of-home activity levels. J Gerontol B Psychol Sci Soc Sci, 55B, S334-S340. doi:10.1093/geronb/55.6.S334.

126. Marshall, S. C., Molnar, F., Man-Son-Hing, M., Blair, R., Brosseau, L., Finestone, H.M. et al. (2007). Predictors of driving ability following stroke: A systematic review. Top Str Rehabil, 14, 98-114. doi:10.1310/tsr1401-98.

127. Mazer, B. L., Sofer, S., Korner-Bitensky, N. & Gelinas, I. (2001). Use of the UFOV to evaluate and retrain visual attention skills in clients with stroke: A pilot study. AJOT 55, 552-557. doi:10.5014/ajot.55.5.552.

128. McCluskey, A. & Middleton, S. (2010). Increasing delivery of an outdoor journey intervention to people with a stroke: A feasibility study involving five community rehabilitation teams. Implementation Science, 5, 59. doi:10.1186/1748-5908-5-59.

129. McCluskey, A., Midleton, S., Kelly, P., Goodall, S., Grimshaw, J., Logan, P. et al. (2013). Improving quality of life by increasing outings after stroke: Study protocol for out-and-about trial. Int J Stroke, 8, 54-58. doi:10.1111/j.1747-4949.2012.00966.x.

130. McKevitt, C., Fudge, N., Redfern, J., Sheldenkar, A., Crichton, S., Rudd, A. R. et al. (2011). Self-reported long-term needs after stroke. Stroke, 42, 1398-1403. doi:10.1161/STROKEAHA.110.598839.

131. Meng, A. & Siren, A. (2012). Cognitive problems, self-rated changes in driving skills, driving related discomfort and self-regulation of driving in older drivers. Accid Anal Prev, 49, 322-329. doi:10.1016/j.aap.2012.01.023.

132. Meuleners, L. B., Harding, A., Lee, A. H. & Legge, M. (2006). Fragility and crash over-representation among older drivers in Western Australia. Accid Anal Prev, 38, 1006-1010. doi:10/1016/j.aap.2006.04.005.

133. Mitle, R., Ratcliffe, J., Miller, M., Whitehead, C., Cameron, I. & Crotty, M. (2013). What are frail older people prepare to endure to achieve improved mobility following hip fracture? A discrete choice experiment. J Rehabil Med, 45, 81-86. doi:10.2340/16501977-1054.

134. Molnar, F., Marshall, S., Man-Son-Hing, M., Wilson, K., Byszewski, A. & Stiell, I. (2007). Acceptability and concurrent validity of measures to predict older driver involvement in motor vehicle crashes: An emergency department pilot case-control study. Accid Anal Prev, 39, 1056-1063.

135. Motta, K., Lee, H. & Falkmer, T. (2014). Post-stroke driving: Examining the effect of executive dysfunction. J Safety Res, 49, 33-38. doi:10.1016/j.jsr.2014.02.005.

136. Murie-Fernandez, M., Iturralde, S., Cenoz, M., Casado, M. & Teasell, R. (2014). Driving ability after a stroke: Evaluation and recovery. Neurologia, 2014:29:3:161-167. doi:10.1016/j.nrl.2012.05.006.

137. Murray, S., Kendall, M., Carduff, E., Worth, A., Harris, F., Lloyd, A. et al. (2009). Use of serial qualitative interviews to understand patients' evolving experiences and Needs. BMJ, 28, b3702. doi:1136/bmj.b3702.

138. Myers, A., Paradis, J. & Blanchard, R. (2008). Conceptualizing and measuring confidence in older drivers: Development of day and night driving scales. Arch Phys Med Rehabil, 89, 630-640. doi:10.1016/j.apmr.2007.09.037.

