Stay SHARP (See, Hear, Attend, Respond, Perform) - Sustaining and Retraining Visual-Perception, Motor and Cognitive Skills Among Older Drivers: A Feasibility Project

Ailene Kua

Department of Physical and Occupational Therapy

McGill University, Montreal

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ABSTRACT

The ability to drive an automobile is a central aspect of independent living for many older adults (Ragland, Satariano, & MacLeod, 2004). Much of the research in the field of driving and the elderly has focused on accident situations in which older drivers are over-involved, with little attention placed on developing and evaluating methods to enhance driving abilities. This thesis is comprised of two manuscripts, one examining the effectiveness of retraining programs for older drivers, and the other exploring older adults' perceptions of driving, concerns/difficulties associated with driving, and factors stimulating interest and participation in a driving program.

The first manuscript presents a systematic review of the most recent literature on evidence regarding the effectiveness of retraining programs for older drivers. Reviewed articles were grouped according to the intervention studied: physical retraining, visual perception or education. Randomized controlled trials (RCTs) were appraised using the Physiotherapy Evidence Database (PEDro) Scale (PEDro, 2006) and interpreted following Foley's quality assessment (Foley, Teasell, Bhogal, & Speechley, 2003). Each intervention was then rated for effectiveness based on Sackett's levels of evidence (Sackett, Richardson, Rosenberg, & Haynes, 2000) . Six RCTs, one pre- post- study design and one descriptive study met the inclusion criteria, one investigating physical retraining, one a visual perception intervention, five using an educational intervention and one examining a combination of all three, in addition to traffic engineering improvements. There is limited evidence that physical retraining (Level 2a) and visual perception retraining (Level 2a) improve driving related skills in older drivers. There is moderate evidence that educational interventions improve

driving awareness and driving behavior (Level 1a), but do not reduce crashes (Level 1b) in older drivers. This suggests that while the evidence is limited, it is sufficiently encouraging to merit further research on interventions for healthy older drivers.

In the second manuscript, the authors explore activities seniors use driving for, when and where they drive, importance of driving, perceived driving habits, behavioral changes as people age, and factors stimulating interest and participation in a driving program. Three focus groups (n=18), conducted using a structured format, were held with former and current drivers, 75 years and older, living in Montreal, Canada. Discussions were audiotaped, transcribed, and analyzed to identify themes/key points. Participants reported driving for short and long-distance trips, personal and leisure activities, or in situations where walking was not practical or possible. They indicated driving during days and evenings, on city streets and highways. Frequently reported changes and difficulties included reduced evening vision, slowing response times, and road signs not being clear or visible. The principle results indicated that participants were enthusiastic about a driving program and perceived a need for content such as: traffic law refreshers, retraining of driving-related skills, as well as an on-road driving component. An objective, comprehensive clinical assessment and on-road evaluation were also deemed important. Furthermore, participants expressed preference for a program offered sometime between 11am-to-5pm for one-to-two hours, once or twice weekly. This focus group research is the first step in a research agenda aimed at developing effective and practical driving interventions for healthy older drivers based on their desired needs and interests.

RÉSUMÉ

L'aptitude à conduire une automobile constitue un aspect important de la vie autonome d'un grand nombre d'aînés (Ragland, Satariano & MacLeod, 2004). Plusieurs recherches dans le domaine de la conduite automobile chez les aînés ont porté sur les accidents, dans lesquels les conducteurs âgés sont surreprésentés, tout en portant peu d'attention à la création et à l'évaluation de méthodes pour améliorer la capacité à conduire. Ce rapport comporte deux manuscrits, dont l'un examine l'efficacité des programmes de recyclage pour les conducteurs âgés, et l'autre étudie les perceptions qu'ont les aînés de la conduite, les préoccupations et les difficultés associées à la conduite et les facteurs suscitant l'intérêt et la participation à un programme de conduite.

Le premier manuscrit présente une revue systématique de la documentation la plus récente sur les preuves de l'efficacité des programmes de recyclage pour les conducteurs âgés. Les articles passés en revue ont été regroupés selon l'intervention étudiée : le recyclage physique, la perception visuelle ou l'éducation. Les essais randomisés ont été évalués selon la base de données de la kinésithérapie (PEDro, 2006) et interprétés selon l'échelle d'évaluation de la qualité des soins de Foley (Foley, Teasell, Bhogal & Speechley, 2003). Ensuite, chaque intervention a été classée selon son efficacité au moyen du niveau de preuve de Sackett (Sackett, Richardson, Rosenberg & Haynes, 2000). Six essais contrôle randomisés (ECR), une étude pré-post et une étude descriptive répondaient aux critères d'inclusion, l'une étudiant le recyclage physique, l'autre une intervention sur la perception visuelle, cinq une intervention éducative et une autre examinant une combinaison des trois, en plus

d'améliorations en ingénierie à la circulation. Il existe des preuves limitées selon lesquelles le recyclage physique (niveau 2a) et que le recyclage de la perception visuelle (niveau 2a) améliorent les aptitudes liées à la conduite chez les chauffeurs âgés. Il existe également des preuves modérées qui démontrent que les interventions éducatives augmentent la sensibilisation et améliorent le comportement lié à la conduite (niveau 1a), mais elles ne diminuent pas les accidents (niveau 1b) chez les conducteurs âgés. Cela suggère que bien que la preuve soit limitée, elle est assez encourageante pour mériter de plus amples recherches sur les interventions chez les conducteurs âgés en bonne santé.

Dans le deuxième manuscrit, les auteurs étudient les activités pour lesquelles les aînés conduisent, quand et où ils conduisent, l'importance de la conduite pour eux, les habitudes perçues de la conduite, les changements comportementaux qui s'installent avec l'âge et les facteurs qui stimulent l'intérêt et la participation à un programme de conduite. Trois groupes de discussion (n=18) dirigés à l'aide d'une présentation structurée ont été formés avec d'anciens conducteurs et des conducteurs actuels de 75 ans et plus, habitant à Montréal, Canada. Les discussions ont été enregistrées sur bandes sonores, transcrites et analysées, afin d'identifier les sujets et les points importants. Les participants ont indiqué qu'ils conduisaient lors de courts ou de longs voyages, pour des activités personnelles et de loisir, ou dans des situations où il était difficile ou complètement impossible de marcher. Ils ont indiqué qu'ils conduisaient durant la journée et le soir, sur les rues comme sur les autoroutes. Les changements et les difficultés les plus fréquemment déclarés comprenaient la vision réduite le soir, le ralentissement des délais de réponse et les panneaux routiers qui n'étaient pas clairs ou

pas visibles. Les principaux résultats ont indiqué que les participants faisaient preuve d'enthousiasme pour un programme de conduite automobile et constataient que les éléments suivants devraient en faire partie : un rappel des règlements de la circulation, le recyclage des capacités liées à la conduite ainsi que les composantes de la conduite routière. Une évaluation clinique objective et complète était également considérée comme importante, de même qu'une évaluation sur la route. En outre, des participants ont exprimé leur préférence pour un programme offert entre 11 h et 17 h pendant une ou deux heures, une ou deux fois par semaine. Cette recherche en groupes de discussion constitue le premier pas dans un calendrier de recherche visant à créer des interventions de conduite efficaces et pratiques pour des conducteurs âgés sains et en bonne santé, selon leurs besoins et intérêts.

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CONTRIBUTION OF AUTHORS

The literature review of this thesis was, in part, a manuscript accepted for publication on September, 2006 to the Journal of Safety Research, entitled, "Older Driver Retraining: A Systematic Review of Evidence of Effectiveness", was mainly written by myself and Dr. Nicol Korner-Bitensky. I conducted the literature review on older driver retraining under the supervision of Dr. Korner-Bitensky. Dr. Korner-Bitensky and I reviewed the research articles found. Dr. Korner-Bitensky and the other co-authors, Dr. Johanne Desrosiers, Dr. Malcolm Man-Son-Hing, Dr. Shawn Marshall, gave insightful comments on the structure, content and clarity of the manuscript.

The second article of this thesis entitled, "Older Individuals' Perceptions Regarding Driving: Focus Group Findings" was written by myself, Dr. Nicol Korner-Bitensky, and Dr. Johanne Desrosiers, and was accepted for publication on October, 2006 by the Physical and Occupational Therapy in Geriatrics. I created the focus group methodology, created the letters of recruitment and the consent forms, submitted the study for ethics approval, contacted potential sites and introduced the study goals to site directors and requested permission to post notices, recruited the participants using introductory letters followed by in-person and telephone contacts, created the focus group question content, participated in the conduct of the three focus groups, and analyzed the auditory tapes and written transcripts under the supervision of Dr. Korner-Bitensky. Dr. Korner-Bitensky and Dr. Johanne Desrosiers gave insightful comments on the structure, content and clarity of the manuscript.

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PREFACE

The thesis consists of a collection of two manuscripts. As per McGill University requirements these papers have a cohesive, unitary character making them a report of a single program of research. The manuscripts have been accepted for publication in scientific journals. It is required by Graduate and Postdoctoral Studies (GPS) at McGill University, that the thesis include a literature review and conclusion that is separate from that included in the manuscripts. Therefore, it is unavoidable to have duplication of materials. Ailene Kua wrote this thesis with editing by Dr. Nicol Korner-Bitensky.

This thesis is organized in 8 chapters. Chapter 1 is an introduction to the topic of driving safety and seniors. Chapter 2 is a review of the literature that covers the following related areas: the magnitude of the problem; specifically, the growing number of older drivers; factors that put older drivers at risk of accidents; theoretical models that help frame the components needed for safe driving; age-related changes that are relevant to driving; and the importance of driving to seniors. Chapter 3 provides the thesis objectives. Chapter 4 consists of the first manuscript entitled, "Older Driver Retraining: A Systematic Review of Evidence of Effectiveness". Chapter 5 provides a link between the conclusions of the first manuscript and the objectives of the second manuscript. It is followed by Chapter 6 that includes the second manuscript entitled, "Older Individuals' Perceptions Regarding Driving: Focus Group Findings". Finally, Chapter 7 and 8 summarize the findings and conclusions of both manuscripts.

1. INTRODUCTION

Driving capability, especially for seniors, represents autonomy and independence and contributes to one's quality-of-life including a sense of well-being and an ability to maintain social contacts (Ragland, Satariano, & MacLeod, 2004). As this segment of the population continues to grow, so does the concern for their safety as the number of fatal crashes in this age group increases annually. This increased crash rate has been attributed to age-related changes in driving skills and various medical conditions that can affect the driving capability of some older people. While some seniors willingly give over their keys as they begin to experience difficulties driving, many will continue to drive even when it becomes dangerous for them to do so (Marrottoli et al., 1997). It is important to note that relinquishing driving rights may not always be the appropriate solution. Cessation of driving carries a high cost, emotionally and financially, to both the older driver and their family. Given that the number of older drivers will increase rapidly in the next decade, we anticipate a dramatic increase in the number of older drivers' crashes if actions are not taken to improve their safety.

It is important to understand that driving is a privilege, not a right. The role of rehabilitation professionals is to make sure that each client who can drive safely is given the opportunity to do so, while ensuring the safety of the individual and society. This decision making process must be based on evidence-based practice that combines clinical expertise and available research to provide rehabilitation professionals with the information they need to address safe driving in older adults.

While a great deal of research has focused on older drivers' crash-involvement patterns (Evan, 1991; Hakamies-Blomqvist, 1993; Hakamies-Blomqvist, 1994), until recently, there has been little attention placed on developing, and evaluating methods to enhance driving abilities. Typically, once an older driver has been deemed an unacceptable safety risk, there is little or nothing he or she can do to acquire or restore the abilities required to safely operate a motor vehicle. Few rehabilitation programs offer interventions targeted at improving driving ability and very little research has been conducted evaluating the effectiveness of the available methods of training driving in older adults. Furthermore, what has not been explored fully is the benefit of a multi-faceted driving intervention. Yet, it is well recognized that the task of driving is a complex task that requires the sophisticated interaction of numerous elements including vision, visuo-perception, cognition, behavior, motor and sensory functioning.

In order to explore the aforementioned idea regarding a multi-faceted driving intervention, this thesis describes the first phase of a pilot study to construct and evaluate the feasibility of providing a multi-faceted driving safety program, Stay SHARP (See, Hear, Attend, Respond, Perform), focused on retraining specific driving skills in older adults. Specifically, the two objectives of this phase of the project were to: (1) review and critically appraise the literature on older driver retraining to clarify the evidence for the use of retraining programs for older adults and, (2) gather qualitative data about activities seniors use driving for, when and where they drive, importance of driving, perceived driving habits, behavioral changes as people age, and factors stimulating interest and participation in a driving program.

2. REVIEW OF LITERATURE

This review of the literature focuses on the following five areas: the magnitude of the problem; specifically, the growing number of older drivers; factors that put older drivers at risk of accidents; theoretical models that help frame the components needed for safe driving; age-related changes that are relevant to driving; and the importance of driving to seniors.

2.1 MAGNITUTE OF THE PROBLEM

Injuries resulting from motor vehicle crashes (MVCs) are a significant cause of morbidity and mortality among seniors. A closer examination of crash rates reveals that older drivers' crash involvement is no greater than that of the overall population, and considerably lower than that of younger drivers. However, once mileage driven is taken into account, fatal MVC rates per 100 million miles traveled follow a U-shaped curve, with the highest rates among the youngest and oldest drivers. More specifically, individuals over 75 have a 3.5 times higher crash rate than middle-aged drivers (aged 35-to-44), a rate that is exceeded by only one group – those under the age of 20 (Canada Safety Council, 2005). In the United States, similar trends have been noted: by age 70, the rate of accidents per miles driven begins to rise and continues through one's 70's with a rapid increase at age 80 (National Highway Traffic Safety Administration [NHTSA], 2004).

