Relationship of Driving Comfort to Perceived and Objective Driving Abilities and Future Driving Behaviour

by

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I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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Abstract

Introduction: Bandura's self-efficacy theory postulates that confidence is a stronger determinant of behaviour than one's actual skills or abilities. The Day and Night time Driving Comfort Scales (D-DCS and N-DCS) are new tools to measure perceived confidence in older drivers. Developed inductively with older drivers, the DCSs have good structural properties and preliminary psychometric support, including test-retest reliability.

Purpose: This thesis builds on previous work by further examining the construct validity of the DCSs via (1) temporal associations (Study 1) and (2) cross-sectional relationships (Study 2). Study 1 prospectively examined the relationship between DCS scores and self-reported driving behaviour. Study 2, meanwhile, examined cross-sectional associations between DCS scores and selected sample characteristics, self-reported driving behaviour and driving problems, perceived abilities and seven objectively measured driving-related abilities (visual acuity, contrast sensitivity, disability glare, brake reaction time, lower body mobility, executive skills and visual attention).

Methods: For Study 1, a convenience sample of 82 older drivers (aged 63 to 93) were assessed at baseline and follow-up (five to 17 months later). Study tools comprised the DCSs, multi-item ratings of driving frequency, avoidance and perceived abilities and a background questionnaire. Telephone interviews were conducted with a subgroup of 45 drivers to examine reasons for changes in driving comfort. For Study 2, cross-sectional relationships with the DCSs were examined using baseline data from 65 drivers (aged 63 to 93). A subgroup of 42 participants completed objective assessments of driving-related abilities assessed via ETDRS charts, Pelli-Robson charts, Brightness Acuity Tester, brake reaction time apparatus, the Rapid Paced Walk, the Trail Making Tests (Parts A and B) and the UFOV subtest 2.

Results: Prospectively, lower baseline N-DCS scores ($p<.001$) and decreased N-DCS scores ($p<.001$) were significant predictors of lower self-reported situational driving frequency (R^2 = 34%) and greater situational avoidance (R^2 = 51%) at follow-up. While DCS scores did not change appreciably for those who continued driving, N-DCS scores were significantly lower at follow-up for seven individuals who stopped driving ($p<.05$). Cross-sectionally, lower DCS scores were significantly associated with lower self-reported situational driving frequency, higher situational avoidance and lower ratings of perceived abilities ($p<.001$). Poorer left eye acuity scores were significantly associated with lower D-DCS ($p<.05$) and N-DCS ($p<.05$), while slower performance on Part A of the Trail Making Test was significantly related to lower D-DCS scores ($p<.05$). Participants with a discrepancy between their perceived and actual abilities had significantly higher D-DCS, situational driving frequency and lower situational avoidance ($p<.05$).

Conclusions: Findings are consistent with Bandura's self-efficacy theory and Rudman's model of driving self-regulation and, thus, provide further support for the construct validity of the DCSs. Further studies are needed with larger, more diverse samples, including those with diagnosed impairments, to establish benchmarks for driving comfort in healthy drivers and various clinical populations (such as those with stroke, Parkinson's or visual conditions). Prospective studies should also involve longer follow-up periods, examination of *actual* driving behaviour and barriers to self-restriction, and attempt to pinpoint whether there is a critical level of discomfort at which voluntary cessation is likely to occur.

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Chapter 1: Introduction and Study Rationale

This thesis is a part of a multi-phase project on the self-perceptions of older drivers, particularly perceived driving confidence. The impetus for this project was that driving confidence appeared to be important but had not been clearly defined, consistently measured, or psychometrically supported. Thus, the initial aims were to: (1) examine the role of driving confidence from the perspective of older drivers themselves; and if relevant (2) develop a tool to measure this construct. As will be described, work to date has substantiated the relevance of this phenomenon and led to the development of the Driving Comfort Scales (DCSs). This thesis builds on this work by further examining the construct validity of the newly developed DCSs.

This chapter begins by highlighting why older drivers are of particular interest in terms of growing numbers, risk for collisions and fatalities and reasons for such risk. Detrimental effects of losing one's license are also considered. The next section discusses strategies for prevention, particularly age-based licensing regulations (specifically in the Ontario context) versus self-regulation by older drivers themselves. Work completed to date on this project is then summarized, followed by the rationale for and an overview of the present thesis.

1.1 Statement of the Problem

1.1.1 Growing Number of Older Drivers

Older drivers (aged 65+) are the fastest growing segment of the driving population, a trend that is expected to grow as the baby boomers enter retirement age (Lyman, Ferguson, Braver & Williams, 2002). In Ontario, it is estimated that the number of drivers aged 65 and older will increase from about one half million in 1986 to approximately 2.5 million by 2028 (Hopkins, Kilik, Day, Rows & Tseng, 2004). People are living longer and healthier lives and are able to drive well into old age (Ball et al., 1998). As well, there are more women driving today than in previous generations, consequently, women will comprise a greater proportion of upcoming cohorts of older drivers (Burkhardt & McGavock, 1999).

In addition to growing numbers, it is projected that future cohorts of older drivers will drive greater distances and take more trips than today's older drivers (Burkhardt & McGavock, 1999; Lyman et al., 2002). These trends (growing numbers and increased mileage of older drivers) have important implications for public safety given the statistics on collision and fatality rates in this age group.

1.1.2 Collisions and Fatalities

Older drivers, particularly those over the age of 75, comprise a high risk group for fatal motor vehicle accidents (MVAs). First, older drivers have higher crash rates per mile driven than most other age groups, except for drivers aged 16-19. One study found that rates of crash involvement were constant from ages 30-69, but then increased at age 70 and continued to rise with increasing age (Li, Braver & Chen, 2003). Secondly, older drivers are more likely to be at-fault. Cooper (1990) found that drivers aged 75+ were responsible for 80% of the crashes in which they were involved, compared to 50% for drivers aged 65+. Thirdly, when collisions occur, older drivers are more likely to sustain serious injuries, hospitalization and/or death than any other age group (Ferrini & Ferrini, 2000; Zhang, Lindsay, Clarke, Robbins & Mao, 2000). In fact, older drivers have the highest rates of MVA fatalities per mile driven (Cerrili, 1998; Loreno et al., 1994; Tasca, 1998), likely due to increased fragility and existing health problems (Li et al., 2003; Lyman et al., 2002).

When adjusted for miles driven, older drivers are more likely to be involved in and be responsible for collisions resulting in serious injury and fatality. A growing body of evidence suggests that this increased crash risk is not associated with age per se, but rather age and health-related declines in driving-related abilities.

1.1.3. Declines in Driving-related Abilities

Safe driving involves a dynamic interplay of various sensory, cognitive and physical abilities. Due to an increased prevalence of age-associated diseases, as well as the normal aging process, older adults (as a group) experience declines in several functional abilities which, consequently, negatively impact driving safety (Eby, Trombley, Molnar & Shope, 1998). For instance, reduced neck flexibility can limit the ability to observe blind spots (Stelmach & Nahom, 1992), while slower reaction times may impede the ability to quickly maneuver the car in response to a changing environment (Cox, 1989). Such declines may contribute to the overrepresentation of older drivers in collisions involving turning, changing lanes, reversing and moving through intersections (Isler, Parsonson & Hansson, 1997). Older drivers typically commit errors of omission and attention processing, such as not yielding the right of way and failing to obey signs and signals (Ferrini & Ferrini, 2000; Morgan & King, 1995). Such aberrant behaviour has been attributed, in part, to declines in visual attention, which is required to scan the driving environment and detect and discriminate relevant stimuli (Richardson & Marottoli, 2003). Chapter Four presents a more detailed discussion of the various sensory, motor and cognitive abilities involved in driving.

While some older drivers have functional impairments, others do not (Eby, Molnar, Shope, Vivoda & Fordyce, 2003). Consequently, screening measures must be able to discriminate older drivers who present a risk (i.e. have functional impairments) from those who are fully competent to drive. As well, there is evidence that older drivers with functional impairments can reduce their crash risk by avoiding challenging driving situations (De Raedt &

Ponjaert-Krisofferson, 2000). This is particularly important given the negative consequences associated with losing one's drivers' license.

1.1.4. Consequences of Driving Cessation

The loss of a drivers' license can have detrimental effects on the quality of life of older adults. For many seniors, driving symbolizes independence, well being, freedom and a sense of identity (Rudman, Friedland, Chipman & Sciortino, 2006; Yassuda, Wilson & von Mering, 1997). In response to license forfeiture, older adults have expressed feelings of loneliness, isolation, regret and a loss of self-worth (Johnson, 1995; Rudman et al., 2006). Prospectively, driving cessation has been associated with depression (Marottoli et al., 1997) and a reduction in out-of-home activities (Marottoli et al., 2000), even after adjusting for socio-demographic and health-related factors. Ideally, the decision to stop driving is voluntary, as opposed to regulatory bodies removing one's license. Efforts to prevent accidents through age-based licensing regulations are compared to self-regulation below.

1.2 Prevention

Together, the increased crash risk and growing numbers of older drivers represent a significant public health concern. Accordingly, jurisdictions across North America have legislated specific requirements for the license renewal of older drivers. The license renewal requirements in Ontario are briefly described below. A more detailed description of the license renewal requirements of older drivers in Ontario, as well as other jurisdictions, can be found in Myers (2004).

1.2.1. Ontario's License Renewal Requirements

In comparison with other Canadian provinces and most US states, Ontario has one of the most stringent and longstanding set of license renewal requirements for older drivers. Beginning at age 80 and every two years thereafter, drivers are required to: (1) pass a written test (rules and signs); (2) pass a vision test (minimal acuity 20/50 in the better eye with or without corrective lenses, and minimum peripheral vision of 120°); and (3) attend a 90-minute Group Education Session (GES). The license renewal process also includes an examination of driving records. All drivers are required to self-report any medical conditions that may affect their ability to safely operate a vehicle (e.g. heart conditions, epilepsy, physical disability, etc.). Older drivers may be required to take a road test at the discretion of the driving counselor. It should be noted that road tests are mandatory for drivers 70+ who have been involved in at-fault collisions, regardless of the time of last renewal. While such regulations may identify unsafe drivers and thereby increase road safety, decisions to revoke a person's license must be carefully weighed against the negative impact on their quality of life.

1.2.2. Self-regulation

Self-regulation refers to the process of evaluating one's own driving abilities and adjusting driving habits accordingly (Baldock, Mathais, McLean & Berndt, 2006). Effective self-regulation may reduce crash risk without severely restricting one's mobility. One study found that drivers who appropriately adapted their driving behaviour (i.e. avoided challenging driving situations and compensated by driving slower, keeping further distance from the car in front and anticipating), had fewer 'at-fault' collisions than drivers who did not use these strategies (De Raedt & Ponjaert-Kristofferson, 2000). The literature suggests that many older drivers make adjustments as they age by reducing the amount they drive, avoiding challenging driving situations (e.g. bad weather, high density traffic, left-hand turns and driving at night), or both (Benekohal, Michaels, Shim & Resende, 1994).

Nonetheless, the elevated crash risk of older drivers suggests that not all drivers appropriately restrict their driving. In one study, almost 70% of older drivers reported that maintenance of their present lifestyle was a barrier to restricting their driving (Baldock et al., 2006). As well, some older drivers lack awareness of their impairments (Freund, Colgrove, Burke & McLeod, 2005; Stalvey & Owsley, 2000). Drivers who lack awareness of, or deny, their deficits present a safety risk as they may continue to drive in situations that exceed their ability to respond safely (Marottoli & Richardson, 1998). In two studies, older drivers who rated their abilities lower reported more self-imposed driving restrictions (Marottoli & Richardson, 1998; Ragland, Satariano & MacLeod, 2004). Perceived confidence may be an important mediator between declining abilities, associated problems (such as night blindness) and ensuing self-regulation (Rudman et al., 2006; Satariano et al., 2004; Parker et al., 2001). Thus, gaining a better understanding of drivers' perceptions may prove useful in predicting driving behaviour and, ultimately, preventing collisions.

1.3 Work Completed to Date and Study Rationale

As shown in Figure 1.1, this study involves several sequential phases. Phases I to IV were conducted by Ms. Paradis for her Master's thesis. Data collection began in June/05 (Phase I) and ended August/05 (Phase IV). Essentially, her findings supported the relevance of driving confidence (conceptualized by older adults as comfort level) and justified the development of a new tool to measure this construct. Collectively called the Driving Comfort Scales (DCSs), the tool actually consists of two scales: (1) the Daytime Driving Comfort Scale (D-DCS); and (2) the Nighttime Driving Comfort Scale (N-DCS).

While the development and psychometric properties of the DCSs are described in detail elsewhere (Paradis, 2006; Myers et al., submitted), a brief overview is provided to set the stage for the present studies. Unlike prior tools, the DCSs were developed inductively, i.e., involving older drivers in the process. Older drivers felt that “comfort” (rather than “confidence”) better captured confidence in their own abilities, as well as coping with on-road situations (including the behaviour of other drivers). Subsequently, a qualitative study by Rudman et al. (2006) has supported this conceptualization. Both current and former drivers highlighted perceived comfort (which included confidence) as a key factor in regulating their driving behaviour, including when they would (or had) stop driving.

The content validity of the DCSs was supported by further samples of older drivers and driving improvement counsellors from the MTO who work with older drivers. Unlike other driving confidence/nervousness/stress tools that have included only a single item on night driving, the samples in Paradis’ studies were adamant that daytime and nighttime driving should be separated, leading to the development of the D-DCS and N-DCS scales. They also felt that the context (traffic flow) and situations needed to be as specific as possible for unambiguous ratings.

The DCSs administered in Phase IV consisted of an 11-point response scale (from 0% to 100%) for both the 17-item D-DCS and 18-item N-DCS (as shown in Appendix A). Subsequently, Rasch analysis supported shortening the response options to a 5-point scale (0, 25, 50, 75 and 100%) and removing certain items (which did not discriminate or produced erratic responses). The final 13-item D-DCS and 16-item N-DCS (also shown in Appendix A) are hierarchic, unidimensional, with good person (.89 and .96) and item (.98 and .97) reliabilities (Paradis, 2006). Test-retest reliability (over 1-2 weeks) was adequate for the final D-DCS and good for the final N-DCS (Paradis, 2006).

Although the longer versions of the DCS (17-item D-DCS and 18-item N-DCS) were administered to the sample of 100 drivers in Phase IV, associations with DCS scores were examined using the 13-item D-DCS and 16-item N-DCS scales, respectively. Misfit items were removed and responses collapsed as follows: 0% (0 & 10); 25% (20 & 30); 50% (40, 50 & 60); 75% (70 & 80) and 100% (90 & 100). Paradis (2006) found that DCS scores were significantly related to:

- **Self-reported driving patterns**: those who drove less frequently and reported greater situational avoidance had lower driving comfort scores (both day and night);
- **Perceived abilities**: those who rated themselves as "better than most" in 7 driving-related tasks had higher D-DCS and N-DCS scores than those who rated themselves as "the same" or "worse than most".

No relationship, however, was found between DCSs scores and self-reported driving problems (accidents, near misses, backing into things and getting lost). Comfort scores were also found to be related to certain driver characteristics. For instance, comfort level decreased with age, but only on the N-DCS. Men also had higher driving comfort scores, but again only on the N-DCS.

While the associations with perceived abilities and reported driving behaviours are consistent with Bandura's self-efficacy theory (1986) and provide support for the construct validity of the newly developed DCSs, further examination is required to verify and extend these findings. In the absence of an uncontested or "gold" standard (criterion validity), subjective rating scales must amass support for construct validity through an ongoing process of hypothesis testing regarding the underlying construct (DeVillis, 2003; McDowell & Newell, 1996; Streiner & Norman, 1989). Psychological measures are designed to get at a hypothetical construct which, in this instance, is "driving comfort" (or confidence). The process of construct validation entails learning more about the construct itself, i.e., the extent to which the measure "behaves as it should", in terms of associations with other measures (at the same point in time or in the future), distinguishing between groups (those who might be expected to high or low), and so on. In addition to supporting evidence, it is also useful to refute evidence to the contrary, i.e., showing that the tool does not measure something other than what it purports to measure (McDowell & Newell, 1996). For instance, Parker et al. (2001) demonstrated that their measure of driving nervousness/confidence was related to self-rated driving ability, independent of personality traits (extroversion, neuroticism) and social desirability (lie scale). Finally, it is important to replicate supporting evidence with new samples in different settings (Streiner & Norman, 1989; Williams & Naylor, 1992).

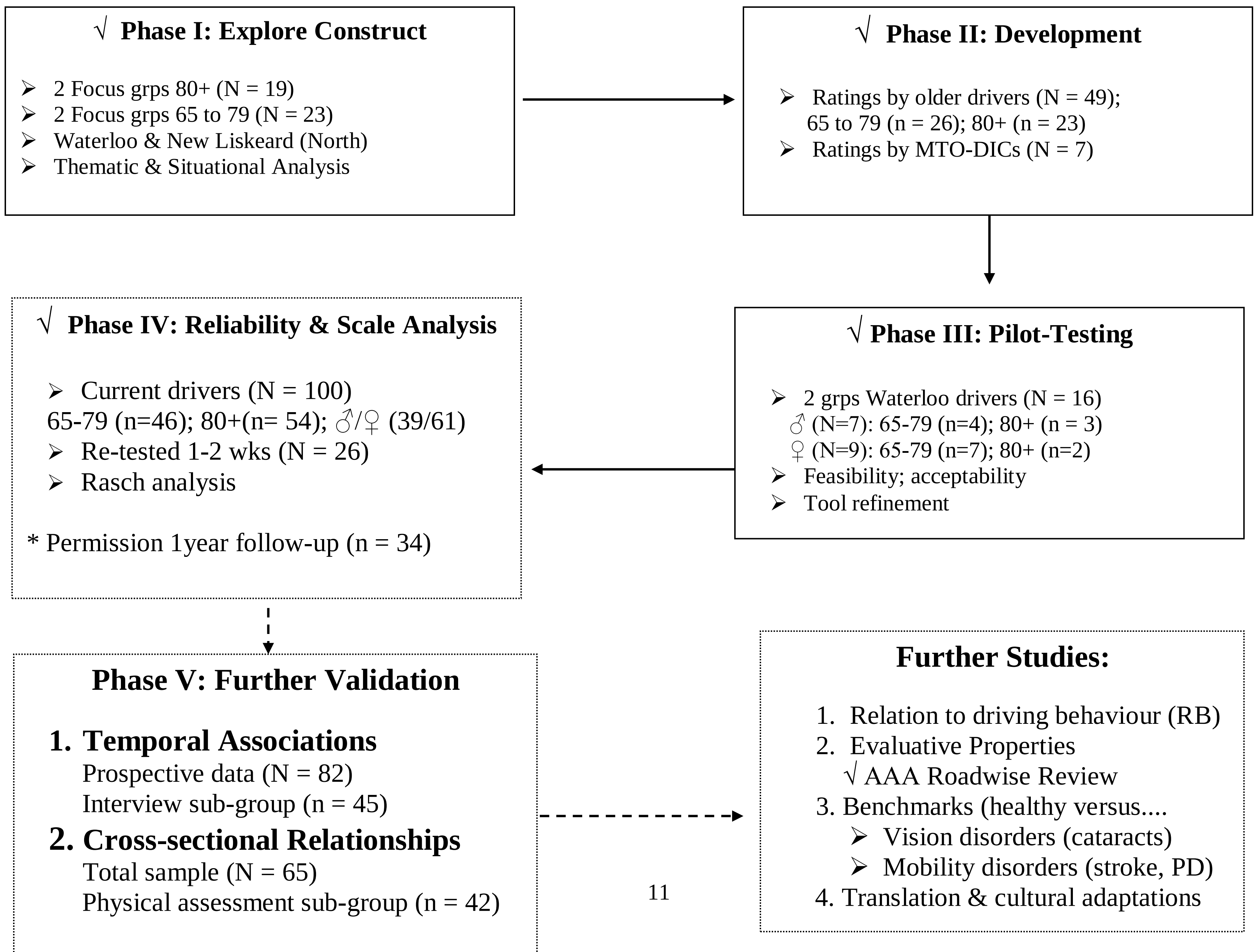
This thesis constituted Phase V of the multi-phase project and entailed further examination of the construct validity of the Driving Comfort Scales via (1) temporal associations and (2) cross-sectional relationships, subsequently referred to as Studies 1 and 2, respectively. Study 1 looked at the prospective relationship between DCS scores and self-reported driving behaviour. Study 2, meanwhile, attempted to replicate Phase IV findings by examining cross-sectional associations with DCS scores, as well as extend the findings (using objective, physical measures of driving related abilities). Specific objectives and corresponding hypotheses are detailed in Chapters Three (Study 1) and Four (Study 2). Figure 1.1 (Phase V) shows the sample sizes obtained for each study. As will be explained, some of the same people participated in both studies.

Chapter Two presents a review of the published literature, which supports the importance of examining self-perceptions in older drivers. Prior to the onset of this project (Phase I), only one scale specifically designed to measure driving confidence had been published (Marottoli & Richardson, 1998). Subsequently, two other multi-item scales have been published (Baldock, Mathias, McLean & Berndt, 2006; George, Clark & Crotty, 2007). The chapter will also summarize the existing evidence pertaining to perceived driving abilities, and discrepancies between perceived and actual driving abilities and performance.

Chapter Three presents the objectives, methods, findings, discussion and conclusions for Study 1 which examined temporal associations between DCS scores and various indicators of self-reported driving behaviour. As shown in Figure 1.1, in Phase IV, Ms. Paradis obtained permission from 34 older drivers for future contact. Seventeen of these individuals took part in the present study (Phase V), together with 65 older drivers recruited specifically for Phase V, for a total of 82 subjects. Telephone interviews were conducted with a sub-sample of 45 of these individuals to examine possible reasons for change in either confidence or driving patterns. Temporal associations (Study 1) are presented before cross-sectional relationships (Study 2) since the latter study used all available baseline data in order to maximize sample size. Follow-up participation rates (Study 1) also dictated which participants would be included in the cross-sectional examination.

Chapter Four describes the objectives, methods, findings, discussion and conclusions for Study 2 which examined cross-sectional relationships with the DCSs. As shown in Figure 1.1, cross-sectional relationships with DCS scores were examined only with the sample of 65 “new” participants to enable comparisons with Paradis’ findings (Phase IV sample). Additionally, relationships with seven objectively measured driving-related abilities (visual acuity, contrast sensitivity, disability glare, brake reaction time, lower body mobility, executive skills and visual attention) and refined measures of perceived abilities were examined with a sub-sample of 42 older drivers.

Figure 1.1: Flowchart of Sequential Studies (Driving Comfort Scales)



Chapter 2: Literature Review

2.1 Introduction

An extensive literature review on the driving habits of older adults, factors related to driving curtailment and cessation, and the role of self-perceptions, particularly driving confidence, is contained in Ms. Paradis' Master's thesis (2006). As noted in Chapter One, however, several key articles pertaining to self-regulation and driving perceptions have been subsequently published.

An updated search was conducted using the following electronic databases: Ageline (1978-present), MEDLINE (PUBMED) (1953-present) and Psych-Info (1840-present). Key words used singly and in combination were: "older drivers", "confidence", "self-regulation", "self-perceptions", "crash risk", "measurement", "visual acuity", "near acuity", "peripheral vision", "mesopic vision", "disability glare", "UFOV", "reaction time", "executive function", "decision making", "lateral mobility", "mobility", "physical mobility", "ETDRS charts", "Snellen" and "car task". Reference lists of relevant articles were examined for further sources. Articles were also supplied by colleagues.

Attempts to quantify older drivers' perceptions and actual driving abilities have varied widely. To date studies have looked at various aspects of older drivers' perceptions, including ratings of confidence/nervousness or stress in specific situations (e.g. Marottoli & Richarson, 1998), the level of difficulty experienced in certain driving situations (e.g. DeRaedt & Ponjaret-Kristofferson, 2000), ratings of driving abilities and/or skills (e.g. Parker et al., 2001) and ratings of specific abilities such as vision (e.g. Owsley et al., 2003). Some studies have asked older drivers to rate their abilities from "very poor" to "very good" (e.g. Parker et al., 2001), while others have asked them to rate their abilities compared to other drivers from "a lot worse" to "a lot better" (e.g. Marottoli & Richardson, 1998). Such ratings have been compared to actual driving abilities via associations with adverse driving events such as accidents (e.g. Marottoli & Richardson, 1998), driving lapses, violations and errors (Parker et al., 2001), on-road driving performance (e.g. Baldock et al., 2006; Freund et al., 2005) and objective assessments of physical abilities (e.g. Fox, 1989). A description of prior *multi-item* measures relating to older drivers' confidence/nervousness/stress and perceived driving abilities, respectively, is shown in Appendix B. Measures of objective driving-related abilities (e.g.vision) are described in Chapter Four. Although variation in measurement makes it difficult to compare results across studies, the current review will highlight what is presently known about older drivers' perceptions of their abilities and confidence, respectively.

2.2 Perceived Driving Abilities

Findings are mixed concerning whether older drivers are aware of declining abilities. When assessed using only a single item, older drivers tend to rate their driving ability as the same or "a little better" than others their own age; few drivers rate themselves as "worse" (Freund et al., 2005; Marottoli & Richardson, 1998). Conversely, studies that used multi-item measures suggest that older drivers are able to distinguish between relatively strong versus weak abilities (Holland & Rabbit, 1992; Parker et al., 2001). Parker et al. (2001) asked older drivers to rate their ability on a five point scale from 'very poor' to 'very good' in 15 driving situations and found that the majority acknowledged weak as well as strong areas of driving competence. As well, Holland and Rabbit (1992) found that although many older adults were not aware of declines in their overall vision, those who did report problems with certain aspects of their vision (e.g. seeing in the dark) made corresponding adjustments to their driving (e.g. avoided night driving). Generally, a score derived from collective responses to multiple items provides a better indication of the “true” score, than responses to single items or statements (Williams and Naylor, 1992).

However, older drivers’ self-perceptions do not always correspond with their driving performance and objective driving-related abilities. Two studies found that drivers who received poor scores on a road test still rated themselves as “as good as” or “better” drivers than their peers (Freund et al., 2005; Marottoli & Richardson, 1998). Similar findings have been reported in studies examining perceived visual abilities (Holland & Rabbit, 1992; Stalvey & Owsley, 2000). Stalvey & Owsley (2000) examined perceived visual abilities in a sample of 402 visually impaired drivers and found that almost 70% rated their vision as “excellent” or “good”. Holland and Rabbit (1992) compared self-rated visual abilities with objective vision assessments in drivers 50 to 70 years of age. Drivers over 60 did not rate their vision as any worse than drivers in their 50’s, even though their objectively measured vision was significantly worse. Thus, it appears that some older drivers lack awareness of their declining abilities, are in denial or may consciously resist reporting deficits due to fear of losing their licenses.

Two studies have examined associations between older drivers’ self-rated driving abilities and their self-reported driving behaviour. Marottoli & Richardson (1998) found that drivers who rated their overall driving ability as “better than most” reported higher mileage and greater driving frequency. Similarly, Ragland et al. (2004) found that perceived limitations in vision were related to avoidance behaviour. In addition, this study also found that relationships with avoidance behaviour were stronger for perceived vision than for objective assessments of vision.

There is preliminary evidence that perceptions of driving ability are related to driving confidence. Parker et al. (2001) reported that low scores on a multi-item measure of perceived driving ability were related to high levels of driving nervousness (indicating low confidence). Marottoli and Richardson (1998) found that drivers who rated themselves as "much better drivers" overall in comparison to others had higher confidence than those who rated themselves as "a little better" and "the same" as others. Furthermore, Marottoli and Richardson (1998) also found that drivers with a *discrepancy* between their perceived and actual abilities (defined as those who rated their driving ability as "better than other drivers" yet had a history of adverse events or poor ratings on a road test) had higher confidence than the rest of the sample. The role of driving confidence and its measurement is described in more detail below.

2.3 Driving Confidence

As defined by Marottoli and Richardson (1998), confidence is "the belief in one's ability" (p.323). More broadly, the construct of confidence or self-efficacy comes from Bandura's Social Cognitive Theory (Bandura, 1986; Bandura, 1997). Bandura defines self-efficacy as the belief in one's capabilities to perform a specific action, or set of actions, in a given situation. Given the demonstrated importance of self-efficacy in other domains of functioning, such as balance confidence (Jorstad, Hauer, Becker & Lamb, 2005), it is not surprising that this construct may also be important to driving. According to Bandura's Social Cognitive Theory, self-efficacy is a stronger determinant of one's behaviour than one's skills or abilities in a particular domain. Self-efficacy is influenced either positively or negatively by four primary sources. These influences, with examples pertaining to driving, are as follows: (1) mastery of performance accomplishments (e.g. presence or absence of accidents, near accidents or traffic violations); (2) vicarious experiences (e.g. peers who have had car accidents); (3) verbal persuasion (by peers, family, health professionals); and (4) physiological cues (e.g. sweaty palms, gripping the steering wheel).

In the driving literature, social factors have been shown to influence the driving habits of older adults. For example, people who drive are more likely to be married and live in larger households than non-drivers (Chipman, Payne, McDonough, 1998; Persson, 1993). In a prospective study, Marottoli et al. (2000) found that those who continued driving were more likely to be younger, male, married and living in the community in comparison to those who stopped. It seems reasonable to expect that others who rely on an older driver to get around may exert pressure on that individual to keep driving.

As mentioned in Chapter One, the study by Rudman et al. (2006) underscored the importance of driving confidence in their model of the process of self-regulation in older drivers. According to their model, which was developed from focus group discussions with 70 community-dwelling drivers aged 55+, an individuals' subjective comfort level (considered a form of self confidence) ultimately influences decisions to adapt or cease driving. A multitude of interpersonal, intrapersonal and environmental factors influence one's driving behaviour and comfort level, including perceived changes in driving-related abilities (e.g. vision and cognitive declines). The authors conclude that further research is needed to understand the interaction between the various factors that influence driving comfort and the direction of the relationship between driving comfort level and behaviour.

Studies that have attempted to measure driving confidence have shown relationships with driving behaviour. Two studies that asked older adults to rate their confidence level in various driving situations found that confidence was significantly related to self-reported avoidance of difficult driving situations (Baldock et al., 2006; Marottoli & Richardson, 1998). Parker et al. (2001) also found that drivers with higher ratings of nervousness/nervousness reported more driving problems (e.g. errors, lapses), lower mileage and less frequent driving. Another study found that former drivers had higher ratings of "experienced stress" than current drivers in a number of traffic and road conditions (Hakamies-Blomquvist & Wahlstrom, 1998). Thus, while driving confidence appears to have an influential role in terms of decisions surrounding driving behaviour, it has not been well defined nor consistently measured.

Prior to the onset of this project, two studies examined ratings of driving stress or nervousness (Hakamies-Blomqvist & Wahlstrom, 1998; Parker et al., 2001) but only one study had employed a multi-item measure specifically of driving confidence (Marottoli & Richardson, 1998). Marottoli and Richardson's (1998) scale asks participants to rate their level of confidence on a ten point scale from 0 (not at all confident) to 10 (completely confident) in ten different driving situations. Unfortunately, no psychometric evidence was provided. Subsequently, Baldock et al. (2006) and George et al. (2007) published new measures of driving confidence. Baldock and colleagues adapted items from the Driving Habits Questionnaire (Owsley, Stalvey, Wells & Sloane, 1999) from difficulty to confidence ratings, with no further psychometric testing. The most recent tool developed by George et al. (2007), named the "Adelaide Driving Self-Efficacy Scale" (ADSES), includes a set of 12 items and a ten point rating scale. A detailed description of these measures is shown in Appendix B. In all three studies, items were generated using a 'deductive approach' (i.e. items were derived from previous questionnaires and expert opinions), as opposed to an inductive approach which involves the intended target audience themselves in scale development (De Vellis, 2003). Furthermore, only George et al. (2007) provided psychometric evidence for their scale, reporting high internal consistency and the ability of scores to discriminate older adults with stroke from younger hospital staff and those who passed or failed an on-road driving assessment. It is clear that there is a need for a tool to measure driving confidence that is both meaningful to older drivers themselves and supported by psychometric evidence. As described in Chapter One the DCSs may provide such a tool (Paradis, 2006).

2.4 Summary and Implications

Older drivers' self-perceptions appear to have a significant influence on their driving behaviour. However, effective self-regulation depends on awareness of one's own limitations, and research has shown that perceptions may not accurately reflect actual driving abilities/skills. Discrepancies between perceived and actual abilities are problematic. For instance, older adults who are "overconfident" may drive in situations that exceed their limitations, putting themselves and others at risk. Conversely, those who are "underconfident" may prematurely restrict or stop driving. Clearly, further investigation of perceived driving confidence and abilities is warranted.

The newly developed DCSs, described in Chapter One, have been systematically developed and psychometrically tested. The present thesis (Phase V), builds on previous work (Phases I to IV, reported by Paradis, 2006) by further examining the construct validity of the DCSs through temporal associations (Study 1) and cross-sectional relationships (Study 2). The following chapter describes Study 1, while Study 2 is presented in Chapter Four.

Chapter 3: Temporal Associations (Study 1)

3.1 Introduction and Study Objectives

As described in Chapter 2, Bandura's theoretical framework (1997, 1986) postulates that self-efficacy in a particular domain is a stronger predictor of behaviour than a person's actual skills or abilities. According to this theory, people with low self-efficacy will avoid challenging situations when possible and are less likely to persist in the face of obstacles (Bandura, 1986). With respect to driving, ultimately, the goal is to determine whether and how confidence affects self-regulation (self-imposed restrictions, as well as possibly cessation). Such examination requires long-term prospective studies, as well as assessments of *actual* driving behaviour, which are beyond the scope of this thesis. The present study constituted a preliminary investigation of: (1) the extent to which driving comfort scores changed over a relatively short period (5 to 17 months); and (2) the relationship of baseline comfort scores with subsequent self-reported behaviour (frequency and avoidance). The specific objectives were to examine:

1. The extent of change in driving comfort over the short term;
2. The relationship between changes in comfort and changes in self-reported driving behaviour;
3. If baseline DCS scores were predictive of self-reported driving behaviour at follow-up; and
4. Potential reasons for changes in driving comfort

A priori, it was expected that: (1) decreases in driving comfort (from baseline to follow-up) would be accompanied by reduced driving frequency and increased situational avoidance; and (2) persons with lower driving comfort scores at baseline would report lower driving frequency and greater avoidance at follow-up. Although we did not know if anyone in our sample would stop driving over the interim, if such cases emerged, we expected their driving comfort scores to be lower at baseline (and possibly decrease from baseline to follow-up) compared to those who continued to drive.

The following sections provide a description of the ethics approval, sample recruitment, data collection methods, results and discussion for Study 1. Study limitations are also acknowledged and the final section presents overall conclusions and directions for further research.

3.2 Ethics Approval and Consent

Ethics approval was obtained from the Office of Research Ethics at the University of Waterloo for both the baseline and follow-up assessments. To ensure confidentiality, the data for each participant was assigned a unique code. Participants' names were not put on any forms and will not be used in any ensuing reports. All data was stored in a secure location and informed consent was obtained from all participants prior to data collection. At baseline, written informed consent was obtained for participation and for audiotaping. Interested participants also completed a Permission for Further Contact form. As will be described below, follow-up assessments were conducted either in-person or over the telephone. Written-informed consent was obtained for the in-person assessments (using same consent form as in baseline), while informed was obtained verbally for those completing the telephone interviews. In addition, participants were also asked about permission to contact for future studies involving older drivers. All consent forms are shown in Appendix C.

3.3 Sample Recruitment

Figure 3.1, below, shows a flow chart for Study 1 with initial targets for sample size. As shown, the study consisted of baseline and follow-up assessments. In addition, telephone interviews were completed by a subsample of participants at follow-up in order to examine possible reasons for changes in driving comfort. As will be described in Chapter 4, the “no telephone interview” group comprised the “physical assessment subsample” for Study 2.

Baseline Assessments N = 100
DCSs, rating forms, background questionnaire

↓

Follow-up Assessments N = 100
DCSs, rating forms

↙ ↘

Telephone Interview N = 60 | **No Telephone Interview N = 40**

Figure 3.1 Proposed Sample Size for Study 1

3.3.1 Baseline Recruitment

There were two steps involved in baseline sample recruitment: (1) contacting participants (N=34) from Phase IV (Paradis’ study) who agreed to one-year follow-up; and (2) recruiting additional volunteers to increase the sample size. Both steps were done concurrently.

In May, 2006, the 34 Phase IV participants (who had provided written permission for follow-up) were contacted by telephone to confirm continued interest in study participation. In order to increase the baseline sample size, additional volunteers were recruited from retirement complexes and seniors’ centres in K-W and surrounding areas (using the same criteria: a valid drivers’ license, aged 65 or older), using established contacts from Phase IV when possible. A description of the facilities (e.g. location, type) will be provided in the results. Administrators or activity directors from each facility were initially contacted by telephone. Recruitment strategies were based on suggestions by the facility activity directors or administrators regarding “what would work best” with their clientele and included the following: (1) posting information letters and/or posters in high-volume areas; (2) inserting flyers in residents’ mailboxes; (3) making announcements by primary researcher or activity director during resident’s social gatherings; and (4) putting notices in resident newsletters. The recruitment poster and information letter are shown in Appendix D. Participants signed up for the study either through the activity director or receptionist at the facility, or directly with the researcher. To avoid confusion, this group will subsequently be referred to as the “new” baseline participants.

Permission for follow-up contact was obtained at baseline. The researcher first explained two opportunities for further study participation. While both opportunities involved completion of the DCSs and rating forms, option one involved a telephone interview, while option two involved physical assessments of driving-related abilities. The latter option pertains to Study 2 and is described in Chapter 4. Those interested completed the Permission for Further Contact form (Appendix C), indicating in which study option they were interested.