139. National Stroke Foundation, Clinical Guidelines for Stroke Management. (2010). Melbourne, Australia [Cited August 2012]. Retrieved from: www.strokefoundation.com.au/health-professionals/clinicalguidelines/

140. National Stroke Foundation, National Stroke Audit Acute Services Report. (2013). Stroke Foundation, Melbourne, Australia. Full document available at: www.strokefoundation.com.au

141. National Stroke Foundation, National Stroke Audit Rehabilitation Services Report. (2014). Stroke Foundation, Melbourne, Australia. Full document available at: www.strokefoundation.com.au

142. National Stroke Foundation, Facts and Figures about Stroke. (2015). Retrieved from: www.strokefoundation.com.au/about-stroke/facts-and-figures-about-stroke

143. Northern Territory Government Department of Transport. (2015a). Motor Vehicle Registry Information Bulletin L34 – Medical Assessment of Fitness to Drive. Retrieved from: www.transport.nt.gov.au/mvr/licensing

144. Northern Territory Government Department of Transport. (2015b). Retrieved from: www.transport.nt.gov.au

145. Nouri, F. (1998). Fitness to drive and the general practitioner. Int Disabil Stud, 10. doi:10.3109/09638288809164122.

146. NSW Department of Roads and Maritime. (2015a). Roads, Licence, Health, Medical and Disabilities. Retrieved from: www.rms.nsw.gov.au/roads/licence/health/health-professionals.html

147. NSW Department of Roads and Maritime. (2015b). Retrieved from: www.rms.nsw.gov.au

148. Nudo, R. J. (2013). Recovery after brain injury: Mechanisms and principles. Frontiers in Human Neuroscience, 24, 887. doi:10.3389/fnhum.2013.00887.

149. NVIVO Qualitative Data Analysis Software QSR International Pty Ltd. (2008). Version 8 accessed October, 2010. Available from: www.qsrinternational.com/#tab_you

150. O'Connor, M.L., Hudak, E.M. & Edwards, J.D. (2011) Cognitive speed of processing training can promote community mobility among older adults: A brief review. J Aging Res, 2011, 430802. doi:10.4061/2011/430802.

151. Organisation for Economic Co-operation and Development. (2001). Ageing and Transport: Mobility Needs and Safety Issues. Paris, France.

152. Owsley, C., Stalvey, B., Wells, J. & Sloane, M. (1999). Older drivers and cataract: Driving habits and crash risk. J Gerontol A Boil Sci Med Sci, 54A, M203-M211. doi:10.1093/Gerona/54.4.M203.

153. Pallant J. (2011). SPSS Survival Manual: A Step by Step Guide to Data Analysis Using SPSS (4th edn). Sydney: Allen & Unwin.

154. Patomella, A., Kottorp, A. & Tham, K. (2008). Awareness of driving disability in people with stroke tested in a simulator. Scand J Occup Ther, 15, 184-192. doi:10.1080/11038120802087600.

155. Patomella, A-H., Tham, K., Johansson, K. & Kottorp, A. (2010). P-Drive on-road: Internal scale validity and reliability of an assessment of on-road driving performance in people with neurological disorders. Scand J Occup Ther, 17, 86-93. doi:10.1080/11038120903071776.

156. Pearce, A. M., Smead, J. M. & Cameron, I. D. (2012). Retrospective cohort study of accident outcomes for individuals who have successfully undergone driver assessment following stroke. Aust Occup Ther J, 59, 56-62. doi:10.111/j.1440-1630.2011.00981.x.

157. Perneger, T. V. (1998). What's wrong with Bonferroni adjustment? BMJ, 316, 1236-8. doi:10.1136/bmj.316.7139.1236.

158. Perrier, M-J., Korner-Bitensky, N. & Mayo, N. E. (2010a). Patient factors associated with return to driving post-stroke: Findings from a multicentre cohort study. Arch Phys Med Rehabil, 91, 868-73.

159. Perrier, M-J., Korner-Bitensky, N., Petzold, A. & Mayo, N. (2010b). The risk of motor vehicle crashes and traffic citations post stroke: A structured review. Top Stroke Rehabil, 17, 191-196. doi:10.1310/tsr.1703-191.

160. Persson, D. (1993). The elderly driver: Deciding when to stop. Gerontologist, 33, 88-91. doi:10.1093/geront/33.1.88.

161. Petrakos, D. & Freund, B. D. (2009). Driving habits of older drivers 3 months before driving evaluation. Top Geri Rehabil, 25, 118-134.

162. Petzold, A., Korner-Bitensky, N., Rochette, A., Teasell, R., Marshall, S. & Perrier, M-J. (2010). Driving post-stroke: Identification, assessment use, and interventions offered by Canadian occupational therapists. Top Stroke Rehabil, 17, 5, 371-379. doi:10.1310/tsr1705-371.