Not only is the crash rate per mile driven higher among seniors, but the clinical implications of these injuries are far more serious: compared to younger individuals, seniors are more vulnerable to injury and have a reduced capacity for recovery. Once

involved in a crash, their greater fragility makes them three to four times more likely to experience serious or fatal injury (Eberhard, 1996). A review of motor vehicle traffic accidents in Canada in 2004 revealed that the fatality to injury ratios was highest among men and women aged 65 years and older (Transport Canada, 2004). Similar results have been obtained in the United States where fatality rates, based on estimated annual travel for drivers 85 years and older, is 9 times higher than the rate for drivers 25 through 65 years of age (NHTSA, 2004).

As the number of older individuals increases, so will the number of older persons holding driving licenses. Concomitantly, the extent of the problem regarding MVCs among older drivers is expected to increase. There were approximately 2.7 million licensed drivers aged 65 and older in 2003, of which approximately 1.5 million were males (Transport Canada, 2004). People over the age of 65 are the fastest growing segment of the Canadian population, representing 13.1% of Canada's total population in 2004, and forecasted to increase to 22.6% by 2041 (Canada Safety Council, 2005). Moreover, older females are expected to drive in greater proportions, as shown by a 6.8% increase over a 2-year period between 2001 and 2003. With life expectancy rising (Canada Safety Council, 2005), and the increasing number of women who are driving, the proportion of older drivers is likely to exceed 4.5 million by 2041. Given the demographics of this population and the seriousness of accident related mortality and morbidity, the research agenda in this area requires much greater attention and at a much quicker pace.

2.2 RISK FACTORS FOR MVCs IN SENIORS

For the population at large, numerous risk factors for MVCs have been identified, although these are primarily directed at the overall population and not specifically to seniors. Of additional interest to the purpose of the current research is an exploration of the characteristics of traffic violations and crashes that are unique to older individuals.

The MVC among the younger age groups are believed to be largely related both to their inexperience in operating motor vehicles as well as their risk taking behaviors, which include high speed and use of alcohol and drugs such as cannabis (West et al., 2003). Older persons, however, are less likely to employ such risk taking behavior (Ball, Owsley, & Stavley, 1998; West et al., 2003). There is some suggestion that older drivers compensate for age-related health limitations by driving shorter distances and avoiding evening driving, busy highways and downtown areas (Brayne et al., 2000; Carr, 2000; Bauer, Rottunda, & Adler, 2003).

Two American population-based surveys (Baker, Falb, Voas, & Lacey, 2003; Johnson, 2003) identified unsafe driving actions that lead to accidents involving older drivers. In one study of accident data in the states of California and Virginia, older drivers had particular difficulty with changing lanes, turning, passing, and driving in reverse (Johnson, 2003). In addition, older drivers were prone to making inattentive responses such as running red lights and stop signs, failing to yield right-of-way, and committing turning violations. These traffic violation characteristics suggest that some older drivers may have problems with traffic decisions requiring complicated perceptual and

cognitive functioning, and that attention deficits may be contributing factors (Johnson, 2003). Baker and colleagues (2003) used the Fatality Analysis Reporting System (FARS) data from 1982 through 2001 to study the characteristics of fatal crashes involving 24 000 females older than 70 years. The report indicated that older women were overrepresented in crashes that occurred under the "safest conditions" including in daylight, when traffic was light, the weather was clear, and the roads were dry. These types of errors that cannot easily be explained by weather conditions or other more obvious road-related problems often result in catastrophic accidents that draw a great deal of media attention and a generally negative impression of older drivers. In turn, we have seen an increasing demand from various sectors of society calling for stricter licensing procedures aimed specifically at the elderly.

2.3 THEORETICAL MODELS OF DRIVING

Driving involves a complex interplay of vision, cognition, and physical function. To successfully drive a car, the driver needs to continually process new information and use it to make decisions. Given that the task of driving is so complex, various theorists have attempted to devise comprehensive models that help frame the components needed for safe driving. To date, given the wide range of approaches used to describe driving, it is clear that no single model fully explains the driving task (Fox, Bowden, & Smith, 1998). There are several models, dating as far back as the 1960s that help explain the relation between human abilities, driving performance and accident involvement (Ranney, 1994). Given the wide variety of driving situations and the complexity of the task, it is difficult to envision one comprehensive model of driving performance. A model that includes all critical aspects of driving is essential in order

to develop effective methods of evaluation and training of driving skills, such as the Stay SHARP program. Two of the most widely accepted models that are pertinent to explain driving behaviour, a multifactorial model (Anstey, Wood, Lord, & Walker, 2005) and Michon's Model of Driving Behaviour (Michon, 1985), will be reviewed briefly.

The multifactorial model (Figure 2.1) proposes that self-monitoring and beliefs about driving capacity involve the capacity to evaluate or to have insight into one's cognitive, visual and physical abilities and deficits, and to adapt driving habits accordingly. Importantly, cognition, vision and physical abilities interact; for example, a decline in visual acuity brings about a greater increase in decision time in the older driver. Therefore, self-monitoring beliefs influence an individual's decision to drive in challenging driving situations such as peak travel times and nighttime driving or adverse weather conditions (Carr 2000; Marottoli & Richardson, 1998; Persson, 1993).

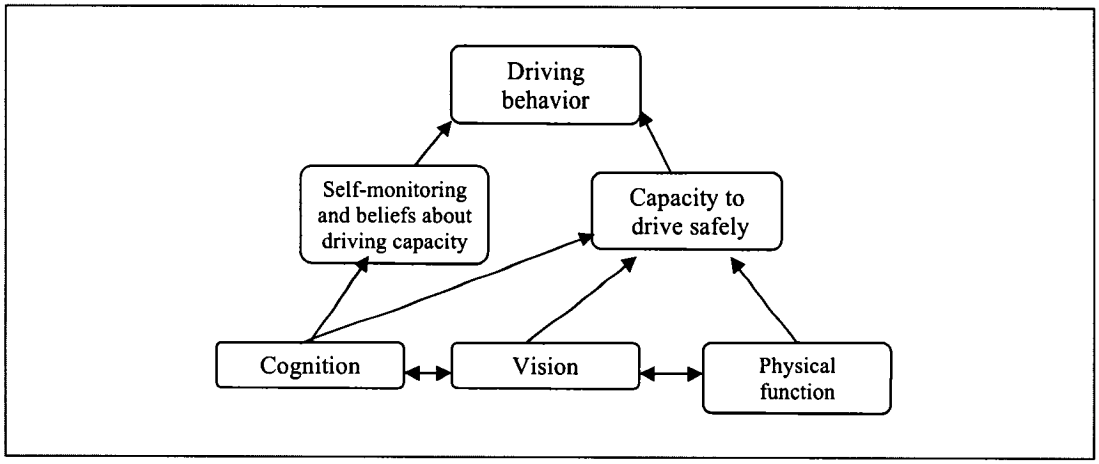

Figure 2.1: Multifactorial Model – factors enabling safe driving behavior

Michon's Model of Driving Behavior (figure 2.2) proposed in 1985 is one of the most widely recognized models for portraying driving as a complex activity. This model describes driving as a hierarchical structured task involving three levels: strategic, tactical, and operational (Michon, 1985). The strategic level includes general trip planning such as making decisions about choice of route, or the decision not to drive during bad weather. The tactical level is concerned with the behavior and decisions in traffic, for instance, switching on our headlights when visibility is reduced. The operational level involves carrying out basic actions of driving, such as steering or braking. The hierarchy assumes a dynamic relationship between the three levels, with control switching from one level to another at the appropriate points in time. The driver allocates attention according to the immediate driving situation. Michon's model has contributed to the conceptualization of the driving task and is used as a theoretical basis for much of the literature on driving involving older adults. These theoretical models are helpful in structuring the literature review around the fundamentals needed for driving.

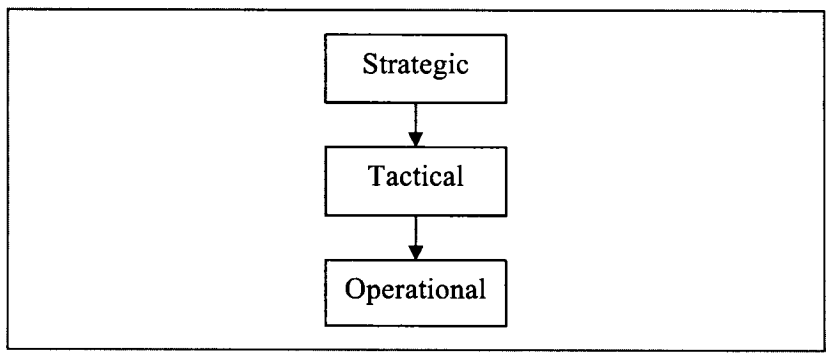

Figure 2.2: Michon's Model of Driving Behavior

2.4 AGE-RELATED CHANGES RELEVANT TO DRIVING

Driving requires the ability to assess multiple environmental stimuli at once, cognitive capacity to process this information, and motor capacity to undertake the actual driving tasks. Age-related changes in various sensory, cognitive, and motor functions in addition to medical conditions can affect the driving capability of some older people. For example, age-related deficiencies in cognitive and perceptual capacities required in driving have raised concerns, and have been shown to be associated with an increased risk of accidents (Johnson & Keltner, 1983; Owsley, Ball, Sloane, Roenker, & Bruni, 1991; Gresset & Meyer, 1994; Morgan & King, 1995).

2.4.1 Visual Function

Visual impairment becomes more common with increasing age (Shinar & Schieber, 1991), through both the normal aging process and the increased prevalence of eye disease. Normal aging is associated with increased yellowing and cloudiness of the crystalline lens, decreased pupil size, and alterations in the integrity of the macular pigment and neural pathway (Haegerstrom-Portnoy, Schneck, & Brabyn, 1999). These changes result in reductions in visual acuity, visual field, and contrast sensitivity observed in older populations (Haegerstrom-Portnoy et al., 1999). Visual acuity is most important for driving basics such as reading traffic signs and seeing other cars and pedestrians. A reduction in visual field decreases the probability of detecting objects in the immediate environment, especially in a complex environment. Contrast sensitivity, the ability to detect brightness and colour, must be sufficient for object detection and recognition (Higgins & Bailey, 2000). In addition, self-reports of visual problems in older adults indicate that cataract, glaucoma and age-related

maculopathy are the most prevalent ocular diseases in this population (Klein et al., 1995). Given the generally held belief that vision comprises 90% of sensory input for driving (Shinar & Schieber, 1991), it is not surprising that these age-related changes in visual functions have been investigated as risk factors for crashes among older adults (Johnson & Keltner, 1983; Gresset & Meyer, 1994). Provincial licensing bureaus have created strict criteria delineating 'fitness to drive' based on function of the primary visual system. These criteria vary from different provinces or states. In Quebec, Canada, for example, visual requirements for licensing include 20/40 vision, a visual acuity of 6/12 in the better eye, and a minimum field of vision of 120 degrees (La Société de l'assurance automobile du Québec [SAAQ], 2005). While in Ontario, Canada the visual requirements include 20/40 vision in the better eye, with or without corrective lenses, and a minimum field of vision of 120 degrees (Ontario Ministry of Transportation [MTO], 2006).

Several studies have examined the association between primary visual functions and driving performance and found that, in general, the association between tests of vision and driving accidents is weak (Goode et al., 1998; Gresset & Meyer, 1994; Johnson & Keltner, 1983; Ivers, Mitchell, & Cumming, 1999; Margolis et al., 2002), accounting for less than 5% of crash variance (Owsley & Ball, 1993). For example, a case-control study (Gresset & Meyer, 1994) found that older drivers convicted of a traffic violation or involved in a road accident were no more likely to have an impairment in visual acuity than matched controls. Specifically, in the group of 1400 male drivers in Quebec, the relative risks for accidents, after controlling for traffic conviction, mileage, time spent and frequency of driving during rush hours, indicated that drivers

with minimal visual acuity (lower than 6/12) were not at increased risk of accidents. Similarly, a large epidemiological study (Margolis et al., 2002) did not find an association between visual acuity and increased risk of accidents in 1416 women aged 65-to-84 years who were assessed on measures of cognitive, visual, and physical functioning. In contrast, another large epidemiological study of 3654 people aged 59 years and older reported that drivers with lower visual acuity had an increased risk of self-reported crashes (Ivers et al., 1999) such that visual acuity worse than 6/18 in the right eye (adjusted prevalence ratio [PR] = 1.6) was associated with an increased risk.

Other visual functions, such as the extent of visual fields, have shown a strong association with driving outcomes. Johnson and Keltner (1983) found that in a testing of 10 000 drivers' license applicants in California, the incidence of visual field loss was 3.0% to 3.5% for those aged 16-to-60 years but was approximately 13.0% for those older than 65 years. Drivers with visual field loss in both eyes had twice the traffic accident conviction rates of those with visual field loss in one eye or no visual field loss. Approximately half of the persons with abnormal visual fields were previously unaware of the problem. While age-related visual declines are often inevitable, some can be compensated for by modifying behaviors and minimizing exposure to traffic hazards (i.e. reducing night and highway driving).

In summary, while the primary visual functions are typically evaluated to determine eligibility for driving, they are poorly associated with driving safety or performance (Shinar & Schieber, 1991). This is not because vision is unrelated to driving performance, but because these visual sensory functions do not in themselves reflect

the complexity of the driving task (Ball & Owsley, 1992; Ball, Owsley, Sloane, Roenker, & Bruni, 1993).