3.3.2 Follow-up Recruitment

Follow-up recruitment began with Phase IV participants. Participants were contacted by telephone to confirm interest, availability and to obtain mailing addresses. If still interested, an appointment for a telephone interview or in-person assessment was scheduled. Subsequently, new baseline sample participants were contacted using the same procedures.

3.4 Data Collection Methods

3.4.1 Baseline Assessments

Procedures

Previously completed DCSs (17 & 18 item versions), background questionnaires and rating forms (collected in Aug/05) constituted the baseline data for the continuing volunteers from Phase IV. No further baseline data was collected from this group.

Data for the new baseline sample was collected between mid May and late June of 2006. The study instruments (described below) were administered in a small group format (ranging from 2 to 11 participants) held at participants' respective facilities, similar to prior study phases (Paradis, 2006). The facility was contacted 24-48 hours prior to the scheduled session to confirm the time and room booking. Reminder calls were made 24 hours in advance to confirm attendance.

At the group sessions, participants were asked to complete, in order: the 13-item D-DCS and 16-item N-DCS, four rating forms and a background questionnaire, described below. The researcher reviewed the instructions for each questionnaire and participants were encouraged to ask for clarification as needed. Once all questionnaires had been completed, the participants were asked for feedback concerning the clarity of each tool. This discussion was audiotaped provided all participants consented. As previously noted, consent for follow-up contact was also obtained from interested participants.

Instruments

The tools used in baseline data collection comprised: the DCSs (Appendix A), four rating forms (Appendix E) and a background questionnaire (Appendix F).

The four rating forms included:

1. Situational driving frequency (14 situations)
2. Situational driving avoidance (20 situations + #21 no avoidance)
3. Perceived driving abilities (15 items)
4. Perceived changes in driving abilities (15 items)

It should be noted that Phase IV participants completed slightly different versions of the driving frequency and avoidance rating forms. Both the Phase IV and V versions are shown in Appendix E, along with a description of the changes made to Phase IV versions. In addition, the Phase IV participants did not receive the two perceived abilities rating forms, as such tools were developed specifically for Phase V. The background questionnaire is shown in Appendix F and a description of changes made from Phase IV is provided.

Although perceived abilities were measured in Phase IV (described at the bottom of Table 2 in Appendix B), the new rating forms permitted a more detailed assessment for comparison with perceived comfort (measured by the DCSs) and objective assessments of driving-related abilities (for Study 2). Specifically, items were chosen based on: (1) areas known to be problematic for seniors; (2) correspondence with the DCSs (e.g. items # 2, #4 & #7 relate to nighttime driving, analogous to the N-DCS); and (3) correspondence with physical measures (e.g. item #1 corresponds with visual acuity, while item #9 corresponds with brake reaction time). Such correspondence is described further in Chapter Four.

Initially, the perceived driving abilities rating form asked individuals to rate their current driving ability in 15 tasks *compared to that of other drivers* (a lot better, a little better, a little worse, a lot worse). This initial version of the form was administered to the first five groups (n=24) at baseline. In three of the five groups, participants found it difficult to compare themselves to other drivers due to variability in others' abilities and a lack of opportunity to observe other drivers. Everyone agreed that they would prefer to simply rate their own abilities. Consequently, the instructions on this form were changed to "How would you rate your current ability to…?" and the response scale was changed to "poor", "fair", "good" and "very good". All subsequent groups received this revised form. Also, on both of the perceived abilities rating forms, item #10 was reworded for clarity by the addition of the word "over" ("making an *over* the shoulder check").

3.4.2 Follow-up Assessments

To account for differences in the timing of baseline assessments for the Phase IV (August/05) and new baseline samples (May – July/06), data collection was staggered. Follow-ups with the Phase IV participants were conducted from November/06-January/07, 15-17 months after initial baseline assessments. Subsequently, follow-ups with new participants were conducted from February – April/07, five to 10 months after baseline assessments.

Participants in the interview subsample were mailed a package containing the DCSs, rating forms, and an information letter (Appendix G) one week before their telephone interview. Responses to the questionnaires were obtained verbally over the telephone. Participants who had stopped driving were asked to rate their comfort level as if they were still driving and, for the avoidance rating form, were asked which situations they would avoid if still driving. In addition, items on the driving frequency rating form were scored as "never" for all situations. Subsequently, a brief (approximately 15 minutes) telephone interview was conducted during which participants were asked about changes to their health, lifestyle and driving since their baseline assessment. The interview script is shown in Appendix H. Interviews were audiotaped and subsequently transcribed by the researcher.

As previously mentioned, participants who were assessed in-person were part of the physical assessment subsample, which will be described in Chapter 4. Such participants were also mailed the package of questionnaires which was collected in-person prior to their physical assessment.

Data collection tools for follow-up assessments include the DCSs and four rating forms, described above. In order to maintain consistency with baseline data, participants were given the same tool versions that they completed at baseline. Thus, Phase IV participants were given the 17 item D-DCS, 18 item N-DCSs and the Phase IV versions of the driving frequency and avoidance rating forms. However, item #21 ("No, I don't try to avoid any of these situations") was added to the Phase IV avoidance rating form to verify that participants (with no avoidance) had not simply missed the form. In addition, Phase IV participants were administered the two perceived abilities rating forms at follow-up. New participants, meanwhile, were given the revised DCSs and rating forms.

3.5 Data Analysis

3.5.1 Scoring of Questionnaires and Dealing with Missing Values

All quantitative data was analyzed using the Statistical Package for Social Sciences (SPSS), Version 14.0. For the rating forms, missing items were dealt with using either the item or person mean substitution methods, as will be specified below. Both methods have shown to be reliable methods for replacing missing data, even when respondents are missing up to 70% of the items on a scale (King, Fogg & Downey, 1998). Item mean substitution replaces a missing value with the mean of that particular item computed across all respondents who have provided a response for that item. Person mean substitution, meanwhile, replaces a missing item with the mean of the responses for the other items that were answered by a particular person. The latter approach assumes that since items measure a single construct, the person's responses on the answered items are representative of potential responses for the item(s) that were missed.

As described by Paradis (2006), for each scale item on the Day and Night DCSs, respectively, participants rate their comfort level from 0 to 100% (collapsed into a 5-point scale). Provided individuals answered at least 75% of the scale items (10 of 13 item D-DCS and 12 of 16 item N-DCS), the ratings are summed and then divided by the total number of items answered to yield a total score ranging from 0 to 100% on each scale. Although Phase IV participants received the longer version of the DCSs, all analyses were performed using the revised version using the method described in section 1.3. Two "new" participants did not complete 75% of the N-DCS scale (one at baseline and one at follow-up) and were thus omitted from further analyses involving this measure.

The driving frequency rating form provides an overall measure of situational driving frequency while the avoidance form provides a measure of situational avoidance. Scoring for both of these measures is described in Appendix E. Missing items on the driving frequency form were dealt with using item-mean substitution, since it did not seem appropriate to assume that an individual's driving frequency for one situation would be representative of all situations (an assumption of the person mean substitution). At baseline 10 participants were missing items and at follow-up, three participants were missing items. In all cases, the maximum number of items missed was three. Two participants (one during baseline and one during follow-up) did not check any items on the avoidance rating form (including item #21) and were excluded from all corresponding analyses since it could not be determined if such participants did not avoid any situations or simply missed the form altogether.

A comparable total score for the Phase IV and V driving frequency rating forms was created as follows: (1) collapsing the four point response scale on the Phase V version to three points by combining "often" and "very often"; (2) removing item #1 ("summer") from the Phase IV version; and (3) using item mean substitution for Phase IV participants for item # 4 ("rural areas") on the Phase V version. Thus, the comparable score comprised a 3 point rating scale ("never" to "often") and included all 14 items on the Phase V version, with possible scores ranging from 0 to 42.

Similarly, a comparable score for the Phase IV and V avoidance rating forms was computed as follows: (1) omitting item # 3 from the Phase IV form; (2) using person mean substitution for item # 19 for Phase IV participants if they did **not** check item #1 ("night"); and (3) assigning a value of one to item #19 for Phase IV participants who **did** check item #1 ("night). With respect to the step 3, it was assumed that if participants avoid night driving in general, they would also avoid night driving in rural areas. In addition, a few avoidance subscales were created by summing several items: "weather-related avoidance" (items 3-8; range

0 - 6); “rush hour avoidance” (items 11 and 12; range 0 - 2); and “highway avoidance” (items 16 and 17; range 0- 2).

The two perceived abilities rating forms provide a measure of current perceived abilities and perceived changes in abilities, respectively. Scoring of these measures is described in Appendix E. It should be noted that a higher score on the current perceived abilities form denotes “better” ratings of abilities and a higher score on the perceived changes in abilities form indicates that participants perceive *less* decline in their abilities compared to 10 years ago. Missing items were dealt with in one of two ways: (1) substitution with related items (e.g. item #8 “quickly spot pedestrians stepping out from between parked cars” and item #11 “quickly find a street or exit in an unfamiliar area or heavy traffic” refer to tasks involving visual attention); (2) or person mean substitution. The latter method was used for items for which there were no other directly related items (e.g. item #3 “see speedometer and controls” is the only item referring to near acuity). A detailed description of the procedures of item substitutions is provided in Appendix E. At baseline, five participants were missing items on the current perceived abilities form and ten participants were missing items on the perceived changes in abilities form. At follow-up, five people were missing items on the current and perceived changes in abilities forms, respectively. In all cases, the maximum number of items missed was three.

Finally, three composite variables were derived from the background questionnaire including a “Driving Problem” score, “Nervousness score and “Diagnosis score. Appendix F contains a description of how such scores were computed.

Prior to any analyses, all variables were assessed for normality, which included examination of normal probability plots and stem and leaf plots, skewness and kurtosis, as well as Kolmogrov-Smirnov and Shaprio-Wilks statistical tests (Pett, 1997). For normally distributed variables, Fisher skewness and kurtosis values should fall between ±1.96 the standard error of skewness and kurtosis, respectively.

In addition, internal consistency of each of the four rating forms was assessed via Chronbach's alpha (α) and item-total correlations using data from follow-up assessments. According to Devellis (2003) each item should correlate at least .20 with the total score. For internal consistency, α coefficients between .70 and .80 are considered acceptable; .80 to .90 are very good; values greater than .90 indicate possible redundancy. Comparative analyses are described in the following section.

3.5.2 Comparative Analyses

Participants who had stopped driving at follow-up were examined separately and then compared with those who continued driving. Table 3.1 summarizes the comparative analyses for Study 1. Paired t-tests were performed to examine group changes in Day and Night DCS scores in both those who continued and stopped driving. Effect sizes were also calculated using the formula for Cohen's *d* (Cohen, 1988): Effect size = (baseline mean score – follow-up mean score)/ baseline standard deviation. Subsequently, individual (relative) changes were examined to look at proportions who had increases and decreases in comfort level, as this information is masked when comparisons are made at the group level.

Percent change in DCS scores for each person were computed using the following formula: % change score = [(follow-up – baseline score)/baseline] X 100**.** Thus a positive score denoted an increased DCS score at follow-up while a negative score denoted a decreased DCS score. Such scores were used to categorize participants. In order to establish appropriate cut-offs for "change" in DCS scores, frequency distributions for percent change scores (shown in Appendix I) were examined, as well as percentile scores for 'absolute' percent change scores.

Absolute percentile scores were used (i.e. irrespective of direction) as cut-offs so that participants were divided according to *magnitude* of change. The 50th percentile scores were then used as cut-offs for both the Day and Night scales to categorize participants into three groups:

(1) No change: percent change score $< 50^{th}$ percentile;

(2) Increased comfort: percent change score $\geq 50^{th}$ percentile; change > 0; and

(3) Decreased comfort: percent change score $\geq 50^{th}$ percentile; change <0

The 50th percentile scores were selected as cut-off scores since they divided participants in to three relatively equal groups for statistical comparisons.

The relationship between changes in driving comfort and changes in self-reported driving behaviour was examined in two ways: (1) Pearson correlation coefficients were used to explore associations between DCS change scores and driving frequency and avoidance change scores (2) ANOVA was performed to examine differences in frequency and avoidance change scores between those with "no change", "increased comfort" and "decreased comfort". A secondary objective of the latter analyses was to explore potential benchmarks for critical changes in comfort level. DCS, frequency and avoidance change scores were computed as follows: Change score = Baseline score – Follow-up Score. Participants who had stopped driving were omitted from such analyses.

Table 3.1 Summary of Comparative Analyses for Study 1

Research Objective	**Analyses**
(1) To examine the extent of change in driving comfort over the short term	**A. Group Changes: Paired t-test**: differences between baseline DCS scores and follow-up DCS scores **B. Individual Changes (% Change in DCS Scores)** % change = [(baseline score – follow-up score)/baseline score] X 100
(2)To examine the relationship between changes in driving comfort and changes in self-reported driving behaviour	**A. Pearson Correlations:** ➢ DCS change scores and frequency change scores ➢ DCS change scores and avoidance change scores **B. ANOVA**: examined differences in driving frequency and avoidance change scores between groups: 1. No change (< 50^{th} percentile) 2. ↑ DCS scores (> 50^{th} percentile; change >0) 3. ↓DCS scores (> 50^{th} percentile; change <0)
(3) To examine if baseline DCS scores predict self-reported driving behaviour at follow-up	**Multiple Regression** ➢ Dependent variables: (1) Follow-up driving avoidance scores (2) Follow-up driving frequency scores
(4) To examine potential reasons for changes in driving comfort	**Independent T-tests:** Comparison of DCS change scores in those with and without changes in health, lifestyle and driving since baseline (data obtained from telephone interviews)

Multiple regression was conducted to explore the ability of baseline DCS scores to predict follow-up driving frequency scores and follow-up driving avoidance scores. Thus, two regression models were examined. Additional baseline variables that were significantly related to baseline DCS scores and/or logically presumed to be influential on driving behaviour (e.g. gender, health characteristics) were also explored as potential predictors. It should be noted that participants who stopped driving were included in such analyses because it was thought that casewise diagnostics (i.e. residuals, Cook's distance or leverage values) would reveal if such participants were highly influential on the model parameters. Analyses began by examining bivariate relationships (using correlations and independent t-tests) between certain baseline variables and follow-up frequency and avoidance scores. Variables that emerged as significant were then explored in the multivariate models. The backward elimination method was used to build the regression models, which involved entering all variables into the model simultaneously and then comparing the significance value of each regression coefficient against a removal criterion. Variables with p values above .05 were removed one at a time (in order from least to most significant) and corresponding changes in the model R^2 value were examined. Variables were permanently removed from the model if the corresponding change in the model R^2 value was not significant (indicating that removal of the variable did not significantly reduce the amount of variance in the outcome variable accounted for by the model).

Following selection of the final model, residuals, leverage and Cook's distance were examined to identify outliers and influential cases. Cases that had Cook's distance greater than 1.0 or a leverage value greater than 2(k+1)/n, where "k" is the number of predictors in the model and "n" is the number of participants, were examined further. Multicollinearity between predictors was also assessed by examining variance inflation factors (VIF) and tolerance statistics. According to Field (2005), VIF values greater than 10 indicate that multicollinearity may be biasing the model. Tolerance values (the reciprocal of VIF values) below .2 are also indicative of problems. Finally, diagnostic plots were examined to confirm that the residuals were independent and normally distributed.

Data from the telephone interview subsample (N=45) was used to determine reasons for changes in driving comfort over time. The interviews were transcribed verbatim and entered into a word file by subject ID code. Content analysis was then used to categorize responses (e.g. health changes vs. no health changes, driving problems vs. no driving problems). Subsequently, independent t-tests were used to examine differences in Day and Night D-DCS change scores in those with and without changes in health, lifestyle and driving factors since baseline.

3.6 Results

This section begins by describing baseline and follow-up participation rates, followed by a description of the participants who took part in both of these components. A comparison of those who continued and stopped driving is presented next and, subsequently, results for each research objective are presented in the following order: (1) Changes in Driving Comfort; (2) Relationship between Changes in Driving Comfort and Driving Behaviour; (2) Relationship between Baseline DCS Scores and Follow-up Driving Behaviour; (4) Reasons for Changes in Driving Comfort (from the telephone interviews).

3.6.1 Participation Rates

3.6. 1.1 Baseline Participation Rates

Of the 34 Phase IV participants who provided permission for contact, 30 were reached after multiple attempts (88% contact rate). Four people could not be contacted (65-79=4; 80+=0; ♂/♀=1/3); two numbers were no longer in service, while two people could not be reached (no answer or answering machine). Of the 30 participants contacted, 22 (or 73%) were still willing to participate (65-79=10; 80+=12; ♂/♀=8/14). Eight people declined further participation (65-79=4; 80+=4; ♂/♀=4/4), citing the following reasons: "not interested" (n=4); "too busy" (n=2); "don't remember the study" (n=1); and "driving is fine" (n=1).

A total of 111 new participants were recruited at baseline, 89 (or 80%) of whom gave permission for further contact. Only those participants who provided permission for further contact were included as part of the baseline sample. Due to recruiting at some of the same locations as Paradis, some overlap was inevitable. For instance, one lady who had participated in Phase IV (who could not be reached by phone) signed up for Ph V and thus was assigned to the new sample. Another four people (one man and three women) from Phase IV (who gave permission for follow-up) also signed up during Ph V recruitment. Two of these four people (both women) were kept with the Phase IV sample while the other two (one man and one woman) were allocated to the "new" sample. Consequently, the total baseline sample consisted of 107 older drivers including 20 from Phase IV and 87 new recruits. Volunteers ranged in age from 63 – 93 and comprised 64 women and 43 men.

Table 3.2 shows the locations and facilities from which the 107 participants were recruited (denoted by initials), as well as further study preferences. As shown, 28 people expressed an interest in Option 1 (including the 20 Phase IV people), 3 were interested in Option 2, and 53 indicated an interest in both. Twenty-three people (classified as DNI – Did Not Indicate) did not indicate a preference.

Table 3.2: Total Baseline Sample and Study Preferences

Location	Gender	Option 1	Option 2	Both	DNI	TOTAL
1. WH (Waterloo) *	M	1		2		**7**
	F	4		1	1	
2. SJ (Waterloo) *	M				2	**4**
	F	1		1		
3. LV (Waterloo) †	M	1		1		**14**
	F	5		5	2	
4. LW (Waterloo) †	M			3		**8**
	F		2	3		
5. BT(Waterloo) *	M				1	**2**
	F	1				
6. MC (Kitchener) †	M	1				**1**
7. SH (Kitchener) *	M	1				**9**
	F	1	1	6		
8. WP (Kitchener) †	M	1			2	**9**
	F			4	2	
9. PS (Kitchener) †	F	2				**2**
10. VP (Kitchener) †	F	1				**1**
11. DV (Kitchener) †	M			2	1	**7**
	F	1		2	1	
12. TV (Kitchener) †	M			2		**2**
13. EV (Kitchener) †	M	1		1	3	**6**
	F				1	
14. DC (Elmira) †	F	2				**2**
15. CG (Elmira) †	F	2				**2**
16. EH (Guelph) †	M	1				**1**
17. EL (Guelph) †	M	1				**2**
	F	1				
18. RG (Guelph) †	M			2		**2**
19. EG (Guelph) ‡	M			2	3	**14**
	F			7	2	
20. SL (Cambridge) †	M			3	1	**8**
	F			3	1	
21. VPK(Fergus) ‡	M	1		3		**4**
						TOTAL
	M	9	0	21	13	**43**
TOTALS	**F**	19	3	32	10	**64**
		28	**3**	**53**	**23**	**107**

* Senior's Apartment; † Retirement Complex; ‡Senior's Centre

Note: Option 1: telephone interviews; Option 2: assessment of driving-related abilities; DNI = Did not indicate a preference

3.6.1.2 Follow-up Participation Rates

Of the initial 107 participants at baseline, 4 (3.7%) could not be contacted for follow-up, 2 (1.9%) had died and 19 (17.8%) declined further participation when contacted. Reasons for refusal included: poor health or vision (N = 9), not interested (N = 5), do very little driving (N = 1), ill spouse (N =1) and 3 people did not provide a reason. Of the 19 people who were contacted and declined further participation, three indicated they had stopped driving and one no longer had a car. In sum, 82 participants, 76.6% of the initial group (17 Phase IV; 65 new), provided both baseline and follow-up data for the present study.

Table 3.3 shows a comparison of selected baseline characteristics for those who did (N = 82) and did not ("drop-outs") participate (N = 25) in the follow-up. A slightly higher proportion of dropouts were female, however, the difference was not significant. Dropouts were significantly older based on average age (t (105) = 2.2, p=.028) and percentage of people aged 80+ (χ^2 (1) = 8.7, p=.003). In addition, dropouts were significantly less likely to have completed college or university (χ^2 (1) = 5.29, p=.021) and were significantly less likely to have others rely on them to drive (χ^2 (1) = 5.01, p=.025). Although not significant, a higher proportion of dropouts did not drive at night. The dropouts also appeared to be in poorer health. While differences were not significant, a higher proportion of the dropouts used a cane or walker and a reported that they were *not* able to walk a quarter mile. As well, a higher proportion of dropouts had been diagnosed with a vision condition. Although the dropouts had slightly lower mean comfort scores (D-DCS and N-DCS), differences were not significant. It should be noted that dropouts were omitted from all further study analyses.

Table 3.3: Participants and Dropouts

Characteristic	Agreed to Follow-up (N = 82)	Drop Outs (N = 25)
Female	48 (58.5%)	16 (64.0%)
80+ **	38 (46.3%)	20 (80.0%)
Age*	78.8 ± 6.1	82.0 ± 7.3
Highschool	56 (68.3%)	15 (62.5%)
College*	38 (48.7%)	5 (21.7%)
Other Driver in Household	27 (32.9%)	12 (48.0%)
Rely on You to Drive*	38 (46.3%)	5 (20.8%)
Accident in Past Year	6 (7.3%)	1 (4.5%)
Cane/Walker	21 (25.6%)	8 (32.0%)
Able to Walk a ¼ Mile	69 (84.1%)	18 (75.0%)
Diagnosed Cataracts, Glaucoma, Mac Degen.	23 (28.0%)	11 (44.0%)
D-DCS Score	69.0 ± 17.9	65.3 ± 21.8
N-DCS Score	56.7 ± 24.4	53.1 ± 24.0
Rarely/ Never Drive at Night	15 (18.3%)	6 (24.0%)

*p<.05; **p<.01

As shown in figure 3.2, among the 82 participants who took part in the follow-up, 45 completed telephone interviews, while 37 were followed up in-person. The mean follow-up interval was 9.34 months ± 3.32 (range 5 to 17). The following section presents a description of the 82 participants who took part in both the baseline and follow-up components of the study.

Baseline Assessments N = 107
DCSs, rating forms, background questionnaire

↓

Follow-up Assessments N = 82
DCSs, rating forms

↙ ↘

Telephone Interview N = 45 | **No Telephone Interview N = 37**

Figure 3.2 Sample Size for Study 1

3.6.2 Sample Description

Table 3.4 shows selected characteristics for the baseline sample (N=82). A description of the telephone interview subsample is presented in section 3.6.7. Comparative analyses were performed when possible (i.e. sufficient sample sizes) to examine gender and age group differences. Overall, the sample was roughly equal with respect to gender and age groupings, however, males (80.5 ± 5.9) were on average significantly older than females (77.5 ± 5.8; t(80) = 2.27, p=.026). Participants were also fairly educated, particularly the women who were significantly more likely to have completed high school (81.3% vs. 50%, $\chi^2(1) = 8.98$, p=.003) and college/university (60% vs. 33.3%, $\chi^2(1) = 5.42$, p=.02). About half lived alone and reported that others rely on them to drive, but only a third had another driver living in their household. Drivers in the younger age group (63-79) were significantly more likely to report that they live close enough to walk to church, social and recreation activities (46% vs. 19.4%, $\chi^2(1) = 5.99$, p=.007).

Table 3.5 shows the sample's reported driving patterns. Most people drove, on average, 5 days per week and most reported that they drive less often than 10 years ago. Although many had taken rides from family and friends in the past month, very few reported using taxis, public or special transportation. Women were significantly more likely to have taken rides from family or friends in the past month (72.9% vs. 50%, $\chi^2(1) = 4.51$, p=.034) compared to men. Only a small percentage acknowledged driving problems, with only 7% reporting accidents. Men were significantly more likely to report near misses (66.7% vs. 33.3%, $\chi^2(1) = 4.81$ p=.028) and had a significantly higher driving problems score (.76 ±.99 vs. .38 ± .71, t (79) = 2.03, p=.046). Interestingly, drivers aged 63-79 had a significantly higher nervousness score than drivers aged 80+ (.76 ± .82 vs. .16 ± .37, t (79) = 3.88, p=.001).

The health characteristics of the sample (according to the background questionnaire) are shown in Table 3.6. Generally, the sample appeared to be in good health. Most participants rated their health as excellent or good, were able to walk a quarter of a mile and few reported using a cane or walker outdoors. Men and drivers aged 80+ were significantly more likely to have hearing problems than women (41.2% vs. 20.8%; χ^2 (1) = 3.98, p=.046) and drivers aged 63-79 (42.1% vs. 18.2%; χ^2 (1) =5.64, p = .018). While just under half had undergone cataract surgery, few people rated their eyesight as "worse than most". Drivers aged 80+ were significantly more likely to have had cataract surgery (57.8% vs. 27.3%; χ^2 (1) =7.24, p = .007). Although not shown in the table, the sample appears to be fairly active as 82% of Phase IV participants reported being physically active on a regular basis, and the "new" participants reported doing 30 minutes of physical activity, on average, 4 days per week. About a third of the sample had discussed driving with their physician or optometrist and slightly more than a third with their family or friends.

Table 3.4: Selected Characteristics at Baseline

Characteristic	**Total** (N=82)
Gender	
Male	34 (41.5%)
Female	48 (58.5%)
Age	
Mean (SD)	78.7 (6.1)
Range	63 – 93
Age Group	
63-79	44 (53.7%)
80+	38 (46.3%)
Education Completed	
High school*	56 (68.3%)
College/university*	38 (46.3%)
Missing	4 (4.9%)
Living Arrangements	
Alone	47 (57.3%)
With spouse/partner	32 (39%)
With roommates (not related)	3 (3.7%)
Other Driver in Household	27 (32.9%)
Others Rely on You to Drive	39 (47.6%)
Worry about Car Related Expenses	
Often	10 (12.2%)
Sometimes	19 (23.2%)
Rarely	37 (45.1%)
Never	16 (19.5%)
Close Enough to Walk	
Yes, weekly shopping & errands	34 (41.5%)
Yes, church, social or recreation †	27 (32.9%)
Missing	2 (2.4%)

*Indicates significant gender differences for the total sample $p<.05$

†Indicates significant age group differences for the total sample $p<.01$ (63-79 vs. 80+)

Phase IV participants did not receive the following questions: “years driven” and “type of residence”

Table 3.5: Driving Patterns at Baseline

Driving Patterns	**Total** (N=82)
# Days Driven in Past Week	
Mean (SD)	4.6 (1.9)
Range	0 - 7
Driving Compared to 10 yrs Ago	
Less often	51 (62.2%)
About the same/More often	29 (35.4%)
Missing	2 (2.4%)
Taken in the Past Month	
Rides from family/friends *	52 (63.4%)
Taxis	3 (3.7%)
Public transport (buses, streetcars)	8 (9.8%)
Special transit services	8 (9.8%)
Physical Discomfort While Driving	
Gripping the steering wheel	25 (30.5%)
Feeling palms sweat or heart race	1 (1.2%)
Feeling shoulders tighten	13 (15.9%)
Missing: 1	
Nervousness Score (0-3) †	
Mean (SD)	.47 (.71)
Range	0 - 2
Missing	1
Driving Problems	
Accidents	6 (7.3%)
Near misses*	15 (18.3%)
Backing into things	7 (8.5%)
Getting lost*	17 (20.7%)
Missing	
Driving Problems Score (0-4) *	
Mean (SD)	.5 (.9)
Range	0 - 4

*Indicates gender differences $p<.05$

† Indicates age group differences $p<.01$ (63-79 vs. 80+)

Multiple responses possible for "taken in the past month"; "physical discomfort" and "driving problems"

Table 3.6: Health Characteristics at Baseline

Health and Abilities	**Total** (N=82)
Overall Health	
Excellent/Good	73 (89.0%)
Fair/Poor/Very Poor	9 (11.0%)
Use Cane/Walker Outdoors	21 (25.6%)
Able to Walk a Quarter Mile	69 (84.1%)
Diagnosed Health Conditions	
arthritis, rheumatism or osteoporosis	31 (37.8%)
Parkinson's or multiple sclerosis	7 (8.5%)
heart problems	46 (56.1%)
diabetes	14 (17.1%)
asthma or breathing problems	8 (9.8%)
back or foot problems	20 (24.4%)
hearing problems* †	24 (29.3%)
cataracts, glaucoma or macular degen	24 (29.3%)
Diagnosis Score (0-8)	
Mean (SD)	2.1 (1.4)
Range	0 - 7
Take Medications	68 (82.9%)
Missing	2 (2.4%)
Cataract Surgery †	33 (40.2%)
Missing	1 (1.2%)
If Yes: How long ago	
Within past year	9 (27.3%)
Over a year ago	24 (72.7%)
Eyesight Compared to Others	
Worse than most	2 (2.4%)
About the same	42 (51.2%)
Better than most	36 (43.9%)
Missing	2 (2.4%)
Last Visit Physician	
Within past 6 months	64 (78%)
Past Year	14 (17.1%)
More than a year ago	4 (4.9%)
Physician Asked If you Drive	
Yes	17 (20.7%)
Missing	3 (3.7%)
Talked About Your Driving	
physician or optometrist	24 (29.3%)
Missing	7 (8.5)
family or friends	30 (36.6%)
Missing	3 (3.7%)

Multiple response exist for: "diagnosed health conditions"
* Indicates gender differences for the total sample p<.05
† Indicates age group differences for the total sample p<.05 (63-79 vs. 80+)

Table 3.7 shows the mean DCS scores and ratings of self-reported driving behaviour and perceived abilities at baseline. All scores were normally distributed except for ratings of item #1 on the N-DCS (Shapiro-Wilks statistic (n = 79) = .790, p<.001) and total scores on the perceived changes in abilities form (Shapiro-Wilks statistic (n = 64) = .961, p=.041). Examination of normal probability plots showed that both values were negatively skewed. Cronbach's alphas (α) for each of the four rating forms are shown in Appendix E and all indicate very good internal consistency (above .80). In addition, item-total correlations were all above .20 and Cronbach's alpha (α) did not change appreciably as items were sequentially deleted. Item #1 on the N-DCS ("in good weather and traffic conditions") provides an indication of general night driving comfort, which was, on average, very high in the sample.

Table 3.7 DCS Scores and Ratings at Baseline

Measure	N	Mean (SD)	Range	95% CI
Day Driving Comfort (D-DCS)	82	69.0 (17.9)	18.8 – 100.0	65.1 – 72.9
Night Driving Comfort (N-DCS)	81	56.8 (24.4)	0.0 – 100.0	51.4 – 62.2
Item # 1 on the N-DCS	79	79.1 (23.5)	0.0 – 100.0	73.9 – 84.4
Situational Driving Frequency (0 - 42)	82	28.6 (6.7)	12.3 – 42.0	27.2 – 30.1
Driving Avoidance (0 - 20)	81	8.1 (4.9)	0.0 – 19.0	7.1 – 9.2
Current Perceived Abilities (0 - 45)	52	31.9 (7.7)	15.0 – 44.0	29.8 – 34.1
Perceived Changes in Abilities (0 – 45)	64	25.6 (5.0)	12.0 – 40.0	24.3 – 26.8

3.6.3 Comparing Participants who Stopped versus Continued Driving

Of the 82 participants who completed the follow-up, only seven people (8.5%) had stopped driving (four within the past six months and three 6-12 months prior). All participants voluntarily stopped driving except for one individual who was told by his physician that he could no longer drive after a stroke. Reasons for cessation included health (n= 2), no longer feeling safe or comfortable (n=1), no longer needing a car (n=2) and two participants reported multiple reasons including age/general declines and finances, and age/general declines and no longer needing a car, respectively. Table 3.8 shows percent change scores on the D-DCS and N-DCS along with the reasons of each person who stopped driving. Three individuals had increased Day DCS scores, three had decreased and one had no change. Night DCS scores, meanwhile, decreased for six participants and increased slightly (3%) for one person. Of note, participants who said they stopped driving for health reasons, or no longer feeling safe or comfortable, had larger declines in night driving comfort than those who stopped because they no longer needed a car.

Table 3.8: Reasons for Cessation and Percent Change in DCS Scores

Reason (s) for Stopping	% Change in D-DCS	% Change in N-DCS
Health (fall)	-66.7%	-96.1%
Health (stroke)	0%	-69.0%
No longer feel safe or comfortable	-55.6%	-73.6%
Age/general declines; Financial	9.8%	-57.2%
Age/general declines; No longer need car	43.6%	3.1%
No longer need car	-23.9%	-23.0%
No longer need car	4.4%	-3.5%

Table 3.9 shows a comparison of selected baseline characteristics for those who stopped and continued driving. Statistical comparisons were examined for continuous variables but not for categorical due to the small number of people who stopped driving. The length of the follow-up interval was significantly longer for those who had stopped driving than for those who continued ($t(80) = 2.68$, $p=.009$). Gender and age distributions were fairly similar between the two samples, although those who stopped driving had a slightly higher mean age. In addition, those who stopped driving were less likely to report that others rely on them to drive at baseline.

While the majority of participants in both groups were able to walk a quarter mile, a slightly higher proportion of those who stopped driving used a cane/walker, possibly indicating greater frailty. On the other hand, those who stopped driving actually had fewer health problems, including diagnosed vision conditions. A slightly higher percentage of those who stopped driving said that they “never or rarely” drive at night at baseline.

Table 3.10 compares baseline scores and follow-up scores between those who stopped and continued driving. As noted previously, participants who stopped driving were asked to rate their comfort level and indicate which situations they would avoid if they were still driving. While there was minimal difference in baseline DCS scores, those who stopped driving had lower scores at follow-up, particularly for N-DCS (approaching significance p=.05). Those who stopped driving scored significantly lower on item #1 ("in good weather and traffic conditions") of the N-DCS (p=.003).

There were virtually no differences in baseline situational frequency and avoidance, however, those who stopped driving had higher avoidance scores at follow-up (although differences were not significant). Unfortunately, perceived abilities at baseline could not be compared as four people (Phase IV sample) who had stopped driving did not complete these forms. As expected, follow-up ratings of both current and perceived changes in abilities were significantly lower for those who stopped driving.

Table 3.9: Selected Characteristics for those who Continued vs. Stopped Driving

Characteristic	Continued Driving (N = 75)	Stopped Driving (N = 7)
Length of Follow-up Period*		
Mean (SD)	9.1 (3.1)	12.4 (3.9)
Range	5.0 – 17.0	8.0 – 17.0
Gender		
Male	31 (41.3%)	3 (42.9%)
Female	44 (58.7%)	4 (57.1%)
Age		
Mean (SD)	78.5 (6.1)	81.0 (4.8)
Range	63 - 93	75.0 – 88.0
Age Group		
63 – 93	41 (54.7%)	3 (42.9%)
80+	34 (45.3%)	4 (57.1%)
Education Completed		
High school	51 (68%)	5 (71.4%)
College/University	35 (46.7%)	3 (42.9%)
Other Driver in Household		
No	50 (66.7%)	5 (71.4%)
Yes	25 (33.3%)	2 (28.6%)
Rely on You		
No	38 (50.7%)	5 (71.4%)
Yes	37 (49.3%)	2 (28.6%)
Use Cane/Walker		
No	57 (76%)	4 (56.1%)
Yes	18 (24%)	3 (42.9%)
Able to Walk ¼ Mile		
No	12 (16%)	1 (14.3%)
Yes	63 (84%)	6 (85.7%)
Diagnosis Score		
Mean (SD)	2.2 (1.5)	1.6 (1.0)
Range	0 - 7	0 - 3
Diagnosed Cataracts, Glaucoma, Mac. Degen.		
No	52 (69.3%)	6 (85.7%)
Yes	23 (30.7%)	1 (14.3%)
# Days Driven in Past Week		
Mean (SD)	4.6 (1.8)	4.3 (3.2)
Range	0 - 7	0 - 7
Drive at Night		
Never/rarely	13 (17.3%)	2 (28.6%)
Sometimes/ Often	62 (82.7%)	5 (71.4%)
Driving Problems Score		
Mean (SD)	.6 (.9)	.3 (.8)
Range	0 - 4	0 – 2

*Indicates significant difference between those who stopped and continued driving (p<.01)

Table 3.10: Perceptions and Driving in those who Stopped and Continued Driving

Measure	N	Baseline	N	Follow-up
D-DCS				
Stopped Driving	7	69.44 (24.75)	7	56.32 (27.88)
Continued Driving	75	68.97 (17.30)	75	66.14 (17.20)
t-value (p)		.066 (.947)		-1.36 (.176)
N-DCS				
Stopped Driving	7	59.60 (33.90)	7	32.59 (33.72)
Continued Driving	74	56.53 (23.55)	74	52.32 (24.18)
t-value (p)		.317 (.752)		-1.99 (.050)
Item #1 N-DCS				
Stopped Driving	7	71.43 (36.60)	7	46.43 (39.34)
Continued Driving	75	79.86 (22.06)	75	74.67 (21.55)
Mann-Whitney Statistic (p)		-.370 (.711)		-2.08 (.038)*
Situational Frequency (0-42)				
Stopped Driving	7	26.84 (5.76)	7	0.00
Continued Driving	75	28.81 (6.74)	75	26.35 (6.94)
t-value (p)		-.747 (.457)		
Situational Avoidance (0-20)				
Stopped Driving	7	9.04 (5.83)	6	13.36 (8.90)
Continued Driving	74	8.66 (5.12)	75	9.54 (5.10
t-value (p)		.184 (.854)		1.08 (.332)
Current Perceived Abilities (0-45)		N/A		
Stopped Driving			7	17.67 (10.37)
Continued Driving			75	31.17 (7.37)
t-value (p)				-4.19 (<.001)***
Perceived Changes in Abilities (0-45)				
Stopped Driving		N/A	7	17.67 (8.52)
Continued Driving			75	26.21 (4.52)
Mann-Whitney Statistic (p)				-2.48 (.013)*

*****p<.05; ******p<.01; ***p<.001

3.6.4 Changes in Driving Comfort

Group changes in comfort are described first, followed by individual changes in comfort level. Table 3.11 shows the within-group change in DCS scores from baseline to follow-up (via paired t-tests) for individuals who stopped driving versus those who continued driving, respectively. For those who stopped driving, both Day and Night DCS scores were lower at follow-up, however, the difference was only significant for the night comfort scores (p=.017). The effect size for the N-DCS score was large (.79), and moderate for the D-DCS score (.53).