163. Pound, P., Gompertz, P. & Ebrahim, S. A. (1998). Patient-centred study of the consequences of stroke. Clin Rehabil, 12, 338-47. doi:10.1191/026921598.67766.1555.

164. Queensland Government, Department of Transport and Main Roads. (2015a). Licensing, Medical Condition Reporting. Retrieved from: www.tmr.qld.gov.au/licensing.aspx.

165. Queensland Government, Department of Transport and Main Roads. (2015b). Documents Relating to Older Drivers. Retrieved from: www.tmr.qld.au

166. Rabadi, M. H., Akinwuntan, A. & Gorelick, P. (2010). The safety of driving a commercial motor vehicle after stroke. Stroke, 41, 2991-2996. doi:10.1161/STROKEAHA.110.587196.

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

168. Ragland, D. R., Satariano, W. A. & MacLeod, K., E. (2005). Driving cessation and increased depressive symptoms. J Gerontol A Biol Sci Med Sci, 60A, 339-403. doi:10.1093/Gerona/60.3.399.

169. Ratcliffe, J. & Buxton, M. (1999). Patient's preferences regarding the process and outcomes of high technology medicine: An application of conjoint analysis to liver transplantation. Int J Technol Assess Health Care, 15, 340-351.

170. Richards, E., Bennett, P. J. & Sekuler, A. B. (2006). Age-related differences in learning with the useful field of view. Vision Res, 46, 4217-4231. doi:10.1016/j.visres.2006.08.011.

171. Roach, K. E. (2006). Measurement of health outcomes: Reliability, validity and responsiveness. JPO, 18, 8-12.

172. Rosenbloom, S. & Morris, J. (1998). Travel patterns of older Australians in an international context: Policy implications and options. TRR, 1617, 189-193.

173. Ross, L. A., Dodson, J., Edwards, J., Ackerman, M. & Ball, K. (2009). Older drivers in Australia: Trends in driving status and cognitive and visual impairment. J Am Geriatr Soc, 57, 1868-73. doi:10.1111/j.1532-5415.2009.02439.x.

174. Ross, L.A., Dodson, J.E., Edwards, J.D., Ackerman, M.L. & Ball, K.K. (2012). Self-rated driving and driving safety in older adults. Accid Anal Prev, 48, 523-527. doi:10.1016/j.aap.2012.02.015.

175. Rowland, T., J., Cooke, D. M. & Gustafsson, L. A. (2008). Role of occupational therapy after stroke. Ann Indian Acad Neurol, 11, Suppl S1, 99-107.

176. Ryan, M. (2004). Discrete choice experiments in health care: NICE should consider using them for patient-centred evaluations of technologies. BMJ, 328, 360-1.

177. Ryan, M., Gerard, K. & Amaya-Amaya, M. (2008). Using discrete choice experiments to value health and health care, vol. 11, Dordrecht: Springer.

178. Safe Mobility for Older Americans Transportation Research Board. (2005). Washington D. C. www.trb.org/publications/conf/CPW2.pdf.

179. Sagberg, F. (2006). Driver health and crash involvement: A case-control study. Accid Anal Prev, 38, 28-34. doi:10.1016/j.aap.2005.06.018.

180. Sandlin, D., McGwin, G. & Owsley, C. (2014). Association between vision impairment and driving exposure in older adults aged 70 years and over: A population-based examination. Acta Ophthalmol, 92, e207-e212. doi:10.1111/aos.12050.

181. Sargent-Cox, K. A., Windsor, T., Walker, J. & Anstey, K. J. (2011). Health literacy of older drivers and the importance of health experience for self-regulation of driving behaviour. Accid Anal Prev, 43, 3, 898-905. doi:10.1016/j.aap.2010.11.012.

182. Scott, C. A., Rapport, L. J., Coleman Bryer, R., Griffen, J., Hanks, R. & McKay, C. (2009). Self-assessment of driving ability and the decision to resume driving following stroke. J Clin Exp Neuropsychol, 31, 353-362. doi:10.1080/13803390502169067.

183. Sengupta, S., van Landingham, S., Solomon, S., Do, D., Friedman, D. & Ramulu, P. (2014). Driving habits in older patients with central vision loss. Opthalmology, 121, 727-732. doi:10.1016/j.ophtha.2013.09.042.