2.4.2 Cognitive and Perceptual Changes

Driving involves the simultaneous use of cognition and perception (Ball et al., 1993; Owsley & Ball, 1993). Cognition refers to the ability of the brain to process, store, retrieve and manipulate information that it receives from the environment. Cognitive changes which may affect driving include: memory, attention, planning and organization, problem solving, distraction by irrelevant stimuli, decline in spatial orientation, decreased visual searching, and decreased visuomotor integration (Johnson, 2003). Perception is the means through which an individual organizes and comes to understand information received by the senses (Simms, 1985). Visual processing is the active process of locating, extracting, and interpreting visual information from the environment using visual-perceptual skills (Tarawneh, McCoy, Bishu, & Ballard, 1993). Perceptual changes associated with aging may include difficulties in depth perception, peripheral vision and figure-ground discrimination (Tarawneh et al., 1993). There is a constant interaction between the physiological system in terms of visual information processing and cognitive performance (Ball et al., 1993). Of particular relevance to driving are age-related changes in Useful Field of View (UFOV) including selective attention, divided attention, and sustained attention (Owsley et al., 1991; Ball et al., 1993; Goode et al., 1998; Guerrier, Manivannan, & Nair, 1999; Myers, Ball, Kalina, Roth, & Goode, 2000). A visual attention analyzer (described in Appendix 1) has been developed to map an individual's useful field of view. UFOV is the functional visual field area in which information can be acquired

and processed without eye and head movement (Ball & Owsley, 1992). Visual attention refers to those attentional skills required to process visual stimuli. The control of attention is critical in performing different types of tasks. Selective attention is the process of selecting portions of simultaneous sources of information either by enhancing the processing of some objects and/or by suppressing information from others (Rossi & Paradiso, 1995; Theeuwes, 1993). In a driving task, this might be ignoring the pretty flower display on the roadside while noting the bicycle driver in front of you. Divided attention is necessary when two or more unrelated tasks have to be carried out simultaneously; shifting from one concept to another within one set of stimuli. Finally, sustained attention requires vigilance when relevant tasks occur at a relatively slow rate over a prolonged period of time. All of these aspects of attention are important components of the task of driving.

Several authors have attempted to describe the prevalence of cognitive and perceptual changes commonly seen in older drivers. Variations in the definition of these functions, as well as differences in the subjects included, measures used, and timing of evaluation make it difficult to compare findings across studies. There are a series of well-conducted studies that have explored the impact of UFOV reductions. In a study of 294 drivers aged 55 and older involved in "at-fault" crashes during the previous five-year period, Ball et al. (1993) found decreased visual attention, particularly a reduction in UFOV as measured using the visual attention analyzer (Ball & Owsley, 1992), to be predictive of vehicle crashes in older drivers. The average number of crashes increased with reductions in UFOV and ranged from approximately 0.2 for those with a 10 percent reduction in UFOV, to 2.5 for those with a 90 percent

reduction. Using a cut-off of 40% reduction, the sensitivity of the UFOV in identifying those with at-fault crashes was 89% and the specificity of identifying those with no crashes was 81%. Similarly, a prospective study conducted by Owsley and colleagues (1998) on 294 older drivers indicated that impaired UFOV was significantly associated with crashes such that those with reductions of 40% or greater were 2.2 times more likely to be involved in a crash over the next three years. In a study of 53 drivers, aged 57-to-83, Owsley and colleagues (1991) found that UFOV and mental status were the best predictors of vehicle accidents, accounting for 20% of the variance for accidents and 29% of the variance for accidents at traffic intersections. Those with a reduced UFOV were 4.2 times more likely to have one or more crashes and 15.6 times more likely to have an accident at an intersection. This is not surprising as driving through an intersection places increased requirements on the peripheral visual fields and awareness of peripheral objects. Those with poor mental status experienced 3.4 times more accidents compared to those with good mental status. Moreover, in a retrospective population-based survey of 239 adults aged 55 and older, Goode and colleagues (1998) found that while the traditional tests significantly differentiated between those who did and did not have a previous crash, the addition of the UFOV scores to the model improved sensitivity of identifying crashers from 57.3% to 76.6% and the specificity of detecting non-crashers from 60.0% to 78.3%. These numerous studies indicate repeatedly that the speed at which visual information is processed, given different circumstances, is an important factor that predicts ability to successfully carry out difficult or dangerous traffic situations (Anstey et al., 2005).

There is a strong association between mental status and driving accidents. A Canadian study of 249 persons referred to a dementia clinic noted that these patients had 2.5 times the crash rate of age-matched controls (Tuokko, Tallman, Beattie, Cooper, & Weir, 1995). Mental status obtained from cognitive screening tests has also been used to examine the relationship between cognitive performance and driving performance or crash risk (Owsley et al., 1991; Goode et al., 1998; Stutts, 1998). For example, Stutts (1998) administered cognitive tests that included the Trail Making Test, Parts A and B (Spreen & Strauss, 1991), a modification of the American Association of Retired Persons 'Reaction Time' test (AARP, 1992), the Short Blessed Cognitive test (Spreen & Strauss, 1991) and the Timed Traffic Sign Recognition Test (Stutts, Stewart. & Martell, 1998) to 3238 drivers aged 65 and older who were applying for renewal of their license at one of eight North Carolina drivers' license offices. The results indicated reduced driving exposure in those with lower levels of cognitive function that included driving fewer miles annually (less than 3000 miles a year) and avoiding high-risk driving situations such as driving during rush hour, on highways and during poor weather conditions.

Studies have also examined the association between the Mini-Mental State Examination (MMSE) and driving performance or crash risk (Fox, Bowden, Bashford, & Smith, 1997; Marottoli, Cooney, Wagner, Doucette, & Tinetti, 1994; Marottoli & Richardson, 1998; Margolis et al. 2002; Johansson et al., 1996). Three studies have shown associations between the MMSE and on-road driving test results whereby poor performance correlated with an increased risk of an adverse driving event (Marottoli et al., 1994; Johansson et al., 1996; Fox et al., 1997). In a prospective investigation of 96

patients aged 59-to-84 years diagnosed with probable Alzheimer's disease, Fox and colleagues (1997) found that a lower MMSE score (MMSE score of 18-24) predicted the likelihood of failure on the on-road test. Similarly, in a prospective cohort study of 283 community-dwelling individuals aged 72-to-92, Marottoli et al. (1994) found that persons with borderline cognitive impairments (MMSE score of 23-25) were more likely to have adverse events (traffic crash, violation, or stopped by police) than those with higher MMSE scores. In particular, the element of the MMSE most strongly associated with adverse events was the inability to accurately copy intersecting pentagons. Likewise, in a matched case-control study of 37 drivers aged 65 and older, Johansson et al. (1996) reported that case subjects involved in MVC had significantly more cognitive impairments as shown by a lower score on the MMSE than control subjects not involved in MVC.

2.4.3 Hearing Loss

Hearing loss is a decrease in the ability to perceive sounds. Hearing loss can be: mild (a loss of 40 dB) with trouble in hearing ordinary conversation; moderate (40 dB-60 dB) where voices must be raised to be heard; and severe (over 60 dB loss) where people have difficulty understanding normal speech even when wearing a hearing aid (McGwin, Sims, Pulley, & Roseman, 2000). There are two studies that have examined the relationship between hearing impairment and risk of motor vehicle crash. Specifically, McCloskey, Koepsel, Wolf, and Buchner (1994), conducted a population-based case control study to determine whether sensory impairments place older drivers at risk for collision injuries. The cases were drivers who sought medical care, within seven days, for injuries sustained in a police recorded motor vehicle crash,

while the controls were subjects who had not been injured in a police reported motor vehicle crash. Driving exposure, based on self-report, was similar for both groups. Sensory impairment data extracted from medical records revealed no significant increase in risk of injury from motor vehicle collisions as a function of hearing impairment. In another study, Ivers, Mitchell, and Cumming (1999) examined the association between vision, hearing loss, and motor vehicle crashes in a cross sectional survey of 2379 current drivers. Self-reports were used to assess hearing loss and motor vehicle crashes. Thirty-eight percent of the sample reported having hearing loss. 5.6 percent of individuals aged 49 to 79 reported being in a crash while 9.1 percent of those 80 years of age and older reporting being in a crash within five years. Moderate hearing loss (adjusted prevalence ratio PR =1.9) and hearing loss in the right ear (PR = 1.8) were associated with an increased crash risk. It is important to note that indices of hearing loss and motor vehicle crashes used in this investigation were based on self-reports.

2.4.4 Motor Function Changes and Medical Conditions

A number of medical conditions may result in functional impairments (e.g., sensory, motor, or cognitive functioning) that negatively affect driving performance. Medical conditions associated with risk of motor vehicle crashes in older people have been investigated and include: cardiovascular disease (McGwin et al., 2000; Margolis et al., 2002; Vernon et al, 2002; Ball et al., 2006), stroke (McGwin et al., 2000; Ball et al., 2006; Parker, McDonald, Rabbitt & Sutcliffe, 2000), diabetes mellitus (McGwin, Pulley, Sims & Roseman, 1999; Ball et al., 2006), cognitive impairments associated with conditions such as dementia, Alzheimer's Disease and traumatic brain injury

(Stutts et al., 1998; Marottoli et al., 1998; Fisk, Schneider & Novack, 1998), neurological disorders (McGwin et al., 2000; Marottoli et al., 1998), epilepsy (Hansotia, 1993), psychiatric disorders (Ball et al., 2006; McGwin et al., 2000), and musculoskeletal disorder (Yee, 1985; McGwin et al., 2000). In addition, medications used to treat various disorders, including benzodiazepines (Hemmelgarn, Suissa, Huang, Boivin, & Pinard, 1997; Barbone, McMahon & Davey, 1998), opioids, analgesics, sedatives (Ray, Thapa, & Shorr, 1993), psychotropic drugs such as lithium (Hatcher, Sims & Thompson, 1990), and neuroleptic medications (Metzner, Dentino, Godard, Hay, & Linnoila, 1993; Kagerer, Winter, Moller & Soyka, 2003) also increase the risk of crashes.

Similarly, reductions in grip strength, muscle strength and endurance, flexibility, and motor speed as a result of aging or age-related disease put older adults at risk of unsafe driving and increase the likelihood of injury associated with crashes (McGwin et al., 2000). In the New Haven cohort described previously, Marottoli et al. (1998) reported that limited neck rotation was one of the factors most closely associated with a self-reported history of adverse driving events (O.R.= 6.10): poor neck rotation was associated with twice the risk of crashing. Neck rotation is important in detecting cars or objects to the side or behind a vehicle, particularly at intersections or when merging, areas with which older drivers typically have problems. Furthermore, in a survey of 446 older drivers 55 years and older, 35% reported problems with arthritis, and 21% indicated that it was difficult to turn their heads and look to the rear when driving (Yee, 1985).

Two studies relating measures of reaction time (RT) and psychomotor speed to on-road driving performance were examined. Marottoli et al. (1998) indicated no significant association between measures of psychomotor speed and reaction time, and self-reported adverse events (crashes, moving violations, or being stopped by police) in the New Haven cohort study. McKnight and McKnight (1998) administered measures of basic abilities including simple and choice response time and visual tracking and an on-road assessment of driving performance to a sample of 407 drivers aged 62 and older referred to licensing agencies on the basis of observed instances of unsafe driving compared to a group of incident-free volunteers. Correlational analyses showed fair associations with on-road driving performance of $r= 0.24$ for simple RT and $r= 0.33$ for choice RT.

In summary, advancing age can lead to changes in vision, perceptual skills, attention, memory, decision-making, reaction time, processing speed, and physical abilities, in addition to medical conditions that can affect safe driving. Some older drivers are able to recognize these functional changes on their own and take adaptive or self-restricting compensatory measures. While a potentially positive action, these self-regulated changes may not be sufficient to adequately reduce crash risk (Ball et al., 1998). In contrast, other individuals will lack self-awareness or constraint as their function declines and will continue to drive without imposing self-restrictions. This is especially true for individuals who are experiencing cognitive decline such as those related to dementia. Friedland and colleagues (Friedland et al., 1988) found that only 42% of patients with Alzheimer's disease stopped driving before a crash occurred.

Hence, the literature is quite clear - people who drive at reduced skill levels are at increased risk for crash involvement, with potentially serious consequences to themselves and others.

2.5 "JUST STOP DRIVING"- IS NOT THE ANSWER

In our society, driving an automobile is considered an important component of one's quality of life, sense of independence, and competence (Persson, 1993). For many individuals, driving becomes the most important form of mobility as they become increasingly limited in their ability to walk extended distances, have difficulty accessing public transportation and carrying heavy bags/parcels (Rosenbloom, 1993).

Community-based studies examining voluntary driving cessation of older drivers have mostly focused on factors such as increasing age, health reasons and medical conditions (Hakamies-Blomqvist & Wahlstrom, 1998; Persson, 1993; Campbell, Bush, & Hale, 1993; Bauer et al., 2003; Carr, 2000; Keplinger, 1998). Research has now begun to focus on the negative outcomes for older people who relinquish driving. One cohort study has shown driving cessation to be associated with personal mobility loss and reduced out-of-home activities (Marottoli et al., 2000), along with, as previously mentioned, elevated depressive symptoms (Marottoli et al., 1997). Specifically, Marottoli and colleagues (1997) examined the association between driving cessation and depressive symptoms in 1316 surviving non-institutionalized members of the New Haven Established Populations for Epidemiologic Studies of the Elderly (EPESE) cohort aged 65 years and older. All New Haven EPESE respondents underwent in-home interviews every 3 years (1982, 1985, and 1988) that assessed

their driving history and current driving practices. In addition, the interview included an assessment of depressive symptoms using the Center for Epidemiologic Studies-Depression (CES-D) scale. Compared to other potential explanatory variables, including the effect of socio-demographic factors and health status, driving cessation was amongst the strongest predictors of increased depressive symptoms with a mean difference of nearly four points on the CES-D from 1982 to 1988 in the group who had stopped driving.

A later follow-up by the same group (Marottoli et al., 2000), using the same New Haven EPESE cohort, examined the effect of driving cessation on out-of-home activity levels. Participation in nine social activities that required some degree of out-of-home mobility (e.g. shopping, going to the movie or restaurant) was ascertained during a face-to-face in-home interview. The results indicated that those who had stopped driving reported lower activity levels during the subsequent in-home interviews.

Given the high emotional, social and financial impact of driving cessation, and the high prevalence of crashes in the elderly (NHTSA, 2004), there is a need to help older drivers sharpen their skills as well as recognize their changing abilities to adapt their driving performance appropriately. Although some skills needed for operating a motor vehicle (such as vision, motor, sensory) show age-related declines that are inevitable, it is encouraging to note that, skill-specific training interventions may play an important role in retraining driving related skills such as visual-perception and response time in older adults.