For those who continued driving, mean Day and Night DCS scores were slightly lower at follow-up, but differences were not significant and the effect sizes for such comparisons were small (.18 and .16 for day and night, respectively). Both groups showed a decline on item # 1 of the N-DCS (good weather and conditions), and although the difference was statistically significant only for the group who continued to drive, the actual difference in mean scores (from 71 to 46) was actually much greater for persons who stopped driving (significance may not have emerged due to the extremely small sample size).

For both groups (those who stopped and continued driving), baseline DCS scores correlated positively with corresponding follow-up scores, indicating that those with higher comfort at baseline also had higher comfort at follow-up. Correlations were particularly strong for the N-DCS scores (above .70). Such associations were significant for all three measures (D-DCS, N-DCS and Item 1 on N-DCS) in those who continued driving, but only for N-DCS scores in those who stopped driving.

Individual changes in DCS scores, expressed as percent change scores (formula described in section 3.5.2), were examined to look at the proportions who had increases or decreases in comfort. Positive scores indicate an increase in comfort while negative scores denote a decrease. Percent change scores ranged from -67% to +59% for the D-DCS and from -96% to +300% for the N-DCS, as shown in Appendix I. The individual who had an increase of 300% was identified as an outlier (much greater change than the rest of the sample) and, consequently, was examined separately (described below).

Table 3.11: Changes in DCS Scores from Baseline to Follow-up

Scale	N	Stopped Driving	N	Continued Driving
D-DCS				
Baseline	7	69.44 (24.75)	75	68.97 (17.85)
Follow-up	7	56.32 (27.88)	75	66.14 (18.31)
Pearson r (p)		.586 (.166)		.692 (<.001)***
t-value (p)		1.44 (.200)		1.81 (.075)
Effect size		.53		.18
N-DCS				
Baseline	7	59.60 (33.90)	73	56.38 (23.68)
Follow-up	7	32.59 (33.72)	73	52.50 (24.30)
Pearson r (p)		.79 (.035)*		.72 (<.001)***
t-value		3.25 (.017)*		1.84 (.070)
Effect size		.79		.16
Item #1 N-DCS				
Baseline	7	71.43 (36.59)	72	79.86 (22.06)
Follow-up	7	46.43 (39.34)	72	75.00 (21.80)
Spearman's rho (p)		.75 (.06)		.61 (<.001)
Wilcoxon test statistic (p)		-1.63 (.10)		-2.18 (.03)*

*p<.05; ***p<.001

Table 3.12 shows the mean percent change scores for Day and Night DCS as well as the proportion of individuals with increased, decreased or no change in DCS scores. On average, both Day and Night DCS scores decreased at follow-up and mean decreases were greater for night comfort than for day. As well, the mean decrease in Day and Night DCS scores was greater for those who stopped driving than for those who continued. For those who continued driving, approximately equal proportions had increased and decreased Day and Night DCS scores, and only a few had no change. For those who stopped driving, an equal number of individuals had increased and decreased Day DCS scores, but a much higher proportion had decreased Night DCS scores.

Table 3.12: Percent Change in DCS Scores

Scale	Total N	Continued Driving	Total N	Stopped Driving
D-DCS % Change	**74**		**7**	
Mean (SD)		-2.4 (21.2)		-12.6 (38.7)
Range		-48.6 to 59.3		-66.7 to 43.6
D-DCS Direction of Change	**74**		**7**	
No change		2 (2.7%)		1 (14.3%)
Increased		33 (44.6%)		3 (42.9%)
Decreased		39 (52.7%)		3 (42.9%)
N-DCS % Change	**72**		**7**	
Mean (SD)		-4.63 (40.2)		-45.6 (38.0)
Range		-100 to 141		-96.00 to 3.13
N-DCS Direction of Change	**72**		**7**	
No change		4 (5.6%)		0
Increased		32 (44.4%)		1 (14.3%)
Decreased		36 (50.0%)		6 (85.7%)

As mentioned above, one individual (female, 77), who continued to drive, had an increase of 300% on the N-DCS. This person had a very low baseline N-DCS score (7.81%) which increased to 31.25% at follow-up. Although the percent change in night driving comfort is large, the follow-up N-DCS score is still relatively low and below the sample mean (56.79%). Additionally, no changes occurred on her D-DCS (61.54%), ratings of item #1 of the N-DCS (50%) and situational driving frequency (21), and situational avoidance increased by only one point (from 13 to 14). Despite having extremely low night comfort at baseline, this participant indicated that she “occasionally” drove at night at baseline, which reduced to “rarely” at follow-up. Although data from the telephone interview revealed that this participant had improved blood pressure levels and had been taken off the corresponding medication, it is unlikely that such changes would trigger a large increase in night driving comfort (particularly since no other scores changed). It is suspected that the baseline N-DCS was filled out incorrectly and, consequently, this participant was removed from all further analyses.

3.6.5 Relationship between Changes in Driving Comfort and Behaviour

Cross-sectional comparisons between baseline DCS scores and driving frequency and avoidance score are presented in Chapter Four (section 4.6.2.2). This section begins by describing associations between D-DCS and N-DCS change scores and driving frequency and avoidance change scores for the sample as a whole. Subsequently, differences between those with increased, decreased and no changes in DCS scores with respect to driving frequency and avoidance are described. Participants who had stopped driving, as well as the individual with a 300% increase in night comfort, were removed from such analyses.

Table 3.13 shows the correlations between DCS, frequency and avoidance change scores. While none were significant, all were in the expected direction; a decrease in DCS scores was associated with a decrease in driving frequency and an increase in driving avoidance. Although still fairly weak, the best association was between changes in N-DCS and driving avoidance (approaching significance).

Table 3.13: Relationships between DCS, Driving Frequency and Avoidance Change Scores

Driving Behaviour	N	D-DCS Change Score	N	N-DCS Change Score
Driving Frequency Change Score Pearson r (p)	74	.17 (.14)	72	.20 (.09)
Driving Avoidance Change Score Pearson r (p)	73	-.14 (.25)	71	-.22 (.06)

*p<.05

As previously mentioned, cut-offs for “change” were established by examining frequency distributions (Appendix I) and percentile scores for percent change D-DCS and N-DCS scores. The 50th percentile scores were selected as cut-offs because they divided participants into three relatively equal groups. The participant with a 300% increase in night comfort was removed from all analyses and calculations of the 50th percentile scores. Table 3.14 displays the 50th percentile scores (cut-offs), as well as the proportions with no change, increased and decreased driving comfort. For both scales, a slightly higher proportion of participants "with change" (i.e. scores ≥ 50th percentile) had decreased comfort than increased.

Table 3.14: 50th Percentile Scores for D-DCS and N-DCS Percent Change Scores

Scale	50th Percentile	Total N	No change	↓ Comfort	↑ Comfort
D-DCS	13.0%	74	36 (48.6%)	23 (31.1%)	15 (20.3%)
N-DCS	22.5%	72	36 (50%)	22 (30.6%)	14 (19.4%)

Gender and age distributions among the three groups are shown in Table 3.15. While age was distributed fairly evenly across the groups, a slightly higher proportion of females had decreased day and night driving comfort (although no differences were significant).

Table 3.15: Gender and Age Distributions for Changes in Driving Comfort

Characteristic	No change	↓ Comfort	↑ Comfort
D-DCS	**N = 36**	**N = 23**	**N = 15**
Female	21 (58.3%)	15 (65.2%)	7 (46.7%)
80+	16 (44.4%)	10 (43.5%)	8 (53.3%)
Mean Age	78.06 (6.3)	78.35 (7.2)	80.07 (3.9)
N-DCS	**N = 36**	**N = 22**	**N = 14**
Female	19 (47.2%)	15 (68.2%)	7 (50%)
80+	17 (47.2%)	9 (40.9%)	6 (42.9%)
Mean Age	78.1 (6.3)	78.7 (5.5)	78.3 (6.5)

Table 3.16 shows differences in driving frequency and avoidance change scores. Although no significant difference emerged, all comparisons were in the expected directions. For both the day and night scales, participants with decreased comfort had, on average, a greater reduction in driving frequency and a greater increase in driving avoidance. Furthermore, participants categorized as "no change" had the smallest (i.e. closest to zero) mean change scores for both driving frequency and avoidance. Such relationships are illustrated more clearly in the mean plots (Figures 3.3, to 3.6), below.

Table 3.16: Changes in Frequency and Avoidance by Changes in DCS Scores

Scale	N	Frequency Change Score	N	Avoidance Change Score
D-DCS				
No change	36	-1.36 (5.00)	35	.03 (5.05)
Decreased	23	-4.24 (4.90)	23	2.04 (4.63)
Increased	15	-2.57 (4.35)	15	1.09 (3.94)
F-value (p)		2.47 (.092)		1.29 (.283)
N-DCS				
No change	36	-1.51 (4.25)	35	-.12 (4.47)
Decreased	22	-4.25 (5.37)	22	2.91 (4.07)
Increased	14	-2.51 (5.74)	14	.60 (5.83)
F-value (p)		2.12 (.127)		2.92 (.061)

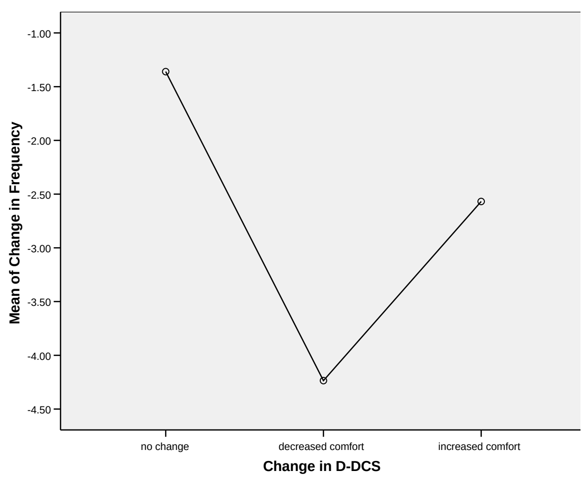


Figure 3.3 Mean plot for changes in frequency and D-DCS scores

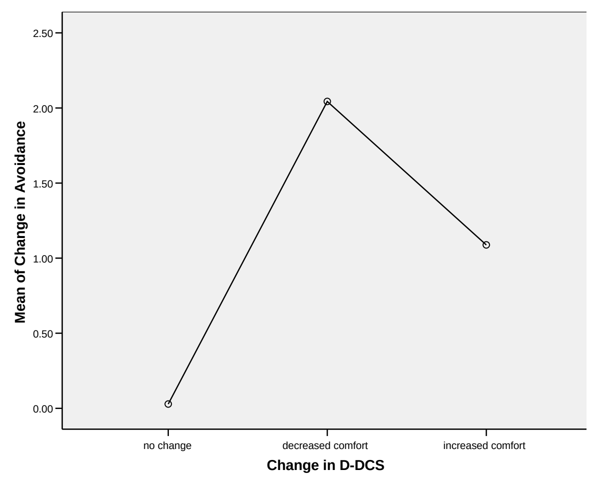


Figure 3.4 Mean plot for changes in avoidance and D-DCS scores

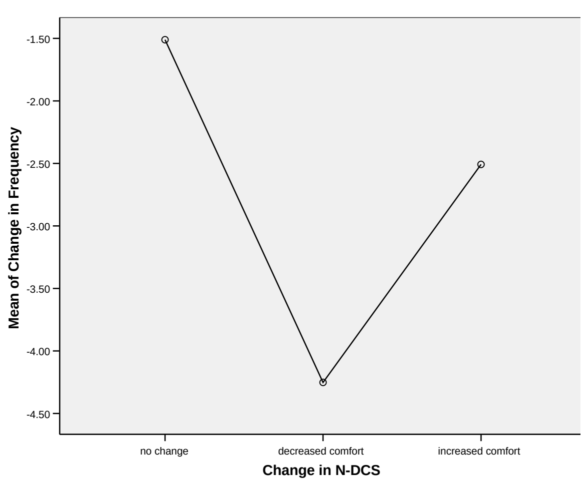


Figure 3.5 Mean plot for changes in frequency and N-DCS scores

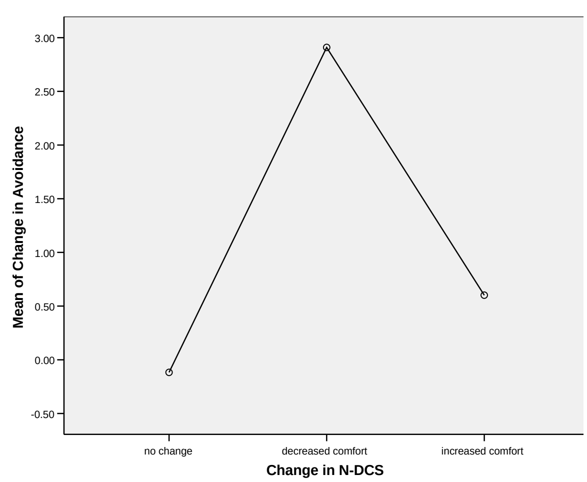


Figure 3.6 Mean plot for changes in avoidance and N-DCS scores

3.6.6. Relationship between Baseline DCS Scores and Follow-up Driving Behaviour

The following section presents the results of multiple regression analyses between baseline DCS scores and follow-up situational driving frequency and avoidance. Four subjects were omitted from the analyses: the outlier identified in section 3.6.4., two participants who did not complete 75% of the N-DCS items, and one person who did not check any items on the follow-up avoidance form, including item #21 ("I do not avoidance any of these situations). Thus, the total sample sizes for driving frequency and avoidance were 79 and 78 participants, respectively. The analysis for driving frequency is presented first, followed by driving avoidance.

3.6.6.1 Follow-up Situational Driving Frequency

Table 3.17 shows the bivariate relationships between selected baseline variables, DCS change scores and follow-up situational driving frequency scores. Based on the bivariate associations, the following variables were selected as potential predictors:

- Age
- N-DCS Score;
- N-DCS Change Score;
- Cane/Walker; and
- Rely on You

While age was not significant, it seemed appropriate to explore the influence of this variable as the literature suggests that driving frequency tends declines with age. Gender was not included because it was not even close to being significant. The rationale for not including current perceived abilities was twofold. First, sample size would be greatly reduced (52 vs. 79 participants). Secondly, as shown in Chapter 4, current perceived abilities is highly correlated with DCS scores ($r = .531$ and $r = .580$ for D-DCS and N-DCS, respectively, $p < .001$ for both). High correlations between predictors (also referred to as "multocollinearity") makes it difficult to assess individual importance of a predictor and, in the present study, the principle interest was driving comfort.

Table 3.17: Bivariate Relationships with Follow-up Frequency

Baseline Variable	N	Follow-up Frequency (0-42)
Gender		
Male	34	24.60 (9.93)
Female	47	23.80 (10.15)
t-value (p)		.36 (.72)
Age		
Pearson r (p)	81	-.19 (.09)
D-DCS Score		
Pearson r (p)	81	.21 (.06)
N-DCS Score		
Pearson r (p)	80	.23 (.03)*
D-DCS Change Score		
Pearson r (p)	81	.20 (.08)
N-DCS Change Score		
Pearson r (p)	79	.33 (.003)**
Current Perceived Abilities		
Pearson r (p)	52	.36 (.008)**
Perceived Changes in Abilities		
Spearman rho (p)	64	.22 (.09)
Diagnosis Score		
Spearman rho (p)	81	-.02 (.83)
Diagnosed Vision Condition		
No	58	24.14 (10.44)
Yes	24	24.00 (8.83)
t-value (p)		.06 (.95)
Self-rated Health		
Excellent/Good	72	24.64 (10.09)
Fair/Poor/Very Poor	9	20.11 (8.72)
t-value (p)		1.29 (.20)
Use Cane/Walker		
No	60	25.68 (9.48)
Yes	21	19.51 (10.07)
t-value (p)		2.53 (.013)*
Rely on You (to Drive)		
No	42	21.45 (10.04)
Yes	39	27.02 (9.10)
t-value (p)		-2.63 (.01)*

*p<.05; **p<.01

When all variables were included in the model simultaneously, the regression coefficients for "Age and "Rely on You" were not significant ($p > 0.05$). As shown in Table 3.18, the R^2 value did not change significantly when these two variables were omitted. When cane/walker was removed (Model IV), however, the R^2 value decreased significantly. Accordingly, Model III was the preferred regression model for predicting follow-up driving frequency.

Casewise diagnostics revealed no outliers or influential cases. All standardized residuals were within ± 3.0, 98% were within ± 2.5 and 94% were within ± 1.96. Cook's distance values were within acceptable limits (all < 1.0) as were leverage values (all < 2(3 + 1)/79). Multicollinearity among the predictors did not exist, as VIF values (< 10) and tolerance statistics (>.2) met the desired criteria. Diagnostic plots, shown in Appendix J (Figures 1-3), indicate that the residuals are independent and normally distributed.

Table 3.18: Successive Changes in R^2 Values for Predicting Follow-up Driving Frequency

Model	Predictors	R^2	Change in R^2 (p-value)
I	Age, N-DCS Score, N-DCS Change Score Cane/Walker, Rely on You	.36	
II	N-DCS Score, N-DCS Change Score, Cane/Walker, Rely on You	.35	-.01 (.75)
III	N-DCS Score, N-DCS Change Score, Cane/Walker	.34	-.01 (.17)
IV	N-DCS Score, N-DCS Change Score	.23	-.11 (.001)

N = 79

Table 3.19 summarizes the preferred model for predicting follow-up driving frequency (Model III). As shown, the regression coefficients for all predictor variables were significant and in the expected directions (i.e. lower baseline N-DCS scores, decreases in N-DCS and the use of a cane/walker at baseline were predictive of lower driving frequency at follow-up). According to the standardize beta values (which indicate the degree of importance of each predictor), N-DCS change score was the most important predictor. As indicated by the R^2 value, the model accounts for 34% of the variance in follow-up driving frequency in this sample. According to the adjusted R^2 value, which indicates the variance that would be accounted for if the model was derived from the general population, the model would account for approximately 3% (34 – 31) less variance if derived from the population.

Table 3.19: Summary of Regression Model for Predicting Follow-up Driving Frequency

	Regression Coefficient (B)	95% Confidence Intervals	Standardized Beta (β)
Constant	18.81	13.67 to 23.95	
N-DCS Score	.15***	.07 to .24	.36
N-DCS Change Score	.25***	.15 to .35	.48
Cane/Walker	-7.47**	-11.83 to – 3.11	-.32

**p<.01; ***p<.001; R^2 = .34; Adjusted R^2 = .31; F-ratio = 12.69 (p <.001); N=79

3.6.6.2 Follow-up Situational Driving Avoidance

Table 3.20 shows the bivariate relationships between selected baseline variables and follow-up situational avoidance scores. Based on these findings, the following variables were explored in the multivariate model:

- Gender
- Age
- D-DCS Score
- N-DCS Score
- D-DCS Change Score
- N-DCS Change Score

For reasons provided above, perceived abilities scores (current and perceived changes) were not included.

When all variables were included in the model simultaneously, the regression coefficients for D-DCS Score and D-DCS Change Score were not significant and the regression coefficient for gender was approaching significance (p=.058). As shown in Table 3.21, R^2 did not change significantly when the former two variables were removed from the model.

Table 3.20: Bivariate Relationships with Follow-up Avoidance

Baseline Variable	N	Follow-up Avoidance (0-20)
Gender		
Male	34	8.04 (5.63)
Female	46	10.94 (5.19)
t-value (p)		-2.32 (.023)*
Age		
Pearson r (p)	80	.30 (.007)**
D-DCS		
Pearson r (p)	80	-.39 (<.001)***
N-DCS		
Pearson r (p)	79	-.43 (<.001)***
D-DCS Change Score		
Pearson r (p)	80	-.23 (.04)*
N-DCS Change Score		
Pearson r (p)	78	-.38 (.001)**
Current Perceived Abilities		
Pearson r (p)	52	-.39 (.004)**
Perceived Changes in Abilities		
Spearman rho (p)	64	-.26 (.037)*
Diagnosis Score		
Spearman rho (p)	80	.01 (.90)
Diagnosed Vision Condition		
No	58	9.62 (5.73)
Yes	22	9.96 (5.13)
t-value (p)		-.25 (.81)
Self-rated Health		
Excellent/Good	71	9.67 (4.64)
Fair/Poor/Very Poor	9	9.67 (5.68)
t-value (p)		0.00 (1.00)
Use Cane/Walker		
No	60	9.66 (5.68)
Yes	20	9.92 (5.20)
t-value (p)		-.18 (.86)
Rely on You to Drive		
No	41	10.48 (5.20)
Yes	39	8.90 (5.83)
t-value (p)		1.29 (.20)

*p<.05; **p<.01; ***p<.001

Table 3.21: Successive Changes in R^2 Values for Predicting Follow-up Driving Avoidance

Model	Predictors	R^2	Change in R^2 (p-value)
1	Gender, Age, D-DCS Score, N-DCS Score, D-DCS Change Score, N-DCS Change Score	.519	
2	Gender, Age, D-DCS, N-DCS Score, N-DCS Change Score	.519	0.00 (.941)
3	Gender, Age, N-DCS Score, N-DCS Change Score	.511	-.008 (.301)

An interesting relationship emerged between gender and age which instigated further exploration. As shown in Model II in Table 3.22, when gender was removed age was no longer significant (p=.087) compared to when gender was included (p=.02). When both gender and age were removed from the model (Model I), R^2 decreased significantly (p=.038) in comparison to when both variables were included (Model III). Consequently, an interaction variable (Gender X Age) was included to explore the combined effect of gender and age on follow-up driving frequency. As shown in Model IV, the interaction variable was not significant nor did the R^2 value significantly increase. Thus, it appeared that gender and age were exhibiting suppressor effects, which occur when a variable increases the predictive ability of another variable by its inclusion in the regression equation (Conger, 1974; Katz, 2006). Woolley (1997) explains suppressor variables as "cleansing agents" such that they remove (or "suppress") the irrelevant, or error variance in another predictor variable. In the present sample, males were found to be significantly older than females (t(80) = 2.27, p=.026), thus including gender in the model suppresses the irrelevant variance in age, thus improving the ability of age to predict follow-up avoidance. According to Woolley (1997), gender would be an "impure" suppressor because it is directly related to follow-up avoidance on its own (see the bivariate associations) and also increases the predictive ability of another predictor (i.e. age). This contrasts with a "pure" suppressor which is not related to the dependent variable but improves the predictive ability of another variable.

Table 3.22: Successive Changes in Models with Gender and Age

Model	Predictors	Regression Coefficients (p)	R^2	Change in R^2 from Model I (p value)	Change in R^2 from Model III (p value)
I	N-DCS N-DCS Change Score	-.165 (<.001)*** -.137 (<.001)**	.466		
II	N-DCS N-DCS Change Score Age	-.130 (<.001)*** -.158 (<.001)*** .139 (.087)	.486	.020 (.087)	
III	N-DCS N-DCS Change Score Gender Age	-.118 (<.001)*** -.145 (<.001)*** 1.95 (.058) .199 (.021)*	.511	.045 (.038)*	
IV	N-DCS N-DCS Change Score Gender Age GenderXAge	-.120 (<.001)*** -.146 (<.001)*** 12.76 (.320) .270 (.026)* -.137 (.397)	.516		.005 (.397)

*p<.05; N=78

Given such results, Model III was selected as the preferred model for predicting follow-up driving avoidance for the following reasons:

- While the regression coefficient for gender was not significant (but is approaching significance), it increased the predictive ability of age
- The amount of variance accounted for in follow-up avoidance (R^2) increased significantly when gender and age were included in the model. Thus, together they made significant contributions to predicting follow-up avoidance

Casewise diagnostics showed that all of the standardized residuals were between ± 3.0, 99% were within ± 2.5 and 97% were within ± 1.96. Cook's distance and leverage values all fell within the desired limit (<1.0 for Cook's distance and < 2(4 +1)/78 for leverage), thus, there were no outliers or influential cases in the sample of 78 older drivers. Despite the apparent relationship between gender and age, VIF values and tolerance statistics met the desired criteria (<10 for VIF values and >.2 for tolerance), indicating that multicollinearity did not exist.

Diagnostic plots, in Appendix J (Figures 4-6), indicate that the residuals are independent and normally distributed.

Table 3.23 summarizes the preferred regression model for predicting follow-up driving avoidance. The model accounts for 51% (R^2 = .51) of the variance in follow-up driving avoidance in the sample and, according to the adjusted R^2 value (.49), would account for 3% less of the variance if derived from the population. The regression coefficients for the predictor variables were all in the expected direction (i.e. those with lower baseline N-DCS scores, decreased N-DCS scores and increased age had higher driving avoidance scores at follow-up). The regression coefficient for gender, although not significant, indicates that the follow-up avoidance score for females will be 1.95 points higher than that of males, when all other variables are held constant. As explained above, while gender itself does not make a significant contribution to predicting follow-up avoidance (p=.058), the inclusion of gender 'suppresses' the age difference among males and females in the sample and thus, increases the predictive ability of age. According to the standardized beta values, baseline N-DCS scores accounted for the most variance in follow-up avoidance scores.

Table 3.23: Summary of Regression Model for Predicting Follow-up Driving Avoidance

	Regression Coefficients (B)	**95% Confidence Intervals**	**Standardized Beta (β)**
Constant	-1.27	-15.84 to 13.31	
N-DCS Score	-.118***	-.198 to -.093	-.512
N-DCS Change Score	-.145***	-.160 to -.076	-.496
Gender	1.95	-.065 to 3.96	.174
Age	.199*	.031 to .368	.214

*p<.05; ***p<.001; R^2 = .51; Adjusted R^2 = .49; F-ratio = 19.10 (<.001); N=78

Of note, when examined on its own, current perceived abilities was a significant predictor of follow-up driving frequency (p=.01) and follow-up driving avoidance (p<.01), accounting for 12.8% and 14.3% of the variance in frequency and avoidance, respectively. When added to the preferred regression models for follow-up frequency (Model III) and avoidance (Model III), however, the sample size was reduced to 49 participants and current perceived abilities was not a significant predictor in either model ($p=.412$ and $p=.201$ for frequency and avoidance, respectively). Baseline N-DCS scores and N-DCS change scores, meanwhile, remained significant predictors in both the frequency ($p<.05$ for both) and avoidance models ($p<.01$ for N-DCS scores and $p<.001$ for N-DCS change scores). Interestingly, the use of a cane or walker was no longer significant with the inclusion of current perceived abilities in the frequency model ($p=.08$), possibly due to the reduced sample size. Similarly, age and gender were no longer significant when current perceived abilities was included in the avoidance model ($p=.504$ and $p=.145$ for age and gender, respectively).

3.6.7 Telephone Interview Findings

3.6.7.1 Sample Description

Table 3.24 displays selected baseline characteristics for the telephone interview subsample. The sample was evenly distributed with respect to age and gender and was fairly educated. Approximately half reported that others relied on them to drive and that they drove "much or a little less often" compared to ten years ago. Only a few reported having an accident within the past year at baseline. The subsample appeared to be in fairly good health at baseline as most rated their health as excellent or good and indicated that they were able to walk a quarter of a mile. That being said, about a third of the sample reported using a cane or walker and had been diagnosed with a vision condition at baseline.

Table 3.24: Selected Baseline Characteristics for the Telephone Interview Sample

Characteristic	Telephone Interview Subsample (N = 45)
Baseline Sample	
From Ph IV	17 (36.8%)
New	28 (62.2%)
Gender	
Male	22 (48.9%)
Female	23 (51.1%)
Age	
Mean (SD)	79.7 (5.9)
Range	67 – 92
Age Group	
64-79	22 (48.9%)
80+	23 (51.1%)
Education Completed	
High school	29 (64.4%)
College/university	19 (42.2%)
Missing	3 (6.7%)
Others Rely on You to Drive	21 (46.7%)
Driving Compared to 10 Years Ago	
Much/ a Little Less Often	26 (57.8%)
Same/ More Often	17 (37.8%)
Missing	2 (4.4%)
Driving Problems	
Accidents	4 (8.9%)
Near misses	7 (15.6%)
Backing into things	3 (6.7%)
Getting lost	10 (22.2%)
Driving Problems Score (0-4)	
Mean (SD)	.52 (.9)
Range	0 - 4
Overall Health	
Excellent/Good	40 (88.9%)
Fair/Poor/Very Poor	5 (11.1)
Use Cane/Walker Outdoors	14 (31.1%)
Able to Walk a Quarter Mile	39 (86.7%)
Diagnosis Score	
Mean (SD)	2.2 (1.71)
Range	0 - 7
Diagnosed cataracts, glaucoma, mac. degen.	14 (31.1%)
Cataract Surgery	18 (40%)

3.6.7.2 Changes over the Follow-up Period

Of the 45 interviewed, 38 continued driving. For consistency, the participant identified as an outlier (N-DCS score increased by 300%) was omitted from all analyses. Table 3.25 shows the results of paired t-tests between baseline and follow-up DCS scores for those who continued driving. Results for those who stopped driving were described in section 3.6.4.

Table 3.25: DCS Scores for those who Continued Driving (Telephone Interview Sample)

Scale	N	Mean (SD)	Range	95% Confidence Interval
D-DCS				
Baseline	37	67.70 (16.79)	42.31 – 98.08	62.09 – 73.29
Follow-up		67.05 (17.06)	32.69 – 100.00	61.35 – 72.74
t-value (p)		.28 (.78)		
N-DCS				
Baseline	35	57.70 (22.44)	3.13 – 100.00	49.99 – 65.41
Follow-up		55.49 (25.71)	0.00 – 93.75	46.66 – 64.32
t-value (p)		.74 (.47)		

D-DCS and N-DCS change scores (Follow-up Score – Baseline Score) for those who stopped and continued driving are shown in Table 3.26. For both groups, N-DCS change scores decreased more than D-DCS change scores. In addition, mean Day and Night changes scores were more negative for those who stopped driving in comparison with those who continued driving.

Table 3.26: DCS Change Scores for the Telephone Interview Sample

Scale	N	Mean (SD)	Range	95% Confidence Interval
Stopped Driving N = 7				
D-DCS Change Score	7	-13.12 (24.10)	-48.08 to 8.17	-35.41 to 9.17
N-DCS Change Score	7	-27.01 (21.96)	-60.94 to 3.13	-47.32 to -6.70
Continued Driving N = 37				
D-DCS Change Score	37	-.65 (14.23)	-32.69 to 30.77	-5.39 to 4.08
N-DCS Change Score	35	-2.21 (17.78)	-50.00 to 26.56	-8.32 to 3.90

Changes in health, lifestyle and driving over the follow-up period (reported in the telephone interviews) in those who stopped and continued driving are shown in Table 3.27. Although groups could not be compared due to small sample sizes, a higher proportion of those who had stopped driving had health problems over the follow-up period. Health improvements were reported by two people who had continued driving; one person had received treatment for angina and no longer experienced cramping in his legs while the other person no longer experienced symptoms from polymyalgia. Medication changes occurred in only a few people, however, no participants indicated that such changes interfered with driving.

Interestingly, a slightly higher proportion of those who continued driving experienced vision problems, while changes in glasses were reported by a higher proportion of those who stopped driving. Of those with vision problems who continued driving, two noticed their vision had worsened (e.g. more difficulty reading street signs), four had cataracts that had recently been diagnosed or had worsened and one person experienced side effects from cataract surgery (fogging up).

In terms of lifestyle changes, only three people had moved over the follow-up period (two had stopped driving and one continued). The majority of participants had no changes in physical activity or social/volunteer activities. The most common reasons for stopping activities (both physical and social) were health and bad weather.

Lastly, with respect to driving-related changes, only three participants (all continued driving) had bought new cars over the follow-up period and almost half of those who continued driving had renewed their license. While two people who stopped driving were no longer able to drive others, three people who continued driving also reported that they stopped driving others. Of the three individuals, two indicated that they stopped driving others because they no longer felt comfortable being responsible for others' safety. Overall, about 21% (all who continued driving) experienced driving problems over the follow-up period, including one person who reported both backing into things and getting lost. In addition, more people reported talking to their family and friends than to their physician or optometrist. No participants had taken driving courses over the follow-up period and there were no changes in whether there was a driver living in anyone's household.

Table 3.27: Changes in Health, Lifestyle and Driving since Baseline Assessments

Changes Since Baseline	Stopped Driving (N=7)	Continued Driving (N=37)
Health Problems	6 (85.7%)	9 (24.3%)
Type of Health Problem		
Fall/Acute injury	2 (33.3%)	3 (33.3%)
Stroke	1 (16.7%)	
Respiratory problems	2 (33.3%)	
Cancer		3 (33.3%)
Knee/leg pain (e.g arthritis)	1 (16.7%)	3 (33.3%)
Neuromuscular problem		1 (11.1%)
Health Improvements	0 (0%)	2 (5.4%)
Changes in Medication	2 (28.6%)	7(18.9%)
Vision Problems	1 (14.3%)	7 (18.9%)
Changes in Glasses	2 (28.6%)	2 (5.4%)
Moved	2 (28.6%)	1 (2.7%)
Change in Physical Activity		
No Change	5 (71.4%)	18 (48.6%)
Stopped an activity	1 (14.3%)	12 (32.4%)
Started a new activity	1 (14.3%)	7 (18.9%)
Reasons for Stopping Physical Activity		
Health	1 (100.0%)	6 (50.0%)
Bad Weather		4 (33.3%)
Too busy		1 (8.3%)
Did not say		1 (8.3%)
Changes in Activities (social, volunteer)		
No	5 (71.4%)	23 (62.2%)
Stopped an activity	1 (14.3%)	3 (8.1%)
Started an activity	1 (14.3%)	11 (29.7%)
Reasons for Stopping Activities		
Health	1 (100%)	1 (33.3%)
Bad Weather		2 (66.7%)
New Car	N/A	3 (8.1%)
Renewed License	2 (28.6%)	17 (45.9%)
Change in Rely on You		
No	5 (71.4%)	32 (86.5%)
Stopped driving others	2 (28.6%)	3 (8.1%)
Started driving others		2 (5.4%)
Driving Problems		**8 (21.6%)**
Accidents		1 (2.6%)
Near misses		1 (2.6%)
Backing into things		3 (7.9%)
Getting lost		3 (7.9%)
Traffic violations with loss of demerit points		1 (2.6%)
Talked about Driving with….		
Physician/Optometrist	2 (28.6%)	9 (24.3%)
Family/Friends	4 (57.1%)	14 (37.8%)
Plan to Stop Driving in Near Future		3 (8.1%)
Drive Less due to Weather		6 (16.2%)

Note: Multiple responses can exist for Health Problems and Driving Problems

3.6.7.3 Relationships with Changes in Driving Comfort

Table 3.28 shows Day and Night DCS Change scores in those with and without changes in health and lifestyle factors. Comparisons were only done for those who continued driving due to the small number of participants who stopped. Very few participants had changes, thus findings must be interpreted with caution. Only one significant relationship was found: those who stopped physical activities for health reasons had significantly greater reductions in N-DCS scores than those who stopped due to bad weather or being too busy. Findings with other health and lifestyle variables were mixed. Those who reported having health problems over the follow-up period had, on average, greater reductions in day comfort but greater increases in night comfort. Although only two individuals reported health improvements, such individuals had a greater increase in day driving comfort and night driving comfort (one person with health improvements was omitted since she did not complete 75% of the N-DCS). As anticipated, participants who reported vision problems and changes in glasses had greater reductions in day and night driving comfort.

As would be expected, participants who started a new physical activity or social activity had a greater increases in day driving comfort than those who stopped such activities. While the opposite was found for night driving comfort, two participants who stopped social activities did not complete 75% of the N-DCS.