184. Shah, S., Vanclay, F. l. & Cooper, B. (1989). Improving the sensitivity of the barthel index for stroke rehabilitation. J Clin Epidemiol, 42, 703-709. doi:10.1016/0895-4356(89)90065-6.

185. Skilbeck, C.E., Wade, D.T., Hewer, R.L. & Wood, V.A. (1983). Recovery after stroke. J Neurol Neurosurg Psych, 46, 5-8. doi:0.1136/jnnp.46.1.5.

186. Smeed, R. (1968). Variations in the patterns of accident rates in different countries and their causes. Traffic Eng Contr, 10, 364-371.

187. Smith-Arena, L., Edelstein, L. & Rabadi, M. H. (2006). Predictors of a successful driver evaluation in stroke patients after discharge based on an acute rehabilitation hospital evaluation. Am J Phys Med Rehabil, 85, 44-52. doi:10.1097/01.phm.0000184157.19912.96.

188. SPSS version 19 (2009). SPSS Inc. PASW Statistics for Windows, Version 19.0 Armonk (NY) IBM Corp.

189. Stacey, B. & Kendig, H. (1997). Driving, cessation of driving and transport safety issues among older people. Health Promo J Aust, 7, 175-179.

190. Stapleton, T. & Connolly, D. (2010). Occupational therapy practice in pre-driving assessments post-stroke in the Irish context: Findings from a nominal group technique meeting. Top Stroke Rehabil, 17, 58-68. doi:10.1310/tsr1701-58.

191. Stapleton, T., Connolly, D. & O'Neil, D. (2012). Exploring the relationship between self-awareness of driving efficacy and that of a proxy when determining fitness to drive after stroke. Aust Occup Ther J, 59, 63-70. doi:10.1111/j.1440-1630.2011.00980.x.

192. Stav, W., Pierce, S., Wheatley, C. & Schold-Davis, E. (2005). Driving and community mobility. Am J Occup Ther, 59, 666-670. doi:10.5014/ajot.59.6.666.

193. Strata 14 Software, StataCorp LP, College Station, TX, USA. Accessed July, 2015 from: www.strata.com

194. Stroke Centre, Statistics about stroke (2015). Retrieved from: www.strokecentre.org/patients/about-stroke/strokestatistics/

195 Sullivan, K. A., Smith, S. S., Horswill, M. S. & Lurie-Beck, J. K. (2011) Older adult's safety perceptions of driving situations: Towards a new driving self-regulation scale. Accid Anal Prev, 43, 1003-1009. doi: 10.1016/j.aap.2010.11.031.

196. Sundet, K., Goffeng, L. & Hofft, E. (1995). To drive or not to drive: Neuropsychological assessment for driver's license among stroke patients. Scand J Psychol, 36, 47-58.

197. Szczerbiriska, K., Topinkova, E., Ceremnych, J, Gindin, J. & Magg, S. (2010). Trajectory of care of an elderly stroke patient in the new EU member countries based on CLESA project. Euro Geri Med, 1, 32-40. doi:10.1016/j.eurger.2010.01.004.

198. Tan, K. M., O'Driscoll, A. & O'Neill, D. (2011). Factors affecting return to driving post-stroke. Ir J Med Sci, 180, 41-45. doi:10.1007/s11845-010-0528-9.

199. Tasmanian Government, Department of State Growth Transport. (2015a). Assessing Fitness to Drive. Retrieved from: www.transport.tas.gov.au/licensing/information/assessing_fitness_to_drive

200. Tasmanian Government, Department of State Growth Transport. (2015b). Tasmanian Older Drivers' Handbook. Retrieved from: www.transport.tas.gov.au/

201. Teasell, R., Bayona, N. & Bitensky, J. (2013). The evidence-based review of stroke rehabilitation (EBRSR) reviews current practice in stroke rehabilitation, chapter 3. Background concepts in stroke rehabilitation, November, 1-48.

202. Torpey, S. (1986). Licence re-testing of older drivers. Melbourne: Road Traffic Authority. UK Stroke Association Website. Driving after stroke fact sheet. Accessed July, 2015 from: www.stroke.org.uk/factsheet/driving-after-stroke

203. Unsworth, C.A., Wells, Y., Browning, C., Thomas, S.A. & Kendig, H. (2007). To continue, modify or relinquish driving: Findings from a longitudinal study of healthy ageing. Gerontology, 53, 423-431. doi:10.1159/000111489.