3. THESIS OBJECTIVES

- **Manuscript 1:** To review and critically appraise the literature on older driver retraining to inform clinical practice related to driver retraining, and to identify gaps in the scientific literature that will guide future research.
- **Manuscript 2:** To explore activities older adults use driving for, when and where they drive, importance of driving, perceived driving habits, behavioral changes as people age, and factors stimulating interest and participation in a driving program.

4. WHAT IS EFFECTIVE IN DRIVING RETRAINING?

4.1 MANUSCRIPT 1

OLDER DRIVER RETRAINING: A SYSTEMATIC REVIEW OF EVIDENCE OF EFFECTIVENESS

Ailene Kua, BA, MSc Student (Rehabilitation Science), Nicol Korner-Bitensky, PhD, OT(c), Johanne Desrosiers PhD, OT (c), Malcolm Man-Son-Hing, MD, MSc, FRCPC, and Shawn Marshall MD, MSc, FRCPC

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The purpose of this paper is to present a systematic and comprehensive review examining and critically analysing the scientific evidence for the effectiveness of retraining programs for older drivers.

Communication addressed to: Ailene Kua
School of Physical & Occupational Therapy
McGill University
3630 Promenade Sir-William-Osler
Montreal, Quebec, H3G IY5, Canada
ailene.kua@mcgill.ca
Telephone: (514) 398-5457
Fax: (514) 398-8193

ABSTRACT

Problem: The safety of older drivers is of growing concern as fatal crashes in this group increase annually. The objective was to systematically and critically appraise the evidence on effectiveness of older driver retraining.

Method: Articles were grouped according to the intervention studied: physical retraining, visual perception or education. Randomized trials were appraised using the Physiotherapy Evidence Database (PEDro) Scale and interpreted following Foley's quality assessment. Each intervention was then rated for effectiveness based on Sackett's levels of evidence.

Results: Six RCTs, one pre- post- study design and one descriptive study met the inclusion criteria, one investigating physical retraining, one a visual perception intervention, five using an educational intervention and one examining a combination of all three, in addition to traffic engineering improvements. There is limited evidence that physical retraining (Level 2a) and that visual perception retraining (Level 2a) improve driving related skills in older drivers. There is moderate evidence that educational interventions improve driving awareness and driving behavior (Level 1a), but do not reduce crashes (Level 1b) in older drivers.

Summary: The current evidence on the effectiveness of retraining aimed at older drivers is limited but sufficiently encouraging to merit further research.

Impact on Industry: Given the potential cost savings to the insurance and health care industries, as well as the safety impact to the general population, the research agenda in this area requires much greater attention.

Key Words: review literature; older driver; driver education; driving; abilities

INTRODUCTION

Driving, especially in seniors, represents autonomy and independence and contributes to quality-of-life including a sense of well-being and an ability to maintain social contacts (Ragland, Satariano, & MacLeod, 2004). People over the age of 65 are the fastest growing segment of the American population, numbering 35 million in 2004, and representing 12% of the United States' total population (U.S. Census Bureau, 2004). The number of older individuals in this age group is expected to double by the year 2030 (Insurance Institute for Highway Safety, 2004). As the number of older individuals increases, so will the number of older persons holding driving licenses. This trend is a major concern because drivers aged 65 and older experience a higher annual driving related fatality rate per mile driven than any other age group except for individuals aged 25 and under (National Highway Traffic Safety Administration [NHTSA], 2004). The risk of crashes rises after age 70 and further escalates after age 80 (NHTSA, 2004). Given that the number of older drivers in each of these age groups will increase rapidly in the next decade, we anticipate a dramatic increase in the number of older drivers' crashes if nation-wide actions are not taken to improve safety.

Age-related changes in sensory, cognitive, and physical abilities, in addition to medical conditions, can affect the driving capability of some older people. For example, changes in cognition and perception have been shown to be associated with an increased risk of accidents (Gresset & Meyer, 1994; Johnson & Keltner, 1983; Morgan & King, 1995; Owsley, Ball, Sloane, Roenker, & Bruni, 1991). Much research has focused on older drivers' crash-involvement patterns (Evans, 1991;

Hakamies-Blomqvist, 1993; 1994), with less attention placed on developing, and evaluating methods to enhance driving abilities. Given the high emotional, social and financial impact of driving cessation, and the high prevalence of crashes in seniors (NHTSA, 2004), it would be important to clarify the evidence regarding benefits of retraining programs in older drivers. Thus, the objective of this systematic and comprehensive review was to assess the scientific evidence for the effectiveness of retraining programs for older drivers.

METHODS

Systematic Review of the Literature

A comprehensive review of the English-language scientific literature was performed covering the period from January 1966 to January 2006 of MEDLINE, January 1982 to January 2006 for the CINAHL database, and January 1980 to January 2006 for EMBASE, to search for articles relating to skill-specific driver training programs for older persons. The following key terms were used: *aged*, *automobile driving*, *training, rehabilitation, intervention, reaction time, visual perception, motor functioning, behavior, education,* and *Useful Field of View (UFOV).* All randomized clinical trials (RCTs), pre-post-design studies, cohort studies, case-control studies and descriptive studies were considered for inclusion if they focused on those aged 55 and older and on retraining of driving skills or prerequisite skills important to driving. Articles on retraining of driving in those with neurological conditions, such as stroke, were excluded. In addition, the reference lists of retrieved articles were reviewed to identify additional articles. The Cochrane database (Cochrane Database of Systematic Review, 2006) and the Cochrane Central Register of Controlled Trials (CENTRAL)

(2006) were explored using *aged, automobile driving* and *training,* as key terms. Publications by major authors working in the area of driving were also sought using the ISI Web of Science database (ISI Web of Knowledge, 2006). Finally, the Canadian Driving Research Initiative for Vehicular Safety in the Elderly (CanDRIVE) database was searched for citations (CanDRIVE, 2006).

The retrieved articles were grouped for review according to intervention. Using the PICO format (Guyatt & Rennie, 2002): 1) **P**opulation (older adults), 2) **I**ntervention, 3) **C**omparison/control, and 4) **O**utcome (measurement of change in outcome measures used), questions were created that were deemed relevant to clinicians and answerable based on the current evidence in the literature. The details of each study were summarized according to: author/date, design, participants, exposure/intensity, outcomes of interest and results.

Data Abstraction and Analysis

RCTs were appraised for methodological quality using the Physiotherapy Evidence Database (PEDro) Scale (PEDro, 2006). The PEDro score provides a nominative description of the internal validity including randomization, concealed allocation, baseline comparability, blinding of the subjects, assessors and therapists, intention to treat analysis and adequacy of follow up. Two reviewers rated each RCT independently and when discrepancies arose these were discussed and the study was reread to determine the final score. When an RCT already had a PEDro score in the PEDro database, the existing score was used. PEDro results were interpreted following Foley and colleague's quality assessment (Foley, Teasell, Bhogal, &

Speechley, 2003) where studies scoring 9-to-10 were considered methodologically "excellent", 6-to-8 were considered "good", 4-to-5 "fair", and below 4, "poor". Cohort and case-control studies were reviewed using the framework provided by the Newcastle-Ottawa Scale (NOS) (Wells et al., 2006).

Ratings of evidence were based on Sackett's Level's of Evidence (Sackett, Richardson, Rosenberg, & Haynes, 2000) which we adapted to include PEDro ratings. For example, if two randomized controlled trials (RCTs) of *high* quality (excellent or good; PEDro $\geq$ 6) found an intervention to be effective, the intervention would receive a 1a rating. If one RCT of *high* quality found an intervention to be effective, the intervention would receive a 1b rating. One or more *fair* quality RCTs (PEDro = 4-5) that found effectiveness would enable a 2a rating. Lower quality studies (PEDro$\leq$3) and non-randomized trials and strong single subject designs (for example those with multiple baselines) received a rating of 2b. A consensus by an expert panel or findings of a number of 'pre/post' design studies that showed similar results, received a 3. Conflicting findings of equally well-designed studies received a 4. Finally, a level of evidence of 5 indicated that there were no experimental studies exploring the question.

Data Retrieved

Thirty-nine citations were retrieved in MEDLINE and 25 in CINAHL, including three RCTs related to retraining of older drivers (Bedard, Isherwood, Moore, Gibbons, & Lindstrom, 2004; Owsley, McGwin, Phillips, McNeal, & Stalvey, 2004; Roenker, Cissell, Ball, Wadley, & Edwards, 2003). By reviewing the reference lists, we

identified one additional RCT (Owsley, Stalvey, & Phillips, 2003). In EMBASE, we retrieved 34 citations: no new RCTs, pre-post-test design, cohort, case-control, or descriptive studies were found. The ISI Web of Science database revealed no additional RCTs. In the Cochrane database (Cochrane Database of Systematic Review, 2006), no systematic review has been published. The Cochrane Central Register of Controlled Trials (CENTRAL, 2006) revealed one additional RCT (McCoy, Tarawneh, Bishu, Ashman, & Foster, 1993). Finally, three additional studies, one RCT (Ostrow, Shaffron, & McPherson, 1992), one pre- post- study design (Eby, Molnar, Shope, Vivoda, & Fordyce, 2003) and one descriptive study (Janke, 1994) were retrieved from the CanDRIVE database (CanDRIVE, 2006).

RESULTS

Of the 103 articles retrieved, eight met the inclusion criteria: six RCTs (Bedard et al., 2004; McCoy et al., 1993; Ostrow et al., 1992; Owsley et al., 2003; Owsley et al., 2004; Roenker et al., 2003), one pre- post- study design (Eby et al., 2003) and one descriptive study (Janke, 1994). These were grouped for review according to the intervention tested: physical retraining, visual perception, education or a combination of education and physical retraining or education and visual perception. Table 4.1 provides a summary of the studies.

[Insert Table 4.1 here]

The Evidence for the Use of Physical Retraining Intervention

In older adults, is intervention focused on physical retraining more effective than no intervention or an alternative intervention in improving driving related skills?

One "fair" quality RCT found significant results including increased trunk rotation, shoulder flexibility, vehicle handling and observing procedures (Ostrow et al., 1992). Another "fair" quality RCT found that an intervention of physical therapy (one of four interventions studied alone or in combination) significantly improved on-road driving performance in the intervention group versus a control group who did not receive any therapy (McCoy et al., 1993).

Conclusion: There is limited evidence (Level 2a) from two "fair" quality RCTs that physical retraining intervention improves driving related skills in older drivers.

Specifically, Ostrow and colleagues (1992) conducted a RCT to investigate the impact of a range-of-motion training program on flexibility and driving skills. Thirty-eight adults aged 60-to-85 years were stratified, by gender, to receive the experimental or control intervention: 32 completed the study. The experimental intervention consisted of an eight-week program using static-type stretching exercises of the upper body performed at home (participants met weekly with a clinician who provided new treatment elements). As well, participants used a daily log to record their compliance, and the frequency, and extent, of driving. Individuals in the control group were asked to keep a log of the frequency and extent of driving and received in-car instruction after the project was completed as incentive to participate. Eight range-of-motion outcomes (trunk and neck rotation, chin flexion and extension, neck flexion and extension, side bends, and shoulder flexion) and nine on-road activities (handling, handling time, strikes, position and direction, straight line backing and backing time, safe driving practices and observing) were assessed at pre-intervention, and again at 8

and 11 weeks for a total of 36 comparisons. Three outcomes, trunk rotation and shoulder flexibility at 8 and 11 weeks; and in-car observing at 11 weeks, were significantly better in the experimental group following intervention. Conversely, the control group showed significantly better improvements in handling position at 8 and 11 weeks as compared to the experimental group. While positive conclusions were drawn about the value of a range-of-motion intervention on flexibility and driving skills, the limitations include no mention of blinding of the examiner and therapists. In addition, multiple comparisons were performed without statistical correction, increasing the likelihood that the three found to be significant occurred by chance.

McCoy et al. (1993) investigated whether any of four interventions (physical therapy, perceptual therapy, driver education, and traffic engineering improvements), or a combination thereof, improved on-road driving performance on a standard 19 km route designed to measure the driving maneuvers associated with older driver accidents. Ninety-five older adults aged 65-to-88 were randomly assigned to one of six groups. The first group received physical therapy (n=18), the second perceptual therapy (n=10), the third driver education (n=15), the fourth physical therapy and driver education (n=15), the fifth perceptual therapy and driver education (n=19) and the sixth served as a control (n=17). Midway through the study, traffic engineering improvements such as pavement markings, and traffic signal displays designed to facilitate driving maneuvers, were incorporated into the driving route used as the main outcome of on-road performance. To determine effectiveness of the engineering improvements, the subjects in each group were further randomized into two subgroups: one who underwent both the pre and post intervention road test before the

traffic engineering improvements were installed, the other who performed the pre intervention test before the traffic engineering improvements and the post test after the improvements were installed. The physical therapy treatment involved seven at-home exercises designed to improve posture, trunk rotation, neck, and shoulder flexibility, to be done four times a week for eight weeks. In addition, participants were to record when they did the exercises in a diary. The perceptual therapy involved an eight-week (four times a week for twenty-minutes) course of at-home exercises designed to improve visual perception. Subjects recorded the frequency of exercising in a diary. The driver education program was based on the AAA (American Automobile Association) Safe Driving for Mature Operators (AAA, 1989) consisting of one day, eight-hour classroom instruction. Mean differences on the pre-to-post road test scores (primary outcome) for all the study groups, except for the control group, were equally positive with each resulting in an average improvement of 7.9 percent. All experimental groups, with the exception of the perceptual therapy subgroup, showed significant improvements in driving performance as compared to controls ($p < .015$). Sub-group comparisons revealed that those exposed to the traffic engineering improvements did significantly better on the road test than those tested without the traffic engineering improvements – with the exception of the perceptual therapy group. Limitations of the study included no mention of blinding of evaluators and very small sub-group sizes.

The Evidence for the Use of Visual Perception Intervention

In older adults, is visual perception intervention more effective than no intervention or an alternative intervention in improving driving related skills?