Table 3.28: Relationships between DCS Changes and Health and Lifestyle Changes

Changes Since Baseline	N	Day Change Score	N	Night Change Score
Health Problems				
No	28	-.03 (15.04)	26	-3.41 (18.46)
Yes	9	-2.56 (11.97)	9	1.24 (16.13)
t-value (p)		.459 (.649)		-.670 (.507)
Health Improvements				
No	35	-.80 (13.87)	34	-2.46 (17.98)
Yes	2	1.92 (27.20)	1	6.25
t-value (p)		-.259 (.797)		
Changes in Medication				
No	30	-1.18 (14.61)	28	-2.72 (19.42)
Yes	7	1.65 (13.30)	7	-.19 (9.41)
t-value (p)		-.469 (.642)		.332 (.742)
Vision Problems				
No	30	.28 (13.79)	28	-1.66 (17.30)
Yes	7	-4.65 (16.55)	7	-4.43 (20.89)
t-value (p)		.822 (.417)		.325 (.753)
Changes in Glasses				
No	35	.08 (14.26)	33	-1.49 (17.64)
Yes	2	-13.46 (5.44)	2	-14.06 (22.10)
t-value (p)		1.32 (.195)		.970 (.339)
Change in Physical Activity				
No Change	19	-3.47 (11.65)	17	-7.83 (39.99)
Stopped an activity	12	-.16 (15.37)	11	3.53 (47.23)
Started a new activity	7	6.27 (17.13)	7	-12.07 (22.69)
F-value (p)		1.26 (.296)		.403 (.672)
Reasons for Stopping Physical Activity				
Health	6	-4.49 (14.98)	6	-7.21 (13.55)
Bad weather/Too busy/Did not say	4	-.48 (11.47)	3	17.19 (7.16)
t-value (p)		-.451 (.664)		-2.74 (.029)*
Changes in Activities (social, volunteer)				
No	24	.04 (14.06)	23	-5.22(38.82)
Stopped an activity	3	-7.05 (11.75)	1	8.10
Started an activity	11	-.35 (15.28)	11	-6.07 (43.52)
F-value (p)		.331 (.720)		

*p<.05

Table 3.29 shows DCS changes among those with and without changes in driving-related factors. Two significant relationships were found with D-DCS change scores: participants who said that they plan to stop driving in the near future ($p=.037$) or reported driving less overall due to bad winter weather ($p=.036$) had greater reductions in day driving comfort. While such participants also had greater reductions in night comfort, differences were not significant. As expected, those who reported that they had stopped driving others had greater reductions in day and night driving comfort than those who had started driving others. Interestingly, participants who had renewed their license over the follow-up period also had greater reductions in driving comfort. Further exploration of the different age groups was performed as drivers aged 80+ would have gone through vision assessments as well as the Group Education Sessions (GES). Findings revealed that greater reductions in day and night comfort were found in the younger age group but only for day comfort in the older age group, and no findings were significant. Findings with the other driving-related variables were mixed.

Table 3.29: Relationships between DCS Changes and Driving-related Changes

Changes Since Baseline	N	Day Change Score	N	Night Change Score
New Car				
No	35	-1.40 (14.25)	32	-3.79 (17.59)
Yes	3	8.33 (8.01)	3	14.58 (10.63)
t-value (p)		1.16 (.255)		1.76 (.087)
Renewed License				
No	20	2.17 (15.12)	19	.98 (15.91)
Yes	18	-3.75 (12.41)	16	-6.00 (19.60)
t-value (p)		1.31 (.198)		1.16 (.253)
67 – 92				
No	10	3.19 (11.99)	10	7.18 (13.67)
Yes	9	-.04 (13.72)	9	-4.42 (23.17)
t-value (p)		.547 (.591)		1.35 (.196)
80+				
No	10	1.15 (18.35)	9	-5.90 (16.06)
Yes	9	-7.46 (10.39)	8	-4.19 (18.07)
t-value (p)		1.24 (.232)		-2.18 (.831)
Change in Rely on You				
No	33	-1.14 (14.33)	30	-2.33 (18.81)
Stopped driving others	3	-5.77 (6.66)	3	-6.70 (11.84)
Started driving others	2	15.38 (5.44)	2	6.25 (0.00)
F-value (p)		1.57 (.222)		.309 (.736)
Driving Problems				
No	30	-.67 (15.49)	27	-3.19 (19.36)
Yes	8	-.48 (6.95)	8	1.08 (11.25)
t-value (p)		-.034 (.975)		
Talked about Driving with….				
Physician/Optometrist				
No	29	-.50 (14.04)	26	-2.62 (18.71)
Yes	9	-1.05 (14.87)	9	-1.02 (15.73)
t-value (p)		.101 (.920)		-.231 (.819)
Family/Friends				
No	24	.28 (13.19)	22	-4.87 (17.32)
Yes	14	-2.19 (15.79)	13	2.28 (18.33)
t-value (p)		.516 (.609)		-1.16 (.256)
Plan to Stop Driving in Near Future				
No	35	.74 (13.34)	32	-1.05 (17.72)
Yes	3	-16.67 (14.18)	3	-14.58 (15.96)
t-value (p)		2.06 (.037)*		1.27 (.212)
Drive Less due to Weather				
No	32	1.41 (12.90)	31	-1.09 (16.89)
Yes	6	-11.54 (16.04)	4	-10.88 (24.82)
t-value (p)		2.18 (.036)*		1.04 (.307)

*p<.05

3.7 Discussion

The present study examined the extent to which driving comfort changed over the short term (i.e. 5 to 17 months). For the sample as a whole, both day and night driving comfort scores decreased somewhat, but not significantly. As would be expected, comfort levels increased for some individuals, decreased for others and remained relatively unchanged for others. Personal driving comfort would not be expected to change dramatically over a relatively short period unless an individual had experienced a significant event (e.g., health problems, accidents, license renewal, concerns by others).

To our knowledge, at least ten people stopped driving over the interim (approximately 10% of the initial 107 baseline sample), however only 7 of these individuals participated in the follow-up. Although the findings must be viewed cautiously due to the small sample size, these seven individuals had marked decreases in both their day (effect size = .53) and night (effect size = .76) comfort scores, compared to those who continued to drive. Change was significant for the N-DCS score. Prior studies with former drivers have reported decreased confidence as a reason for driving cessation (e.g., Persson, 1993; Rudman et al., 2006). Rudman et al.'s (2006) model of self-regulation postulates that voluntary driving cessation is most likely to occur when one reaches a "personally unacceptable level of comfort" (p. 72). It may be that comfort in night driving progressively declines to the point where people are uncomfortable even in good conditions before daytime driving comfort level is appreciably affected. Or it may simply be that nighttime driving comfort level plays a more important role in self-regulation. Although only one individual explicitly mentioned reduced driving comfort as a reason for cessation, six of the seven had reduced night driving comfort scores and reductions were the greatest for those who stopped due to health and general declines (factors that may influence comfort), as opposed to no longer needing a car or finances.

The second objective was to examine the relationship between changes in driving comfort and self-reported driving behaviour. Based on Bandura's theory, it was hypothesized that decreased comfort would be accompanied by reduced situational driving frequency and increased avoidance. For those who continued driving, correlations between changes in DCS scores and frequency and avoidance scores were not significant, but in the expected direction. The process of self-regulation is complex and influenced by a multitude of intrapersonal, interpersonal and environmental factors (Rudman et al., 2006). In a study by Baldock et al. (2006), drivers aged 60+ reported that the greatest barriers to self-restriction were maintaining their lifestyle, unavailability of others to provide transport or reluctance to ask family and friends for rides.

The third objective was to examine whether baseline DCS scores were predictive of self-reported driving behaviour at follow-up. As hypothesized, lower baseline night driving comfort was predictive of reduced driving frequency and higher avoidance at follow-up. Reductions in night driving comfort (change scores) were also predictive of driving restrictions. These findings support Rudman's (2006) model by demonstrating that subjective comfort levels, particularly night driving comfort, may be a precursor to restricting one's driving behaviour. The variance accounted for was only 34% for driving frequency and 51% for avoidance, however, it makes intuitive sense that driving comfort would account for only a moderate amount of variance in driving behaviour due to other influencing factors. As noted above, barriers to self-regulation, such as lifestyle and availability of other transport, may prevent one from restricting driving despite low comfort. In addition, factors such as the weather, convenience (e.g. avoiding rush hour to prevent delays) and personal preferences (e.g. disliking driving with passengers or tight parking spaces) are also likely to influence driving behaviour.

While baseline N-DCS and N-DCS change scores were the strongest predictors of both driving frequency and avoidance at follow-up, other intrapersonal variables, including the use of cane/walker (frequency) and age and gender (avoidance), also remained in the model. The finding that the use of a cane/walker at baseline was predictive of lower driving frequency demonstrates the influence of physical mobility (independent of driving comfort), on driving behaviour, thus revealing a subgroup that may be more susceptible to early driving restrictions. In a prospective study, Marottoli and colleagues (2000) found that seniors who continued to drive reported fewer limitations to their activities of daily living (including walking) at baseline compared to those who stopped driving. These findings suggest that interventions designed to lessen the negative consequences of driving cessation should be directed at those with reduced mobility. For example, encouraging support from family and friends as well as providing alternative modes of transportation.

No prior studies have prospectively examined the relationship between age, gender and self-reported avoidance. Of the studies that have examined cross-sectional relationships, only one study (Benekohal et al., 1994) reported that older age was associated with greater avoidance of peak-hour traffic, ice and snow, and night driving in a sample of 664 drivers (aged 66+). With respect to gender, Hakamies-Blomqvist and Wahlstrom (1998) found that women reported more avoidance than men in six driving situations, and Marottoli and Richardson (1998) reported that men were more likely to drive in riskier conditions. In the present study, bivariate associations between age, gender and future driving avoidance were significant, however, when included in the regression analyses with night driving comfort, results were inconclusive.

The last objective of the present study was to explore possible reasons for changes in driving comfort. Although few findings were significant (likely due to the small sample size and small number who had changes over the follow-up period, several results are worth mentioning. Participants who were planning to stop driving in the near future had greater reductions in day driving comfort (significant for day), which further illustrates the importance of reduced comfort level as a precursor to driving cessation. While self-reported health problems were not related to changes in comfort level, participants who reported vision problems or changes in glasses had greater reduction in driving comfort than those who did not. Such findings illustrate the importance of perceived vision in driving, as will be further illustrated in Chapter Four. As well drivers who said they drove less overall due to bad weather (an environmental hazard) had greater reductions in day and night comfort (significant for day). Bandura's theory postulates that verbal persuasion (e.g. feedback from family/friends) impacts on one's self-efficacy. Consistent with this notion, drivers who reported talking to health professionals had greater reductions in day driving comfort. That being said, in Rudman et al.'s (2006) study, feedback from influential persons may impact one's driving comfort depending on whether the elderly driver is willing to accept the feedback. Participants in their study had mixed opinions on whether family and friends were worth listening to. This may also be one of the reasons that no significant findings emerged in the present study.

According to Rudman's (2006) model and consistent with Bandura's theory, experiencing an accident or a near accident may intensify driving discomfort. However, in the present study, participants who reported driving problems over the interim actually had greater increases in driving comfort. Cross-sectional comparisons, presented in the next chapter, also showed no relationship between driving comfort and self-reported driving problems. Older drivers may be reluctant to report such events. In addition, influences on driving comfort may depend on the severity of collisions, whether someone was charged and/or thought they were 'at fault'. Examination of actual driving records (as opposed to self-report) would provide more credible information about such relationships.

3.8 Limitations

Limitations of the presents study must be acknowledged. The convenience sample was limited to English speaking older drivers living in southern Ontario. A large proportion (64%) of the sample lived in retirement complexes and may be more affluent than the general population. People who volunteer for such studies may be more motivated to drive, may have more interest in driving issues and more likely to consider themselves good drivers. Generalizability of the findings is limited by the small sample size, particularly the group who stopped driving (n = 7). To examine changes in comfort level, those who stopped driving at follow-up were asked to rate their driving comfort level, abilities and to indicate which situations they would avoid *as if they were still driving*. All had stopped driving within the past year and four of the seven had stopped within the past six months.

It should also be noted that baseline assessments were conducted in the spring and summer (May to June for new sample; Aug for Ph IV sample), while follow-up assessments took place between November to April. Thus, winter driving could have played a role in frequency ratings. Only 45 of the 75 participants were interviewed by phone. Errors in recall concerning the timing of health, driving problems (e.g., accidents) are possible. Due to limited resources and realistic expectations for a Master's thesis, the present study relied on self-reports of driving behaviour. Finally, only 52 participants completed ratings of perceived abilities at baseline which, consequently, limited the ability to explore prospective relationships with follow-up driving comfort and self-reported driving behaviour.

3.9 Conclusions

Notwithstanding these limitations, this is the first study to prospectively examine driving comfort. The aim of the Study 1 was to examine temporal associations between driving comfort scores and self-reported driving behaviour. It was hypothesized that decreased comfort level would be accompanied by reduced driving frequency and increased avoidance at follow-up. While associations were in the expected direction for those who continued to drive, none were significant. However, those who stopped driving, albeit a small group (n = 7), showed substantial changes in driving comfort scores, particularly for night driving. The time interval (average of 12 months) between baseline and follow-up was longer for the group who stopped driving, versus those who continued to drive (average of 9 months). This implies that had the follow-up period been longer, we may have found more people who stopped driving. Continued follow-ups at six month intervals are underway with individuals from this sample who provided permission for further contact (n = 72). A larger database of drivers who stopped driving will permit more defensible conclusions concerning temporal associations.

As expected, people who had lower comfort scores were more likely to restrict their driving. Lower comfort scores at baseline, specifically with respect to night driving, were predictive of driving frequency and avoidance at follow-up over a relatively short period (five to 17 months). Furthermore, reductions in night comfort significantly predicted lower driving frequency and higher avoidance at follow-up. The regression models accounted for 34 % and 51 % of the variance in situational driving frequency and avoidance, respectively. Although preliminary, these results indicate a temporal association between driving comfort level (particularly concerning night driving) and self-regulation.

Ultimately, temporal associations between perceptions (of comfort level and abilities) and *actual* driving behaviour (rather than self-report) need to be examined. Another important goal is to identify whether there is a critical level of discomfort at which voluntary cessation tends to occur. Barriers to driving restrictions should also be investigated, particularly those that may affect driving persistence despite high levels of personal discomfort. For example, seniors may feel pressured to continue to drive if others rely on them, and they may be reluctant to stop if other forms of transport are not readily available or if their current lifestyle requires driving.

Chapter 4: Cross-sectional Relationships (Study 2)

4.1 Introduction and Study Objectives

As explained in Chapter One, the on-going process of construct validation entails accumulating evidence concerning the extent to which the tool "behaves as it should" in terms of expected associations with other measures, discrimination between groups and replication with new samples. While Study 1 looked at temporal associations, Study 2 examined cross-sectional relationships with Day and Night DCS scores, including investigation of the scales' discriminative and convergent properties. Discriminative properties refer to the tool's ability to distinguish between specific groups that differ on an important variable or characteristic (Guyatt, Kirshner & Jaeschke, 1992), which is also referred to as "known groups validity" (DeVellis, 2003). Convergent properties, meanwhile, examine whether scores on a scale are associated with scores on other measures in the expected directions.

Bandura's theory postulates that confidence is a stronger determinant of behaviour than one's actual skills or abilities. Consistent with this framework, prior studies have found significant relationships between driving confidence, perceived abilities and self-reported driving behaviour (Baldock et al., 2006; Marottoli and Richardson, 1998; Paradis, 2006). A recent qualitative study by Rudman et al. (2006) supported such notions and also found that accidents or near accidents, as well as feedback from others, influenced comfort levels. Additionally, Marottoli and Richardson (1998) found that individuals with discrepancies (defined as those who rated their overall driving ability as "better than other drivers" yet had a history of adverse events and/or poor rating on a road test) had higher confidence than the rest of the sample.

Accordingly, the specific objectives of Study 2 were to examine cross-sectional relationships between DCS scores and:

(1) selected sample characteristics (e.g., age, gender, health conditions);
(2) self-reported driving behaviour (frequency and avoidance);
(3) self-reported driving problems (such as accidents, near misses, backing into things and getting lost);
(4) perceived driving abilities; and
(5) objective measures of seven driving-related abilities (visual acuity, contrast sensitivity, disability glare, brake reaction time, executive skills and visual attention).

With respect to sample characteristics, self-reported driving behaviour and driving problems, this study examined whether findings from Phase IV (described in Chapter 1 and reported in Paradis, 2006) could be replicated with a new sample. This study also extended the examination of the DCSs through inclusion of objective measures of ability. In this regard, it was hypothesized that:

1. perceived comfort would be more strongly related to perceived abilities than objective abilities;
2. self-reported driving behaviour would be more strongly related to perceptions (of both comfort and abilities) than to objective abilities; and
3. older drivers with impairments who lack awareness of their limitations (i.e., discrepancy between objective and perceived abilities) will have higher comfort levels than those who appear to be aware of their limitations (i.e., correspondence between objective and perceived abilities).

Discriminative properties were assessed by categorizing participants into groups when possible, for instance: “night drivers vs. non-night drivers” and “those with impairments versus no impairments” (i.e. for objective assessments). When categorization was not possible (e.g. cutoff scores on physical tests were not available or there were insufficient numbers with impairments), convergent properties were assessed by examining whether associations between the DCSs and other variables were in the expected direction. Ultimately, perceived driving abilities and confidence should be assessed against actual driving performance, however, this was beyond the scope of the present thesis. Consequently, this study laid the groundwork by examining relationships with proxy measures of abilities known to be correlated with driving performance or crash risk.

The following sections provide a description of the ethics approval, sample recruitment, data collection methods, results and discussion for Study 2. The chapter concludes by acknowledging limitations and presenting overall conclusions from both studies 1 and 2.

4.2 Ethics Approval and Consent

Ethics approval was obtained from the Office of Research Ethics at the University of Waterloo at the same time as the predictive validity study. Similar measures were taken to ensure confidentiality and anonymity, as described in Chapter Three. Written informed consent was obtained using the consent for participation forms shown in Appendix C. Participants completing the physical assessments were given an information letter (Appendix K) prior to their participation, which explained the abilities to assessed and corresponding measurement tools.

4.3 Sample Recruitment

Of the 82 people who took part in Study 1, the 65 *new* participants were used to examine cross-sectional relationships between the DCSs and demographics, self-reported driving behaviour, driving problems and perceived abilities. The 17 Phase IV participants were excluded from such analyses so that comparisons could be made with Phase IV results (described in Paradis, 2006).

Assessments of driving-related abilities were conducted with a subsample of participants who were recruited from the initial baseline sample of 107 older drivers (described in Chapter Three). For the **new participants** two criteria were applied for selecting participants for the physical assessments: (1) the number of people who expressed interest in the physical assessments at each facility (as indicated on the Permission for Further Contact form described in Chapter Three) and (2) facility appropriateness (i.e. availability of a suitable room for conducting the assessments). With respect to the former criterion, it was more efficient for the researcher to assess several participants (individually, one after another) in one day at the same facility, than to travel to a number of different facilities. For this reason, facilities were not considered if less than five people had indicated an interest in the physical assessments. In order to increase the sample size, Phase IV participants who took part in the telephone interviews (for Study 1) were also told about the physical assessments and the researcher recorded names of those who were interested.

Seven facilities were selected for recruiting participants, including five retirement complexes (two in Waterloo, three in Kitchener), one senior's apartment building in Kitchener and one senior's community centre in Guelph. Prior to contacting participants, each facility was contacted and potential dates and rooms were booked for conducting the physical assessments. Subsequently, participants were contacted by telephone and the present study was fully explained (e.g. nature of the assessments, total time required). If interested, an individual appointment was scheduled. Following recruitment of the new participants, the researcher contacted Phase IV participants from the above seven facilities who had expressed interest in participating in the physical assessments. An appointment was booked for those who were still interested.

4.4 Data Collection Methods

4.4.1 Procedures

Baseline data collection for the new participants took place in May-July/06 and is described in Chapter Three. The study instruments, namely the DCSs, four rating forms (driving frequency, driving avoidance, current perceived abilities and perceived changes in abilities) and background questionnaire, are also described in detail in Chapter Three.

Data collection for the physical assessment subsample involved two steps. First, participants were mailed a package containing the DCSs, rating forms and background questionnaire as well as an information letter describing the study (Appendix K). Although these measures were completed at baseline, the physical assessments were conducted in February, 2007, approximately seven to eight months later. Thus, to ensure accurate comparisons, it was deemed appropriate to re-administer the tools. A slight modification was made to Question # 10 on the background questionnaire which included adding “Overall, in good weather, about how often would you say you go outside your home or suite for various activities?”. Secondly, participants completed a physical assessment battery, described below. The assessments were conducted individually, by the researcher, and took place at the participants’ respective facilities for their convenience. All were performed in private areas to minimize external noise and distractions. Participants were asked to bring the completed forms to their physical assessment appointments. Prior to the assessments, the researcher explained the battery of tests to participants and provided an opportunity for questions.

Prior to conducting assessments, the researcher received training in conducting the vision assessments from Dr. Strong at the University of Waterloo, School of Optometry. Dr. Callaghan (University of Waterloo, Dept of Kinesiology) and Dr. Porter (University of Manitoba, Faculty of Kinesiology and Recreation Management), provided expertise in the measurement of brake reaction time and visual attention. The entire assessment battery was pilot tested with a convenience sample of five individuals comprising two females and three males aged 24-86. Revisions to the physical assessment battery were made based on challenges identified during the pilot testing.

4.4.2 Physical and Cognitive Assessment Battery

A more detailed description of other driving abilities that were considered, but not selected, for measurement can be found in the proposal. Two criteria were used to select the seven physical and cognitive abilities: (1) demonstrated importance for safe driving; and (2) correspondence with items on the perceived abilities ratings. Potential measurement tools were identified and selected based on a review of the literature and consultation with experts. Additional factors considered in tool selection were feasibility, credibility and acceptability (Myers, 1999). Specifically, measurement tools needed be low cost, portable and require minimal time for set-up and feasible for administration by a single researcher (the author). With respect to credibility, it was essential that measurement tools have demonstrated scientific credibility in terms of psychometric properties and known relationships to driving performance in older adults (e.g. crash risk, on-road tests, etc.). Finally, assessment tools needed to be appropriate for and acceptable to relatively healthy community living older adults. The seven driving-related abilities that were assessed in this study are described below, in order of administration. All tests were conducted and scored according to the developers instructions. A detailed protocol for administration of the assessment battery (including each measurement tool) can be found in Appendix L.

4.4.2.1. Visual Acuity

Corresponding Perceived Abilities Item: #1: 'See road signs at a distance'

Definition and Relevance

Visual acuity is the ability to perceive spatial detail at a given distance (Wood, 2002). The present study assessed distance (far) acuity which is required for reading traffic signs and seeing environmental cues (Fox, 1988). Due to normal aging processes and the increased prevalence of eye diseases, visual acuity decreases significantly with age (Haegerstrom-Portnoy, Schneck& Brabyn, 1999; Owsley & Sloane, 1990). Although visual acuity is not a strong predictor of crash risk on its own, it has been associated with reduced driving exposure (Ball et al., 1998), self-imposed restrictions (West et al., 2003) and driving cessation (Freeman, Munoz, Turano & West., 2006).

Measurement Tool: **ETDRS (Early Treatment Diabetic Retinopathy Study) Chart**

ETDRS charts, shown in figure 4.1 below, were used to assess visual acuity. The charts consist of rows of letters printed in lines of decreasing size and the test determines the smallest possible letter size that a person can read. ETDRS charts are considered the "gold standard" for measuring visual acuity in clinical research (McGraw et al., 1995) and were chosen over the traditional Snellen chart because they possess specific design characteristics that make them more accurate and reliable than the Snellen chart including: (a) a geometric decrease in size of letters (decrease in height by 0.1 log units per line) and (b) the same number of letters per line (5 per line). Such characteristics enable the ETDRS chart to make more precise and reliable measurements of acuity by ensuring that the only variable that changes between lines is the angular size of the letters (Ferris, Kassoff, Brsnick & Bailey, 1982; McGraw, Winn & Whitaker, 1995). Additionally, ETDRS charts are scored using a LogMAR (logarithm of the minimum angle of resoluation) scale which decreases by 0.1 units for each lower line on the chart. This standardized scoring method allows the data to be more easily subjected to statistical analyses compared to Snellen scoring (Rosser et al., 2001). As mentioned in Chapter One, the Ministry of Transportation in Ontario requires all drivers to have at least 20/50 in their better eye. Accordingly, the present study used this cut-off (which corresponds to +0.39 LogMAR) as the benchmark for impairment.

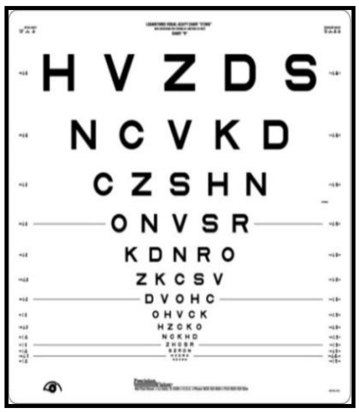


Figure 4.1 ETDRS Chart

A set of three ETDRS charts were purchased from Precision-Vision (www.precision-vision.com). Each chart has a slightly different ordering of the letters and a different chart was used for each of the three visual acuity assessments (monocular right eye, left eye and binocular) to prevent memorization of the letters. Attempts were made to standardize factors that influence visual acuity as much as possible, such as uncorrected refractive error, test distance and luminance. With respect to the former, participants were instructed to wear their habitual spectacle correction while testing. The test distance required for the ETDRS charts is 4m, which was measured prior to testing and marked with masking tape. Finally, the luminance of the chart plane was also measured and recorded prior to testing at each facility. The recommended surround luminance for test charts is at least 200 lux (Hyrnchak, 2003) and a desk lamp was brought to each facility in case of inadequate illuminance (although it was never required).

Across the seven facilities, illuminance level ranged from 249 to 900 lux (mean = 432.52 ± 207.98).

4.4.2.2. Contrast Sensitivity

Corresponding Perceived Abilities Item: #5: 'Avoid hitting curbs and medians'

Definition and Relevance

Contrast sensitivity is the ability to detect differences in contrast between objects (Eby et al., 1998) and is required for night driving, seeing objects on the road (including pavement markings) and seeing signs at a distance (Hennesy, 1995). Similar to visual acuity, contrast sensitivity declines with age due to the normal aging process and increased prevalence of cataracts (Owsley, Stalvey, Wells, Sloane & McGwin, 2001). A number of studies have shown a significant association between decreased contrast sensitivity and increased crash risk (Janke & Eberhard, 1998; McGwin, Chapman & Owsley, 2000; Owsley et al., 2001). Other studies have shown reduced contrast sensitivity to be associated with self-reported driving restrictions (Ball et al., 1998; West et al., 2003).

Measurement Tool: **Pelli-Robson Chart**

The Pelli-Robson chart (Pelli, Robson & Wilkins, 1988), shown below, was used to measure contrast sensitivity. The letters on the chart are organized into groups of three (triplets) with two triplets per line, and all letters within a triplet have the same contrast. The contrast in each successive triplet decreases by a factor of 0.15 log units, from the top left to the bottom right, while the size of the letters remains constant. The test identifies the lowest contrast for which at least two letters in a group are correctly identified. A higher Pelli-Robson score indicates better contrast sensitivity. Although there are no widely accepted or validated benchmarks for increased crash risk, one study reported that a Pelli-Robson score of 1.25 or less was predictive of crash involvement (Owsley et al., 2001). Consequently, this benchmark was used as the impairment cut-off in the present study.

Figure 4.2 Pelli-Robson Chart

The Pelli-Robson chart was chosen to measure contrast sensitivity because it has excellent test-retest repeatability and its discriminative ability is comparable to other contrast sensitivity tests (Buhren, Terzi, Bach, Weseman & Kohen, 2006; Elliot & Bullimore, 1993; Pelli et al., 1988). Two charts were borrowed from Dr. Strong from the School of Optometry, University of Waterloo. Similar to visual acuity, the charts were alternated for each assessment of contrast sensitivity (monocular and binocular) to prevent memorization of the letters. Similar to visual acuity, participants were instructed to wear their habitual spectacle correction and the luminance of the chart plane was measured and recorded prior to testing. In addition to ensuring that the surround luminance was at least 200 lux, the researcher also ensured that the lighting provided uniform luminance over the chart, in accordance with recommended standards (Hrynchak, 2003). Also, the test distance of 1 m was measured and marked with masking tape to standardize the viewing distance.

4.4.2.3. Disability Glare

Corresponding Perceived Abilities Item: #7: 'See objects on the road (at night) with glare from lights or wet roads'.

Definition and Relevance

Disability glare is the reduced visibility of a target due the presence of a nearby light source (Strong, Jutai, Hooper, Evans & Russell-Minda, in press). The debilitating effects of glare increase with age due to the normal aging process and increased prevalence of cataracts (Babizhayev, 2003). In the presence of glare, older adults experience greater impairments and take longer to recover than younger adults (Wolf, 1960, cited in Eby et al., 1998). This presents a problem for older drivers, as glare can occur at night from headlights of oncoming cars or during the day when the sun is too bright or reflects off of snow. The evidence linking disability glare with crash risk is mixed, which may be in part due to older adults regulating their driving to avoid high glare conditions (Strong et al., in press). In support of this viewpoint, several studies have found that glare sensitivity is associated with self-reported driving restrictions (Freeman et al., 2006; West et al., 2003). As well, problems with glare are frequently reported by older drivers (Mcgregor & Chaparro, 2005; Owsley & McGwin, 1999).

Measurement Tool: **Brightness Acuity Tester**

The Brightness Acuity Tester (BAT), shown in Figure 4.3 below, is a hand-held instrument that consists of an internally illuminated hemispheric bowl (60 mm diameter) with a central aperture (12 mm diameter) (Holiday, Trujillo & Ruiz, 1987). The luminance of the central aperture can be set to three different brightness settings to simulate different lighting conditions. The device is held over the eye while viewing a vision chart through the central aperture. The present study used the BAT in combination with the Pelli-Robson Chart. The medium intensity luminance setting was used as it has been shown to provide valid and reliable estimates of disability glare (Elliot & Bullimore, 1993). Conversely, the high intensity setting has been reported to overestimate disability glare (Prager, Urso, Holladay & Stewart, 1989).

Figure 4.3 Brightness Acuity Tester

Disability glare was computed as the difference between Pelli-Robson scores when measured with and without the BAT. A larger positive score indicates greater disruption in vision as a result of the glare. The disability glare score in the "better eye" was used in analyses, defined as the eye with better performance on the visual acuity and contrast sensitivity measures. Unfortunately, there are no benchmarks for impairments in disability glare, however, when the BAT is used in combination with a visual acuity chart, a decrease of 1 line or less is considered to be "normal" (Hyrnchack, 2003). The author was not able to find a reference to define a "normal" decrease in contrast sensitivity in the presence of glare.

4.4.2.4 Brake Reaction Time

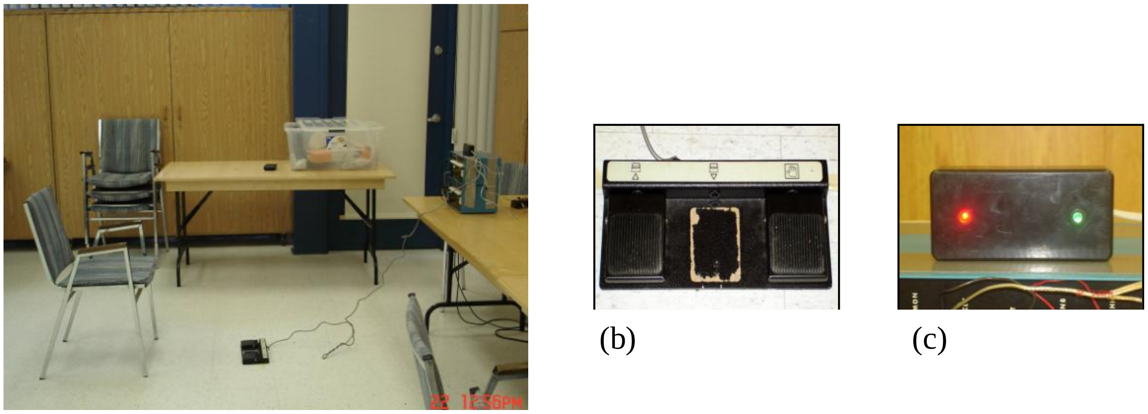
<u>Corresponding Perceived Abilities Item</u>: # 9: Move your foot quickly from the gas to the brake pedal.

<u>Definition and Relevance</u>

Brake reaction time involves two components: (1) reaction time and (2) movement time. Reaction time is the time interval between the onset of a stimulus and the initiation of movement (i.e. see stop sign and lift foot off of the accelerator). Movement time is the time between initiation and completion of movement (i.e. depressing brake pedal) (Magill, 2001). Driving involves Simple Reaction Time (depressing brake when traffic light turns red), Choice Reaction Time (deciding whether to brake or accelerate at a yellow light) and Discrimination Reaction Time (accelerating only in response to green light, but not red or yellow lights) (Spirduso, 1995). Both reaction time and movement time slow with age. Research indicates that age-related slowing of reaction time is the greatest for tasks involving multiple responses (i.e. choice and discrimination reaction time) (Stelmach & Nahom, 1992). As well, associations between reaction time and on-road driving performance are stronger for choice rather than simple reaction time (McKnight & McKnight, 1999). Several studies have found that reaction time measures differentiate older from younger drivers (Kortelling, 1990; Olsen & Sivak, 1986, Retchin, Cox, Fox & Irwin., 1988).

Measurement Tool: **Brake Reaction Time Apparatus**

The brake reaction time apparatus used in the present study is shown in the Figure 4.4 (a), below. The apparatus includes foot switches (Figure 4.5 (b)) mounted on a board to simulate the position of an accelerator and brake pedal, a timing device and a light stimulus (Figure 4.5 (c)) which comprises a red light and a green light. The task involved a discrimination reaction time task in which the participant was instructed to move his/her foot from the accelerator to the brake pedal only when the red light was shown. No movement was to be made when the green light was shown. The foot switches and light stimulus were connected to the timing device which measured both reaction time (time between presentation of red light and lifting foot off of the accelerator) and movement time (time between lifting foot off accelerator and depressing the brake pedal). Unfortunately, there are no validated benchmarks for impaired brake reaction time.



(a) (b) (c)

Figure 4.4 Brake Reaction Time Apparatus: (a) entire apparatus; (b) foot switches; and (c) light stimulus.

The task was standardized in several ways. The red and green lights were controlled by the researcher and a standardized sequence of light stimuli were presented to all subjects (described in protocol: Appendix L). The distance between the light stimulus and pedals was standardized (3 m), although participants could adjust the distance between the chair and pedals as needed. Finally, participants were given standardized instructions and five practice trials were performed prior to testing.

4.4.2.5. Lower Body Mobility

<u>Corresponding Perceived Abilities Item</u>: #12 ‘Get in and out of your car’

<u>Definition and Relevance</u>:

Lower body mobility involves lower limb strength and endurance, trunk stability and balance (Wang et al., 2003). Adequate lower limb functioning is needed to safely get in and out of the car and to control the brake and gas pedals (Cox, 1989; Wang et al., 2003). The muscular system shows major declines with age, including bone loss, atrophy and decreased cartilage which lead to reduced muscle strength, flexibility and joint stability (Mallon & Wood, 2004; Roberts & Roberts, 1993). Although decreased lower body mobility has been linked with crash risk (Marottoli et al., 1994, Staplin, Lococo, Gish & Decina, 2003), this relationship is not consistently found. However, mixed findings may be due to the limited number of studies, variable measurement and self-imposed driving restrictions. With respect to the latter, physical impairments may be more easily recognized than cognitive impairments which, consequently, prompts individuals to restrict or stop driving (Anstey, Wood, Lord & Walker., 2005). As well, if license renewal must be done in person, older adults with decreased mobility may be less likely to renew their licenses (Vance et al., 2006). Thus, lower body mobility may be an important determinant of driving behaviour in older adults.

Measurement Tool: **Rapid Paced Walk**

The Rapid Paced Walk measures the time (in seconds) required to walk 10 feet, turn around and return to the starting point (Marottoli et al., 1994; Wang et al., 2003). Participants were instructed to walk as fast as they could (safely and comfortably) and were allowed to use a walker or cane if normally used. The Rapid Paced Walk was chosen over other tests of lower body mobility because it requires minimal time for set-up and administration and, more importantly, has been found to be a significant predictor of at-fault crash involvement. One prospective study found that community-dwelling older adults (age 72-92) who took > 7 seconds to complete the test were twice as likely to experience a crash, traffic violation or be stopped by the police (Marottoli et al., 1994). Another study found that drivers aged 55 and older who took > 9 seconds to complete the test were 2.64 times more likely to have had an at-fault collision (Staplin et al., 2003). The present study used the more conservative 9 second benchmark for impairment as the corresponding study was conducted more recently and the study sample included those aged 65 and older (not just 70+), as in the present study.

4.4.2.6. Executive Skills

Corresponding Perceived Abilities Items:

- #14: Make quick driving decisions
- #8: 'Quickly spot pedestrians stepping out from between parked cars'
- #11: 'Quickly find a street or exit in an unfamiliar area or heavy traffic'

Definition and Relevance:

Executive skills refer to a number of higher order cognitive processes such as decision making, problem solving, judgment, planning and goal-oriented behaviour (Daigneault, Joly & Frigon., 2002). Executive skills are crucial for analyzing driving-related information, adapting to complex driving situation and making appropriate driving decisions (Daigneault et al., 2002, Wang et al., 2003). Examples of driving-related decisions are: deciding whether to proceed at intersections at a yellow light, or determining the appropriate driving speed when in a hurry (Eby et al., 1998). There is evidence that executive skills decline with age (Eby et al., 1998; Wang et al., 2003) and several studies have found crash frequency to be associated with poor performance on executive function tasks (Bieliauskas, 2005; Daigneault et al., 2002). One study also found that the inability to make rapid decisions and judgments on a driving simulator task was highly associated with the occurrence of a crash (Lee, Lee, Cameron & Li-Tsang, 2003).

Measurement Tool: **The Trail Making Test**

The **Trail Making Test** (Reitan, 1958) assesses visual search, visuospatial skills, working memory, divided attention, mental flexibility, information processing speed and executive skills (Ball et al., 2006; Good et al., 1998; Wang et al., 2003). The test consists of a Part A and a Part B and the templates for each are shown in Appendix M. Participants are required to sequentially connect integers in ascending order from 1 to 25 (Part A), or connect integers and letters in alternating and ascending order (Part B). Test performance is based on time for completion. The researcher followed the procedures specified by Reiten and Wolfson (1985) for administration of the test.

Several studies have found both Parts A and B to be significant predictors of driving performance and crash risk (Anderson, Rizzo, Shit, Uc & Dawson, 2005; Odenheimer et al., 1994; Stutts, Stewart & Martell, 1998), however, the evidence is stronger for Part B. The Trail Making Test has also been shown to be highly sensitive to the progressive cognitive declines experienced with dementia (Botwinick, Storandt, Berg & Boland, 1988). Benchmarks for impairments and increased crash risk have been established for Part B, but not Part A. Drivers aged 55 and older who took longer than 180 seconds on Part B were significantly more likely to have had an at-fault collision (Staplin et al., 2003), thus, this benchmark was used in the present study.