204. Unsworth, C. A., Pallant, J. F., Russell, K. J., Germano, C. & Odell, M. (2010). Validation of a test of road law and road craft knowledge with older or functionally impaired drivers. Am J Occup Ther, 64, 306-315. doi:10.5014/ajot.64.2.306.

205. Unsworth, C. (2012). Community mobility promotes participation for people of all ages and abilities. Aust Occup Ther J, 59, 1. doi:10.1111/J.1440-1630.2011.00994.x.

206. Unsworth, C., & Baker, A. (2014), Driver rehabilitation: A systematic review of types and effectiveness of interventions used by occupational therapists to improve on-road fitness-to-drive. Accid Anal Prev, 71, 106-114. doi:10.1016/j.aap.2014.04.017.

207. Useful Field of View User's Guide. (2009). Version 6.1.4, © Visual Awareness Research Group Inc.

208. Vallar, G. & Perani, D. (1986) The anatomy of unilateral neglect after right-hemisphere stroke lesions. A clinical/CT-scan correlation study in man. Neuropsychologia 24, 5, 609-622. Doi:10.1016/0028-3932(86)90001-1.

209. Vance, D., Roenker, D., Cissell, G., Edwards, J., Wadley, V. & Ball, K. (2006). Predictors of driving exposure and avoidance in a field study of older drivers from the State of Maryland. Accid Anal Prev, 38, 4, 823-831. doi:10.1016/j.aap.2006.02.008.

210. van Til, J. A., Stiggelbout, A. M. & Ljzerman, M. J. (2009). The effect of information on preferences stated in a choice-based conjoint analysis. Patient Edu Couns, 74, 264-271. doi:10.1016/j.pec.2008.08.025.

211. Vicroads. (2015a). Licences, Medical Conditions and Driving. Retrieved from: www.vicroads.vic.gov.au/licences

212. Vicroads. (2015b). Safety and Road Rules, Older Drivers. Retrieved from: www.vicroads.vic.gov.au/

213. Wade, D. T. & Hewer, R. L. (1987). Functional abilities after stroke: Measurement, natural history and prognosis. J Neurosurg Psychiatry, 50, 177-182. doi:10.1136/jnnp.50.2.177.

214. Western Australian Government, Department of Transport. (2015a). Licensing, Report on a Medical Condition. Retrieved from: www.transport.wa.gov.au/licensing/report-a-medical-condtion.asp

215. Western Australian Government, Department of Transport. (2015b). Retrieved from: www.transport.wa.gov.au/

216. White, J., MacKenzie, L., Magin, P. & Pollack, M. (2008). The occupational experience of stroke survivors in a community setting. OTJR: Occupation, Participation and Health, 28, 160-167.

217. White, J., Miller, B., Magin, P., Attia, J., Sturm, J. & Pollack, M. (2012a). Access and participation in the community: A prospective qualitative study of driving post-stroke. Dis Rehabil 34, 831-838. doi:10.3109/09638288.2011.623754.

218. White, J., et al. (2012b). Trajectories of psychological distress after stroke. Ann Fam Med, 10, 435-442. doi:10.1370/afm.1374.

219. Whitehead, B. J., Howie, L. & Lovell, R. K. (2006). Older people's experience of driver licence cancellation: A phenomenological study. Aust Occup Ther J, 53, 173-180. doi:10.1111/j.1440-1630.2006.00564.x.

220. Wilson, L. R., & Kirby, N. H. (2008). Individual differences in South Australian general practitioners' knowledge, procedures and opinions of the assessment of older drivers. Australas J Ageing, 27, 121-125. doi:10.1111/j.1741-6612.2008.00304.x.

221. Wong, I. Y., Smith, S. S., & Sullivan, K. A. (2012). The relationship between cognitive ability, insight and self-regulatory behaviours: Findings from the older driver population. Accid Anal Prev, 49, 316-321. doi:10.1016/j.aap.2012.05.031.

222. World Heart Federation, Stroke: The global burden of stroke. Accessed June, 2015 from: www.world-heart-federation.org/cardiovascular-health/stroke

223. Yassuda, M. S., Wilson, J. J. & von Mering O . (1997). Driving cessation: The perspectives of senior drivers. Ed Gerontology, 23, 525-538. doi:10.1080/0360127970230603.