One "fair" quality RCT investigated this question and showed a significant decrease in dangerous maneuvers and an increase in useful field of view at post-test for subjects receiving the experimental intervention consisting of speed-of-processing training versus the control group who received simulator training (Roenker et al., 2003). At post-test, those in the simulator-trained group performed better on two driving performance measures – turning into the correct lane and using proper signaling. Another "fair" quality RCT found that individuals who received perceptual therapy (one of four interventions offered alone or in combination with others) significantly improved on-road driving performance in the intervention group versus a control group who did not receive any therapy (McCoy et al., 1993).

Conclusion: There is limited evidence (Level 2a) from two "fair" quality RCTs that visual perception intervention improves driving related skills in older drivers.

Specifically, Roenker et al. (2003) examined the effects of speed-of-processing training versus simulator training on psychomotor performance and driving performance. Assessments were performed at three points: pre-training, post-training, and an optional 18-month follow-up. Individuals were screened and categorized as either those who exhibited useful field of view (UFOV) decline or not. Those who exhibited UFOV decline were randomly selected to either the "high-risk" speed-of-processing training group (N=51) or the "control" simulator-training group (N= 26). A random selection of individuals with no UFOV decline was considered a "low-risk" control group (N= 27). The speed-of-processing training group received a one-day, 4.5-hour training on a touch-screen computer. The simulator-training group received

two, 2-hour education sessions on the driving simulator (Model L-225, Doron Precision Systems Inc., Binghamton, NY). The first session consisted of simulation instruction of rules of the road, safe driving and crash prevention behaviors. The second session continued with the simulation instruction and ended with a one-hour in-car demonstration by a driving instructor. The "low-risk" control group did not receive any training. Psychomotor skills were assessed using the driving simulator that assessed simple and choice reaction time, and the UFOV testing apparatus. Driving performance, including maintaining lane position, activating signals, stopping smoothly, searching, and dangerous maneuvers, was assessed using a 7-mile route and rated on a three-level scale of 0 (very unsafe) to 2 (safe or appropriate) by three raters (one was blind to group assignment). Raters provided also a global rating from 1 (drive aborted/very unsafe) to 6 (very competent driver). An analysis of the UFOV scores revealed UFOV reductions in all three groups from baseline to post-training, with the "low-risk" control group having a significantly smaller reduction than the other two groups. Furthermore, the speed-of-processing group scored significantly better on the UFOV as compared to the simulator trained group. This pattern was still present at 18-months. At immediate post-test, both groups that received training improved on the driving evaluation, with a significant decrease in the number of dangerous maneuvers observed for the speed-of-processing trained group as compared to the simulator trained group. However, those in the simulator trained group showed significantly better scores on two driving performance measures- turning into the correct lane and using proper signaling. While positive conclusions were drawn about the value of speed-of-processing and simulator training on psychomotor skills and

driving performance in older drivers, the limitations of this study include an apparent lack of blinding of evaluators.

McCoy et al. (1993) as described in detail in the previous section on physical retraining, found that eight-weeks of perceptual therapy performed independently at home was equally effective to physical therapy, driver education, and traffic engineering improvements, or a combination thereof, in improving driving performance and, superior to a control intervention of no treatment.

The Evidence for the Use of Educational Intervention

In older adults, is an educational intervention more effective than no intervention or an alternative intervention in improving driving related skills?

One "high" quality RCT found significant results including: acknowledgement of changes in quality of vision, more frequent performance of self-regulatory practices, avoidance of hazardous driving, no increase in dependence on others to drive, and reduced driving exposure in the intervention group receiving an educational intervention and a comprehensive eye examination versus the control group receiving only a comprehensive eye examination (Owsley et al., 2003). Another "high" quality RCT (Owsley et al., 2004) found significant reduction in the mileage driven and increased driving avoidance and self-regulatory behaviors at post-intervention in the experimental group, but no significant difference in the two-year incidence of crashes (primary outcome) in the experimental group receiving an educational intervention versus a control who did not receive an educational intervention. Another "high" quality RCT found no significant differences in driving performance for an

experimental group receiving an educational intervention versus a control who did not receive education (Bédard et al., 2003). A "fair" quality RCT found that driver education (one of four interventions), a combination of physical therapy and driver education, and a combination of perceptual therapy and education, significantly improved on-road driving performance in the intervention group versus a control group (McCoy et al, 1993). One descriptive study found that participants in an educational driving program had significantly lower citation rates than those who did not participate (Janke, 1994). One pre- post- study design by Eby and colleagues (2003) indicated that a driving workbook intervention significantly increased self-awareness and general driving knowledge.

Conclusion: There is moderate evidence (Level 1a) from two "high" quality RCTs and one "fair" quality RCT, that an educational intervention curriculum improves driving awareness and driving behavior. There is moderate evidence (Level 1b) from one "high" quality RCT, that an educational intervention curriculum does not reduce crashes. Note: Given the variations in the definition of safe driving as well as measures used, it is difficult to compare findings across studies.

Specifically, Owsley and colleagues (2003) investigated whether a one-on-one educational curriculum changed older adults' self-perceptions about the quality of their vision, general attitudes towards driver safety and avoidance of challenging driving situations. In this study, 365 older drivers, aged 60 years and older who were visually-impaired and had a restricted UFOV as indicated by a score of 40% or greater on the UFOV test were randomly assigned to one of two groups. The experimental

group received an educational curriculum to promote safe driving in two sessions and a comprehensive eye examination: the control group received the eye exam. The first session consisted of a two-hour discussion about the participant's self-awareness of his or her visual impairment and results of the eye examination. This session included a slide presentation of eight hazardous driving situations (i.e. on coming traffic left-turn), followed by a discussion of the presentation and safe driving strategies. One month later, the second session consisted of a one-hour review of information covered in the first session and a discussion of progress on driving strategies. Before randomization, and six-months following, both groups responded to a questionnaire administered by a blinded interviewer. Outcome measures included: 1) an item from the National Eye Institute Visual Function Questionnaire-25 (NEI-VFQ-25) assessing *self-rated eyesight* (Mangione et al., 1998), 2) a subscale of the Driver Perceptions and Practices Questionnaire (DPPQ) (Stalvey & Owsley, 2000) assessing *attitudes toward driver safety* and *self-regulatory practices* (i.e. wait until rain stops before driving) and, 3) a subscale of the Driving Habits Questionnaire (DHQ) (Owsley, Stalvey, Wells, & Sloane, 1999) regarding *self-perception of driving difficulty*, *driving avoidance*, *driver dependency* and *driving exposure*. With regards to self-rated eyesight, significant results were found indicating that at post-test, those who participated in the intervention were more likely to acknowledge they had poorer eyesight versus the control group. In addition, those in the intervention group reported more difficulty with visually challenging driving situations. Participants in the intervention group reported more frequent performance of self-regulatory practices; more frequent avoidance of hazardous driving; did not increase their dependence on others to drive; and reduced their driving exposure. The authors suggest that an

educational program tailored for the needs of a specific high-risk, older driver population may be a promising primary prevention initiative that needs further research.

In a similar study, Owsley and colleagues (2004) again investigated the impact of an educational program. Four hundred and three drivers 60 years and older, with similar inclusion criteria as the previous study (Owsley et al., 2003), were randomly assigned to one of two groups. The experimental group received an educational curriculum to promote safe driving and a comprehensive eye examination. The control group received the eye exam. The educational curriculum, already described in detail in Owsley and colleagues (2003), was similar to that provided here. Both groups underwent baseline screening and follow-up using a questionnaire administered by telephone every six months for two years. Specifically, the driving exposure section of the Driving Habits Questionnaire (Owsley et al., 1999), a valid and reliable instrument, was used to collect information regarding estimates of driving exposure, self-regulatory practices and self-reported avoidance of challenging driving situations (e.g. left turns) at each follow up. In addition, a subscale of the Driving Perception and Practice Questionnaire was used at the 6- and 18-month follow-up, to assess the frequency with which participants performed eight self-regulatory strategies. The primary outcome of interest was crash involvement as obtained from accident reports. Both groups reported declines in mileage, with the decline in the experimental group being significantly greater ($p=.02$). The experimental group reported increased driving avoidance and self-regulatory behaviors compared to the control group ($p<.00001$). Both groups declined in average number of days driven and average trips

taken per week, with no significant differences between groups. Crash rates did not differ between groups, when measured in person years or person-miles. Numerous strengths of the study included the use of blind examiners, standardized outcome measures and the use of intention-to-treat analyses. The sample size was larger than in most other studies, but still quite small to identify differences in crashes, given the expected prevalence rates. Furthermore, as noted by the authors, causes of crash are multi-factorial and the study of reducing crash rates is complex.

Bédard and colleagues (2004) evaluated the effectiveness of a driver re-training program. Sixty-five participants aged 55-to-86 were block randomized, based on their scores on a first driving evaluation, age, and gender, to either the intervention group (two half-day sessions for three-hours each of the 55-Alive program adapted by the Canada Safety Council) or control group (no treatment until after they had completed the second driving evaluation, following which they received the 55-Alive intervention program). Topics covered in the program included: self-assessment, vision/hearing, normal driving situations, hazardous driving environment, driver guidance, the vehicle, alcohol and medication, and driver decisions. Participants were mixed with members of the general public who were also taking the course and the three instructors were blind as to who in the group was a study participant. The primary outcome of interest was the scores on a 35-minute on-road driving assessment performed on a standardized driving circuit. The evaluation mimicked the Ministry of Transportation licensing exam. An experienced evaluator, who was blind to group allocation, scored performance from 0-to-100. Scores of 70 or greater were considered a "pass". Serious errors resulted in an automatic "fail". While both the

control and experimental group exhibited improvements between the first and second evaluation, the difference between the control and intervention groups at the second evaluation did not reach statistical significance. There was a strong effect of instructor, although not significant, that suggests that instructors and their individualized style of teaching may impact on outcomes.

McCoy et al. (1993) as described earlier in detail, showed that a driver education program based on the AAA Safe Driving for Mature Operators, a combination of physical therapy and driver education, and a combination of perceptual therapy and driver education, along with the other interventions (physical therapy, perceptual therapy, and traffic engineering improvements), were equally effective in improving driving performance and superior to no treatment.

Janke (1994) used driving records of five cohorts (1988-1992) to evaluate a Mature Driver Improvement (MDI) program in California by comparing crash and citation rates of course graduates and comparison drivers. The MDI program consisted of a 400-minute classroom driver improvement course that included topics on age-related physical changes and driving performance, rules of the road, effects of medications and alcohol on driving performance, trip planning, and handling hazardous conditions. Upon completion of the course, participants were entitled to receive automobile insurance premium reductions for the next three years. The MDI group consisted of drivers aged 55 and older selected from the years 1988 to 1992, called here as graduates. The comparison group, obtained randomly from the department's automated driver files, consisted of drivers aged 55 and older who had never taken the

course. The comparison group drivers were assigned the same reference dates as those in the MDI group. In all five cohorts, 6-month post-course driving records for that year's cohort and an 18-and 30-month follow-up on driving records, were analyzed in two ways. In the first analysis, the groups were compared on unadjusted (raw) rates per cohort on total accidents, fatal and injury accidents combined, and total traffic citations. In the second analysis, rates were adjusted to correct for group differences in age, gender, license class and prior driving history. Analysis of the unadjusted rates showed that the MDI group had significantly lower citation rates across cohorts and time intervals. However, there were no significant differences on total accidents, nor on total fatal/injury accidents between the MDI and comparison groups. The authors suggest that completion of the MDI course may have increased graduates' knowledge of traffic laws and their confidence behind the wheel. This may have helped graduates to reduce the number of citations and prompted them to both increase the amount of driving and thus increased their exposure to challenging driving situations.

Eby and colleagues (2003) used a pre- post- study design to evaluate the effects the "Driving Decision Workbook" (Eby, Molnar, & Shope, 2000), on self-awareness and general driving knowledge in a convenience sample of 99 licensed drivers aged 65 and older. Participants completed the workbook, a self-assessment instrument specifically for older drivers, covering driving-related issues on vision, cognition, reaction time, crashes, traffic citations, medical conditions and medications, then completed a questionnaire and performed a road test, all over the course of one day. The questionnaire included 27 items to identify self-reported increases in self-

awareness and general knowledge after completing the workbook, and perceived usefulness of the workbook. Information on socio-demographics and current driving habits was also collected. The 15-minute road test included a 7-mile course with 28 structured maneuvers. Post-intervention, 75% of participants reported being more aware of changes that could affect driving and 14% reported that they had discovered a change in themselves that could affect driving, of which they had not previously been aware. Moreover, when asked on a four-point scale, to indicate the overall usefulness of the workbook, 50% indicated that the workbook was "very useful" while 40% indicated that it was "somewhat useful". Scores on the workbook were positively correlated with road test scores. The authors suggest that while these are preliminary findings, future study on the use of the workbook as an intervention is warranted.

DISCUSSION

Evidence-based practice is the judicious use of current best evidence in making decisions regarding health care interventions (Bury & Mead, 1998). In the case of older drivers, there is a pressing need for interventions aimed at safe driving and crash prevention. As the results of the reviewed studies suggest, the use of skill-specific training may play an important role in re-training driving skills of older adults. The evidence-based recommendations to rehabilitation specialists regarding strategies to include in a driving retraining program for older adults based on current evidence include: 1. physical training involving range-of-motion exercises to enhance flexibility and driving related skills such as observing (observing to the rear, side, mirrors, over the shoulder etc.); 2. visual perception training to enhance psychomotor skills and

driving related skills and; 3. an educational intervention for well elderly to increase general driving knowledge and driving related skills.

Interestingly, what has not been explored fully is the benefit of a multi-faceted educational, motor, sensory and cognitive intervention program using components that individually have been shown to be reasonably effective in improving driving behaviors. Given that the task of driving involves a complex interplay of vision, cognition, and physical function, the need for such studies is clear. We are currently conducting the first phase of a pilot study to construct and evaluate the feasibility of providing a multi-faceted driving safety program, Stay SHARP (See, Hear, Attend, Respond, Perform) that is focused on retraining specific driving skills in seniors.