4.4.2.7. Visual Attention

<u>Corresponding Perceived Abilities Items:</u>

- #8: ‘Quickly spot pedestrians stepping out from between parked cars’
- #11: ‘Quickly find a street or exit in an unfamiliar area or heavy traffic’.

<u>Definition and Relevance:</u>

Visual attention refers to the processes required to attend to relevant information and ignore irrelevant information in any part of the visual field (Anstey et al., 2005). Visual attention requires selective attention, divided attention and switching attention (Bieliauskas, 2005; Parasuraman & Nestor, 1991)) and is crucial for driving in order to direct information processing resources to potentially hazardous visual events (Ball, Owsley, Sloane, Roenker & Bruni, 1993) and to discriminate relevant and irrelevant information in complex visual scenes (Anstey et al., 2005). Age-related declines in visual attention, which negatively affects driving ability, are well established (Ball & Owsley, 1991; Eby et al., 1998; Parasuraman & Nestor, 1991). In fact, The Useful Field of View (UFOV) test, a measure of visual attention, is a strong predictor of crash risk in older adults, both retrospectively (Ball & Owsley, 1993) and prospectively (Owsley et al., 1998). Interestingly, a study by West et al. (2003) found that deficits in visual sensory function (acuity, contrast-sensitivity, disability glare, glare recovery, depth perception, visual field size, central vision and flicker resolution) were correlated with self-imposed driving restrictions, however, deficits in visual attention were not.

Measurement Tool: **UFOV Subtest 2**

The UFOV test has been used extensively in relation to driving performance in older adults. A recent meta-analysis by Clay et al. (2005) reported that the UFOV test is a valid, reliable index of driving performance and safety. The UFOV test includes three subtests; while all look at visual processing speed, subtest 2 also includes a divided attention task while subtest 3 includes a selective attention task (Edwards et al., 2005). Compared with the other two subtests, Subtest 2 correlates most highly with the total UFOV score and provides the best prediction of crash involvement (Owsley et al., 1998). For efficiency, the present study used only **subtest 2** which requires participants to identify a central target (silhouette of a truck or car), in addition to localizing a simultaneous peripheral target presented at one of eight radial locations. The speed of the display duration is varied between 16.67 and 500ms using a double-staircase method and scores are expressed as the display duration (ms) at which participants could correctly perform each subtest 75% of the time. The present study used 353 ms as the cut-off for impairment, as Ball et al., (2006) found that older drivers who took longer than 353 milliseconds on Subtest 2 were 2.02 times more likely to have had an at-fault motor vehicle collision.

The UFOV Subtest 2 was administered on a laptop computer using software provided by Dr. Porter (University of Manitoba). The program provides several examples and a set of four practice trials prior to the actual test. Participants were allowed to repeat the practice trials as many as three times, if necessary. Standardized instructions were given to all participants, as described in the protocol in Appendix L. As many people had minimal computer/mouse experience, participants were given the option of having the researcher manipulate the mouse for them; 14 (33%) chose this option. This adaptation did not influence test performance since participants still had to choose the correct response. Subsequent to testing, an independent t-test was performed to check for differences between participants who used the mouse and participants who did not. On average, participants who used the mouse had a slightly faster score ($M=142.13 \pm 105.49$) than participant who did not use the mouse ($M=182.35$; ± 151.94), however, the difference was not significant ($t(40) = -1.00$; $p = .322$). It should be noted, however, that there was no age difference between those who used the mouse and those who did not.

***4.4.2.8*. Summary**

A summary of the physical and cognitive assessment battery is provided in Table 4.1, below. The battery took approximately 30 to 45 minutes per participant to administer. Following the assessment, participants were provided with a Results Sheet (Appendix N) to take home, which indicated their score on each measure and a standard for comparison (when available). The researcher thoroughly discussed the results with each participant and answered questions. If participants had concerns about their performance on a measure, they were advised to consult their physician or eye care professional.

Table 4.1 Physical and Cognitive Assessment Battery

Ability	Measurement Tool	Benchmark
Visual acuity	ETRDS charts	+0.39 Log Mar (20/50)
Contrast Sensitivity	Pelli-Robson chart	≤1.25 log units
Disability Glare	Brightness Acuity Tester + Pelli-Robson chart	N/A
Brake Reaction Time	Brake Reaction Apparatus (foot switches & light stimulus)	N/A
Lower Body Mobility	Rapid Paced Walk	> 9 sec
Executive Skills	The Trail Making Test	> 180 sec
Visual Attention	UFOV Subtest 2	> 353 msec

4.5 Data Analysis

All quantitative data was analyzed using the Statistical Package for Social Sciences (SPSS), Version 14.0. A detailed description of the scoring of questionnaires (DCSs and rating forms) can be found in Chapter Three. It should be noted that, since all participants in the present study received the Phase V driving frequency rating form (Appendix E), responses were scored as 0 to 4 ("never" to "very often") with total scores ranging from 0 to 56. Total scores for the avoidance rating form ranged from 0 to 20, and from 0 to 45 for the two perceived abilities rating forms. Missing items were dealt with in the same way as in predictive validity and all variables were assessed for normality using the procedures described in Chapter Three. Comparative analyses involved Pearson correlations (normally distributed variables), Spearman Rank correlations (non-normally distributed variables), independent t-tests (normally distributed variables), Mann-Whitney tests (non-normally distributed variables), chi-square tests and ANOVA. Several sub-scales from the perceived abilities rating forms were created specifically for comparisons with objective driving-related abilities:

- "Vision" score: items 1 to 7; range 0 – 21
- "Night Vision" score: items 2, 4 and 7; range 0 – 9
- "Contrast Sensitivity" score: items 2, 4 and 5; range 0 – 9
- "Visual Attention" score: items 8 and 11; range 0 – 6
- "Executive Skills" score: items 8, 11 and 14; range 0 – 9

4.6 Results

As described in Chapter Three, 65 new (i.e. Phase V) participants were assessed at baseline. Of the 82 participants who took part in Study 1, 41 took part in the physical assessments including 36 new participants and five Phase IV participants. An additional participant (a spouse of a participant) who was not part of the initial baseline sample also took part in the physical assessments and was only included in the analyses pertaining to this subsample. It should be noted that the five Phase IV participants took part in both the telephone interviews (Study 1) and the physical assessments, while one individual from the “new” baseline sample did not take part in either component (only completed the DCSs and rating forms at follow-up).

This section begins with a sample description. Associations between DCS scores and demographics, self-reported driving behaviour and problems and perceived abilities are then presented, followed by a description of consistencies and discrepancies between the present study and Phase IV findings. Lastly, findings pertaining to the physical assessments are described.

4.6.1 Sample Description

Table 4.2 presents selected characteristics of the new (Phase V) sample. A description of the physical assessment subsample will follow in section 4.6.4. A slightly higher proportion of the sample were females and aged 63-79. The male participants had a slightly higher mean age, although differences were not significant. Overall, the sample was well educated (almost half completed college or university) and females were significantly more likely to have completed high school (83.8%% vs. 50%; χ^2 (1) = 8.54, p=.003) and college/university (58.3% vs. 33.3%, χ^2 (1) = 3.87, p=.049). The distribution of participants living alone or with a spouse/partner was fairly even, and a higher proportion were living in retirement complexes in comparison to the other types of facilities. About half of the sample said that others rely on them to drive. The older age group were more likely to say that they did *not* live close enough to walk to church, social and recreation activities (82.1% vs. 50%; χ^2 (1) = 7.07, p=.008).

Driving characteristics obtained from the background questionnaire are shown in Table 4.3. The majority said that they drove less often in comparison to ten years ago. While most had taken rides from family and friends in the past month, few had taken other modes of transportation. About a third of the sample reported gripping the steering wheel while driving, but few reported feeling their palms sweat or feeling their shoulders tighten while driving. Interestingly, the younger age group (63-79) had a significantly higher nervousness score (.69 ± .79, .14 ± .35; t (62) = 3.44, p=.001) and were significantly more likely to report gripping the steering wheel and feeling their shoulders tighten while driving. Men, meanwhile, were significantly more likely to report near misses in the past year (32.1% vs. 8.1%; χ^2 (1) = 6.17, p=.013). Few participants reported accidents or other driving problems in the past year. As expected, the majority of drivers rated driving as “extremely” or “very” important. About a quarter of the sample had even taken driving courses.

Table 4.4 shows the sample health characteristics. Overall the sample appeared to be in good health as the large majority rated their health as “excellent” or “good” and were able to walk a quarter of a mile, while few reported using a cane/walker. Men and drivers aged 80+ were significantly more likely to report hearing problems than females (42.9% vs. 18.9%; χ^2 (1) = 4.42, p=.036) and drivers aged 63-79 (44.8% vs. 16.7%; χ^2(1) = 6.16, p=.013). Drivers aged 80+ were also significantly more likely to have had cataract surgery (57.1% vs. 25%; χ^2(1 = 6.84, p=.009). As expected, the majority of drivers rated their eyesight as the same or better than others, and only one person rated their eyesight as worse than others. Interestingly, a significantly higher proportion of younger drivers said that their physician had asked them if they drive (83.3% vs. 16.7%; χ^2 (1) = 4.88, p = .027).

Table 4.2 Phase V Sample Selected Characteristics

Characteristic	Ph V (N=65)
Gender	
Male	28 (43.1%)
Female	37 (56.9%)
Age	
Mean (SD)	78.4 (6.3)
Range	63 – 93
Age Group	
63-79	36 (55.4%)
80+	29 (44.6%)
A1. Years Driven**†††	
Mean (SD)	56.3 (10.7)
Range	16 – 78
Missing	1
Education Completed	
High school**	45 (69.2%)
College/university*	30 (46.2%)
Missing	2 (3.1%)
Living Arrangements	
Alone	34 (52.3%)
With spouse/partner	29 (44.6%)
With roommates (not related)	2 (3.1%)
Type of Residence	
Private home	8 (12.3)
Apartment or condo	18 (27.7%)
Retirement or senior's complex	39 (60%)
Other Driver in Household	25 (38.5%)
Others Rely on You to Drive	32 (49.2%)
Close Enough to Walk	
Yes, weekly shopping & errands	26 (40%)
Yes, church, social or recreation ††	23 (35.4%)
Missing	1 (1.5%)

* indicates significant gender differences p<.05; **p<.01
†† indicates significant age group differences (63-93 vs. 80+) p<.01; †††p<.001

Table 4.3 Phase V Sample Driving Characteristics

Driving Patterns	Ph V (N=65)
# Days Driven in Past Week	
Mean (SD)	4.42 (1.9)
Range	0 – 7
Driving Compared to 10 yrs Ago	
Less often	42 (64.6%)
About the same/More often	22 (33.8%)
Missing	1 (1.5%)
Taken in the Past Month	
Rides from family/friends	41 (63.1%)
Taxis	2 (3.1%)
Public transport (buses, streetcars)	6 (9.2%)
Special transit services	5 (7.7%)
Physical Discomfort While Driving	
Gripping the steering wheel††	20 (30.8%)
Feeling palms sweat or heart race	1 (1.5%)
Feeling shoulders tighten†	9 (13.8%)
Missing: 1	1 (1.5%)
Nervousness Score (0-3) ††	
Mean (SD)	.5 (.7)
Range	0 – 2
Missing	1
Driving Problems	
Accidents	5 (7.7%)
Near misses*	12 (18.5%)
Backing into things	4 (6.2%)
Getting lost	14 (21.5%)
Missing	
Driving Problems Score (0-4)	
Mean (SD)	.5 (.8)
Range	0 – 3
Importance of Driving (1-5)	
(5) Extremely Important	22 (33.8%)
(4) Very Important	24 (36.9%)
(3) Moderately Important	10 (15.4%)
(2) Somewhat Important	4 (6.2%)
(1)Not that important	1 (1.5%)
Missing	4 (6.2%)
Mean (SD)	4.02 (.97)
Range	1- 5
Taken Driving Courses (other than GES)	20 (24.4%)

*Indicates significant gender differences $p<.05$

† Indicates significant age group differences $p<.05$; †† $p<.01$

Table 4.4 Phase V Sample Health Characteristics

Health and Abilities	Ph V (N=65)
Overall Health	
Excellent/Good	56 (86.2%)
Fair/Poor/Very Poor	9 (13.8%)
Use Cane/Walker Outdoors	15 (23.1%)
Able to Walk a Quarter Mile	55 (86.4%)
Diagnosed Health Conditions	
arthritis, rheumatism or osteoporosis	22 (33.8%)
Parkinson's or multiple sclerosis	4 (6.2%)
heart problems	38 (58.5%)
diabetes	9 (13.8%)
asthma or breathing problems	5 (7.7%)
back or foot problems	16 (24.6%)
hearing problems†*	19 (29.2%)
cataracts, glaucoma or macular degen	18 (27.7%)
Diagnosis Score (0-8)	
Mean (SD)	2.0 (1.1)
Range	0 - 5
Cataract Surgery ††	25 (38.5%)
Missing	1 (1.5%)
If Yes: How long ago	
Within past year	7 (28%)
Over a year ago	18 (72%)
Eyesight Compared to Others	
Worse than most	1 (1.5%)
About the same	35 (53.8%)
Better than most	27 (41.5%)
Missing	2 (3.1%)
Take Medications	56 (86.2%)
Missing	2 (3.1%)
Physician Asked If you Drive†	
Yes	12 (18.5%)
Missing	3 (4.6%)
Talked About Your Driving	
physician or optometrist	19 (29.2%)
Missing	4 (6.2%)
family or friends	22 (33.8%)
Missing	2 (3.1%)

*Indicates significant gender differences p<.05
†Indicates significant age group differences p<.05; ††p<.01

Table 4.5 shows the Phase V sample scores on the DCSs and four rating forms, including the 95% confidence intervals (CI). One person did not complete 75% of the N-DCS and another did not check any items on the avoidance rating form. As well, one person did not complete the perceived changes in abilities form at baseline. Such participants were omitted from the corresponding analyses. Overall the sample had fairly high day confidence and moderate night confidence, given theoretical means of 50% for both scales. The mean N-DCS score was significantly lower than the mean D-DCS score ($t(63) = 7.49$, $p<.001$). Furthermore, scores on the D-DCS were highly and significantly correlated with scores on the N-DCS ($r=.834$, $p<.001$); lower day confidence was associated with lower night confidence.

As indicated by the mean rating of item #1 on the N-DCS ("in good weather and traffic conditions"), the sample had fairly high general night driving confidence (mean rating was 81.05 ± 23.82). The majority (47.7%; N=31) rated their confidence as 100% for item #1, and only two individuals rated their confidence as 0%. Ten (15.4%) participants had scores of 50% and 19 (29.2%) had scores of 75%.

Thirteen Phase V participants received the initial current perceived abilities rating form (rated their abilities compared to other drivers) and thus were omitted from such analyses. As well, one person did not complete the perceived changes in abilities form. It should be noted that lower scores on the perceived changes in abilities form indicate that the respondent perceives *more* decline in their abilities. There were no age or gender differences in any of the measures in Table 4.5.

Table 4.5: Phase V Sample DCS and Rating Form Scores

Measure	N	Mean (SD)	Range	95% CI
Day Driving Comfort (D-DCS)	65	70.04 (18.25)	18.75 – 100.00	65.52 – 74.56
Night Driving Comfort (N-DCS)	64	57.84 (24.05)	0.00 – 96.88	51.83 – 63.85
Item # 1 on the N-DCS	62	81.05 (23.82)	0.00 – 100.00	75.00 – 87.10
Situational Driving Frequency (0 - 56)	65	30.45 (8.46)	16.00 – 54.00	28.35 – 32.54
Driving Avoidance (0 - 20)	64	8.19 (5.04)	0.00 – 20.00	6.93 – 9.45
Current Perceived Abilities (0 - 45)	52	31.92 (7.68)	15.00 – 44.00	29.78 – 34.06
Perceived Changes in Abilities (0 – 45)	64	25.56 (4.96)	13.00 – 40.00	24.32 – 26.80

4.6.2 Associations with Driving Confidence

4.6.2.1. Demographic and Health Characteristics

Table 4.6 shows the relationships between DCSs scores and selected characteristics (obtained from the background questionnaire). While no associations were significant, many were in the expected directions. No differences were found between the older and younger age groups, however, as a continuous variable, age was inversely associated with both day and night driving comfort. Men also had higher night driving comfort than women. In addition, those who said that others rely on them to drive had slightly higher driving comfort, particularly at night. Interestingly, participants who lived in an apartment or condo had lower day and night driving comfort when compared to those who lived in a private home or senior's complex (approaching significant for the N-DCS).

Associations between driving comfort scores and sample health characteristics (obtained from the background questionnaire) are shown in Table 4.7. Ratings of health were not significantly associated with comfort level and surprisingly, drivers who rated their health as "very poor"/"poor"/"fair" had slightly higher mean night driving comfort than those who rated their health as "excellent"/"good". In addition, the use of a cane/walker and the ability to walk a quarter of a mile, both indicators of physical mobility, were not significant related to driving comfort.

The number of diagnosed health problems (indicated by the diagnosis score) was inversely related to both Day and Night DCS scores, but was only significant for daytime. In addition, drivers with a diagnosed vision condition (cataracts, glaucoma or macular degeneration) had significantly lower comfort in the day and particularly at night. Although not shown in Table 4.7, none of the other categories of health problems (arthritis/rheumatism/osteoporosis, neurological disorders, cardiovascular conditions, diabetes, respiratory conditions, hearing problems) were significantly related to driving comfort. While drivers who had undergone cataract surgery had lower day and night comfort, differences were not significant. Only two people rated their eyesight as "worse than most" and although such individuals had lower day and night comfort than those who rated their eyesight as "about the same" or "better than most", differences were not significant. Interestingly, drivers who had discussed their driving with a physician or optometrist had lower mean day and night driving comfort (although not significant). Similarly, drivers who had discussed their driving with family and friends had lower day and night comfort, and differences were significant for daytime.

Table 4.6 Relationships between DCS Scores and Selected Characteristics

Characteristic	N	D-DCS (N=65)	N	N-DCS (N=64)
Gender				
Male	28	70.31 (15.44)	28	61.32 (18.65)
Female	37	69.84 (20.33)	36	55.14 (27.49)
t-value (p)		.101 (.920)		1.02 (.312)
Age				
Pearson r (p)	65	-.144 (.253)	64	-.113 (.375)
Age Group				
63-79	36	70.00 (19.55)	36	58.00 (25.62)
80+	29	70.09 (16.84)	28	57.63 (22.34)
t-value (p)		-.02 (.984)		.061 (.952)
A1. # Years Driven				
Pearson r (p)	64	.105 (.409)	63	.126 (.326)
A5. Other Driver in Household				
No	40	69.76 (17.27)	40	56.02 (24.86)
Yes	25	70.49 (20.08)	24	60.88 (22.83)
t-value (p)		-.156 (.876)		-.780 (.438)
A6. Others Rely on you to Drive				
No	33	68.07 (20.09)	33	54.18 (27.02)
Yes	32	72.07 (16.21)	31	61.74 (20.15)
t-value (p)		-.881 (.382)		-1.26 (.211)
B3. Education Level				
High School				
No	20	68.58 (18.74)	19	62.86 (22.82)
Yes	45	70.69 (18.21)	45	55.72 (24.49)
t-value (p)		-.427 (.671)		1.09 (.282)
College/University				
No	33	68.32 (19.94)	32	57.43 (28.89)
Yes	30	71.67 (16.85)	30	58.18 (19.08)
t-value (p)		-.715 (.477)		-.121 (.904)
B5. Type of Residence				
Private home	8	76.78 (17.90)	8	62.93 (26.47)
Apartment or condo	18	63.03 (21.07)	18	46.52 (29.16)
Senior's complex	39	71.89 (16.34)	38	62.13 (19.37)
F-value (p)		2.15 (.125)		2.95 (.060)
B6. Living Arrangements				
Alone	34	67.25 (21.40)	33	54.75 (28.93)
Spouse/partner	29	73.24 (14.05)	29	61.57 (17.37)
Roommates	2	71.16 (10.88)	2	54.69 (22.10)
F-value (p)		.841 (.436)		.631 (.535)

Table 4.7 Relationships between DCS Scores and Health Characteristics

Health Characteristic	N	D-DCS (N=65)	N	N-DCS (N=64)
C1. Overall Health				
Very poor/poor/fair	9	69.23 (18.45)	9	61.26 (19.04)
Good/Excellent	56	70.17 (18.38)	55	57.28 (24.88)
t-value (p)		-.142 (.887)		.457 (.649)
C2. Use Cane/Walker				
No	50	69.58 (19.06)	49	57.92 (25.20)
Yes	15	71.57 (15.77)	15	57.60 (20.67)
t-value (p)		-.367 (.714)		.046 (.964)
C3. Able to Walk ¼ Mile				
No	10	67.36 (18.60)	10	54.82 (20.64)
Yes	55	70.53 (18.32)	54	58.40 (24.77)
t-value (p)		-.503 (.617)		-.429 (.669)
C4. # Days/wk of Phys. Activity				
Spearman's rho (p)	61	-.017 (.698)	60	-.058 (.661)
C6. Diagnosis Score				
Spearman's rho (p)	65	-.245 (.049)*	64	-.214 (.089)
C6. Diagnosed Cataracts/Glaucoma/Mac.Degen.				
No	47	73.18 (18.48)	46	62.72 (23.53)
Yes	18	61.86 (15.22)	18	45.38 (21.20)
t-value (p)		2.31 (.024)*		2.72 (.008)**
C7. Cataract Surgery				
No	39	72.41 (18.00)	39	60.83 (24.46)
Yes	25	66.54 (18.77)	24	53.24 (23.61)
t-value (p)		1.25 (.216)		1.21 (.230)
C9. Eyesight Compared to Others				
Worse than most	2	46.15 (2.72)	2	27.34 (7.73)
About the same	42	69.97 (15.99)	42	58.48 (21.31)
Better than most	36	69.73 (19.94)	35	57.37 (24.34)
F-value (p)		1.73 (.184)		1.59 (.211)
C10. Take Medications				
No	7	73.08 (22.04)	7	60.97 (26.23)
Yes	56	69.96 (17.81)	55	57.47 (24.04)
t-value (p)		.426 (.672)		.359 (.721)
A12. Talked About Your Driving				
Physician/Optometrist				
No	42	70.90 (18.00)	41	60.13 (22.47)
Yes	19	68.52 (20.24)	19	52.75 (29.18)
t-value (p)		.459 (.648)		1.07 (.287)
Family/Friends				
No	38	73.26 (16.94)	37	61.73 (22.78)
Yes	22	63.70 (19.08)	22	51.51 (25.34)
t-value (p)		2.01 (.049)*		1.60 (.116)

*p<.05; **p<.01

4.6.2.2 Self-Reported Driving Characteristics

Table 4.8 shows associations between driving comfort and various driving characteristics (obtained from the background questionnaire). No relationship was found with the number of days driven in past week, nor with driving restriction (driving compared to 10 years ago). Although participants who drive longer than 60 minutes for most trips had higher day and night comfort than those who drove less than 60 minutes, differences were not significant (approaching significance for N-DCS).

The composite driving problems score was not related to driving comfort scores. Each component (accidents, near misses, backing into things, getting lost) was also examined separately, but no findings were significant. That being said, the five drivers who had experienced an accident (involving another vehicle) in the past year had slightly lower day and night driving comfort. The composite driving nervousness score, meanwhile, was significantly and inversely related to day and night driving comfort. When the components were analyzed individually, two of the items were significant. Drivers who said they find themselves "gripping the wheel" or "feel their shoulders tighten" had significantly lower day and night driving comfort. Only one participant indicated "feeling their palms sweat or heart race" while driving, and this person had much lower day and night comfort scores than the rest of the sample (Day: 42.31% vs. 70.47%; Night: 25.00% vs. 58.36%).

Interestingly, personal ratings of driving importance were positively related to DCS scores (higher comfort associated with greater importance of driving) and the relationship was significant for the D-DCS. While drivers who had taken a driving course had higher night comfort, differences were not significant.

Table 4.8 Relationships between DCS Scores and Driving Characteristics

Driving Characteristics	N	D-DCS (N=65)	N	N-DCS (N=64)
A2. # Days Driven in Past Week				
Spearman's rho (p)	65	.111 (.380)	64	.008 (.952)
A4. Driving Compared to 10yrs Ago				
Less often	42	68.75 (18.93)	42	57.36 (18.93)
About the same/more often	22	71.85 (17.29)	21	58.43 (26.03)
t-value (p)		-.642 (.523)		-.165 (.870)
A3. Length of Most Driving Trips				
< 30 minutes	37	69.55 (17.47)	37	55.06 (22.76)
> 30 minutes	20	68.00 (19.35)	20	55.82 (24.80)
> 60 minutes	6	84.62 (16.27)	6	78.87 (23.68)
F-value (p)		2.09 (.133)		2.73 (.073)
A13. Nervousness Score (0-3)				
Spearman's rho (p)	64	-.463 (<.001)	63	-.434 (<.001)
A14. Driving Problems Score (0-4)				
Spearman's rho (p)	65	-.195 (.120)	64	-.178 (.159)
A14. Accidents in the Past Year				
No	60	70.59 (18.56)	59	58.58 (24.23)
Yes	5	63.46 (13.80)	5	49.06 (22.22)
t-value (p)		.837 (.406)		.848 (.400)
A15. Importance of Driving				
Spearman's rho (p)	61	.270 (.035)*	60	.228 (.079)
C14. Taken Driving Courses (other than GES)				
No	45	69.93 (17.18)	44	56.37 (23.40)
Yes	20	70.29 (20.93)	20	61.08 (25.75)
t-value (p)		-.072 (.093)		-.724 (.472)

*****p<.05

Table 4.9 presents the relationships between driving comfort and ratings of situational driving frequency and avoidance. The situational driving frequency total score was significantly and positively correlated with both day and night driving comfort. The situational driving avoidance score was significantly and inversely related to both D-DCS and N-DCS. Significant relationships were also found with the weather-related, rush-hour and highway avoidance scores in the expected directions (inversely related to comfort).

Table 4.9 Relationships between DCS Scores and Driving Frequency and Avoidance

Driving Behaviour	N	D-DCS (N=65)	N	N-DCS (N=64)
Situational Driving Frequency (0-56) Pearson r (p)	65	.472 (<.001)***	64	.571 (<.001)***
Situational Driving Avoidance (0-20) Pearson r (p)	64	-.520 (<.001)***	63	-.555 (<.001)***
Weather-related Avoidance (0-6) Pearson r (p)	64	-.439 (<.001)***	63	-.462 (<.001)***
Rush-hour Avoidance (0-2) Pearson r (p)	64	-.381 (.002)**	63	-.420 (.001)**
Highway Avoidance (0-2) Pearson r (p)	64	-.369 (.003)**	63	-.455 (<.001)***

**p<.01; ***p<.001

To further investigate night driving behaviour, comparisons were made between those who responded "never or rarely" (non-night drivers) and those who responded "occasionally, often or very often" (night drivers) to item #2 on the driving frequency rating form. Although chi-square tests could not be performed due to small sample sizes (only 10 non-night drivers), relative proportions of night and non-night drivers for certain categorical variables are shown in Table 4.10. Comparisons with selected continuous variables are shown in Table 4.11. Those who responded "never or rarely" to driving at night (non-night drivers) had a higher mean age (although not significantly different) and a higher proportion of participants in the older age group. The proportion of women was also slightly higher for this group. Furthermore, the non-night drivers appeared to be in poorer health. The mean total number of health problems (diagnosis score) was significantly greater for non-night drivers, and a higher proportion had been diagnosed with a vision condition and had undergone cataract surgery. With respect to mobility indicators, a higher proportion of non-night drivers reported using a cane or walker, however, there were no differences in the proportions able to walk a quarter mile.

As would be expected, the non-night drivers had significantly lower driving comfort during the day and particularly at night. They also responded significantly lower to item #1 on the N-DCS, which examined general night driving confidence in "good weather and traffic conditions". Non-night drivers had significantly lower situational driving frequency and, although their situational avoidance was higher, differences were not significant (but approaching significance $p=.054$). It should also be noted that 90% of non-night drivers also indicated that they purposely try to avoid night driving if possible (indicated by item #1 on the avoidance rating form) in comparison with only 45.5% of night drivers. Not surprisingly, non-night drivers had a significantly lower perceived abilities total score, however, there were no differences in their perceived changes in abilities compared to 10 years ago. Although not shown in the table, non-night drivers had a significantly lower night vision score (2.00 ± 2.19 vs. 5.52 ± 2.02; $t(50) = 3.98$, $p<.001$) but there were no differences in their perceived changes in night vision score. As well, no differences were found in the composite nervousness or driving problems scores.

Table 4.10 Night Drivers versus Non-Night Drivers: Categorical Variables

	Drive at Night	
	Never/Rarely N=10	**Occasionally/Often N = 55**
Gender		
Male	4 (40%)	24 (43.6%)
Female	6 (60%)	31 (56.4%)
Age Group		
63-79	3 (30%)	33 (60%)
80+	7 (70%)	22 (40%)
Other Driver in Household		
Yes	3 (30%)	22 (40%)
Others Rely on you to Drive		
Yes	4 (40%)	28 (50.9%)
Diagnosed Vision Condition		
Yes	5 (50%)	13 (23.5%)
Cataract Surgery		
Yes	7 (70%)	18 (33.3%)
Cane/Walker		
Yes	4 (40%)	11 (20%)
Able to Walk ¼ Mile		
Yes	8 (80%)	47 (85.5%)

Table 4.11 Night Drivers versus Non-Night Drivers: Continuous Variables

Characteristic	N	Mean (SD)
D-DCS		
Never/Rarely	10	59.42 (20.60)
Occasionally/Often/Very Often	55	71.97 (17.30)
t-value (p)		-2.05 (.045)*
N-DCS		
Never/Rarely	10	38.67 (23.28)
Occasionally/Often/Very Often	54	61.39 (22.66)
t-value (p)		-2.90 (.005)**
Item #1 N-DCS		
Never/Rarely	9	58.33 (27.95)
Occasionally/Often/Very Often	53	84.91 (21.00)
t-value (p)		-3.34 (.001)**
Age		
Never/Rarely	10	81.70 (4.40)
Occasionally/Often/Very Often	55	77.80 (6.45)
t-value (p)		1.83 (.072)
Situational Driving Frequency		
Never/Rarely	10	23.76 (5.58)
Occasionally/Often/Very Often	55	31.66 (8.36)
t-value (p)		-2.87 (.006)**
Situational Driving Avoidance		
Never/Rarely	10	11.00 (3.97)
Occasionally/Often/Very Often	54	7.67 (5.08)
t-value (p)		1.96 (.054)
Current Perceived Abilities		
Never/Rarely	6	22.50 (5.32)
Occasionally/Often/Very Often	46	33.15 (7.10)
t-value (p)		-3.53 (.001)**
Perceived Changes in Abilities		
Never/Rarely	10	25.14 (6.36)
Occasionally/Often/Very Often	54	25.64 (4.72)
Mann-Whitney Statistic (p)		-.294 (.769)
Driving Nervousness Score		
Never/Rarely	9	.33 (.71)
Occasionally/Often/Very Often	55	.47 (.69)
t-value (p)		-.560 (.577)
Driving Problems Score		
Never/Rarely	10	.30 (.48)
Occasionally/Often/Very Often	55	.58 (.83)
t-value (p)		-1.04 (.304)
Diagnosis Score		
Never/Rarely	10	2.80 (1.03)
Occasionally/Often/Very Often	55	1.87 (1.00)
t-value (p)		2.68 (.009)**

*****p<.05; **p<.01

4.6.2.3. Perceived Abilities

Table 4.12 shows the relationships between DCS scores and ratings of current and perceived changes driving-related abilities. As expected, significant positive relationships were found between the current perceived abilities total score and both day and night driving comfort. Significant relationships were also found with each of the subscale scores in the expected directions. Similarly, the perceived changes in abilities total score was also significantly related to day and night comfort in the expected directions; participants who perceived *less* decline in the abilities compared to ten years ago had higher ratings for day and night comfort. Each of the subscale scores for perceived changes in abilities was also significantly related to DCS scores in the expected directions. For both day and night driving, relationships were stronger for current perceptions than perceived changes in abilities. Furthermore, relationships with current and perceived changes in night vision were stronger for Night DCS scores than for Day.

Table 4.12 Relationship between DCS Scores and Perceived Abilities

	N	D-DCS	N-DCS
Perceived Abilities Score (0 – 45) Pearson r (p)	52	.531 (<.001)***	.580 (<.001)***
Vision Score (0 – 21) Pearson r (p)	52	.514 (<.001)***	.536 (<.001)***
Night Vision Score (0 – 9) Pearson r (p)	52	.502 (<.001)***	.569 (<.001)***
Visual Attention Score (0 – 6) Pearson r (p)	52	.433 (.001)**	.454 (.001)**
Executive Skills Score (0 – 9) Pearson r (p)	52	.522 (.001)***	.559 (<.001)***
Perceived Changes in Abilities (0 – 45) Spearman's rho (p)	64	.444 (<.001)***	.439 (<.001)***
Perceived Changes in Vision Score (0 – 21) Spearman's rho (p)	64	.403 (.001)**	.441 (<.001)***
Perceived Changes in Night Vision Score (0 – 9) Spearman's rho (p)	64	.359 (.004)**	.431 (<.001)***
Perceived Changes in Visual Attention Score (0 – 6) Spearman's rho (p)	64	.418 (.001)**	.414 (.001)**
Perceived Changes in Executive Skills Score (0 – 9) Spearman's rho (p)	64	.447 (<.001)***	.390 (.002)**

******p<.01; *******p<.001

4.6.3 Comparisons with Phase IV Results

One objective of the present study was to re-examine associations found in Phase IV between the DCSs and demographic, health and driving characteristics (reported in Paradis, 2006). In the present chapter, the Phase IV sample (N = 100) refers to the participants in Ms. Paradis (2006) Master's Thesis and the Phase V sample refers to the "new participants" (N = 65) in Phase V (the present study). Table 4.13 shows the breakdown of facility type and location for data collection for the Phase IV and V samples. In both samples, the majority of participants were recruited from retirement complexes. A larger proportion of the Phase IV sample was from senior's apartments, while a larger proportion of the Phase V sample was from senior's community centres. In addition, the Phase IV sample had a small northern population (12%) which was 83% female.

Table 4.13 Facility Type and Location for Phase IV and V Samples

Facility Type	Total in Phase IV Sample (N=100)	Total in Phase V Sample (N=65)
Senior's Apartments		
Waterloo	19	1
Kitchener	9	7
Total	**28 (28%)**	**8 (12.3%)**
Retirement Complex		
Waterloo	14	13
Kitchener	12	18
Guelph	12	2
Cambridge		6
Elmira	18	0
New Liskeard (North)	12	0
Total	**68 (68%)**	**39 (60%)**
Senior's Centre		
Guelph	4	14
Fergus		4
Total	**4 (4%)**	**18 (27.7%)**

Table 4.14 shows selected characteristics for the Phase IV and V samples. Statistical comparisons were not performed as the data were in two separate databases, however, this may be done prior to publication if necessary. As shown, the samples were basically similar with respect to gender and age, although a slightly higher proportion of Phase IV participants were female and aged 80+. The Phase V sample was also somewhat more educated. In both samples, the majority of participants lived alone, and approximately 38% had another driver living in their household. The Phase IV sample appeared to be in poorer health, as they were more likely to rate their health as "fair" or 'poor", use a cane a walker, have a diagnosed vision condition and have undergone cataract surgery.

Table 4.15 shows the mean DCS scores for the Phase IV and V samples. Although the range of DCS scores were fairly similar in both samples, the Phase V sample means for D-DCS and N-DCS scores were approximately 10% higher than the Phase IV sample.

Table 4.14 Comparison of Phase IV and V Sample Characteristics

Characteristics	Phase IV Sample (N=100)	Phase V Sample (N=65)
Gender		
Male	39%	43.1%
Female	61%	56.9%
Age		
Mean (SD)	79.8 (6.2)	78.4 (6.3)
Range	65 – 92	63- 93
Age Group		
63-79	46%	55.4%
80+	54%	44.6%
Education Completed		
High School	58%	69.2%
College/University	32%	46.2%
Living Arrangements		
Alone	58%	52.3%
Spouse/partner	35%	44.6%
Family members	2%	0%
Roommates	4%	3.1%
Other Driver in Household	38%	38.5%
# Days Driven in Past Week	4.8 (2.2)	4.42 (1.9)
Drive at Night (Occasionally/Often)	64%	84.6%
Overall Health		
Excellent/Good	72%	86.2%
Fair/poor	28%	13.8%
Diagnosis Score	2.66 (2.0)	2.02 (1.1)
Diagnosed Vision Condition	33%	27.7%
Cataract Sugery	56%	38.5%
Use Cane/Walker	32%	23.1%
Able to Walk ¼ Mile	80%	86.4%

Table 4.15: Phase IV and V Samples: DCS Scores

Driving Comfort Scores	Phase IV Sample (N=100)	Phase V Sample (N=65)
D-DCS	59.7 (17.9)	70.0 (18.3)
N-DCS	47.9 (23.8)	57.8 (24.0)
Item #1 N-DCS	71.2 (25.0)	81.1 (23.8)

Similarities and differences exist between the associations found in Phase IV and the present study. With respect to similarities, N-DCS scores were significantly lower than D-DCS scores in both studies. In addition, the following variables were significantly related to DCS scores in the expected direction:

- Situational driving frequency and avoidance
- Perceived abilities (although different measures were used in Phase IV and V)
- Nervousness score

The perceived abilities measure used in Phase IV is described in Appendix B (bottom of Table 2) and included some similar items as the Phase V version (e.g. “reversing or backing up”, “seeing road signs or lanes when its raining or dark out”). Furthermore, in both Phase IV and V, the driving problems score was not found to be significantly related to DCS scores, nor was using a cane or walker (a mobility indicator) or self-ratings of overall health.