Appendix I

National Stroke Foundation of Australia Clinical Guidelines for Stroke Management 2010 Chapter 8: Community Participation and long term recovery 8.2 pages 113-114.

8.2 Driving

The effects of a stroke can lead to isolation and reduced QOL as people reduce the amount of community access they had prior to the stroke. The inability to return to driving in particular often has a profound impact on community participation. The issue of returning to driving can be confusing and the topic is often raised by the patient or their family/carer, especially by patients with minor stroke or TIA.

Motor, sensory, visual or cognitive impairments can have a major impact on a person's ability to drive after stroke. Studies have found that the impairments most likely to predict poor on-road driving ability are visuospatial and attention deficits, reduced motor processing, homonymous hemianopia and a right cerebral hemisphere lesion.

The current draft national guidelines describe criteria for unconditional licences and, where conditional licences exist, for private and commercial drivers. For private drivers, stroke survivors are not to return to driving for a minimum of one month (three months for commercial drivers), even if there are no significant neurological, perceptual or cognitive deficits. Stroke survivors are responsible for informing the relevant licensing authority and are advised to contact their car insurance company. An unconditional licence may be granted if there is no significant impairment of any of the following: visuospatial perception, insight, judgement, attention, reaction time, sensation, muscle power, co-ordination and vision (including visual fields). A conditional licence may be considered after the non-driving period, taking into account the opinion of an appropriate specialist, the nature of the driving task and subject to at least an annual review, after consideration of the results of a practical driving assessment.

In the case of TIA, the draft national guidelines currently state that private vehicle drivers should not driver for two weeks and commercial vehicle drivers should not drive for four weeks after a TIA. A conditional licence is not required, as there is no long-term impairment.

Stroke survivors who held a driver's licence pre-stroke should be provided with written information about returning to drive including their legal obligations and the assessments needed including occupational therapy driver assessment. This information should be provided prior to discharge from hospital, or at the first visit, in the case of those not admitted to hospital after a TIA.

There is little agreement regarding the most appropriate method of assessing ability to drive. However, a three-step process is generally followed.

1. Medical assessment of fitness to drive.
2. A comprehensive off-road driving test of motor, sensory, visual and cognitive skills that may incorporate tests such as the Dynavision Performance Assessment Battery, or the Cognitive Behavioural Driver's Inventory or newly developed Australian tools such as Drive Safe Drive Aware and Occupational Therapy Driver Off-Road Assessment Battery.
3. An on-road test.

Evidence for interventions to improve driving ability is limited. One RCT found a visual attention retraining program was no more beneficial than traditional perceptual training in improving on-road driving performance in stroke survivors. Another RCT found simulator-based driving training in a stationary full-sized car with adaptive aids significantly improved aspects of driving compared to standard training. Access to simulated driving training is very limited in Australia. A further, small RCT found retraining visual processing skills (such as

executing a continuous wide scan, combining motor and visual processing into a motor response) using the Dynavision apparatus did not improve any outcome related to control.

8.2 Driving	Grade
a) All patients admitted to hospital should be asked if they intend to drive again.	GPP
b) Any patient who does wish to drive should be given information about driving after stroke and be assessed for fitness to return to driving using the national guidelines (Assessing Fitness To Drive) and relevant state guidelines. Patients should be informed that they are required to report their condition to the relevant driver licence authority and notify their car insurance company before returning to driving.	GPP
c) Stroke survivors should not return to driving for at least one month post event. A follow-up assessment (normally undertaken by a GP or specialist) should be conducted prior to driving to assess suitability. Patients with TIA should be instructed not to drive for two weeks.	GPP
d) If a person is deemed medically fit but is required to undertake further testing, they should be referred for an occupational therapy driving assessment. Relevant health professionals should discuss the results of the test and provide a written record of the decision to the patient as well as informing the GP.	GPP

Appendix II

Assessing Fitness to Drive – Austroads Guidelines – Other neurological and neurodevelopmental conditions

NEUROLOGICAL CONDITIONS

6.4 Other neurological and neurodevelopmental conditions

6.4.1 General assessment and management guidelines

The person with a neurological condition should be examined to determine the impact on the functions required for safe driving as listed below.