CONCLUSION

The current evidence on the effectiveness of retraining interventions is sparse but sufficiently encouraging to warrant further investigation of rehabilitation interventions aimed at older drivers. Given the prevalence of this population and the seriousness of accident related mortality and morbidity, the research agenda in this area requires much greater attention and at a much quicker pace.

IMPACT ON INDUSTRY

The older adult population is growing, and will continue to increase in the future. If an effective driving retraining program can be created for widespread use by the well elderly, this should reduce traffic violations, motor vehicle crashes, injuries due to accidents, and costs associated with insurance claims and health care expenditures. It

is estimated that nearly 28,000 vehicle related injuries occur in the 65 years and older age group (NHTSA, 2002) annually in the US and that the average cost per motor vehicle injury is approximately $58,500 US (National Safety Council, 2004). Extrapolating to the population of older drivers, if an effective intervention program reduced motor vehicle crashes by 10% annually, this would lead to a $163.8 million US reduction in direct costs of motor vehicle crashes.

This area of research and practice has relevance to numerous stakeholders, including the general public who have a growing concern for safety in light of horrific accidents that have received widespread media attention, seniors who place high value on preserving mobility and are indignant about suggestions that they are unsafe drivers, the health care system that is becoming increasingly burdened by this group of drivers, and the insurance companies who could begin to consider incentives for those seniors who participate in evidence-based interventions that enhance safe driving behaviors.

Table 4.1: Summary of studies and ratings

Author/ Year	Study Design	Population characteristics	Intervention	Outcome Measures	Change	PEDro Score
Ostrow et al., 1992	RCT	38 older adults (aged 60-85)	Intervention group: 8 weeks range-of-motion training program + daily log Control group: Daily log	-Flexibility -Driving performance	-Three outcomes, trunk rotation and shoulder flexibility at 8 and 11 weeks; and in-car observing at 11 weeks, significantly better in experimental group following intervention -Control group significantly better improvements in handling position at 8 and 11 weeks compared to experimental group	5
McCoy et al., 1993	RCT	95 older adults (aged 65-88)	Intervention groups: Physical therapy Perceptual therapy Driver Education Traffic Engineering Improvement Control group: No intervention	-On-road driving performance	-All experimental groups with the exception of the perceptual therapy subgroup (N=4), showed significant improvements in driving performance compared to control group ($p<0.15$) -Sub-group comparisons: those exposed to traffic engineering improvements did significantly better on road test versus those tested without traffic engineering improvements (with exception to perceptual therapy group)	4
Janke et al., 1994	Descriptive comparative study	Driving records of 5 cohorts (1988-1982) of drivers aged 55 and older	Intervention group: Mature Driver Improvement (MDI) Program in California Comparison Group: Those that did not participate in the program	-Total accidents -Fatal/Injury accidents -Total traffic citations	-Unadjusted rates: MDI group significantly lower citation rates across cohorts and time intervals -No significant differences on total accidents, nor on total fatal/injury accidents between MDI and comparison groups.	No score
Eby et al., 2003	Pre-post study design	99 licensed drivers (aged 65 and older)	Driving Decision Workbook	-Self awareness and general driving knowledge	-75% report being aware of changes that affect driving -14% report changes in themselves -50% indicate the workbook was "very useful", while 40% indicate it was "somewhat useful"	No score
Owsley et al., 2003	RCT	365 individuals with visual acuity between 20/30 and 20/60, and restricted UFOV (score of 40% or greater on UFOV test) (aged 60 years and older)	Intervention group: 2 session Educational curriculum + comprehensive eye examination Control group: Comprehensive eye examination	-Self-perception about quality of vision -General attitudes toward driver safety -Avoidance of challenging driving situations	-At post-test, intervention group more likely to acknowledge they had less than excellent eyesight compared to control group -At post-test, intervention group reported more difficulty with visually challenging driving situations -No significant differences between the two groups regarding attitudes about general safety issue -At post-test, intervention group reported more frequent performance of self-regulatory practice; more frequent avoidance of hazardous driving; did not increase their dependence on others to drive; reduction in driving exposure compared to control group	5

Author/ Year	Study Design	Population characteristics	Intervention	Outcome Measures	Change	PEDro Score
Roenker et al., 2003	RCT	Total of 104 individuals (mean age of 71 years): 77 individuals with UFOV decline 27 individuals with no UFOV decline	"High-risk" Intervention Group: 4.5 hours of speed-of-processing training "High-risk" Control group: 4 hours of simulator training "Low-Risk" Control group: No training	-Psychomotor performance -Driving performance	-Significant UFOV reductions in all three groups from baseline to post-training, with "low-risk" control group having significantly smaller reduction that the other two groups. -Speed-of-processing group significantly better UFOV score as compared to simulator trained group -Both speed-of-processing group and simulator group improved on driving evaluation -Significant decrease in number of dangerous maneuvers for speed-of-processing as compared to simulator training -Simulator group significantly better scores on two driving performance measures (turning into correct lane and using proper signaling)	4
Bedard et al., 2004	RCT	65 participants (age 55-86)	Intervention group: two half-day sessions for three hours each of educational curriculum Control group: No educational curriculum	-Driving performance	-Both control and experimental group exhibited improvements between the first and second evaluation -Difference between the control and intervention groups at second evaluation not statistically significant	6
Owsley et al., 2004	RCT	403 older adults who had visual acuity deficits or slowed visual processing speed or both who were involved in crashes in the previous year (age 60 years and older)	Intervention group: 2 session Educational curriculum + comprehensive eye examination Control group: Comprehensive eye examination	-Safe driving strategies	-Both experimental and control group reported declines in mileage, with the decline in the experimental group being significantly greater (p=.02) -Experimental group reported increased driving avoidance and self-regulatory behaviors compared to control (p<.00001) -Both groups declined in average number of days driven and average trips taken per week, with no significant differences between groups	6

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5. INTEGRATION OF MANUSCRIPT 1 AND 2

Typically, once an older driver has been deemed an unacceptable safety risk, there is little or nothing he or she can do to acquire or restore the abilities required to safely operate a motor vehicle. Until recently, research has put very little attention on developing, and evaluating the effectiveness of methods to enhance driving abilities. The systematic literature review from the first manuscript provides a synopsis of the limited scientific evidence regarding the effectiveness of retraining programs for older drivers. Overall, the results suggest that the use of skill-specific training may play a critical role in the re-training of driving skills of older adults. Given that the task of driving involves a complex interplay of vision, cognition, and physical function, rehabilitation professionals should investigate the content and feasibility of offering a multi-modal intervention based on retraining driving skills in older drivers. Research on this topic of interest would provide rehabilitation professionals with the information they need to address safe driving in older adults. Yet, to our knowledge, no study has explored the perception of older individuals regarding skill-specific driver training or the factors stimulating their interest and participation in such an intervention or program. Hence, the second manuscript of this thesis presents the results from three focus groups exploring: (a) activities older adults use driving for; (b) when and where older adults typically drive; (c) importance of driving to older individuals; (d) how driving habits and behaviors change as people get older; (e) driving habits and behavioral changes observed in older friends and relatives; (f) driving changes/difficulties they notice in themselves and (g) factors stimulating interest and willingness to participate in a driving safety program.

6. OLDER INDIVIDUALS' PERCEPTIONS OF DRIVING AND A REFRESHER PROGRAM

6.1 MANUSCRIPT 2

OLDER INDIVIDUALS' PERCEPTIONS REGARDING DRIVING: FOCUS GROUP FINDINGS

Ailene Kua, BA, MSc Student (Rehabilitation Science), Nicol Korner-Bitensky, PhD, OT(c), and Johanne Desrosiers PhD, OT (c)

Manuscript accepted by the Physical & Occupational Therapy in Geriatrics

The purpose of this paper is to present the results of three focus groups exploring: activities older adults use driving for, when and where they drive, importance of driving, perceived driving habits, behavioral changes as people age, and factors stimulating interest and participation in a driving program.

Communication addressed to: Ailene Kua
School of Physical & Occupational Therapy
McGill University
3630 Promenade Sir-William-Osler
Montreal, Quebec, H3G IY5, Canada
ailene.kua@mcgill.ca
Telephone: (514) 398-5457
Fax: (514) 398-8193

ABSTRACT

This paper presents the results of a focus group study exploring older individuals' perceptions of skill-specific driver training and factors stimulating interest and participation in a driving program. Three focus groups (n=18) were conducted with former and current drivers, 75 years and older, living in Montreal, Canada. Participants were enthusiastic about a driving program and provided recommendations including program content such as: traffic law refreshers, retraining of driving-related skills, and on-road driving training/evaluation. This focus group research is the first step in developing effective and practical driving interventions for healthy older drivers based on their desired needs and interests.

Key words: older drivers, focus group, driving rehabilitation

INTRODUCTION

The ability to drive an automobile is a central aspect of independent living for many older adults (Ragland, Satariano, & MacLeod, 2004). In the United States, those over the age of 65 numbered 35 millions in 2004 and this figure is expected to double by the year 2030 (Insurance Institute for Highway Safety, 2004). As the number of older individuals increases, so will the number of older persons holding driving licenses. This trend is a major concern given that drivers aged 65 and older experience a higher annual driving related fatality rate per miles driven than any other age group except individuals aged 25 and under (National Highway Traffic Safety Administration [NHTSA], 2004). By the age of 70, the accident rate per miles driven rises, with an even more rapid increase at age 80 (NHTSA, 2004).

Much of the research in the field of driving and the elderly has focused on accident situations in which older drivers are over-involved (Evan, 1991; Hakamies-Bomqvist, 1993; Hakamies-Blomqvist, 1994), and in studying deficits in physical, perceptual, and cognitive abilities that impact on safe driving (Gresset & Meyer, 1994; Johnson & Keltner, 1983; Morgan & King, 1995; Owsley, Ball, Sloane, Roenker, & Bruni, 1991). While this work has brought a clearer understanding of older drivers' crash-involvement patterns, and factors associated with driving reduction and cessation, little attention has been placed on developing and evaluating methods to enhance driving abilities. Typically, once an older driver has been deemed an unacceptable safety risk, there is little or nothing he or she can do to acquire or restore the abilities required to safely operate a motor vehicle. Yet, skill-specific training interventions may play an important role in retraining driving skills in older adults.

A number of driving related interventions for seniors have been studied, most quite recently. A systematic review (Kua, Korner-Bitensky, Desrosiers, Man-Son-Hing, & Marshall, accepted) of studies investigating skill-specific retraining interventions for older adults revealed few studies. Of the eight existing English language studies, three have looked at the benefit of an educational curriculum (Bédard, Isherwood, Moore, Gibbons, & Lindstrom, 2004; Janke, 1994; McCoy, Tarawneh, Bishu, Ashman, & Foster, 1993), two explored an educational curriculum in combination with a comprehensive eye examination (Owsley, Stalvey, & Phillips, 2003; Owsley, McGwin, Phillips, McNeal, & Stalvey, 2004) while one studied the value of a" Driving Decision Workbook" on improving self-awareness and general driving knowledge (Eby, Molnar, Shope, Vivoda, & Fordyce, 2003). In regards to visual-perception retraining, Roenker and colleagues (2003) investigated the use of speed-of-processing training and simulator training on psychomotor performance and driving performance in older adults, while McCoy et al. (1993) investigated the value of using perceptual therapy along with driver education. Physical retraining interventions have also been investigated, with resultant improvements in trunk rotation, shoulder flexibility, vehicle handling and observational skills (Ostrow, Shaffron, & McPherson, 1992), and improved on-road driving performance (McCoy et al., 1993). Overall, the results suggest that the use of skill-specific training may play a critical role in the re-training of driving skills in older drivers. Yet, to our knowledge, no study has explored the perception of older individuals regarding skill-specific driver training or the factors stimulating their interest and participation in such an intervention or program. Therefore, the current study was undertaken to explore: types of activities older adults use driving for; when and where older adults typically drive; older adults perception of

how important driving is to them and other older individuals; how driving habits and behaviors change as people get older; driving habits and behavioral changes and difficulties observed in older friends and relatives and in themselves; and, factors stimulating interest and willingness to participate in a driving safety program.

METHODS

Three focus groups were designed around need assessment and program development (Morgan & Krueger, 1997). Focus group methodology was chosen as it typically leads to insights beyond those that are attained through individual interviews (Morgan & Krueger, 1997). Also, by using a structured format, participants are able to discuss topics that are most relevant to them, thereby providing insights into the issues they deem important (Stewart & Shamdasani, 1990) and to provide a context for their comments, which is not possible in other forms of survey research. In this study structured focus group methodology included five steps: development of questions around the domains of interest; structured group discussions; focus group/research team debriefing; transcription of discussions; and analyses/report preparation for use by the research team. Focus groups were held until no further new ideas were generated, that is, saturation had occurred. The Research Ethics Board of McGill University Montreal, Quebec, Canada, approved the study.

Development of Questions

After reviewing the literature specific to the fundamentals needed for safe driving, and the research on remediation strategies, the research team devised a list of questions to guide the focus group discussions. To validate the questions, five experts including

researchers, occupational therapists (OTs), and physicians, involved with seniors and driving related studies, reviewed the questions and suggested modifications, additions, and clarifications. The final series of questions included two main themes. The first series was used to elicit information on driving including: what type of activities they used driving for; when and where participants typically drive; driving behaviors and how they change as people get older; and driving concerns and difficulties they personally encountered or observed in other older drivers. The second series related to factors that might potentially stimulate interest and participation in a driving safety program including questions related to the types of activities, and the timing, frequency, location, and group size of a program or intervention.