Dissimilar findings are shown in Table 4.16. While females had lower N-DCS scores in both the Phase IV and V samples, this difference was only significant in the Phase IV sample. In addition, a weak but significant correlation was found between age and N-DCS scores in the Phase IV sample but not in the Phase V sample. That being said, inverse relationships between age and DCS scores were found in both samples.

While no differences were found in the present study, DCS scores were significantly lower for participants in the Phase IV sample who had another driver in their household. In addition, DCS scores were significantly lower for participants who said they were not able to walk a quarter mile in the Phase IV sample, but only slightly lower in the Phase V sample. With respect to health, the total number of health problems (diagnosis score) was significantly and inversely related to day driving confidence in the Phase V sample, and people who were diagnosed with a vision condition (cataracts, glaucoma or macular degeneration) had significantly lower day and night driving confidence. Such differences were not found in the Phase IV sample. It should be noted however, participants who had undergone cataract surgery in the Phase IV and V samples had lower mean DCS scores (approaching significance for night confidence in the Phase IV sample). Finally, the number of days driven in the past week was significantly correlated with both day and night confidence in the Phase IV sample, but not in the Phase V sample.

Table 4.16 Inconsistencies between Phase IV and V Findings

	D-DCS		**N-DCS**	
	Phase IV N=100	Phase V N=65	Phase IV N=99	Phase V N=64
Gender				
Male	63.74 (15.7)	70.31 (15.44)	56.21 (19.6)	61.32 (18.65)
Female	57.09 (18.9)	69.84 (20.33)	42.59 (25.86)	55.14 (27.49)
t-value (p)	1.91 (.060)	.101 (.920)	3.03 (.003)**	1.02 (.312)
Age				
Pearson r (p)	-.167 (.097)	-.144 (.253)	-.216 (.032)*	-.113 (.375)
Other driver in household				
No	64.04 (16.83)	69.76 (17.27)	52.92 (23.08)	56.02 (24.86)
Yes	53.01 (17.87)	70.49 (20.08)	39.90 (23.36)	60.88 (22.83)
t-value (p)	3.06 (.003)**	-.156 (.876)	2.69 (.009)**	-.780 (.438)
Able to walk ¼ mile				
No	51.85 (17.28)	67.36 (18.60)	36.82 (20.43)	54.82 (20.64)
Yes	61.63 (17.81)	70.53 (18.32)	50.34 (23.73)	58.40 (24.77)
t-value (p)	-2.24 (.032)*	-.503 (.617)	-2.54 (.016)*	-.429 (.669)
Diagnosis Score				
Pearson r (p)	.054 (.597)	-.245 (.049)*	-.054 (.599)	-.214 (.089)
Cataracts/Glaucoma/Mac. Deg.				
No	58.58 (18.18)	73.18 (18.48)	48.54 (24.55)	62.72 (23.53)
Yes	61.83 (16.84)	61.86 (15.22)	46.20 (22.88)	45.38 (21.20)
t-value (p)	-.872 (.386)	2.31 (.024)*	.466 (.643)	2.72 (.008)**
# Days driven in past week				
Pearson r (p)	.357 <.001)***	.111 (.380)	.366 <.001)***	.008 (.952)

*p<.05; **p<.01; ***p<.001

4.6.4 Physical Assessments

4.6.4.1 Sample Description

As shown in Table 4.17, 42 participants were recruited and assessed at seven difference facilities; six in Kitchener-Waterloo and one in Guelph. Seven (16.7%) were from seniors' apartments, 24 (57.1%) from retirement complexes and 11 (26.2%) from a seniors' community centre. Recall that the physical assessment subsample includes 36 of the new participants, five Phase IV participants and one additional participant (male, 73) who was a spouse of another participant.

Table 4.17 Physical Assessment Subsample: Facility Type and Location

Facility	Type	Location	Total Number (N = 42)	Males	Females
SH	Senior's Apartments	Kitchener	N = 7	2	5
WP	Retirement Complex	Kitchener	N = 3	0	3
EV	Retirement Complex	Kitchener	N = 3	2	1
DV	Retirement Complex	Kitchener	N = 3	2	1
LV	Retirement Complex	Waterloo	N = 9	2	7
LW	Retirement Complex	Waterloo	N = 6	2	4
EG	Senior's Community Centre	Guelph	N = 11	4	7
		Totals	**42**	**14**	**28**

Table 4.18 presents selected characteristics for the physical assessment subsample. As shown, the sample was disproportionately female, highly educated and roughly equal with respect to age groupings (64-79 vs. 80+). The majority drove "much less" or "a little less often" compared to ten years ago and, participants reported leaving their home a mean value of 23 days per month for various activities.

Overall, the sample appeared to be in fairly good health, as almost all rated their health as "excellent or good", few reported using a cane or walker and the large majority said they were able to walk a quarter mile. With respect to vision, just over about 40% reported diagnosed vision conditions and had undergone cataract surgery. Drivers who had been diagnosed with a vision condition had significantly lower Day (70.18 ± 17.59 vs. 56.32 ± 17.20; $t(40) = 2.50$, $p=.017$) and Night (59.17 ± 22.07 vs. 36.72 ± 19.26; $t(40) = 3.36$, $p=.002$) DCS scores.

Table 4.19 shows the sample mean Day and Night DCS scores, item #1 on the N-DCS, ratings of perceived abilities and self-reported driving behaviour. For item #1 on the N-DCS ("in good weather and traffic conditions"), no participants rated their comfort as 0% or 25% on item #1, and 12 people (28.6%) provided ratings of 100%. Overall, the sample had fairly high ratings of their current perceived abilities. As well, scores on the current perceived abilities ratings were significantly and positively correlated with scores on the perceived changes in abilities ratings (rho = .65, $p<.001$). Thus, participants with lower perceptions of their current driving abilities also reported more decline in their abilities compared to ten years ago. There were no significant gender or age group differences for any of the measures. As a continuous variable, however, age was inversely related to DCS, driving frequency and perceived abilities scores (significant for current perceived abilities $r=.312$, $p=.04$), but positively related to avoidance scores.

Sample means for the objective measures of driving–related abilities are shown in Table 4.20. It should be noted that one participant had no vision in her left eye, thus the right eye was used for all binocular vision analyses. In addition, one person did not complete the brake reaction time assessment due to equipment failure.

Table: 4.18 Selected Characteristics for the Physical Assessment Subsample

Characteristic	Physical Assessment Subsample (N = 42)
Gender	
Male	14 (33.3%)
Female	28 (66.7%)
Age	
Mean (SD)	77.8 (6.0)
Range	64 - 94
Age Group	
64-79	44 (53.7%)
80+	38 (46.3%)
Education Completed	
Yes, High school	31 (73.8%)
Yes, College/university	25 (59.5%)
Missing	
Others Rely on You to Drive	20 (47.6%)
Driving Compared to 10 Years Ago	
Much/ a Little Less Often	27 (64.3%)
Same/ More Often	15 (35.7%)
Driving Problems	
Accidents	1 (2.4%)
Near misses	7 (16.7%)
Backing into things	2 (4.8%)
Getting lost	5 (11.9%)
Driving Problems Score (0-4)	
Mean (SD)	.33 (.5)
Range	0 - 2
# Days/Mth Leave Home for Activities	
Mean (SD)	22.83 (7.71)
Range	4 - 31
Overall Health	
Excellent/Good	41 (97.6%)
Fair/Poor/Very Poor	1 (2.4%)
Use Cane/Walker Outdoors	6 (14.3%)
Able to Walk a Quarter Mile	38 (90.5%)
Diagnosis Score	1.9 (1.2)
Diagnosed cataracts, glaucoma, mac. degen. *	16 (38.1%)
Cataract Surgery	18 (42.9%)

*Indicates significant relationship with D-DCS and N-DCS

Table 4.19 Physical Assessment Subsample DCS and Rating Form Scores

Scale	Mean (SD)	Range	95% Confidence Interval
D-DCS (0–100)	64.91 (18.53)	25 – 100	59.13 – 70.68
N-DCS (0–100)	50.62 (23.55)	12.5 – 98.44	43.29 – 57.96
Item #1 N-DCS (0 – 100)	75.60 (18.71)	50 – 100	69.76 – 81.43
Current Perceived Abilities (0-45)	31.06 (7.21)	19 – 44	28.85 – 33.34
Perceived Changes in Abilities (0-45)	26.17 (5.00)	15 – 37	24.61 – 27.72
Situational Driving Frequency (0–56)	27.63 (7.97)	12 – 48	25.15 – 30.11
Situational Driving Avoidance (0-20)	8.86 (4.89)	0 – 17	7.33 – 10.38

As shown, the mean binocular acuity score was +0.08 LogMAR, which corresponds to roughly 20/25 using traditional Snellen scoring (0.0 LogMAR = 20/20). The mean disability glare score was 0.31, indicating that Pelli-Robson scores decreased by a mean of 0.31 log contrast sensitivity units in the presence of glare. This corresponds to a decrease of 7 letters (roughly two triplets) on the Pelli-Robson Chart. Visual acuity, contrast sensitivity and disability glare scores were also compared to luminance (which varied from 249 to 900 lux across assessment sites); findings showed that scores were not significantly related to luminance level. Women had significantly better binocular acuity than men (.15± 15 vs. .05± .10; t (40) = 2.89, p =.003) and a significantly smaller disability glare score (.44±.25 vs. .25±.12; t (40) = 3.35, p=.002), indicating less disruption in vision due to glare. The older age group (80+) had significantly slower scores on the Trails B (90.02±27.78 vs. 120.37 ±59.08; t(40) = -2.16, p = .037) and the UFOV Subtest 2 (106.95±82.65 vs. 208.98±138.24; t (40) = -2.94, p= .00).

Table 4.20 Mean Scores for Objective Measures of Driving-related Abilities

Measure	N	Mean (SD)	Range
Binocular Visual Acuity*	42	+0.08 LogMAR (.13)	-.14 LogMAR to +.50 LogMAR
Binocular Contrast Sensitivity	42	2.01 log units	1.65 log units to 2.25 log units
Disability Glare*	42	.31 (.19)	0.00 to 0.85
Brake Reaction Time	41	.642 seconds (.14)	.428 sec to .956 sec
Rapid Paced Walk	42	6.71 seconds (1.76)	4.56 sec to 14.22 sec
Trails A	42	39.65 seconds (14.94)	18.75 sec to 92.78 sec
Trails B†	42	104.46 seconds (47.41)	55.22 sec to 273.85 sec
UFOV Subtest 2††	42	155.54 milliseconds (122.54)	16.67 ms to 500 ms

*****Indicates significant gender differences p<.01
†Indicates significant age group differences (64-79 vs. 80+) p<.05; ††p<.01

Table 4.21 shows the criteria for impairments and the number of subjects with impairments by age group and gender for five of the objective measures. As previously explained, no benchmarks exist for disability glare, brake reaction time or Trails A. A total of seven (16.7%) participants had impairments. Of the seven, two had a single impairment and three had impairments in two measures. As shown, a higher proportion of impairments were found in men (70%) and the older age group (80%). Only one person had impaired visual acuity (male, 85) and no participants had impaired contrast sensitivity. Of the three participants who had impaired UFOV subtest 2 scores, one person used the mouse while the other two did not. It should be noted that two participants (male, 85; female, 78) had impaired monocular acuity in their right eye and six participants (4 male, 2 female, aged 71 – 94) had impaired monocular acuity in their left eye. Such participants were not considered to have "impaired" vision in the present study provided their binocular vision scores were within the respective benchmark.

Table 4.21 Impairments in Objective Measures of Driving-related Abilities

Measure	Benchmark	# Impaired	Age Group	Males	Females	
Bin Visual Acuity	>.39 LogMAR	1 (2.4%)	80+	1	0	
Bin Contrast Sensitivity	<1.25 log units	0	n/a	0	0	
Rapid Paced Walk	>9.0 sec	4 (9.5%)	64 - 79	1	1	
			80+	2	0	
Trails B	>180.0 sec	2 (4.8%)	80+	1	1	
UFOV Subtest 2	>353.0 msec	3 (7.1%)	80+	2	1	
Totals						**Totals**
			64-79	**1**	**1**	**2**
			80+	**6**	**2**	**8**
			Totals	**7**	**3**	**10**

Note: Benchmarks for impairment do not exist for disability glare, brake reaction time or Trails A

4.6.4.2 Associations between Perceptions and Driving Behaviour

Table 4.22 presents associations between DCS scores, ratings of perceived abilities and ratings of driving frequency and avoidance. As shown, all relationships are significant and in the expected directions; lower DCS and perceived abilities scores are associated with significantly lower driving frequency and higher avoidance. Interestingly, relationships with Day and Night DCS scores are stronger for avoidance than for frequency, while relationships with current and perceived changes in driving abilities are slightly stronger for driving frequency than for avoidance.

Table 4.22 Relationships between Perceptions and Self-reported Driving Behaviour

Driving Characteristic	N	Frequency (0-56)	N	Avoidance (0-20)
D-DCS Pearson r (p)	42	.330 (.033)*	42	-.560 (<.001)***
N-DCS Pearson r(p)	41	.407 (<.001)***	42	-.646 (<.001)***
Current Perceived Abilities (0-45) Pearson r (p)	42	.510 (.001)**	42	-.389 (.011)*
Perceived Changes in Abilities (0-45) Spearman's rho(p)	42	.477 (.001)**	42	-.389 (.011)*

*p<.05; **p<.01; ***p<.001

4.6.4.3 Associations with Physical Abilities

Driving Comfort

Relationships between objective measures of driving-related abilities and Day and Night D-DCS scores are shown in Table 4.23. Only one significant relationship was found between scores on the Trail Making Test Part A and D-DCS scores' as scores on Part A decreased (i.e. improved), day driving confidence increased. Although not significant, associations were in the expected direction for binocular visual acuity, contrast sensitivity, the Rapid Paced Walk, Trails B and UFOV Subtest 2; as scores on such measures improved, day and night driving comfort increased. As well the total number of impairments was inversely associated with day driving comfort (approaching significance). Given that some participants had monocular visual acuity impairments, associations with such measures were also examined. For both the right and left eyes, visual acuity scores were associated with Day and Night DCS scores in the expected direction, and associations were significant for left eye acuity. The association between disability glare and night driving comfort was not in the expected direction, as higher disability glare scores (i.e. more disruption to do glare) were associated with higher N-DCS scores. Virtually no association was found with brake reaction time.

For measures with validated benchmarks, DCS scores were compared between those with impairments and without impairments. Surprisingly, the one individual with impaired visual acuity had higher day and night comfort in comparison to the mean value for the rest of the sample. While differences were not significant, the mean DCS scores for participants with impaired right and left eye acuity were lower than for those with no monocular impairments (approaching significance for left eye acuity and Day DCS scores). It should be noted that the woman with no vision in her left eye was included in the "impairment" group for left eye acuity. Although findings were not significant, participants with impaired scores on the Rapid Paced Walk and the UFOV Subtest 2 had lower day and night driving comfort than those without impairments. In addition, participants with at least one impairment had lower day and night driving comfort (approaching significance for day) than those with no impairments. Findings for the Trail Making Test Part B were mixed, such that drivers with impaired scores had slightly lower D-DCS scores but higher N-DCS scores than those with no impairments.

Table 4.23 Relationships between Objective Abilities and DCS Scores

Measure	N	D-DCS	N	N-DCS
Binocular Visual Acuity				
Spearman's rho (p)	42	-.168 (.288)	42	-.147 (.352)
No Impairment	41	64.89 (18.76)	41	50.33 (23.77)
Impairment (>.39 LogMAR)	1	65.38	1	62.50
Right Eye Acuity				
Spearman's rho (p)	42	-.302 (.052)	42	-.192 (.223)
No Impairment	40	65.70 (18.27)	40	51.23 (23.34)
Impairment (>.39 LogMAR)	2	49.04 (23.12)	2	38.28 (34.25)
t-value (p)		1.25 (.219)		.755 (.455)
Left Eye Acuity				
Spearman's rho (p)	41	-.386 (.013)*	41	-.316 (.044)*
No Impairment	36	67.09 (17.94)	36	52.80 (23.64)
Impairment (>.39 LogMAR)	6	51.79 (17.92)	6	37.50 (19.83)
t-value (p)		1.93 (.060)		1.50 (.143)
Binocular Contrast Sensitivity (CS)				
Spearman's rho (p)	42	.228 (.147)	42	.276 (.077)
Disability Glare				
Spearman's rho (p)	42	-.091 (.567)	42	.105 (.508)
Brake Reaction Time				
Spearman's rho (p)	41	.06 (.709)	41	.07 (.665)
Rapid Paced Walk				
Spearman's rho (p)	42	-.200 (.205)	42	-.161 (.310)
No Impairment	38	66.44 (17.98)	38	51.63 (23.66)
Impairment (>9.0 sec)	4	50.28 (19.75)	4	41.02 (23.19)
t-value (p)		1.69 (.097)		.854 (.398)
Trails A				
Spearman's rho (p)	42	-.361 (.019)*	42	-.233 (.138)
Trails B				
Spearman's rho (p)	42	-.243 (.120)	42	-.155 (.326)
No Impairment	40	65.06 (18.95)	40	49.87 (23.85)
Impairment (>180.0 sec)	2	61.88 (7.67)	2	65.63 (8.84)
t-value (p)		.233 (.817)		-.922 (.362)
UFOV Subtest 2				
Spearman's rho (p)	42	-.203 (.198)	42	-.045 (.779)
No Impairment	39	65.33 (19.05)	39	50.99 (24.19)
Impairment (>353.0 sec)	3	59.35 (9.77)	3	45.83 (14.52)
t-value (p)		.534 (.596)		.361 (.720)
# Impairments				
Spearman's rho (p)	42	-.279 (.074)	42	-.045 (.779)
No Impairments	35	67.28 (18.39)	35	51.54 (24.43)
At least 1 impairment	7	53.01 (15.22)	7	45.98 (19.43)
t-value (p)		1.92 (.062)		.566 (.575)

*p<.05

Self-reported Driving Behaviour

Table 4.24 shows the relationships between objective abilities and ratings of situational driving frequency and avoidance. Only two significant relationship were found: Lower scores for left eye visual acuity and Part A of the Trail Making Test were significantly associated with higher situational avoidance. With the exception of disability glare, all associations between objective measures and situational avoidance were weak (i.e. not significant), but in the expected direction. Conversely, only scores for visual acuity (binocular and monocular), contrast sensitivity and Trails A were associated with situational frequency in the expected the direction. Findings were mixed when those with impairments were compared to those with no impairments, and no differences were significant.

Table 4.25 shows the mean scores on the vision measures and ratings of perceived night vision for night drivers and non-night drivers. While no differences were significant, non-night drivers had a slightly lower mean contrast sensitivity score. Conversely, non-night drivers had better visual acuity and disability glare scores, opposite to what one might expect. Ratings of perceived night vision and perceived changes in night vision, meanwhile, were significantly lower in non-night drivers.

Table 4.24 Relationships between Objective Abilities, Driving Frequency and Avoidance

Measure	N	Situational Frequency	N	Situational Avoidance
Binocular Visual Acuity				
Spearman's rho (p)	42	-.132 (.405)	42	.152 (.335)
No Impairment	41	27.45 (7.98)	41	8.88 (4.95)
Impairment (>.39 LogMAR)	1	35.00	1	8.00
Right Eye Visual Acuity				
Spearman's rho (p)	42	.008 (.961)	42	.195 (.216)
No Impairment	40	27.61 (8.01)	40	8.73 (4.91)
Impairment (>.39 LogMAR)	2	28.00 (9.90)	2	11.5 (4.95)
t-value (p)		-.066 (.947)		-.779 (4.95)
Left Eye Visual Acuity				
Spearman's rho (p)	41	-.238 (.134)	41	.332 (.034)*
No Impairment	36	27.71 (7.89)	36	8.69 (5.05)
Impairment (>.39 LogMAR)	6	27.17 (9.17)	6	9.83 (4.07)
t-value (p)		.152 (.880)		-.523 (.604)
Binocular Contrast Sensitivity				
Spearman's rho (p)	42	.060 (.707)	42	-.159 (.314)
Disability Glare				
Spearman's rho (p)	42	.237 (.131)	42	-.213 (.176)
Brake Reaction Time				
Spearman's rho (p)	42	.089 (.58)	42	.156 (.32)
Rapid Paced Walk				
Spearman's rho (p)	42	.079 (.621)	42	.086 (.589)
No Impairment	38	27.97 (8.16)	38	8.76 (5.08)
Impairment (>9.0 sec)	4	24.37 (5.59)	4	9.75 (2.75)
t-value (p)		.857 (.396)		-.380 (.706)
Trails A				
Spearman's rho (p)	42	-.063 (.692)	42	.372 (.015)*
Trails B				
Spearman's rho (p)	42	.087 (.585)	42	.229 (.144)
No Impairment	40	27.44 (8.05)	40	8.83 (5.00)
Impairment (>180.0 sec)	2	31.50 (6.36)	2	9.50 (2.12)
t-value (p)		-.700 (.488)		-.188 (.852)
UFOV Subtest 2				
Spearman's rho (p)	42	.090 (.571)	42	.137 (.387)
No Impairment	39	27.14 (8.02)	39	8.97 (5.06)
Impairment (>353.0 sec)	3	34.00 (3.61)	3	7.33 (.58)
t-value (p)		-1.46 (.153)		.555 (.582)
# Impairments				
Spearman's rho (p)	42	.135 (.394)	42	0.0 (1.00)
No Impairments	35	27.29 (8.13)	35	8.77 (5.28)
At least 1 impairment	7	29.36 (7.39)	7	9.29 (2.36)
t-value (p)		-.623 (.537)		-.251 (.803)

*p<.05

Table 4.25 Actual and Perceived Vision in Night Drivers versus Non-Night Drivers

Variable	N	Mean (SD)
Binocular Visual Acuity		
Rarely/never	10	.08 (.08)
Occasionally/often/very often	32	.09 (.14)
Mann-Whitney Statistic		-.296 (.787)
Right Eye Visual Acuity		
Rarely/never	10	.15 (.07)
Occasionally/often/very often	32	.14 (.14)
Mann-Whitney Statistic		-.637 (.524)
Left Eye Visual Acuity		
Rarely/never	10	.14 (.13)
Occasionally/often/very often	32	.18 (.21)
Mann-Whitney Statistic		-.300 (.764)
Binocular Contrast Sensitivity		
Rarely/never	10	1.95 (.16)
Occasionally/often/very often	32	2.03 (.12)
Mann-Whitney Statistic		-1.58 (.114)
Disability Glare		
Rarely/never	10	.22 (.13)
Occasionally/often/very often	32	.34 (.21)
Mann-Whitney Statistic		-1.65 (.100)
Perceived Night Vision		
Rarely/never	10	3.5 (2.01)
Occasionally/often/very often	32	5.25 (1.98)
t value (p)		-2.42 (.020)*
Perceived Changes in Night Vision		
Rarely/never	10	3.00 (1.05)
Occasionally/often/very often	32	4.78 (1.70)
t value (p)		-3.97 (.001)**

*p<.05; **p<.01

<u>Perceived Abilities</u>

Relationships between objective measures of driving-related abilities and ratings of current perceived abilities are shown in Table 4.26. Comparisons were made both with the total score and with corresponding subscale scores. Only one significant finding emerged between left eye acuity and the vision subscale score; participants with lower left eye acuity scores had significantly lower ratings of their perceived vision. Although other associations were not significant, most were in the expected direction; poorer scores were associated with lower ratings of perceived abilities. The association between contrast sensitivity and the night vision subscale score approached significance.

Findings were mixed when those with impairments were compared to those with no impairments, and none were significant. Participants with impaired scores on the rapid paced walk had lower perceived abilities scores than those with no impairment, and those with impaired right and left eye acuity had lower total scores and vision scores. Conversely, the one individual with impaired visual acuity had a slightly lower total score yet a higher vision score and participants with impaired Trails B and UFOV Subtest 2 scores had higher total scores and subscale scores.

Table 4.27 shows the relationship between objective measures of driving-related abilities and ratings of perceived changes in abilities compared to ten years ago. Similar to ratings of current perceived abilities, most associations were not significant but were in the expected direction (poor scores are associated with lower ratings of abilities). Significant associations were found between contrast sensitivity scores and perceived changes in abilities; participants with lower contrast sensitivity scores have significantly lower total scores, contrast sensitivity and night vision scores. The association between disability glare and the night vision subscale score, meanwhile, was not in the expected direction; poorer scores were related to higher night vision scores.

Differences between those with and without impairments were mixed and no findings were significant. Similar to ratings of current abilities, participants with impaired right and left eye acuity had lower total scores and vision scores and participants with impairments on the Rapid Paced Walk had slightly lower total scores than those with no impairment. Interestingly, participants with at least one impairment had a slightly lower total scores than those without impairments, indicating that they perceived slightly more decline in their overall abilities. While participants with impaired scores on the UFOV Subtest 2 had a slightly lower total scores and visual attention scores, those with impaired Trails B scores had higher total scores and higher executive skills scores.

Table 4.26: Relationships between Objective Abilities and Current Perceived Abilities

Measure	N	Total Score	N	Subscale Score
Binocular Visual Acuity				**Vision Score (0-21)**
Spearman's rho (p)	42	-.030 (.848)	42	-.215 (.172)
No Impairment	41	31.12 (7.30)	41	13.95 (3.74)
Impairment (>.39 LogMAR)	1	30.00	1	15.00
Right Eye Acuity				**Vision Score (0-21)**
Spearman's rho (p)	42	-.149 (.346)	42	-.110 (.487)
No Impairment	40	34.43 (7.12)	40	14.10 (3.66)
Impairment (>.39 LogMAR)	2	24.50 (7.87)	2	11.50 (4.95)
t-value (p)		1.34 (.188)		.969 (.338)
Left Eye Acuity				**Vision Score (0-21)**
Spearman's rho (p)	41	-.258 (.103)	41	-.322 (.040)*
No Impairment	36	31.64 (7.47)	36	14.28 (3.78)
Impairment (>.39 LogMAR)	6	27.83 (4.54)	6	12.17 (2.79)
t-value (p)		1.20 (.236)		1.31 (.199)
Binocular Contrast Sensitivity				**CS Score (0-6)**
Spearman's rho (p)	42	.247 (.114)	42	.240 (.126)
				Night Vision Score (0-6)
				.299 (.055)
Disability Glare				**Night Vision Score (0-6)**
Spearman's rho (p)	42	-.021 (.894)	42	.031 (.845)
Brake Reaction Time				
Spearman's rho (p)	41	-.280 (.076)	41	
Rapid Paced Walk				
Spearman's rho (p)	42	-.289 (.063)	42	
No Impairment	38	31.61 (7.24)	38	
Impairment (>9.0 sec)	4	26.25 (5.50)	4	
t-value (p)		1.43 (.160)		
Trails A				**Executive Skills Score (0-9)**
Spearman's rho (p)	42	-.159 (.313)	42	-.150 (.342)
Trails B				**Executive Skills Score (0-9)**
Spearman's rho (p)	42	-.115 (.469)	42	-.156 (.324)
No Impairment	40	30.85 (7.29)	40	5.63 (1.81)
Impairment (>180.0 sec)	2	36.00 (2.83)	2	6.00
t-value (p)		-.985 (.330)		-.290 (.773)
UFOV Subtest 2				**Visual Attention Score (0-6)**
Spearman's rho (p)	42	-.251 (.109)	42	-.253 (.106)
No Impairment	39	30.97 (7.17)	39	3.36 (1.33)
Impairment (>353.0 sec)	3	32.67 (9.29)	3	3.67 (2.08)
t-value (p)		-.388 (.700)		-.373 (.711)
# Impairments				
Spearman's rho (p)	42	-.035 (.826)	42	
No Impairments	35	31.14 (7.19)	35	
At least 1 impairment	7	30.86 (7.90)	7	
t-value (p)		.095 (.925)		

*****p<.05

Table 4.27: Relationships between Objective Abilities and Perceived Changes in Abilities

Measure	N	Total Score	N	Subscale Score
Binocular Visual Acuity				**Vision Score (0-21)**
Spearman's rho (p)	42	-.191 (.225)	42	-.082 (.606)
No Impairment	41	26.17 (5.06)	41	11.85 (2.75)
Impairment (>.39 LogMAR)	1	26.00	1	12.00
Right Eye Visual Acuity				**Vision Score (0-21)**
Spearman's rho (p)	42	-.050 (.753)	42	-.071 (.654)
No Impairment	40	26.28 (5.08)	40	11.93 (2.75)
Impairment (>.39 LogMAR)	2	24.00 (2.83)	2	10.50 (2.12)
Mann-Whitney Statistic (p)		-.808 (.419)		-.966 (.334)
Left Eye Visual Acuity				**Vision Score (0-21)**
Spearman's rho (p)	41	-.089 (.578)	41	-.164 (.304)
No Impairment	36	26.47 (5.06)	36	12.11 (2.67)
Impairment (>.39 LogMAR)	6	24.33 (5.59)	6	10.33 (2.73)
Mann-Whitney Statistic (p)		-.892 (.372)		-1.42 (.157)
Binocular Contrast Sensitivity				**CS Score (0-6)**
Spearman's rho (p)	42	.377 (.014)*	42	.406 (.008)**
				Night Vision Score (0-6)
				.374 (.015)*
Better Eye Disability Glare				**Night Vision Score (0-6)**
Spearman's rho (p)	42	.040 (.801)	42	.140 (.376)
Brake Reaction Time				
Spearman's rho (p)	41	-.237 (.136)	41	
Rapid Paced Walk				
Spearman's rho (p)	42	-.176 (.264)	42	
No Impairment	38	26.50 (4.51)	38	
Impairment (>9.0 sec)	4	23.00 (8.72)	4	
Mann-Whitney Statistic (p)		-1.39 (.165)		
Trails A				**Executive Skills Score (0-9)**
Spearman's rho (p)	42	-.050 (.752)	42	-.150 (.342)
Trails B				**Executive Skills Score (0-9)**
Spearman's rho (p)	42	.009 (.954)	42	-.132 (.403)
No Impairment	40	25.83 (4.82)	40	4.95 (1.38)
Impairment (>180.0 sec)	2	33.00 (4.24)	2	6.00
Mann-Whitney Statistic (p)		-1.89 (.059)		-1.21 (.228)
UFOV Subtest 2				**Visual Attention Score (0-6)**
Spearman's rho (p)	42	-.052 (.743)	42	-.148 (.349)
No Impairment	39	26.28 (4.98)	39	3.26 (1.14)
Impairment (>353.0 sec)	3	24.67 (6.11)	3	3.00 (1.00)
Mann-Whitney Statistic (p)		-.421 (.674)		-.628 (.530)
# Impairments				
Spearman's rho (p)	42	-.189 (.229)	42	
No Impairments	35	26.31 (4.62)	35	
At least 1 impairment	7	25.43 (7.00)	7	
t-value (p)		-.359 (.719)		

*p<.05; **p<.01

Table 4.28 shows comparisons between objective driving-related abilities and corresponding items on the perceived abilities rating forms. Participants who missed certain items were omitted from such analyses. Once again, the majority of associations were in the expected direction. Significant relationships were found with contrast sensitivity scores and the Rapid Paced Walk. Participants with poorer contrast sensitivity scores had significantly lower ratings on item #2 ("see signs at night") and perceived significantly more decline in their abilities for items #4 ("see pavement lines at night"), #5 ("avoid curbs and medians") and #7 ("see objects on the road at night"). Participants who took longer to perform the rapid paced walk perceived significantly more decline in their ability for item #12 ("get in and out of your car") and had lower ratings of their current ability for item #12 (approaching significance). No relationship was found between the number of impairments and item #15 ("drive safely") on either perceived abilities form.

Table 4.28: Relationships between Objective Abilities and Related Item Ratings

Measure	N	Current	N	Changes
Binocular Visual Acuity Spearman's rho (p)	42	**#1 Signs Distance** -.114 (.471)	42	**#1 Signs Distance** .026 (.870)
Right Eye Visual Acuity Spearman's rho (p)	42	**#1 Signs Distance** -.009 (.956)	42	**#1 Signs Distance** -.086 (.589)
Left Eye Visual Acuity Spearman's rho (p)	41	**#1 Signs Distance** -.246 (.120)	41	**#1 Signs Distance** -.142 (.375)
Contrast Sensitivity Spearman's rho (p)	41	**#2 Signs Night** .349 (.025)*	42	**#2 Signs Night** .266 (.089)
	42	**#4 Pavement Lines Night** .240 (.125)	42	**#4 Pavement Lines Night** .450 (.003)**
	41	**#5 Avoid Curbs** -.118 (.461)	40	**#5 Avoid Curbs** .342 (.032)*
	42	**#7 Objects on Road Night** .253 (.106)	42	**#7 Objects on Road Night** .38=94 (.010)*
Better Eye Disability Glare Spearman's rho (p)	42	**# 7 Objects on Road Night** -.085 (.592)	42	**# 7 Objects on Road Night** -.026 (.872)
Brake Reaction Time Spearman's rho (p)	41	**#9 Move Foot Quickly** -.193 (.228)	41	**#9 Move Foot Quickly** -.144 (.368)
Rapid Paced Walk Spearman's rho (p)	42	**#12 Get in/out of Car** -.300 (.053)	42	**#12 Get in/out of Car** -.354 (.021)*
Trails A Spearman's rho (p)	41	**#8 Spot Pedestrians** -.179 (.263)	42	**#8 Spot Pedestrians** -.183 (.246)
	42	**#11 Find Street** -.181 (.252)	42	**#11 Find Street** -.272 (.081)
	42	**#14 Make Quick Decisions** -.152 (.337)	42	**#14 Make Quick Decisions** -.045 (.775)
Trails B Spearman's rho (p)	41	**#8 Spot Pedestrians** -.289 (.067)	42	**#8 Spot Pedestrians** .025 (.874)
	42	**#11 Find Street** -.164 (.300)	42	**#11 Find Street** -.292 (.061)
	42	**#14 Make Quick Decisions** .069 (.670)	42	**#14 Make Quick Decisions** -.008 (.980)
UFOV Subtest 2 Spearman's rho (p)	41	**#8 Spot Pedestrians** -.100 (.535)	42	**#8 Spot Pedestrians** .132 (.403)
	42	**#11 Find Street** .253 (.099)	42	**#11 Find Street** -.266 (.088)
# Impairments Spearman's rho (p)	42	**#15 Drive Safely** .027 (.863)	41	**#15 Drive Safely** .029 (.858)

***p<.05; **p<.01**

4.6.4.4 Discrepancies between Perceived and Actual Abilities

This section looks at discrepancies between perceived abilities and objectively measured abilities. As before, results must be interpreted with caution since only seven individuals were identified with impairments. Table 4.29 shows the response distributions for item #15 ("drive safely") for those with and without impairments. Statistical comparisons (chi-squares) could not be performed due to small sample sizes. No participants rated themselves as "poor" or "fair" on item #15 ("drive safely") on the current perceived abilities form, but 19 (45.2%) rated themselves as "good" and 23 (54.8%) rated themselves as "very good". Despite having impairments, four individuals (two with multiple impairments) rated their ability to drive safely as "very good". On the perceived changes in abilities form, no participants rated their ability to drive safely (item #15) as "a lot worse" on item #15 ("drive safely"), 4 (9.5%) rated themselves as "a little worse", 35 (83.3%) as "the same" and 3 (7.1%) as "better". Surprisingly, one individual with multiple impairments (Rapid Paced Walk and Trails B) rated his ability to drive safely as "better" when compared to ten years ago.

Table 4.29: No Impairments versus Impairments: Ratings on Item #15 "Drive Safely"

Item # 15 "Drive Safely"	**N**	**No Impairments (N = 35)**	**Impairments (N = 7)**
Current Perceived Abilities			
Good	19	16	3
Very Good	23	19	4
Perceived Changes in			
Abilities	4	3	1
A little worse	35	30	5
The same	3	2	1
Better			

Table 4.30 shows how those with and without impairments on objective measures rated their current abilities on corresponding items. Participants with impairments were identified as having a "discrepancy" if they rated their ability as "good" or "very good" on the corresponding perceived ability item. In total seven discrepancies were identified, however, this included some

participants with multiple impairments. One person had discrepancies in both the Rapid Paced Walk and the UFOV Subtest 2, while another on the Rapid Paced Walk and Trails B. As well, the individual with an impaired UFOV score who did *not* have a discrepancy also had impaired visual acuity and thus was considered as having a discrepancy. Thus, in total, five participants had discrepancies between their perceived and actual abilities, while two did not. The two individuals *without* discrepancies were both female (ages 75 and 80) and had impairments in the Rapid Paced Walk. Of the five individuals *with* discrepancies, two were female and all were aged 80+.

Table 4.30: Discrepancies between Current Perceptions and Objective Abilities

Measure	**Item (Current Abilities)**	**Poor/Fair**	**Good/Very Good**
Visual Acuity	**#1 See road signs at a distance**		
	No Impairment (n = 41)	5	36
	Impairment (n = 1)	0	**1**
Rapid Paced Walk	**#12 Get in and out of your car**		
	No Impairment (n = 38)	4	34
	Impairment (n = 4)	2	**2**
Trails B	**#14 Make quick driving decisions**		
	No Impairment (n = 40)	4	36
	Impairment (n = 2)	0	**2**
UFOV Subtest 2	**#8 Quickly spot pedestrians stepping out from between parked cars**		
	No Impairment (n = 39)	8	31
	Impairment (n = 3)	1	**2**

Table 4.31 shows how drivers with and without discrepancies responded to item #15 (“drive safely”) on the perceived abilities rating forms. As shown, participants with discrepancies were more likely to rate their current ability to drive safely as “very good”, while both participants without discrepancies rated their ability as “good”. Furthermore, no participants with discrepancies rated their ability compared to ten years ago as “a little worse” and one person (with impairments on the Rapid Paced Walk and Trails B) even rated himself as “better”.