If the health professional is concerned about a person's ability to drive safely, the person may be referred for a driver assessment or for appropriate allied health assessment.

Checklist for neurological disorders

If the answer is YES to any of the following questions, the person may be unfit to drive and warrants further assessment.

1. Are there significant impairments of any of the following?

• Visuospatial perception

• Insight

• Judgement

• Attention and concentration

• Reaction time

• Memory

• Sensation

• Muscle power

• Coordination.

2. Are the visual fields abnormal?

3. Have there been one or more seizures?

Some neurological conditions are progressive, while others are static. In the case of static conditions in those who are fit to drive, the requirement for periodic review may be waived.

Stroke (cerebral infarction or intracerebral haemorrhage)

Stroke may impair driving ability either because of the long-term neurological deficit it produces, or because of a recurrent stroke or transient ischaemic attack (TIA) at the wheel of a vehicle (refer below). Stroke and TIA rarely produce loss of consciousness. It is very uncommon for undiagnosed strokes or TIA to result in motor vehicle crashes. When they do, it is usually due to an unrecognised visual field deficit. The risk of recurrent stroke is probably highest in the first month after the initial stroke, but is still sufficiently low (about 10% in the first year) that it does not on its own require suspension of driving. However, fatigue and impairments in concentration and attention are common after stroke (even in those with no persisting neurological deficits) and may impair the ability to perform the driving task, particularly for commercial vehicle drivers. For this reason, there should be a non-driving period after stroke, even in those with no detectable persisting neurological deficit. For those with a persistent neurological deficit, subsequent driving fitness will depend on the extent of impairment of the functions listed in the checklist. A practical driver assessment may be required.

If the person has had a seizure, the seizures and epilepsy standards also apply. People who have made a full neurological recovery do not require a conditional licence.

Stroke (cerebral infarction or intracerebral haemorrhage)

A person should not drive for at least four weeks following a stroke. A person is not fit to hold an unconditional licence if the person has had a stroke producing significant impairment

of any of the following: visuospatial perception, insight, judgement, attention, reaction time, memory, sensation, muscle power, coordination, vision (including visual fields).

A conditional licence may be considered by the driver licensing authority at least four weeks after a stroke and subject to at least annual review, taking into account:

- the nature of the driving task
- information provided by an appropriate specialist regarding the likely impact of the neurological impairment on driving ability.
- the results of a practical driver assessment if required. A person should not drive for at least three months following a stroke. A person is not fit to hold an unconditional licence:
- if the person has had a stroke. A conditional licence may be considered by the driver licensing authority after at least three months and subject to at least annual review, taking into account:
- the nature of the driving task
- information provided by an appropriate specialist regarding the level of impairment of any of the following: visuospatial perception, insight, judgement, attention, reaction time, memory, sensation, muscle power, coordination, vision (including visual fields) and the likely impact on driving ability
- the results of a practical driver assessment if required (refer to Part A section 4.9 Practical driver assessments).

IMPORTANT: The medical standards and management guidelines contained in this chapter should be read in conjunction with the general information contained in Part A of this publication. Practitioners should give consideration to the following:

Licensing responsibility:

The responsibility for issuing, renewing, suspending or cancelling a person's driver's licence (including a conditional licence) lies ultimately with the driver licensing authority.

Licensing decisions are based on a full consideration of relevant factors relating to health and driving performance.

Conditional licences:

For a conditional licence to be issued, the health professional must provide to the driver licensing authority details of the medical criteria not met, evidence of the medical criteria met, as well as the proposed conditions and monitoring requirements.

The nature of the driving task:

The driver licensing authority will take into consideration the nature of the driving task as well as the medical condition, particularly when granting a conditional licence.

For example, the licence status of a farmer requiring a commercial vehicle licence for the occasional use of a heavy vehicle may be quite different from that of an interstate multiple combination vehicle driver. The examining health professional should bear this in mind when examining a person and when providing advice to the driver licensing authority.

The presence of other medical conditions:

While a person may meet individual disease criteria, concurrent medical conditions may combine to affect fitness to drive, for example, hearing and visual impairment.

Reporting responsibilities:

Patients should be made aware of the effects of their condition on driving and should be advised of their legal obligation to notify the driver licensing authority where driving is likely to be affected. The health professional may themselves advise the driver licensing authority as the situation requires.