Participant Recruitment

Potential participants were recruited from senior community centers and doctors' offices throughout Montreal, Canada. With permission, posters were posted on their bulletin boards. In addition, coordinators in seniors' centers were asked to announce the focus group project to staff and visitors as well as to distribute information letters to invite participation. Participants were required to be 75 years and older; hold a current valid driver's license or have been a driver in the recent past; speak English; and, reside in Montreal or surrounding suburbs. Interested older individuals were asked to call the project telephone number for more information. The research coordinator, once having been contacted by a potential participant, screened for eligibility and further described the project and time commitment. Those who agreed were asked to specify their availability to participate in a two-hour session. A follow-up telephone call one day prior to the focus group reminded the participants of the

focus group location, time and date and confirmed their attendance. Participants were paid a small honorarium to cover travel expenses and parking.

Focus Group Session

All three focus groups were conducted at McGill University, Montreal, Canada, and each was two hours in length. Participants provided informed consent. An experienced moderator led the group along with two assistants. The moderator began each session by clarifying the purpose of the study and by explaining the key components of focus group participation including the equality of all members and the importance of confidentiality. The moderator then posed each prepared question. As the participants discussed their comments, feedback and suggestions, one assistant audio-recorded and took field notes, while the second used a large flipchart, viewable by all participants, to record their comments. Once participants indicated they had said all they wished to say regarding a specific question, the comments related to that question were read back to the group to ensure that the essence of each discussion point had been captured. This enabled the participants to review and validate the written text while their comments were still fresh in their minds.

Immediately following completion of the focus group, the moderator and assistants met to debrief and share their perceptions of critical points. The tape-recorded discussions for each focus group were then transcribed by one of the assistants. Content-based analysis techniques were used to identify emerging themes and key points related to each question. Relevant quotes and/or statements that depicted themes were categorized according to topic areas and conclusions drawn based on the

tallied comments as reviewed by the focus group leaders. Finally, to help illustrate themes, the research team selected participants' salient quotes to report (Morgan & Krueger, 1997).

RESULTS

Participants

Twenty-five individuals agreed to participate; seven did not attend citing various reasons including a fear of losing their driver's licence (n=3), and four because of illness or scheduling conflicts. Table 6.1 lists demographic data for the 18 participants. The majority of them are male (n = 14) and actual drivers (n = 16). Their age varies from 75 to 85 years.

[Insert Table 6.1 here]

Driving

Focus group participants were first asked what types of activities they used driving for. Responses included: day trips, out of town trips (especially very long trips), trips where the buses and trains are not convenient such as visits to the suburbs where family and friends live, shopping, to transport heavy loads, part-time or full-time employment, and personal appointments such as visiting family, health related appointments, daily errands, social outings, and volunteering. A recurrent theme was driving, rather than walking or using alternative forms of transport, when having to transport heavy objects such as groceries or pharmacy orders.

When asked when and where they typically drove, responses included a wide variety of answers with some indicating that they drive, anytime (day and evening), anywhere (city streets and highways, in-town and out-of-town). "On *highways, in the evening, when it's raining...I drive through anything, anywhere and anytime*" *(Participant 8).* Participants also indicated that they drive (rather than walk) when weather conditions are bad, when the destination is far and not within walking distance, and when there are no alternative modes of transportation to reach the destination. *"Under bad weather like ice or rain, I would drive. I would rather drive because I fell down once and it's safer than walking" (Participant 11).* Others indicated they avoid the following driving conditions: night driving when visibility is difficult; prolonged hours of driving; peak traffic periods; and bad weather conditions such as fog, heavy rain or snow.

When asked to discuss the importance of driving in their lives, participants indicated that driving permits accessibility to a wide range of destinations- the ability to go anywhere at any time. *"I drive to get from point A to B" (Participant 4). "Driving saves me time...I can do all the things I need to do in a day" (Participant 14). "Driving is freedom to go wherever I want to go...freedom to choose when to go" (Participant 8).*

Most associated driving cessation with a loss of independence and decreased quality of life. "I *have grandchildren that live far and it's scary when I can't reach them because I can't walk to get to them...driving is my lifeline" (Participant 3). "I have friends in the suburbs...you lose your friends without a car. As you get older you need*

your friends more and you don't want to lose them" (Participant 4). "The car is mobility. When people move to the suburbs, it costs a lot to get there by taxi, and you lose friends without a car because you cut those ties" (Participant 1).

Generally, participants suggested that cessation added a burden on family members and friends- a burden they do not want to impose. They identified several negative factors when accepting rides: feelings of being a burden, schedules or routes of drivers that did not meet their needs as passengers. For example, one participant who was forced to discontinue driving for a period of time indicated: "*When I couldn't drive, I needed someone to drive me to places and pick me up. Everything is centered on the car; I couldn't do anything without it. I have grandchildren here and there and I can't reach them and that's scary" (Participant 3).* Another participant who couldn't drive for six months indicated: *"I got sick and depressed when I lost my friends. It also interrupted my hobby when I couldn't drive. My hobby is wood carving and I need the car to get materials" (Participant 4).* Interestingly, for the two former drivers, walking and taking the bus were modes of transportation to which they had learned to adapt. "*I use the bus or walk to visit my friends. You change your lifestyle to fit" (Participant 5). "I walk everywhere. I don't drive and if I want to visit family or friends, I take the bus" (Participant 2).* The statements were made with a sense of pride in being able to be mobile without a car.

Driving Behavior

When participants were asked if they thought driving habits and behaviors change as people age, and if yes, how so, most participants indicated that driving habits and

behaviors do change as people get older, and that older individuals accommodate for these changes to feel more confident on the road. For example, a common theme amongst participants was being more cautious on the roads. *"I'm more aware and drive more cautious" (Participant 9). "I get less aggravated by the honkers. I figure they are just in a hurry and let them go ahead of me. I used to get mad but I don't anymore" (Participant 14). "I'm just slower in city driving. I take my time but don't hold up traffic" (Participant 9). "I've had two accidents before.... In February when it was slippery, my neighbor said, "on a day like this I would take the bus". I should have listened to her. I've changed my driving behavior since" (Participant 14). "My coordination isn't as it was, as a result of that; I drive more defensively and cautiously. I don't count on the other person to do the right thing" (Participant 1).*

In addition, a consistent theme in all three focus groups was the need to plan ahead. The majority of participants indicated they now plan their route (especially unfamiliar ones) ahead of time to familiarize themselves with street names and distance between exits or turns. *"When I'm going out of the city, I need a map" (Participant 4). "I need to plan what streets I am going to take before I leave the house" (Participant 6). "I need to get organized before I start. I need to know which lane I have to be in" (Participant 1).* A number expressed that when they do not plan ahead, they feel anxious and lack confidence in driving. *"I feel confident when I know where I am going; I don't want to wait until the last minute because it shakes me" (Participant 3). "I need to plan ahead or modify my travel route to control my stress level" (Participant 9).* In addition, a number of participants indicated they found it important to leave early for social activities, functions and appointments to provide

plenty of time for unforeseen situations such as traffic conditions or parking challenges. *"If someone gives me an appointment, I try to arrive earlier" (Participant 13). "I just don't know what traffic or parking is like, so I give myself plenty of time" (Participant 14).*

When asked to think about older friends or family relatives and if they have noticed any having difficulties or that they perceive to be dangerous drivers, participants reported a multitude of responses. Some indicated there were friends with whom they would no longer drive. Others indicated that older adults drive more cautiously, or at inappropriate speeds, either too quickly or too slowly. *"They are more aware, more cautious when driving" (Participant 12). "Older people are aware of other people on the roads...they follow the rules of the road and are cautious" (Participant 11). "A person driving with less patience is a dangerous driver. Some are driving too fast" (Participant 5). "My brother has no patience, he drives too fast" (Participant 2). "My friend drives too slow and he drives slow consistently" (Participant 3). "There's a danger in driving too slow...they should stay away from the highway" (Participant 16). "When I see older people driving cautious, slow, I am critical of those who should be walking or taking the bus" (Participant 1). "I see them hesitating at stop signs, red lights and working areas because they are scared. They should not be in the driver's seat" (Participant 8). "They hold up traffic" (Participant 9). "Some of them should not be on the road anymore" (Participant 12).*

Driving Difficulties with Age

When asked to think back over the past two years and indicate if they have noticed any changes with their driving, participants reported difficulties with reduced vision particularly in the evening, and slower response times (such as movement and reflexes). *"As we get older, we are not as fast" (Participant 7). "Now that I'm older, I have slower movements, I can't move as easily" (Participant 11). "I drive 10 miles slower at night to adjust for vision" (Participant 14). "I have a little more difficulty at night" (Participant 18).* Reading road signs at a distance was a commonly reported difficulty. A number stated that road signs were not always clear or visible, and that there is a need for both larger street signs and advanced warning signs to give drivers enough time to slow down and be in the proper lanes. *"There are a lot of streets where the street signs are not visible. We need them (visible signs) so we can slow down and we don't have to stop at the last minute" (Participant 3). "When I go on trips and I'm not sure, I'm really nervous and I make people nervous too... Our signs don't give as much warning" (Participant 1).*

Other concerns and difficulties with driving included: costs of owning and operating a car such as insurance, maintenance and high gas prices, and unsafe and aggressive behaviors by other drivers. As one participant indicated, the joy of driving had disappeared. *"Driving became utilitarian- became more automatic and more dangerous. Other people have that urgency and motivation to get to their destination before me" (Participant 1).* Another participant indicated, *"I let them go ahead of me and stay put; and meet them at the next light" (Participant 16).* There was also a

sentiment that driving, in general, has changed with drivers being more reckless, discourteous and dangerous on the road.

Driving Program

The second series of questions focused on the possible development of a driving program and the perceptions that participants had regarding the creation of such a program. First the rationale for a driving program and a description of potential components were presented. Specifically, participants were informed that while some skills needed for operating a motor vehicle (such as vision, motor, sensory) show age-related declines that are inevitable, others such as visual-perception and response time, can be retrained with intervention. In light of this, a good number of participants indicated an enthusiasm for the concept of a driving program to refresh skills necessary for safe driving in older adults and indicated that such a program would be "important". Some of the reasons expressed included: "*I think it's important. The idea is to break yourself from old habits if they are not good" (Participant 7); "I would do it (the program); I don't want to lose my confidence" (Participant 3); "I would go because I want to keep driving" (Participant 7); "I think it's important to inform or remind ourselves of the rules of the road" (Participant 6).* A large number of participants were so enthused by the concept of a program that they wanted to "sign up" even though the focus group leader indicated that such a program did not currently exist.

When asked about the content that would be important to include in a driving program, participants concurred that, "*it depended on the individual - something that*

the individual could relate to (i.e. information and skills training) and enjoy" *(Participant 8)*. Some recurrent and common themes included an interest in: refresher education on traffic laws and rules of the road, retraining driving skills such as response time and flexibility, blind spot scanning, compensatory strategies, and defensive driving techniques. Most participants were not opposed to the idea of using videos or computer-based software for some of this education, but there was some concern about being computer illiterate: *"A touch screen computer activity would be good. Some people don't know how to use the computer and are not comfortable with the keyboard" (Participant 8)*. For the most part, they indicated that exercises pertinent to driving safety such as trunk and neck flexibility training would be interesting, and other educational materials related to safe driving would be helpful. *"A driving program to help us on the road and train reflexes, I think it's very interesting and encouraging" (Participant 11)*. In addition, a number of participants suggested that instructions on how to properly use equipment, for example, the proper adjustment of side mirrors, would be very useful. *"People have been driving for years, but cars and rules change over the years. We didn't take any driving lessons back in the days and we need ways to train safety" (Participant 11). "We've learned to drive over 50 years ago, but as we get older the world changes" (Participant 1). "Back in the days we didn't have turn signals, we stuck our hands out of the window to signal where we want to go" (Participant 16).* Furthermore, some participants indicated that an on-road driving component would be important for them, especially if they could be observed by an expert and given feedback about their driving and where they could improve.

Another recurrent theme was the need for an objective, comprehensive clinical assessment and on-road evaluation by a trained and licensed professional to determine fitness to drive. *"I would like to drive for about an hour with someone in the car so they can evaluate how well I drive, and tell me if it's safe or not safe to continue driving" (Participant 3). "I would like to know where my weaknesses are in driving" (Participant 8).* In addition, participants discussed the lack of validity of current driving evaluations by health practitioners and the importance of more rigorous evaluation process. *"There was an exam at approximately 75 years old. If I didn't go I would lose my license. The ophthalmologist and physician assessed my general physical condition and eyesight. I think this is important; I have a friend with a change in eyesight and he was able to continue to drive. It wasn't safe, I don't know how he passed the test" (Participant 6). "I know a lot of people who passed the test (license renewal for seniors), that shouldn't have" (Participant 8). "Some people have major eye problems or medical conditions. Even though they have a problem, they pass the test and will continue to drive" (Participant 7). "As you get older, people think you need to be handled in a gentle, civilized way because you are older. I would prefer a specific, hard edge test. We can't afford it with the safety of others on the road...three strikes won't work, it's either you can drive or you can't" (Participant 1).* Participants also thought that it would be interesting if a refresher program provided feedback regarding driving related performance, for example, response time scores, so that older drivers (or their family members), could compare results from one session to another, or use the results to make decisions regarding the need for further training or evaluation.