Conversely, the two participants without discrepancies rated their ability to drive safely as "the same" and "a little worse".

Table 4.31: Discrepancy vs. No Discrepancy: Ratings on Item #15 "Drive Safely"

Item # 15 "Drive Safely"	**Discrepancy (N = 5)**	**No Discrepancy (N = 2)**
Current Perceived Abilities		
Good	1	2
Very Good	4	0
Perceived Changes in Abilities		
A little worse	0	1
The same	4	1
Better	1	0

Table 4.32 shows the DCSs scores and total scores of perceived abilities and self-reported driving behaviour for those with and without discrepancies. The two participants without discrepancies had lower Day and Night DCS scores (although only significant for day), significantly lower situational driving frequency and significantly higher avoidance. Total scores for current and perceived changes in abilities were also lower for those without a discrepancy. It should be noted that all seven participants rated some abilities higher and/or lower than others, indicating that participants were discriminating between areas of strength and weakness in their driving abilities.

Table 4.32: Comparison of Drivers With and Without Discrepancies

Measure		**Mean (SD)**
D-DCS		
No Discrepancy	2	34.62 (13.60)
Discrepancy	5	60.36 (8.02)
t-value		-3.27 (.022)*
N-DCS		
No Discrepancy	2	26.56 (15.47)
Discrepancy	5	53.75 (15.57)
t-value		-2.09 (.091)
Situational Driving Frequency		
No Discrepancy	2	20.25 (4.59)
Discrepancy	5	33.00 (4.30)
t-value		-3.50 (.017)*
Situational Driving Avoidance		
No Discrepancy	2	12.00 (1.41)
Discrepancy	5	8.20 (1.64)
t-value		2.84 (.036)*
Current Perceived Abilities (0-45)		
No Discrepancy	2	23.00 (2.83)
Discrepancy	5	34.00 (6.96)
t-value		-2.07 (.093)
Perceived Changes in Abilities (0-45)		
No Discrepancy	2	19.00 (1.41)
Discrepancy	5	28.00 (6.63)
Mann-Whitney test value (p)		-1.38 (.167)

*****$p<.05$

4.7 Discussion

Associations with Selected Characteristics

Similar to the Phase IV sample of 100 older drivers (Paradis, 2006), women in this sample also had lower driver comfort scores. Unlike Phase IV, however, gender differences in DCS scores were not significant. Prior findings concerning gender differences in confidence ratings are also mixed. For instance, George et al. (2007) found that among stroke patients, women had significantly lower driving confidence and the negative effect of having a stroke on confidence was greater for women. Other studies have found that women reported higher nervousness, confidence or stress levels than men in various traffic situations (Hakamies-

Blomqvist & Wahlstrom, 1998; Parker et al., 2001). Conversely, Marottoli and Richardson (1998) did not find any gender differences in driving confidence when adjusted for usual driving (as men drove in more high risk conditions). Research concerning balance confidence has consistently found gender differences on fear of falling measures, but not on efficacy measures, likely due to the reluctance of men to acknowledge "fear" (Jorstad et al., 2005). Similarly, men may be more reluctant to admit to being "nervous" or "frightened" when driving.

In both the Paradis' (2006) and the present study, age was negatively associated with comfort levels. This relationship, however, was only significant for night comfort in Paradis' (2006) study. No other studies on driving confidence have reported age differences.

With respect to health, participants with more health problems (significant for day comfort) and a diagnosed vision condition had significantly lower driving comfort; these relationships were not found in Phase IV. However, subjects who had cataract surgery had *lower* driving comfort in both studies (approaching significance in Phase IV for night, $p = .063$). The relationship between vision conditions and driving comfort may depend on the severity of the condition and whether or not it has been corrected. Only one study to date has examined driving confidence in a sample with a specific, serious health condition. Not surprisingly, George et al. (2007) found that stroke patients had significantly lower driving confidence scores than healthy (middle aged) hospital staff members.

Consistent with Bandura's theory that verbal persuasion from significant others can influence self-efficacy, participants who had discussed their driving with family or friends had lower day and night driving comfort (significant only for day), while those who had talked to health professionals had lower night comfort (although not significant). When examined prospectively (as described in Chapter Three) participants who reported talking to family and friends over the follow-up period had greater reductions in day driving comfort (although not significant). Retrospectively, older drivers have reported that family and friends offered advice about their driving, although opinions were mixed regarding whether this advice was worth considering (Johnson, 1995; Rudman et al., 2006). In this study, it is not known whether family approached the older driver or vice versa, however, significant others can play an important role in older drivers'self-regulatory behaviour (Rudman et al., 2006).

Associations with Self-reported Driving Behaviour

Consistent with Paradis (2006) and other studies, the present findings provide further evidence that driving comfort is positively related to self-reported driving frequency (Marottoli & Richardson, 1998; Parker et al., 2001) and negatively related to situational avoidance (Baldock et al., 2006). Also consistent with Paradis (2006), scores on the DCSs (particularly the N-DCS) discriminated between those who 'rarely/never' and 'occasionally/often' drive at night and, as one would expect, driving comfort was significantly related to reported nervousness (i.e. physiological signs of discomfort). These findings are consistent with both Bandura's general self-efficacy framework and Rudman et al.'s (2006) specific model of driving self-regulation.

In contrast to Phase IV, the number of days driven in the past week was not related to DCS scores in this sample. While this measure provides an indicator of trip frequency, it does not provide information about distance travelled nor driving conditions. For instance, an individual may have driven seven days a week but only during the day time, on low traffic roads or on familiar routes. And, the 'past week' may not be a typical week for everyone. As Bandura (1977; 1986) says, self-efficacy is context- and situation-specific. As previously mentioned, a score derived from responses to multiple items provides a better indicator of the "true score" on a variable than responses to single statements or items (Williams & Naylor, 1992). Situational driving frequency (based on ratings of multiple items) was consistently related to driving comfort level in both the Phase IV and V samples.

Similar to Paradis' (2006) and Marottoli & Richardson (1998), no relationship was found between driving confidence and self-reported driving problems. However, neither of these studies, nor the present study, asked drivers to indicate whether they were 'at fault' for such events. In Rudman et al.'s (2006) study, older drivers reported that accidents or near accidents intensified driving discomfort and, for some, would even lead to cessation. It may be that older drivers are reluctant to report adverse events for fear of losing their license or being viewed as a bad driver. Ideally, actual driving records should be examined to explore the influence of mastery (performance accomplishments or failures) on driving confidence. Driving records would also indicate who was at fault and whether charges were laid. Driving records, however, will not show whether a driver had other problems (such as getting lost) which also might be expected to influence confidence.

Associations with Perceived Abilities

Similar to other studies (Freund et al., 2005; Marottoli & Richardson, 1998), current participants had positive perceptions of their overall driving ability. All participants rated their ability to "drive safely" as either "good" or "very good". When asked to rate multiple aspects of their abilities, similar to Parker et al. (2001), participants rated some abilities as good and others as fair or poor. When piloting the perceived abilities rating forms, our sample preferred to rate their own abilities on a continuum (from "poor" to "very good"), as opposed to comparing themselves to other drivers (as was done by Freund et al., 2005; Marottoli & Richardson, 1998). Our multi-item measures of perceived abilities showed good internal consistency, as did Parker et al.'s 15-item perceived abilities measure.

Consistent with Paradis (2006) and other studies (Marottoli & Richardson, 1998; Parker et al., 2001), higher driving comfort scores were significantly related to higher ratings of perceived abilities. The present study also showed that drivers who perceived more decline in their abilities (compared to ten years ago) had lower driving comfort. Importantly, Parker et al. (2001) demonstrated that the relationship between perceived abilities and driving confidence was not influenced by personality (extroversion, neuroticism) or social desirability (lie scale). As noted in Chapter One, it is also useful to show that the tool does not measure something other than what it claims to measure (McDowell & Newell, 1996).

Associations with Physical Abilities

Consistent with a priori expectations, findings in the physical assessment subsample support the hypotheses that driving comfort is more strongly related to perceived abilities and self-reported driving behaviour than to objective measures of driving abilities. The relationship between perceptions and behaviour is further illustrated by the finding that perceived vision scores significantly discriminated between night drivers and non-night drivers, while objective vision abilities did not. Holland & Rabbitt (1992) also found that individuals who reported difficulty seeing in the dark or in bright light (from headlights) avoided driving at night.

Table 4.33 presents a summary of the associations between objective abilities and driving confidence, perceived abilities (both current or ten year change), situational avoidance and situational frequency. Significant relationships emerged for only four of the objective measures: left eye acuity, contrast sensitivity, the Rapid Paced Walk and Trails A. These results may be due to the high performance of the sample, as few participants had impairments. Greater variation in scores may be the reason that significant associations were found with left eye acuity (six people had impairments) but not with binocular acuity (only one person impaired). With the exception of disability glare, associations between objective abilities, driving comfort, perceived abilities and avoidance were in the expected directions (i.e., poorer scores were associated with lower perceived driving comfort and abilities and greater avoidance). Conversely, only three associations were in the expected direction for driving frequency, and none were significant. A possible reason why associations were better for situational avoidance than for situational frequency is that the former measure indicates what people intend to do *when possible*, while the latter measure indicates what people actually do and may be influenced to a greater extent by others factors (e.g. barriers to self-restrictions).

Table 4.33: Summary of Associations with Driving-related Abilities

Measure	Comfort	Current Abilities	10 Year Change	Avoidance	Frequency
Binocular acuity	√	√	√	√	√
Left eye acuity	√*	√*	√	√*	√
Contrast sensitivity	√	√*	√*	√	
Disability Glare					
Brake Reaction Time		√	√	√	
Rapid Paced Walk	√	√	√*	√	
Trails A	√*	√	√	√*	√
Trails B	√	√	√	√	
UFOV Subtest 2	√	√	√	√	
# of Impairments	√	√	√		

√ indicates association in the expected direction
* indicates significant association

As noted at the outset of this chapter, Marottoli and Richardson (1998) found that individuals with "discrepancies" (defined as those who rated their overall driving ability as "better than other drivers" yet had a history of adverse events and/or poor rating on a road test) had higher confidence than those without such discrepancies. Of note, only 27% (34 of 125 drivers) of their sample showed such discrepancies. The five participants in the present study with discrepancies between their perceived and actual abilities had significantly higher day driving comfort (night driving comfort was also lower but not significantly), situational driving frequency and lower situational avoidance compared to the two subjects with no discrepancies.

Obviously, our findings must be interpreted very cautiously as only seven participants had impairments. The two people without discrepancies in the present sample may simply be more conservative in their ratings of abilities and more cautious drivers (i.e. lower frequency, higher avoidance).

Declines in physical mobility and vision may be more noticeable than executive function or attention deficits. Neither the Trail Making Test nor the UFOV subtest 2 were significantly associated with ratings of perceived abilities. Two of the four individuals who had impairments in lower body mobility (indicated by slow scores the Rapid Paced Walk) were aware of their declines (i.e. rated their ability as 'poor or fair') and, for the sample as a whole, participants with slower scores on the Rapid Paced Walk had lower ratings of ability to get in and out of a car. Another study by Cox (1989) found that older adults were able to accurately rate their motor abilities in their lower extremities.

With respect to vision, poorer scores for left eye acuity and contrast sensitivity were significantly associated with lower ratings of perceived vision and perceived night vision, respectively. While participants with left eye acuity scores below 20/50 do not have impaired vision per se (i.e., would pass the MTO's vision screening), nevertheless they may be aware of this problem. Associations are more likely to emerge if ratings are specific and closely correspond to measured abilities. For instance, Holland and Rabbitt (1992) did not find an association between an aggregated objective vision score (binocular acuity across three conditions: glare, normal and gloomy lighting conditions) and an overall self-rated vision score (calculated by summing scores on six items).

4.8 Limitations

Limitations of the present study are similar to Study 1 (Chapter Three) particularly with respect to the reliance on self-reported driving behaviour and the use of a convenience sample. A sampling bias is also evident in that only seven individuals had impairments. Individuals who suspect (or are aware) of declines in their abilities may be less motivated to participate due to fear of losing their license. Poor health, in general, may prevent some drivers from participating in a research study. In any case, this severely limits the generalizability of the findings concerning physical abilities. As well, the present study utilized proxy measures of driving-related abilities. There is no consensus on how to best measure *actual* driving abilities (for instance on-road performance, adverse driving events or specific skills), however, in order to identify discrepancies between perceived and actual abilities, the measures themselves should correspond.

Additionally, the physical assessments were conducted in the field for participant convenience. While efforts were made to standardize such assessments (described in section 4.4.2), variations in between facilities were inevitable. For example, ambient luminance and type of floor surface (e.g. carpet or linoleum) varied across sites. The former may have influenced vision performance while the latter may have influenced performance on the rapid paced walk. That being said, no significant relationship was found between luminance and performance on the ETDRS, Pelli-Robson charts or disability glare scores. Finally, it is also possible that fatigue may have influenced performance on the assessments, since the totally battery took approximately 30 to 45 minutes to complete.

4.9 Overall Conclusions

Study 2 examined cross-sectional relationships with the DCSs. As expected, perceived comfort was more strongly related to perceived abilities than objective abilities, self-reported driving behaviour was more strongly related to perceived comfort and abilities than to objective abilities, and participants with discrepancies between their actual and perceived abilities (indicating a possible lack of awareness) had higher comfort levels. Furthermore, driving comfort and perceived vision discriminated between those who drove ‘rarely/never’ and ‘occasionally/often’ at night, while objectively measured vision did not. However, some findings (particularly those concerning impairments) must be interpreted cautiously due to the small sample size. Drivers who are over-confident may put themselves and others at increased risk, thus, further research with larger, more diverse samples (including individuals with diagnosed impairments) is urgently needed.

Together, findings from study 1 (temporal associations) and 2 (cross-sectional relationships) provided added support for the construct validity of the DCSs. Relationships between driving comfort, perceived abilities and self-reported driving frequency and avoidance was replicated with a new sample. In addition, the present study extended work by Paradis (2006) by showing temporal associations and that perceptions were more strongly related to self-reported behaviour than objective measures of abilities.

The premise of interventions for older drivers (including the MTO’s mandatory group education session for license renewal by drivers 80+) is that increasing awareness, knowledge of hazardous situations and compensatory strategies will promote self-regulation (Eby et al., 2003; Owsley et al., 2003). Reduced exposure itself may not enhance safety as driving skills may deteriorate due to decreased practice. Driving interventions can also “backfire by making some individuals “over-confident” (Owsley et al., 2003). Examiners and rehabilitation specialists can assist older drivers by assessing comfort level and perceived abilities (in addition to functional limitations) to identify those with discrepancies and counsel such individuals accordingly.

As Rudman et al. (2006) noted, it is important to determine the direction of the relationship between driving exposure and comfort level. For instance, does decreased comfort level lead to reduced exposure or vice versa? It may be worth examining with our longitudinal data set whether lower frequency at baseline is predictive of decreased DCS scores at follow-up. It has been also been suggested that confidence may be an important mediator or pathway between declining abilities, associated problems (such as night blindness) and ensuing self-regulation (Marottoli and Richardson, 1998; Rudman et al., 2006; Satariano et al., 2004). The present study suggests that perceptions of night driving comfort may be particularly important for predicting which individuals will curtail their driving. Further studies with larger samples should examine this potential mediating role of driving comfort.

Directions for further research and validation of the DCSs are shown in Figure 1.1. As mentioned in Chapter Three, studies are currently underway to examine driving comfort in relation to *actual* driving behaviour and responsiveness to change as a result of interventions. Relationships with objective abilities should also be examined with larger, more diverse samples, including those with diagnosed impairments. Further studies are required to replicate comparisons between those with and without discrepancies, as well as develop benchmarks for driving comfort in healthy drivers and various clinical populations (such as those with stroke, Parkinson’s or visual conditions). Prospective studies should attempt to identify barriers to self-restrictions and whether there is a critical level of discomfort at which voluntary cessation is likely to occur.

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Appendix A: Driving Comfort Scales (DCSs)

1. Initial (Ph IV) Driving Comfort Scales (17-item D-DCS and 18-item N-DCS)

2. Revised Driving Comfort Scales (13-item D-DCS and 16-item N-DCS)

Initial (Ph IV) Driving Comfort Scale

Using the scale below, please rate your level of comfort by choosing a whole number (example: 70% not 75%) and writing it in the blank beside each situation.

If you do not normally drive in the situation, imagine how comfortable you would be if you absolutely had to go somewhere and found yourself in the situation

In your ratings, consider confidence in your own abilities and driving skills, as well as the situation itself (including other drivers).

Assume **normal** traffic flow and **daytime** driving unless otherwise specified.

0%	10	20	30	40	50	60	70	80	90	100%
Not at all comfortable					**Moderately comfortable**					**Completely comfortable**

‘How **comfortable** are you driving in the **daytime**…?’

1. In light rain? ____%
2. In heavy rain? ____%
3. In winter conditions (snow, ice)? ____%
4. When there is glare or reflection from the sun? ____%
5. Caught in an unexpected or sudden storm? ____%
6. In unfamiliar routes (different areas), detours or sign changes? ____%
7. Making a left hand turn with no lights or stop signs? ____%
8. Completing a left hand turn on a yellow or red light when already at mid-intersection? ____%

~ Please continue ~

0%	10	20	30	40	50	60	70	80	90	100%
Not at all comfortable					**Moderately comfortable**					**Completely comfortable**

"How **comfortable** are you driving in the **daytime**…?"

9. Pulling in or backing up from tight spots in parking lots with large vehicles on either side? ____%

10. Seeing street or exit signs with little warning? ____%

11. On two-lane highways? ____%

12. Keeping up with the flow of highway traffic when the flow is over the posted speed limit of 100 km/h (60 miles/h)? ____%

13. With multiple transport trucks around you? ____%

14. Merging with traffic and changing lanes on the highway? ____%

15. Other drivers tailgate or drive too close behind you? ____%

16. Other drivers pass on a non-passing lane? ___%

17. Other drivers do not signal or seem distracted? ____%

~ Please continue ~

Now, please rate your level of comfort in the following situations when driving **at night.** Assume normal traffic flow unless otherwise specified.

0%	10	20	30	40	50	60	70	80	90	100%
Not at all comfortable					**Moderately comfortable**					**Completely comfortable**

‘How **comfortable** are you driving **at night** …?’

1. In good weather and traffic conditions? ____%

2. In light rain? ____%

3. In heavy rain? ____%

4. In winter conditions (snow, ice)? ____%

5. When there is glare or reflection from lights? ____%

6. Caught in an unexpected or sudden storm? ____%

7. In unfamiliar routes (different areas), detours or sign changes? ____%

8. Making a left hand turn with no lights or stop signs? ____%

9. Completing a left hand turn on a yellow or red light when already at mid-intersection? ____%

10. Pulling in or backing up from tight spots in parking lots with large vehicles on either side? ____%

11. Seeing street or exit signs with little warning? ____%

12. On two-lane highways? ____%

~ Please continue ~

0%	10	20	30	40	50	60	70	80	90	100%
Not at all comfortable					**Moderately comfortable**					**Completely comfortable**

'How **comfortable** are you driving **at night** …?'

13. Keeping up with the flow of highway traffic when the flow is over the posted speed limit of 100 km/h (60 miles/h)? ____%
14. With multiple transport trucks around you? ____%
15. Merging with traffic and changing lanes on the highway? ____%
16. Other drivers tailgate or drive too close behind you? ____%
17. Other drivers pass on a non-passing lane? ___%
18. Other drivers do not signal or seem distracted? ____%

Thank You!!

Revised Driving Comfort Scales

Please rate your level of comfort by choosing one option from the scale (0, 25, 50, 75 or 100 %) and writing it beside each situation.

If you do not normally drive in the situation, imagine how comfortable you would be if you absolutely had to go somewhere and found yourself in the situation.

In your ratings, consider confidence in your own abilities and driving skills, as well as the situation itself (including other drivers).

Assume **normal traffic flow** unless otherwise specified.

0%	**25%**	**50%**	**75%**	**100%**
Not at all comfortable		Moderately comfortable		Completely comfortable

'How **comfortable** are you driving in the **daytime**…?'

1. In light rain? _____ %
2. In heavy rain? _____ %
3. In winter conditions (snow, ice)? _____ %
4. If caught in an unexpected or sudden storm? _____ %
5. Making a left hand turn with no lights or stop signs? _____ %

~ Please continue ~

0%	25%	50%	75%	100%
Not at all comfortable		Moderately comfortable		Completely comfortable

'How **comfortable** are you driving in the **daytime**…?'

6. Pulling in or backing up from tight spots in parking lots with large vehicles on either side? _____ %
7. Seeing street or exit signs with little warning? _____ %
8. On two-lane highways? _____ %
9. Keeping up with the flow of highway traffic when the flow is over the posted speed limit of 100 km/h (60 miles/h)? _____ %
10. With multiple transport trucks around you? _____ %
11. When other drivers tailgate or drive too close behind you? _____ %
12. When other drivers pass on a non-passing lane? _____ %
13. When other drivers do not signal or seem distracted? _____ %

~ Please continue ~

Now we would like you to rate your level of comfort when driving in the following situations **at night**.

Even if you **do not normally drive at night**, imagine that you were out in the afternoon, got delayed and it was dark on your way back.

In your ratings, consider confidence in your own abilities and driving skills, as well as the situation itself (including other drivers).

Assume **normal traffic flow** unless otherwise specified.

0%	**25%**	**50%**	**75%**	**100%**
Not at all comfortable		Moderately comfortable		Completely comfortable

'How **comfortable** are you driving **at night** …?'

1. In good weather and traffic conditions? _____ %
2. In light rain? _____ %
3. In heavy rain? _____ %
4. In winter conditions (snow, ice)? _____ %
5. When there is glare or reflection from lights? _____ %

~ Please continue ~

0%	25%	50%	75%	100%
Not at all comfortable		Moderately comfortable		Completely comfortable

'How **comfortable** are you driving **at night** …?'

6. In unfamiliar routes (different areas), detours or sign changes?

   _____ %

7. Making a left hand turn with no lights or stop signs? _____ %
8. Pulling in or backing up from tight spots in parking lots with large vehicles on either side? _____ %
9. Seeing street or exit signs with little warning? _____ %
10. On two-lane highways? _____ %
11. Keeping up with the flow of highway traffic when the flow is <u>over</u> the posted speed limit of 100 km/h (60 miles/h)? _____ %
12. With multiple transport trucks around you? _____ %
13. Merging with traffic and changing lanes on the highway? _____ %
14. When other drivers tailgate or drive too close behind you? _____ %
15. When other drivers pass on a non-passing lane? _____ %
16. When other drivers do not signal or seem distracted? _____%

Appendix B: Prior Multi-Item Perception Measures

Table 1: Perceived Confidence. Stress. Nervousness

Study	Measurement Tool
George et al. ,2007 * Adelaide, South Australia *n=79 (non stroke sample) *Mean age = 40.6, SD ±6.96, *♂: n=29, ♀: n=50 *n=81 (stroke patients) *Mean age=67.4, SD±13.2, *♂: n=60, ♀: n=21	**The Adelaide Driving Self-Efficacy Scale (ADSES)** * 10 point scale (not confidence to completely confident) *12 items (1) in local area; (2)in heavy traffic; (3) in unfamiliar areas; (4) at night; (5)with people in the car; (6) responding to road signs/traffic signals; (7) around a roundabout; (8) attempting to merge with traffic; (9) turning right across oncoming traffic; (10) planning travel to a new destination; (11) in high speed areas; (12) parallel parking
Baldock et al., 2006 *Adelaide, Australia *n=104 current drivers *Mean age=74.2, SD±6.3, *Range=60-92 *♂: n=39, ♀: n=65	**Driving Confidence Rating Scale** * 5 point scale (not at all confidence, not very confident, reasonably confident, very confident, completely confident) * 9 items: (1) in rain; (2) alone; (3) reverse parallel parking; (4) turning right across traffic; (5) on freeways or high speed highways; (6) on high traffic roads; 97) in peak hour traffic; (8) at night; (9) at night in the rain
Hakamies-Blomqvist & Wahlstrom, 1998 *Finland *n=1,397 former drivers; 35%♂ and 65%♀ *n=2,414 current drivers; 78%♂, 22%♀ *Age: all 70	**Experienced Driving Stress** *4 point scale (heavy stress, moderate stress, negligible stress, no stress) *16 items: (1) slippery roadways; (2) tired; (3) night driving; (4) competitiveness of others; (5) rush hours; (6) unfamiliar surroundings; (7) long distances; (8) carefulness of others; (9) overtaking; (10) parking or reversing; 911) crossings; (12) adjusting to traffic flow; (13) switching lanes; (14) traffic signs; (15) highways; (16) merging from side road
Marottoli & Richardson, 1998 *New Haven, Conneticut *n=125 current drivers *Mean age=81, SD ± 3.27 *57%♂; 43%♀	**The Driving Confidence Rating Scale** *10 point scale (not at all confident to completely confident) * 10 items: (1) at night; (2) in bad weather; (3) in rush hour or heavy traffic; (4) on the highway; (5) on long trips; (6) changing lanes on a busy street; (7) reacting quickly; (8) pulling into traffic from a stop; (9) making a left turn across traffic; (10) Parallel parking or backing into a space between cars
Parker et al., 2001 *British Drivers *n=555 current drivers *Mean age=69 *Range=50-90 *♂: n=271, ♀: n=284	*5 point scale (not at all, a little, moderately, very, extremely) *How nervous do you feel?* (1) when overtaking; (2) when turning right; (3) when negotiating a mini roundabout; (4) when negotiating a large roundabout; (5) when joining a motorway; (6) when changing lanes on a motorway; (7)when driving in heavy traffic *When driving…* (8) how *relaxed* do you feel; (9) how *stressed* do you feel; (10) how *confident* do you usually feel *When you are driving….* (11) and are suddenly faced with a potentially dangerous situation how *flustered* do you become? (12) and things happen quickly, giving you little time to think, how *calm* do you remain?

Table 2: Perceived Driving Abilities

Study	Measurement Tool
Owsley et al. , 2003 *Birmingham, Alabama *n=365 current drivers *Mean age=74, SD±6 *Range=60-91 *69%♂; 31%♀	**Perceived Driving Difficulty** *subscale of 'driving habits questionnaire' (DHQ) *rate degree of *visual difficulty* experienced with respect to 8 driving situations *5 point scale (no difficulty, a little difficulty, moderate difficulty, extreme difficulty, so difficult I no longer drive in that situation) *8 items: (1) rain,(2) alone; (3) parallel parking; (4) left-hand turns; (5) interstate; (6) heavy traffic; (7) rush-hour; (8) night
Parker et al., 2001 *British Drivers *n=555 current drivers *Mean age=69 *Range=50-90 *♂: n=271, ♀: n=284	**Self-rated Driving Abilities** *5 point scale (very poor, poor, adequate, good, very good) *Self-rated ability as a driver to* (1) read road signs; (2) judge gaps in traffic; (3) notice vehicles, pedestrians, etc. out of corner of your eye; (4) see clearly in low light conditions; (5) see clearly in bright light conditions; (6) make decisions quickly in traffic; (7) react quickly in traffic; (8) navigate efficiently an unknown area; (9) follow a route traveled only once before from memory; (10) stay alert for long periods while driving; (11) recognize when your attention has wandered; (12) judge the speed of oncoming traffic; (13) divide your attention between two tasks; (14) reverse park into a confined space
Paradis, 2006 *Ontario, Canada *n=100 current drivers; Mean age=79.8, SD=±6.2; Range = 65-92; 39%♂; 61%♀ *n=28 former drivers, Mean age=82.7, SD±6.4; Range=79-90; 54%/♂, 46%/♀	**Self-rated Driving Abilities** *3 point scale (better than most, about the same, worse than most) Current Drivers: *How would you say your driving abilities in each of these areas are?* (1) parking in tight spaces; (2) reversing or backing up; (3) concentration while driving with passengers; (4) reacting quickly if needed (e.g. hitting the break); (5) turning completely to shoulder check for other cars; (6) seeing road signs or lanes when its raining or dark out; (7) my overall driving ability Former Drivers: *In the six months before you stopped driving, how would you rate your driving abilities in each of these areas?* (same 7 items as above)

Appendix C: Consent Forms for Baseline and Follow-up

1. Consent for Participation Form
2. Consent for Audiotaping Form
3. Permission for Further Contact Form (administered at baseline)
4. Permission to Contact for Future Studies Form (administered at follow-up)

Consent for Participation

(larger font used and on separate pages)

This study has been explained to my satisfaction and I have had the opportunity to ask questions. I understand that my participation is totally voluntary and will in no way affect my license renewal now or in the future. I choose whether or not to make any comments during the discussion session or complete the questionnaire.

I understand that all information collected will be kept totally confidential by the researchers and trust each of us will keep confidential whatever is said by fellow participants. I also understand that the results will be summarized across all older drivers who have taken part in this study. No individual will ever be identified by name and any quotes used in reports will be anonymous. This consent form will be kept secure (in a locked cabinet) and separate from the data. All consent forms, tapes and questionnaires will be destroyed following publication of the findings.

____

I understand that this project has reviewed and received ethics clearance from the Office of Research Ethics at the University of Waterloo. If I have any questions or concerns regarding my involvement, I know that I can contact the researchers or the Office of Research. The contact numbers are in the letter of information I have been given.

Participant's name (please print): ____

Participant's signature: ________________________________ Date: ___________

Researcher's signature: ________________________________ Date: ___________

Consent to Audio-tape the Discussion

We require the permission of each and every group member in order to audio-tape the discussion. The reason for taping the discussion is to make sure that we do not miss or forget any important information later during analysis. While names may be used during the discussion itself, all names will be removed when we transcribe the audio-tape. Any quotes used will be anonymous. The tapes will be kept in a locked cabinet and destroyed, along with these consent forms, when the study is finished and the results published. All results will be summarized across groups.

____

The reasons for audio-taping the discussion session have been explained to my satisfaction and I have had the opportunity to ask questions. I understand that everyone in the group has to agree, before the audio-tape is turned on.

I give my consent for audio-taping the discussion session I am taking part in today.

Participant's name (please print): ____

Participant's signature: ________________________________ Date: ___________

Researcher's signature: ________________________________ Date: ___________

Permission for Further Contact

(larger font used)

As noted in the letter of information, we will be conducting further studies this fall and winter. The first study will involve completion of the driving comfort scale and a discussion of whether anything has changed in your driving patterns. This may be done in small groups, similar to today, or it may be done individually in a telephone survey, and should take no more than 30 minutes of your time.

The second study will involve simulations of driving-related abilities. These simulations will assess abilities such as vision, reaction time and neck flexibility and will take no more than 45 minutes of your time.

If you think that you might be interested in either of these studies, please complete this form allowing Lisa MacDonald or Robin Blanchard to contact you with more information regarding these studies.

By signing below, you are simply giving us permission to contact you by phone when we set up sessions at your facility this coming fall or winter. Lisa MacDonald or Robin Blanchard from the University of Waterloo who you met today will be calling you. We may not contact you at all, and certainly would only contact you once. If you do not wish to participate further or participation is inconvenient, no further calls will take place. We will keep these forms secure and destroy them after we have contacted you or reach a sufficient number of study participants. We will not give out your names or number to anyone or use it for any purpose apart from this project.

I give my permission for either Lisa MacDonald or Robin Blanchard to call me to see if I am interested and available to participate further in this project this summer.

Name (please print):____
Signature:_______________________________________ Date: ____________
Researcher's Signature: _____________________________ Date: ____________

Study I am interested in: (please check one)
1. ___ completion of driving comfort scale and discussion of driving habits
2. ___ simulations of driving-related abilities
3. ___ both studies

Phone number(s): ____

Most convenient days to call: ___ Mon ___Tues ____Wed ___Thurs ___Fri

Best times to call: ____morning ___afternoon; OR ___early evening

Check times you may be away: ___ June ___ July ___ August

Do you currently drive? ___ Yes ___ No

Are you over age 65? ___ Yes ___ No Over age 80? ___ Yes ___ No

Permission to Contact for Future Studies
(larger font used)

In the future, we will likely be conducting further studies with older drivers at the University of Waterloo. If you would like to receive information about such studies, we require your permission to contact by mail, phone or e-mail.

I give my permission for Dr. Anita Myers from the University of Waterloo or her graduate students to contact me in the next five years to let me know about further studies with older drivers. I understand that I am under no obligation to participate in future studies should I be contacted. Contact information will be kept secure (in a locked file cabinet) and not be given to anyone or used for any other purpose. This information will be destroyed once contact has been made, if any, or within five years from this date.

Name (please print):____

Address: ____

Phone number: ___________________Email: ________________________

Signature:____________________________________ Date: ___________

Researcher's Signature: __________________________Date: ___________

Appendix D: Materials for Further Baseline Recruitment

1. Information Letter

2. Recruitment Poster

Driving Comfort Study: Letter of Information

(to go on UW Letterhead)

Dear Driver,

My name is Lisa MacDonald and I am a graduate student at the University of Waterloo. I am doing the present study for my Master's thesis, funded by a scholarship from the Canadian Driving Research Institute for Vehicular Safety in the Elderly.

Last year, two other graduate students (Josee and Robin) from the University of Waterloo met with older drivers in the Kitchener-Waterloo, Guelph and Elmira areas to look at the importance of driving and the role of confidence in driving behavior. As a result, a new tool to assess level of driving comfort was developed with older drivers themselves. Some of you may have taken part in this initial study last summer.

Now we are again looking for drivers aged 65 years and over to take part in a small group session, which will involve completing this scale, a background questionnaire and a few driving rating forms, followed by a group discussion to give us some feedback on these tools.

The groups will be held here at Victoria Park Senior's Centre and the entire process should take no more than 60 minutes of your time. Light refreshments will be provided.

Following the discussion group, we will also tell you about future studies we are planning for this coming fall and winter. For instance, we would like to follow-up with participants six to twelve months later to look at whether there are any changes in driving comfort levels or driving habits. Another component of the study will involve simulations of driving-related abilities such as neck and head flexibility, reaction time, and mobility for getting in and out of a car, as well as tests of different aspects of vision. These simulations will allow us to look at the relationship between comfort levels and physical driving abilities and will provide participants with an opportunity to learn more about their own driving abilities. Even if you choose to participate in the present study, you are under no obligation to participate in the future studies.

Right now we are looking for volunteers for the 60 minute group session. Participation is totally voluntary and will, in no way, affect your license renewal now or in the future. While the Ministry of Transportation of Ontario supports this research to further our understanding of older drivers, this project is totally separate from the Ministry's re-licensing requirements.

It is totally up to each person whether they want to make comments during the discussion or to complete the scale, rating forms or the background questionnaire. You may withdraw from the study at any time. The discussion will be audio-taped provided everyone agrees. Your name will only appear on the consent forms which will be kept secure (in a locked cabinet) and separate from the data. All consent forms, tapes and questionnaires will be destroyed following publication of the findings. We certainly will keep all information totally confidential. No individual will be identified by name in my thesis or other reports. Results will be summarized across several groups in the project.

The information from this study will, hopefully, help us to better understand the issues important to older drivers themselves. As a result, both driving counselors and health care professionals will be better able to offer support and guidance.

For each study phase your written consent to participate is required. This project has been reviewed and has received ethics clearance from the Office of Research Ethics at the University of Waterloo. Please take this letter home with you. If you have any questions or would like to volunteer for the study, please contact me at (519) 888-4567 extension 6786.

Sincerely,

Lisa MacDonald
Dept of Health Studies & Gerontology
University of Waterloo

If you have concerns about your participation in this study, you can also contact the Office of Research Ethics at the University of Waterloo at (519) 888-4567, ext. 6005.

University of Waterloo

We Need You!

The University of Waterloo is looking for **DRIVERS AGED 65 YEARS AND OVER** to take part in a small group discussion to talk about driving habits and concerns. We will also be happy to answer any questions you may have regarding Ontario's requirements for license renewal for senior drivers.

The group discussion will be held on: **[Insert date, time and location]**

This should take approximately 1 hour and light refreshments will be served.

If you are interested in participating in the discussion group please **SIGN-UP** with **[insert appropriate name]**

If you are interested but cannot make this session, please ask **[insert appropriate name]** about future opportunities

For more information, please contact **Lisa MacDonald** at **888-4567 ext. 6786**

** Your participation will NOT affect your license renewal in any way **

Appendix E: Rating Forms

1. Situational Driving Frequency
2. Situational Avoidance
3. Current Perceived Abilities
4. Perceived Changes in Abilities
5. Dealing with Missing Items on the Perceived Abilities Forms

<u>Situational Driving Frequency (14 items)</u>

Scoring: 0 (never); 1 (rarely), 2 (occasionally), 3 (often), 4 (very often)
Possible Range: 0 to 42 for Phase IV version; 0 to 56 for Phase V version

Based on your present lifestyle, on average how often do you drive…

Phase IV	Phase V
Response options: never, rarely (less than once a month), occasionally (at least once a month, but not weekly), often (once a week or more).	**Response options**: never, rarely (less than once a month), occasionally (at least once a month, but not weekly), often (1 – 3 days a week or more), very often (4 – 7 days a week)
1. In the summer?	1. In the winter?
2. In the winter?	2. At night?
3. At night?	3. On two-lane highways?
4. On two-lane highways?	4. In rural areas?
5. On highways with 3 or more lanes?	5. On highways with 3 or more lanes?
6. Over the posted speed limit?	6. Over the posted speed limit?
7. On one-way trips lasting 2 hours?	7. On one-way trips lasting 2 hours?
8. In heavy traffic or rush hour traffic in town?	8. In heavy traffic or rush hour traffic in town?
9. In heavy traffic or rush hour on the highway?	9. In heavy traffic or rush hour on the highway?
10. With passengers?	10. With passengers?
11. Outside your village, town or city?	11. Outside your village, town or city?
12. In new or unfamiliar areas?	12. In new or unfamiliar areas?
13. Making left hand turns at intersections?	13. Making left hand turns at intersections?
14. In parking lots with tight spaces?	14. In parking lots with tight spaces?
Cronbach's alpha: .90	**Cronbach's alpha: .93**

<u>Description of Changes from Phase IV to Phase V</u>:

Modifications to the driving frequency rating form include: (1) expansion of the response scale to include the option "very often"; and (2) substitution of the item "in the summer" with item #4 "in rural areas".