In regards to other components of the program such as timing, the participants consistently expressed a preference for a program offered late in the morning (11:00 am) or early in the afternoon (1:00 pm), with none preferring evening or suppertime hours. *"In the morning like 11 am to the afternoon would be good" (Participant 17). "Not during rush hour" (Participant 13). "Daytime to afternoon. After lunch is good and 5:00 pm is late" (Participant 10).* The participants also stated that depending on the length (approximately one-to-two hours) and intensity (four-to-six weeks) of the program, they would attend the program one-to-two times per week, with most indicating once a week as the preferred frequency. Most indicated that it was hard to answer these questions because much of the decision would be based on how much they felt the program benefited them and how much enjoyment or value they gained from the program. *"It depends on the person because some will need more or some will need less" (Participant 8). "It depends if this is something interesting or not. It's time based on enjoyment" (Participant 7).* Interestingly, none of the participants indicated a preference for a one-on-one program – rather, all preferred the idea of a group session, with a group of eight-to-ten people generally thought to be ideal. *"I would prefer a group session. It would be nice to meet new people" (Participant 7).*

Participants were also asked to spend time discussing the impression that older drivers would have of a driving program and the appropriateness of various names for the program. Most thought the program name should suggest some form of "refresher" course and not "retraining" as the latter was perceived to be more offensive and could potentially scare people away, especially those fearful of losing their driving privileges. Participants also thought that the program should be advertised as having

neither a connection with the licensing bureau, nor any impact on participants' driving privileges. *"If they think they will lose their license, they will not come" (Participant 6). "I think you should say something to people that will not frighten them. You should make them feel ok...for example, tell them that you will not be involved with the licensing bureau or that their name will not show up anywhere that can affect their license" (Participant 7).*

Finally, participants were asked to suggest possible locations where the program could be held. Participants stated that an easily accessible location where parking is not difficult would be highly preferable. In addition, the program environment should include space to assess and practice on-road driving skills. Participants suggested that shopping malls and senior community centers would be ideal because of the large parking areas as well as the familiarity and comfort level older individuals have with such locations. *"How about shopping malls where there is a big parking lot" (Participant 11). "Parking is a big issue; you need a place that has an easy access. If you have a place where there is parking, people will come" (Participant 14). "Senior community centers would be good- a lot of them go there" (Participant 9). "If you need to use a car to take a test, a big parking area to practice driving or evaluate driving would be good" (Participant 6).* A common sentiment was that health care clinics and even a gym would be "scary" and would make older adults feel uncomfortable. *"I don't think health care clinics are a good idea, people will be scared to come" (Participant 6). "Some people are not used to the gym. It could be scary" (Participant 7).*

DISCUSSION

The purpose of this study was to enhance our understanding of the various activities older individuals use driving for, the importance of driving, driving habits and behavioral changes and difficulties as people get older, and factors stimulating their interest and participation in a driving program. The reasons for driving and the times and places older individuals typically drive are consistent with previous work (Rosenbloom, 1993; Marottoli et al., 1997; Marottoli et al., 2000; Ragland, et al., 2004). The reliance on the automobile by older adults is so great that those who are beginning to experience difficulty in driving may continue to drive even when it becomes dangerous for them to do so (Marrottoli et al., 1997). Indeed, in this study, participants indicated that although some older adults drive cautiously, they observe changes in their own peer group that they feel are incongruent with safe driving. In addition, they also observe age-related changes that affect their own driving skills, such as slower reflexes and poor visibility in the evening. Surprisingly, participants expressed some very strong feelings regarding the need for older drivers to either drive safely or get off the road, and to have proper assessments that would be indicative of safe driving.

Our results indicated that focus group participants were very interested in a driving program that would include retraining regarding response time, visual-perception, and driving knowledge. Many indicated a desire to update and refresh their knowledge of the rules of the road because of the length of time, 50 years or more, since they had undergone any driving test or training. Participants also indicated that cars change over time with new technology and there was interest in being trained regarding

modern amenities in the car. Some participants already implement compensatory strategies such as planning ahead and avoiding difficult driving situations, a finding that has also been reported in the literature (Brayne et al., 2000; Carr, 2000; Bauer, Rottunda, & Alder, 2003), but thought it would be important that a program include structured teaching regarding these strategies. Interestingly, the focus group participants referred quite often to planning their route ahead of time to familiarize themselves with street names and distance between exits or turns. This action corresponds to the strategic level as described in Michon's Model of Driving Behavior (Michon, 1985). This Model describes driving as a hierarchical structured task involving three levels: strategic, tactical, and operational (Michon, 1985). The strategic level includes general trip planning such as making decisions about choice of route, or the decision not to drive during bad weather. The tactical level is concerned with the behavior and decisions in traffic, for instance, switching on our headlights when visibility is reduced. The operational level involves carrying out basic actions of driving, such as steering or braking. Without awareness of the Model, participants referred to all three levels and changes they found with age that affected each.

Our study findings are based on a small number of participants. Based on the three focus groups, however, a saturation of themes was reached, making it likely that additional focus groups would reveal little new information. The only exception is likely to be in the area of rural driving: our participants were recruited from a major city and surrounding suburbs and as such may not be representative of older individuals who live in rural communities.

CONCLUSION

In our society, driving an automobile is highly valued (Ragland et al., 2004). There is an emerging role for rehabilitation clinicians and researchers aimed at the retraining or maintenance of safe driving in older adults and individuals with disabilities. This focus group research is the first step in a research agenda aimed at developing effective and practical driving interventions for healthy older drivers based on their desired needs and interests. Given the high prevalence of elderly drivers, this is an area of clinical practice and health promotion that is certain to expand dramatically and rapidly in coming years.

Table 6.1: Participants' demographic data

Participant	Age	Gender	Driving Status
1	78	Male	Driver
2	80	Male	Former Driver
3	84	Female	Driver
4	80	Male	Driver
5	78	Male	Former Driver
6	77	Male	Driver
7	75	Male	Driver
8	75	Female	Driver
9	81	Female	Driver
10	84	Male	Driver
11	75	Male	Driver
12	77	Male	Driver
13	75	Male	Driver
14	76	Female	Driver
15	85	Male	Driver
16	77	Male	Driver
17	83	Male	Driver
18	85	Male	Driver

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7. THESIS SUMMARY

The results of the studies presented in the two preceding manuscripts provide important information for both clinicians and researchers working towards developing and evaluating the effective of driver retraining interventions for older adults. This section summarizes and discusses the main findings from these studies.

The first manuscript was a systematic review of the evidence of effectiveness of older driver retraining. Six RCTs, one pre-post-study design and one descriptive study met the inclusion criteria, one investigating physical retraining, one a visual perception intervention, five using an educational intervention and one examining a combination of all three, in addition to traffic engineering improvements. All included licensed drivers aged 55 and older. In addition, some studies included those with visual acuity deficits, slowed visual processing speed, restricted UFOV, or those who were involved in crashes in the previous year. Outcome measures included: driving performance, safe driving knowledge, flexibility, psychomotor performance, total accidents, and traffic citations or fatal/injury accidents.

In regards to the effectiveness of the interventions, there is limited evidence that physical retraining (Level 2a) and that visual perception retraining (Level 2a) improve driving related skills in older drivers. There is moderate evidence that educational interventions improve driving awareness and driving behavior (Level 1a), but do not reduce crashes (Level 1b) in older drivers. There is a pressing need for evidence-based safe driving and crash prevention interventions for the growing population of older

drivers. The current evidence on the effectiveness of retraining interventions is sparse but sufficiently encouraging to warrant further investigation of rehabilitation interventions aimed at older drivers.

Despite a growing interest in helping older drivers ensure their continued safe mobility, little information is currently available to help rehabilitation professionals develop safe driving and crash prevention interventions or programs. As the results of the reviewed studies suggest, the use of skill specific training may play a critical role in the retraining of driving skills of older adults. Interestingly, what has not been explored fully is the benefit of a multi-faceted educational, motor, sensory and cognitive intervention program using components that individually have been shown to be reasonably effective in improving driving behaviors. Given that the task of driving involves a complex interplay of vision, cognition, and physical function, the need for such studies is clear.

This focus group study explored activities seniors use driving for; when and where they drive, importance of driving, perceptions of driving habits and behavioral changes as people get older, and factors stimulating their interest and participation in a driving program. To our knowledge, no study has explored the perception of older individuals regarding skill-specific driver training or the factors stimulating their interest and participation in such an intervention or program.

Our focus group results provided insight into the reasons that older adults drive and when and where they typically drive. In addition, driving changes and difficulties

such as reduced vision particularly in the evening, slowing response times, and road signs not being clear or visible, were also reported. Our participants indicated an enthusiasm for the concept of a driving program and recommended content such as: refreshers on traffic laws and rules of the road, retraining of driving skills such as response time and flexibility, compensation strategies, and defensive driving techniques. In addition, an on-road driving component and an objective, comprehensive clinical assessment and on-road evaluation by a professional, were also deemed important. Furthermore, participants expressed preference for a program offered between 11am-to-5pm for approximately one-to-two hours, once or twice times a week for four-to-six weeks held at shopping malls and/or senior community centers with large parking areas. They also thought it important that the program name should suggest some form of "refresher" course and not "retraining", and be advertised as having neither any connection with the licensing bureau nor any impact on participants' driving privileges.

The information provided by the focus group participants will be integrated with clinical expertise and available research to construct a multi-faceted intervention, Stay SHARP, which could potentially extend the period during which older adults are able to provide for their own mobility needs with safety and confidence. Our results provide rehabilitation professionals with information on factors stimulating interest and participation in a driving intervention that can be used in designing interventions focused on extending the years of safe driving in older populations.

8. CONCLUSIONS

In our society, driving an automobile is highly valued (Ragland et al., 2004). The current evidence on the effectiveness of retraining interventions is sparse but the result of the systematic review suggest that the use of skill-specific training may play a critical role in the re-training of driving skills in older drivers. Given the prevalence of this population and the seriousness of accident related mortality and morbidity, the research agenda in this area requires much greater attention and at a much quicker pace. The focus group research is the first step in a research agenda aimed at developing effective and practical driving interventions for healthy older drivers based on their desired needs and interests. The potential benefits in terms of increased mobility and safety for older adults, as well as the safety of the general public, are great.

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APPENDICES

APPENDIX 1: UFOV VISUAL ATTENTION ANALYZER

The visual attention analyzer (Ball et al., 1992) is a specially designed software program that presents visual stimuli onto a large computer monitor. This tool tests three components of visual attention: processing speed, divided attention and selective attention. The evaluation is conducted in a darkened room free of distractions.

Processing Speed: This task requires the participants to identify a centrally located object, either a car or a truck, presented in a white box on the computer monitor. The participant must indicate what he or she saw, either a car or truck by touching the appropriate image on the screen after each trial. The duration of the presentation will range from 250 to 12.5 milliseconds. Gradually, the object presentation becomes shorter in duration until the participant can no longer identify which of the objects was presented.

Divided Attention: The participant must identify the centrally presented target and concurrently locate a simultaneously presented peripheral target. The target can appear at any time and be located at various locations (10, 20, 30 degrees of visual angle) and directions (4 cardinal and 4 oblique). Divided attention is tested at decreasing exposure durations, ranging from 240 to 40 milliseconds.

Selective attention: This subtest provides a measure of distractibility by having the participant perform the same task as in the divided attention task, with the addition of visual distracters in the form of numerous triangles. White triangles are presented throughout the screen to evaluate the subject's ability to differentiate the peripheral target from the distracters.

Score: The score for each of the three subtests is automatically calculated by the computer as the percentage reduction form the maximum area of useful field of view. Each subtest scores ranges from 0-30% reduction. The total percentage loss of UFOV is composite of the 3 subtests and can range from 0-90% reduction. The time taken to complete the test is also recorded.

How many people will take part in this focus group?
If you decide to participate in this focus group, you will be one of approximately eight to ten people. We are holding three separate focus groups, so a total of about 30 individuals will participate. The focus groups will be conducted at a designated conference room at McGill University, Hosmer House, 3630 Promenade Sir William Osler (formerly Drummond St.) Montreal, Quebec, Canada H3G 1Y5.

How long will my part in this focus group last?
You will be invited to attend one group session that will last approximately 2-to-2½ hours with a break for refreshments. The group will be held during the day, at a time that is convenient for you.

What will happen if I take part in the focus group?
You will be asked to discuss concerns and difficulties related to driving in old age and factors stimulating interest in a driving safety program for older individuals. No questions will be directed to you individually, but instead will be posed to the group. You may choose to respond or not respond at any point during the discussion. The group leaders will electronically record the session and take notes on a large board so that everyone can follow along and will then read the notes back to you to make sure that they have correctly recorded what you have said. There is no need to read or prepare anything before you come to the focus group. It is your opinions that we are interested in.

What are the possible benefits from being in this focus group?
Research is designed to benefit society by gaining new knowledge. You may not benefit personally from participating in this group. However, the information that is obtained from this focus group may be used scientifically and may possibly help others.

What are the possible risks or discomforts involved from being in this focus group?
We do not anticipate any risks or discomfort to you from participating in the focus group. Even though we will emphasize to all participants that comments made during the focus group session should be kept confidential, it is possible that participants may repeat comments outside of the group at some time in the future. Therefore, we encourage you to be as honest and open as you can, but remain aware of our limits in protecting confidentiality.

Will I be able to withdraw from the focus group?
You may withdraw from the focus group for any reason, at any time. Your decision will in no way affect current or future care you receive.

Will it cost me anything to be in this study?
There will be no costs charged for your participation.

Will I receive anything for being in this study?
Snacks and refreshments will be served and reasonable costs (maximum $25)

associated with transportation will be covered.

How will my privacy be protected?
Every effort will be taken to protect your identity as a participant in this study. Your name will not be identified in any report or publication of this study or its results.

What if I have questions about this study?
You have the right to ask, and have answered, any questions you may have about this research. If you would like additional information or have any questions or concerns regarding the focus group, please contact Dr. Nicol Korner-Bitensky or Ailene Kua: School of Physical and Occupational Therapy, McGill University, telephone (514) 398-5457.

What if I have questions about my rights as a research participant?
All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, Ms. Ilde Lepore of the Faculty of Medicine's Institutional Review Board at (514) 398-8302 or by email to ilde.lepore@mcgill.ca.

Participant's Agreement

I,_____, agree to participate in the focus group described above. I give permission to Dr. Nicol Korner-Bitensky and Ailene Kua and their collaborators to use the information that I provide in the group discussion to plan a driving program for older individuals. I know that I may withdraw from participating before the scheduled date of the focus group and that I may leave the focus group meeting at any time. All questions that I had regarding the focus group have been answered to my satisfaction. I have read and understand the procedures of the focus group and willingly give my consent to participate in this focus group.

_____	_____
Participant's Signature	Date
_____	_____
Witness	Date

I_____ hereby certify that I have explained to _____ the nature of the focus group and the known risks of participating in the focus group, and that they have the option of withdrawing from the focus group at any time.

_____	_____
Signature	Date