<u>Situational Driving Avoidance (20 items)</u>

Scoring: 1 for each item checked. Possible range 0 to 20

If possible, do you try to avoid any of these driving situations? (check all that apply)

Phase IV	Phase V
1. Night	1. Night
2. Dawn or dusk	2. Dawn or dusk
3. Light rain	3. Bad weather conditions (in general)
4. Heavy rain	4. Heavy rain
5. Fog	5. Fog
6. Rain at night	6. Nighttime driving in bad weather (e.g. heavy rain)
7. Winter	7. Winter
8. First snow storm of the season	8. First snow storm of the season
9. Bad weather conditions (in general)	9. Trips lasting more than two hours (one way)
10. Unfamiliar routes (different areas) or detours	10. Unfamiliar routes (different areas) or detours
11. Heavy traffic or rush hour in town	11. Heavy traffic or rush hour in town
12. Heavy traffic or rush hour on the highway (or expressway)	12. Heavy traffic or rush hour on the highway (or expressway)
13. Making left hand turns with traffic lights	13. Making left hand turns with traffic lights
14. Making left hand turns with <u>no</u> lights or stop signs	14. Making left hand turns with <u>no</u> lights or stop signs
15. Parking lots with tight spaces	15. Parking lots with tight spaces
16. Highways with 3 or more lanes and speed limits of 100 km/h or more	16. Highways with 3 or more lanes and speed limits of 100 km/h or more
17. Changing lanes on a highway with 3 or more lanes	17. Changing lanes on a highway with 3 or more lanes
18. Two-lane highways	18. Two-lane highways
19. One-way trips over 2 hours	19. Rural areas at night
20. Driving with passengers who may distract you	20. Driving with passengers who may distract you
	21. No I don't try and avoid any of these situations
Cronbach's alpha:.85	**Cronbach's alpha: .89**

<u>Description of Changes from Phase IV to Phase V</u>:

Changes made to the avoidance rating form, include: (1) deletion of the items "light rain" and "rain at night"; (2) addition of item #6 "nighttime driving in bad weather (e.g. heavy rain)" and #19 "rural areas at night"; and (3) addition of item #21 "No: I don't try to avoid any of these situations" to verify that participants (who indicated no avoidance) did not simply miss the form.

<u>Current Perceived Abilities (15 items)</u>

Response options: poor, fair, good or very good
Scoring: 0 (poor); 1 (fair), 2 (good), 3 (very good)

How would you rate your current ability to…..?

1. See road signs at a distance
2. See road signs at a distance (night)
3. See your speedometer and controls
4. See pavement lines (at night)
5. Avoid hitting curbs or medians
6. See vehicles coming up beside you
7. See objects on the road (at night) with glare from lights or wet roads
8. Quickly spot pedestrians stepping out from between parked cars
9. Move your foot quickly from the gas to the brake pedal
10. Make an over the shoulder check
11. Quickly find a street or exit in an unfamiliar area and heavy traffic
12. Get in and out of your car
13. Reverse or back up
14. Make quick driving decisions
15. Drive safely (avoid accidents)

Cronbach's alpha: .94

<u>Perceived Changes in Abilities (15 items)</u>

Response options: a lot worse, a little worse, same, better
Scoring: 0 (a lot worse); 1 (a little worse), 2 (same), 3 (better)

Compared to 10 years ago, how would you rate your own ability to…..?

1. See road signs at a distance
2. See road signs at a distance (night)
3. See your speedometer and controls
4. See pavement lines (at night)
5. Avoid hitting curbs or medians
6. See vehicles coming up beside you
7. See objects on the road (at night) with glare from lights or wet roads
8. Quickly spot pedestrians stepping out from between parked cars
9. Move your foot quickly from the gas to the brake pedal
10. Make an over the shoulder check
11. Quickly find a street or exit in an unfamiliar area and heavy traffic
12. Get in and out of your car
13. Reverse or back up
14. Make quick driving decisions
15. Drive safely (avoid accidents)

    Cronbach's alpha: .91

Dealing with Missing Items on the Perceived Abilities Rating Forms

Missing items were dealt with in one of two ways: (1) substitution with related items (e.g. items 2, 4 and 5 refer to tasks involving contrast sensitivity); or (2) person mean substitution. The latter method was used for items for which there were no other directly related items (e.g. item #3 which involves near acuity). The method used for item substitutions was as follows:

- Item 1 → person mean substitution
- Item 2 → mean of items 1 and 4
- Item 3 → person mean substitution
- Item 4 → mean of items 2 and 5
- Item 5 → item 4
- Item 6 → person mean substitution
- Item 7 → mean of items 2 and 4
- Item 8 → item 11
- Item 9 → person mean substitution
- Item 10 → person mean substitution
- Item 11 → item 8
- Item 12 → person mean substitution
- Item 13 → person mean substitution
- Item 14 → person mean substitution
- Item 15 → person mean substitution

Appendix F: Phase V Background Questionnaire

1. Background Questionnaire

2. Revisions from Phase IV and Composite Scores

Background Questionnaire
(larger font used)

Part A. First, please tell us about your general driving habits.

1. **About how long** have you been driving? _____ (# of years)

2. **How many days** have you driven in the **past week**? _____ (# days)

3. **How long** are most of your driving trips (each way)?

   ___ less than 30 minutes ___ over 30 minutes ___ over 60 minutes

4. Overall, **compared to 10 years ago**, do you drive:

   ___ much less often ___ a little less ___ the same ___ more often

5. If you do not feel like driving, is there **someone else in your household** who can drive you? ___ Yes ___ No

6. Does **anyone else rely on you** to drive them? ___ Yes ___ No
   Note: this person may or may not live with you

7. In the **past month have you taken:** (Check all that apply)

   ___ rides from family or friends ___ taxis ___ buses

   ___ streetcars, subway or GO train ___ special transit services

8. Do you feel that **taxis are too expensive to take once a week?**

   ___ Yes ___ No ___ Don't know (never use)

9. To what extent **do you worry about car related expenses**?
   (gas, maintenance or repair costs, license and insurance costs)

   ____ Often ____ Sometimes ____ Rarely ____ Never

10. Typically (in good weather), **how many days per month** do you go out to do the following activities? **And do <u>you</u> usually drive there**?

	# of days per month	Usually drive? (circle <u>one</u>)	
a) shopping, banking, other errands	_____	**Yes**	**No**
b) volunteer work or paid employment	_____	**Yes**	**No**
c) visiting or assisting family or friends	_____	**Yes**	**No**
d) attending religious services	_____	**Yes**	**No**
e) going to a movie, concert, play or sports event	_____	**Yes**	**No**
f) going to a restaurant	_____	**Yes**	**No**
g) to play cards, bingo or other games (at other people's homes)	_____	**Yes**	**No**
h) senior or community centers	_____	**Yes**	**No**
i) fitness centers, pools, curling, bowling golf or other physical activity centers	_____	**Yes**	**No**
j) taking day trips	_____	**Yes**	**No**

If there are any **other activities** you do regularly outside the home not listed above, please list below:

	# of days	Usually drive? (circle <u>one</u>)
Activity: ________________________	_____	**Yes or No**
Activity: ________________________	_____	**Yes or No**

11. If you did not feel like driving, are you **close enough to walk** to:

a) do your weekly shopping & errands? ___ Yes ___ No

b) get to church, social or recreation clubs? ____ Yes ___ No

12. Have you **talked about your driving with any of the following**?

Your physician	___ Yes	___ No
An eye care professional	___ Yes	___ No
Family members	___ Yes	___ No
Friends	___ Yes	___ No

13. While driving, **do you ever find yourself**………?

Tightly gripping the steering wheel? ___ Yes ___ No

Feeling your palms sweat or heart race? ___ Yes ___ No

Feeling your shoulders tighten? ___ Yes ___ No

14. In the past year, have you had **any of these problems when driving**?

Accidents involving another vehicle? ___ Yes ___ No

Near misses (almost an accident)? ___ Yes ___ No

Backing into things besides other cars? ___ Yes ___ No

Getting lost? ___ Yes ___ No

Traffic violations with loss of demerit points? ___ Yes ___ No

15. How **important** is it for you, personally, to **continue** to drive? (circle one)

1	2	3	4	5
Extremely Important	Very	Moderately Important	Somewhat	Not that Important

Part B. Now, please tell us about yourself.

1. Are you? ___ male or ___ female

2. Your age: _____

3. Did you complete high school? ___ Yes ___ No

   College or university? ____ Yes ___ No

4. a) Are you comfortable **using a computer**? ___ Yes ___ No

   b) Are you comfortable **using the Internet**? ____ Yes ____ No

   c) Do you **install software programs** on your own? ____ Yes ____ No

5. Do you live in? ____ a private home ____ apartment or condo
   or ____ a retirement or seniors' complex

6. Do you live? ___ alone ___ with spouse or partner
   ___ with family members or ___ with roommates (not related)

Part C. Finally, a few questions about your health and activities.

1. **Overall,** would you say your health is:
   ___Excellent ___Good ___Fair ____Poor

2. Do you ever use a cane or walker outdoors? ___ Yes ___ No

3. Are you able to walk a quarter of a mile? ___ Yes ___ No

4. How many days in an **average week** do you do at least 30 minutes of moderate physical activity (e.g., a brisk walk)? _____ (# of days)

5. Are you in any organized **exercise** classes or activities (such as curling, golfing or bowling)? ____ No ____ Yes # days/week:_____

6. Have you been **diagnosed** with any of the following? (check all that apply)
   ____ arthritis, rheumatism or osteoporosis
   ____ Parkinson's, Multiple Sclerosis or other neurological disorder
   ____ high blood pressure, cholesterol or heart problems
   ____ diabetes
   ____ asthma or other breathing problems
   ____ back or foot problems
   ____ hearing problems
   ____ cataracts, glaucoma or macular degeneration

7. Have you ever had **cataract surgery**? ___ Yes ___ No
   If yes, how long ago? ____ within the past year ___ over a year ago

8. Do you wear **prescription glasses or contacts for driving**?
   ___ All the time ___ Sometimes ___ Never

9. Compared to others your age, **would you say that your eyesight is**:
   ____Better than most ___About the same ___Worse than most

10. Do you take **any prescribed medications**? ____ Yes ____ No

11. When did you **last visit a physician**?
    ___Within past 6 months ___ Past year ___More than a year ago

12. Has your physician **ever asked you whether you drive**? ___ Yes ___No

13. In the past five years, have you been asked by the provincial Ministry of Transportation **to take a vision test**? ___ No ___ Yes
a rules test? ___ No ___ Yes **a road test**? ___ No ___ Yes
a medical examination? ___ No ___ Yes

14. Have you taken the Ministry of Ontario's **Group Education Session** for license renewal (required for drivers over age 80)? ___ Yes ___ No

15. Have you taken **any other driving courses**? ___ Yes ___ No

If so, have you taken **more than one** course? ____ Yes ____ No

About **how long ago?** (1)________________**;** (2) _________________

(specify approximate # of months (e.g., 6 months) or # years ago: (e.g. 2 years)

Was the course(s)? ___ classroom ____ on-road or ___ both

Was this a **"specialized" course**(s) (such as **skid)?** ___ Yes ___ No

If you remember, **who offered the course(s)**?
(1) ________________________ ; (2) ____________________
Please try and provide as much information as you can about each course.

Thank you very much for completing this questionnaire.
Please let us know if any of the questions are unclear.

Background Questionnaire

Description of Changes from Phase IV to Phase V:

Several new questions were developed including: (1) Part A #4, #10, #15; and (2) Part C #4, #5, #8, #13, #14, #15. As well, a 5th option was added to question #14 (Part A): "traffic violations with loss of demerit points". Initially, question #10 (Part A) asked participants how many days per "*week*" they go out for various activities, however, piloting (during baseline data collection) suggested that this be changed to per "*month*".

Composite Scores:

(1) Driving Problems Score: # of items checked (1 point per check) for Question A 14; range 0 – 4 (item "traffic violations" was omitted since it was not on the Phase IV version)
(2) Nervousness Score: # of items checked for question A 13; range 0 – 3

(3) Diagnosis Score: # of items checked for Question C6; range 0 – 8

Appendix G: Information Letter for Telephone Interviews

(To go on UW Letterhead)

Dear Driver,

Thank you for your interest in the Driving Comfort Study. My name is Lisa MacDonald and I am a graduate student at the University of Waterloo. I am doing the present study for my Master's thesis under the supervision of Dr. Anita Myers of the Department of Health Studies and Gerontology. This study is being funded by a scholarship from the Canadian Driving Research Institute for Vehicular Safety in the Elderly.

Last **[month & year of baseline assessment]**, you and others took part in our study at **[name of facility]** where you filled out various forms related to your driving habits and comfort level. Thanks to your help, we have developed the Driving Comfort Scales. Now, we would like to follow-up with people, such as yourself, who took part in the initial study.

Participation in the follow-up is voluntary and will in no way affect your license renewal now or in the future. This follow-up entails 2 parts: (1) completion of questionnaires; and (2) telephone interview. **The questionnaires** involve completing rating forms on driving comfort level and patterns, included in this package. This should take about 15 minutes of your time. If you have any questions, we can discuss them during the telephone interview. **The telephone interview** will involve you providing your responses on the rating forms. As well, you will be asked about any changes that have occurred to your health, lifestyle or driving since last **[date of baseline]**. The phone interview should take between 15-20 minutes of your time.

It is totally up to you whether you want to complete the rating forms or participate in the telephone interview. You may decline to answer questions if you wish and you may withdraw from the study at any time. If you agree, the telephone interview will be audio-taped. Your name will only appear on the consent forms which will be kept secure (in a locked cabinet) and separate from the data. All consent forms, tapes and questionnaires will be destroyed three years after publication of the findings. We certainly will keep all information totally confidential. No individual will be identified by name in my thesis or other reports. Results will be summarized across several groups in the project. **We will call you on [date & time] for your interview**. If you are interested in participating, we can do the interview at that time, or schedule another time.

The information from this study will, hopefully, help us to better understand the issues important to older drivers themselves. As a result, both driving counselors and health care professionals will be better able to offer support and guidance.
This project has been reviewed and has received ethics clearance from the Office of Research Ethics at the University of Waterloo. If you have any questions, please contact me at (519) 888-4567 extension 37030.

Sincerely,

Lisa MacDonald
Dept of Health Studies & Gerontology
University of Waterloo

If you have concerns about your participation in this study, you can also contact the Office of Research Ethics at the University of Waterloo at (519) 888-4567, ext. 36005.

Appendix H: Telephone Interview Script

Name: ____

Date of baseline assessment:______________ Current date: ___________

Phase IV sample: ______ New baseline sample: _____

Location of baseline assessment: __________________________________

Only person in household who can drive? _____Yes _____No

Others rely on them to drive? ____Yes _____No

Living arrangements (baseline) : ____ alone _____spouse/partner

_____family members ________roommates (not related)

Initial Greetings

Hello Mr/Mrs. ___[insert name]_________. My name is Lisa MacDonald and I am a graduate student from the University of Waterloo. A few weeks ago I mentioned that I would contact you at this time about the Driving Comfort Study. Are you still interested in participating in the study?

If no: Sorry to disturb you and thank you for letting me know. Good bye.

If yes: Is this still a good time to talk?

Scenario 1: Not a good time to talk:

Sorry to disturb you. When would be a good time to talk? The interview should take about 15 minutes. _______________________.

Before I let you go, did you receive the package of questionnaires I sent you in the mail? *If yes….*

If you have any questions or concerns about the forms, we can discuss them during the interview on __[date of interview]_____, or, if you prefer, we can complete the forms together at that time.

Thank you for your time, and I look forward to speaking with you on __[date and time of interview]___. Good-bye.

***Scenario 2: Is a good time to talk*:**

Ok great. Before we get started, did you receive the package of questionnaires I sent you in the mail? Did you have any questions or concerns about any of the forms? *If Yes, discuss. Then, get responses to questionnaires (DCSs, rating forms).*

Obtain Verbal Consent for Participation and Audiotaping

As you recall, you participated in our driving study at __[name of facility]___ last __[month of baseline assessment]_____. We would like to know if there have been any changes in your life since this time. We will be asking you questions about any changes to your health, lifestyle and driving. Would you like to continue with the interview? Is it okay if I turn on the taperecorder? [obtain verbal consent for participation]

Interview Script

Since ___[date of baseline assessment]____. . . . . . .

Part A: Health Changes

1. Have you had any health problems or injuries? ____No ____Yes *If yes, what?*

2. How about health improvements? ____No ____Yes *If yes, what?*

3. Any changes in medication you take? ____No ____Yes *If yes, what?*

4. Any vision problems or changes in glasses? ____No ____Yes *If yes, what?*

Part B: General Lifestyle Changes

1. Have you moved? ____No ___Yes
If yes:
(a) Are you closer/further to shopping malls, family, friends, recreational facilities?
(b) Is public transportation more/less available?

2. How about your physical activity, any changes? ____No ____Yes *If yes, what?*
Probes: (a) Stopped/started attending fitness classes, sports teams, etc. (b) Walk less/more

3. Have you started any new work or volunteer commitments? ____No ____Yes
If yes:
(a) Do you drive there? ____No ____Yes
(b) Live close enough to walk? ____No ____Yes

8. Have you joined any new social clubs or activities? (e.g. card/bingo groups, senior centres, special interest classes, etc.) ____No ____Yes

<u>If yes:</u>

(a) Do you drive there? ____No ____Yes

(b) Live close enough to walk? ____No ____Yes

Part C: Driving-Related Changes

1. Are you still driving? ____No ____Yes *If no, can you tell me why?*

2. Do you still drive the same car? ____No ____Yes

3. Have you had your drivers' license renewed? ____No ____Yes *If yes, when?*

4. Have you taken any driving courses? (e.g. 55 Alive, Drive Wise, skid control, private lessons) ____No ____Yes *If yes, what?*

5. Have you talked about your driving with anyone (e.g. physician, optometrist, family, friend?) ____No ____Yes *If yes, who?*

6. Last __[month of baseline assessment]___ you said that there was/was not someone else in your household who could drive you if necessary, is this still true?
___No ____Yes

7. (a) You also said that there was/was not someone who relies on you to drive them, is this still so? ____No ____Yes

(b) Does anyone *new* rely on you to drive them? ____No ____Yes *If yes, who?*

8. Have you had any problems with your driving? ____No ____Yes *If yes, what?*

<u>Probes</u>:

(a) Accidents, near misses, backing into things?

(b) Traffic violations with loss of demerit points?

(c) Gotten lost?

Final Question

1. Has anything else happened or changed over the past ____months that you feel is important to your driving? ____No ____Yes *If yes, what?*

Permission to Contact for Future Studies

In the future, we will likely be conducting other studies with older drivers. If you like, we can contact you with information about these studies. Of course, you would be under no obligation to participate if we contact you. Would you like to receive information about future studies? _____No _____Yes

Appendix I: Frequency Distributions for Day and Night DCS Percent Change Scores

Day DCS Percent Change Scores

Table 1: Day DCS % Change Scores

		Frequency	Percent
Valid	-66.67	1	1.2
	-55.56	1	1.2
	-48.57	1	1.2
	-40.91	1	1.2
	-40.00	1	1.2
	-36.17	1	1.2
	-33.33	1	1.2
	-31.82	1	1.2
	-30.95	1	1.2
	-29.55	1	1.2
	-29.27	1	1.2
	-27.27	1	1.2
	-26.47	1	1.2
	-23.91	1	1.2
	-23.53	1	1.2
	-22.73	1	1.2
	-20.93	1	1.2
	-18.00	1	1.2
	-17.16	1	1.2
	-16.33	1	1.2
	-15.79	1	1.2
	-15.22	1	1.2
	-15.15	1	1.2
	-14.71	1	1.2
	-14.41	1	1.2
	-13.33	1	1.2
	-12.50	1	1.2
	-12.00	1	1.2
	-10.71	1	1.2
	-10.26	1	1.2
	-9.52	1	1.2
	-8.89	1	1.2
	-8.16	1	1.2
	-8.00	2	2.4
	-7.14	1	1.2
	-6.67	1	1.2
	-5.56	2	2.4

⇦ 50th percentile cut-off; change < 0

50th Percentile (absolute value): 13.04%

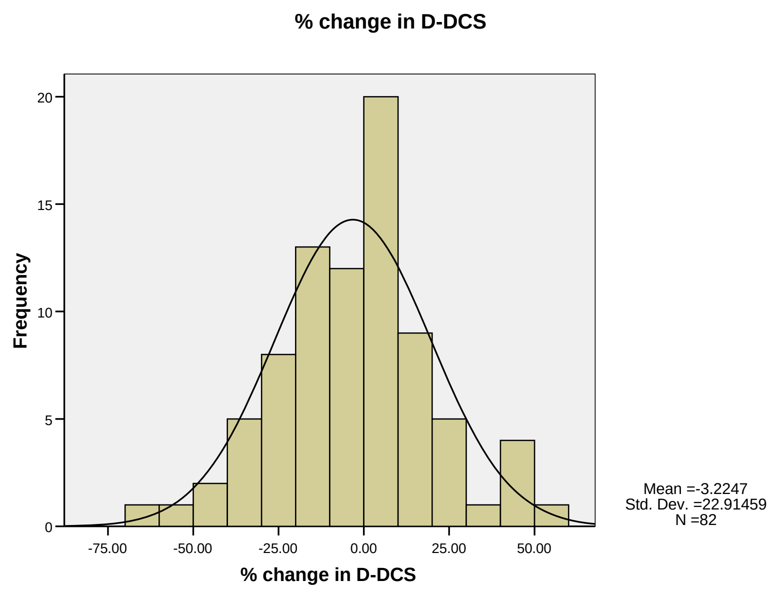


Figure 1. Frequency distribution of percent change in D-DCS Scores

	Frequency	Percent
-2.78	1	1.2
-2.50	1	1.2
-2.17	1	1.2
.00	4	4.9
1.77	1	1.2
1.96	1	1.2
2.33	1	1.2
2.86	1	1.2
4.00	2	2.4
4.44	1	1.2
4.55	1	1.2
4.65	1	1.2
5.13	1	1.2
5.56	1	1.2
5.71	1	1.2
5.87	1	1.2
7.32	1	1.2
8.00	1	1.2
9.75	1	1.2
10.26	1	1.2
10.71	1	1.2
11.43	1	1.2
12.00	1	1.2
13.04	2	2.4
13.64	1	1.2
15.63	2	2.4
22.58	1	1.2
23.08	1	1.2
24.24	1	1.2
25.93	1	1.2
29.17	1	1.2
30.30	1	1.2
40.90	1	1.2
42.31	1	1.2
43.59	1	1.2
49.11	1	1.2
59.26	1	1.2
Total	82	100.0

⇐ 50th percentile cut-off; change > 0 (between 12.00 and 13.04)

Night DCS Percent Change Scores

Table 2: Night DCS % Change Scores **50th percentile (absolute value): 22.54%**

	Frequency	Percent
-96.00	1	1.2
-95.45	1	1.2
-73.58	1	1.2
-68.97	1	1.2
-64.29	1	1.2
-57.58	1	1.2
-57.15	1	1.2
-55.17	1	1.2
-54.55	1	1.2
-54.24	1	1.2
-52.38	1	1.2
-50.00	1	1.2
-48.87	1	1.2
-47.62	1	1.2
-45.10	1	1.2
-44.74	1	1.2
-38.46	1	1.2
-36.11	1	1.2
-35.85	1	1.2
-34.62	1	1.2
-33.04	1	1.2
-32.14	1	1.2
-28.57	1	1.2
-27.03	1	1.2
-23.73	1	1.2
-22.95	1	1.2
-20.00	2	2.4
-18.87	1	1.2
-18.37	1	1.2
-17.78	1	1.2
-17.24	1	1.2
-15.13	1	1.2
-14.29	1	1.2
-13.73	1	1.2
-12.50	1	1.2
-9.80	1	1.2
-9.68	1	1.2
-7.89	1	1.2
-6.25	1	1.2
-3.51	1	1.2
.00	4	4.9

⇦ 50th percentile cut-off; change < 0

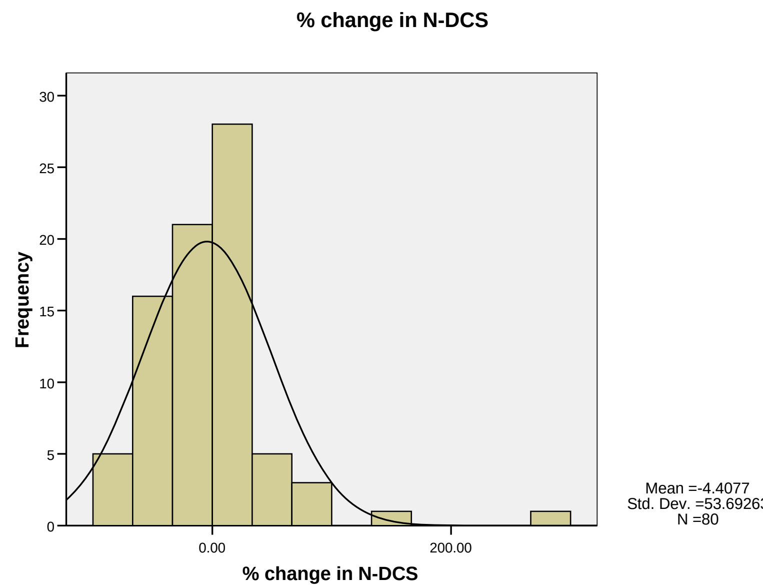


Figure 2. Frequency distribution of percent change in N-DCS scores

		Frequency	Percent
	1.61	1	1.2
	3.13	1	1.2
	3.13	1	1.2
	3.64	1	1.2
	4.17	1	1.2
	6.67	1	1.2
	7.41	1	1.2
	8.10	1	1.2
	8.11	1	1.2
	8.33	1	1.2
	9.09	1	1.2
	10.53	1	1.2
	13.33	1	1.2
	13.79	1	1.2
	15.22	1	1.2
	15.38	1	1.2
	20.00	1	1.2
	21.21	1	1.2
	21.82	1	1.2
	23.26	1	1.2
	26.67	1	1.2
	26.83	1	1.2
	29.41	1	1.2
	32.35	1	1.2
	40.00	1	1.2
	43.24	1	1.2
	43.75	1	1.2
	53.85	1	1.2
	56.25	1	1.2
	69.23	1	1.2
	73.90	1	1.2
	76.19	1	1.2
	141.00	1	1.2
	300.00	1	1.2
	Total	80	97.6
Missing	999.00	2	2.4
Total		82	100.0

⇦ 50th percentile cut-off; change > 0 (between 21.82 and 23.26)

Appendix J: Diagnostic Plots for Multiple Regression Analyses

Plots for Follow-up Frequency

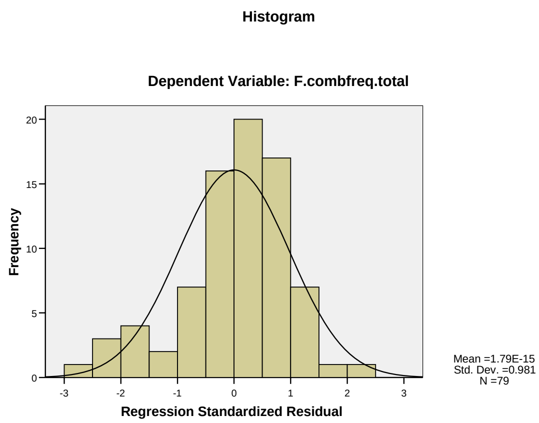


Figure 1. Frequency distribution of the Standardized Residuals

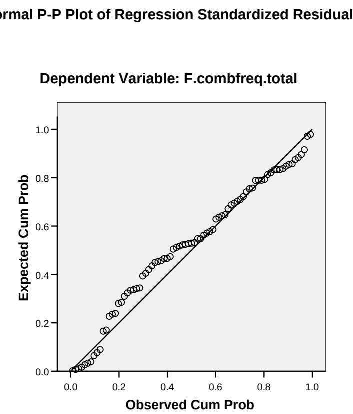


Figure 2. Normal Probability Plot for the Standardized Residuals

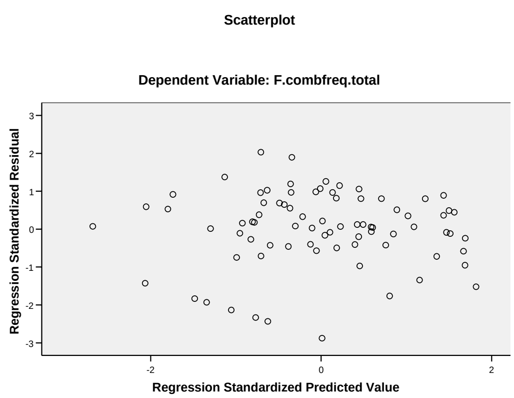


Figure 3. Plot of the Standardized Residuals vs. the Standardize Predicted Values

Plots for Follow-up Driving Avoidance

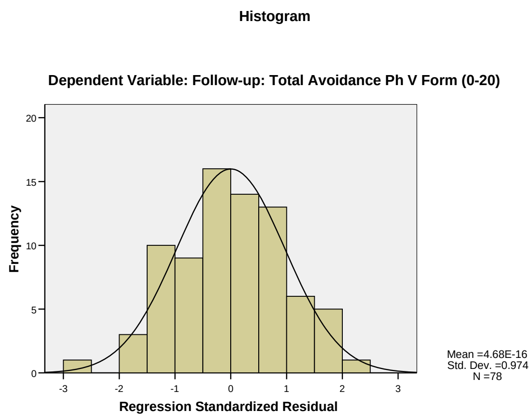


Figure 4. Frequency distribution of the Standardized Residuals

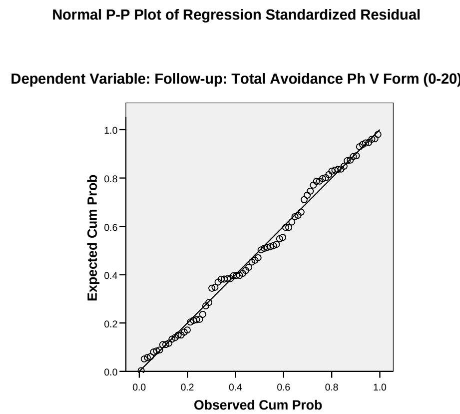


Figure 5. Normal Probability Plot of the Standardized Residuals

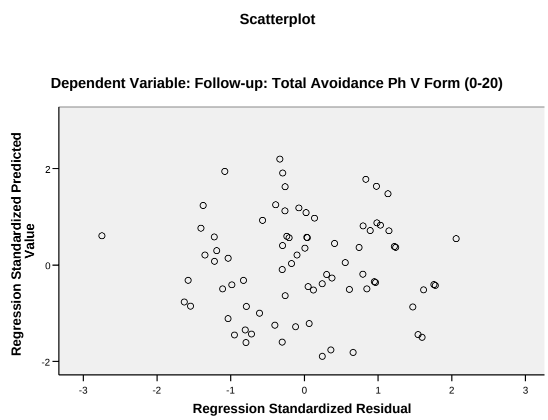


Figure 6. Plot of the Standardized Residuals vs. the Standardized Predicted Values

Appendix K: Information Letter for Physical Assessment Sessions

Driving Comfort Study Letter of Information
(to go on UW letterhead)

Dear Driver,

Thank you for your interest in the Driving Comfort Study. My name is Lisa MacDonald and I am a graduate student at the University of Waterloo. I am doing the present study for my Master's thesis under the supervision of Dr. Anita Myers of the Department of Health Studies and Gerontology. This study is being funded by a scholarship from the Canadian Driving Research Institute for Vehicular Safety in the Elderly.

Last **[date & time of baseline assessment]**, you and others took part in our study at **[name of facility]** where you filled out various forms related to your driving habits and comfort level. Thanks to your help, we have developed the Driving Comfort Scales. Now, we are doing another study which is looking at the relationship between driving comfort levels and driving related abilities.

Participation in this study is totally voluntary and will, in no way, affect your license renewal now or in the future. This study entails 2 parts: (1) completion of questionnaires; and (2) physical assessments. **The questionnaires** involve the rating of driving comfort level and patterns, and are included in this package. This should take about 15 minutes of your time. The questionnaires are completed before the physical assessment session. We ask that you try and complete these questionnaires on your own and bring them with you to the physical assessments session. If you have any questions, we can discuss them at the session.

The physical assessment session involves doing seven exercises, each of which will assess a different driving-related ability. For instance, visual acuity, contrast sensitivity and glare sensitivity will be assessed by reading letter charts, similar to what you may do with your eye doctor. Lower body mobility is assessed by doing a short (20 foot) walking test. Each exercise will be clearly explained to you beforehand. The session should last between 45 to 60 minutes. If you choose to participate in the study, a physical assessment will be done on **[date & time] in [name of room].** If this time is not suitable for you, please call Lisa at (519) 888-4567 extension 37030. The abilities to be assessed and how they are assessed are described in Attachment 1, entitled "Assessment of Driving-related Abilities".

It is totally up to you whether you want to complete the rating forms or participate in any of the physical assessments. You may withdraw from the study at any time. Your name will only appear on the consent forms which will be kept secure (in a locked cabinet) and separate from the data. All consent forms and questionnaires will be destroyed three years after publication of the findings. We certainly will keep all information totally confidential. No individual will be identified by name in my thesis or other reports. Results will be summarized across several groups in the project.

You will be given a copy of your results to take home with you, which will tell you your score for each exercise (e.g. time taken or number of errors) and how this score compares to other older drivers. These assessments should be considered only preliminary and it is best to consult with a health care professional (e.g. doctor, optometrist or occupational therapist) if you have any concerns about your driving abilities. If you are concerned about driving home, we will call someone to pick you up or arrange a taxi.

This study may provide you with information about your driving-related abilities. In addition, the information from this study will, hopefully, help us to better understand the issues important to older drivers themselves. As a result, both driving counselors and health care professionals will be better able to offer support and guidance.

This project has been reviewed and has received ethics clearance from the Office of Research Ethics at the University of Waterloo. If you have any questions, please contact me at (519) 888-4567 extension 37030.

Sincerely,

Lisa MacDonald
Dept of Health Studies & Gerontology
University of Waterloo

If you have concerns about your participation in this study, you can also contact the Office of Research Ethics at the University of Waterloo at (519) 888-4567, ext. 36005.

Assessment of Driving-related Abilities

1. **Visual Acuity** – helps you to see road signs and spot hazards on or near the road.

Assessment: Participants read a visual acuity chart while standing at a distance of 4 metres. The visual acuity chart has rows of letters printed in lines that decrease in size.

2. **Contrast Sensitivity –** enables you to see curbs and medians and drive safely in rain, dusk, haze, fog and at night

Assessment: Participants read a contrast sensitivity chart while standing at a distance of 1 metre. The chart has rows of letters that decrease in contrast (appear fainter).

3. Glare Sensitivity – heightened sensitivity to glare can make it difficult to see when there is glare from lights, wet roads or when the sun is too bright

Assessment: Participants read a visual acuity chart while looking through a Brightness Acuity Tester (BAT). The BAT is a hand-held instrument that is placed over the eye and produces glare.

4. Visual Attention – allows you to pay attention to what is in front of you while also detecting threats at the edge of your field of view

Assessment: Involves using a computer program called "The Useful Field of View Test". Participants are asked to identify and locate various objects on the computer screen. *Prior computer experience is not necessary for this assessment.*

5. Executive Skills – help you to make quick driving decisions and adapt to different driving conditions

***Assessment*:** First, participants connect the numbers 1 to 25 on a sheet of paper by drawing a line between each number with a pencil. On another sheet of paper, participants then connect numbers and letters in alternating and sequential order by drawing a line with a pencil.

6. Brake Reaction Time – enables you to respond quickly in emergencies

Assessment: Participants sit in a chair with a gas and brake pedal on the floor in front of them and are asked to depress the brake pedal when they see a red light.

7. **Lower Body Mobility –** helps you to control the gas and brake pedal and safely get in and out of your car

Assessment: Participants are asked to walk 20 feet as fast as they feel safe and comfortable doing.

Appendix L: Protocol for Physical and Cognitive Assessments

Participant ID: **Date:**

A. Advanced Preparation

1. Call facilities 24-48 hours in advance. Confirm room booking.

2. Call participants 24-48 hours in advance. Confirm attendance and location of physical assessment. Remind them to bring their usual distance and reading glasses.

3. Checklist of materials to bring:

- Consent forms, participant certificates, feedback sheets
- Extras: Information letter, DCS, Rating forms, Background questionnaire
- Calculator
- Vision:
  - 2 Pelli-Robson (PR) charts
  - 2 ETDR charts
  - BAT
  - Light metre
  - Collapsible stand
  - Occluder
  - Desk lamp(s)
  - Tape measure and masking tape
- Cognition
  - UFOV software
  - Laptop & mouse & mousepad
  - Extension cord
  - Trail making test sheets
  - Pencil
  - Stopwatch
- Psychomotor:
  - Tape measure and masking tape
  - Reaction time equipment

B. Set-Up:

Vision

- ETDRS Chart: measure distance of 4 metres (13 feet); mark with masking tape
- Pelli-Robson Chart: measure distance of 1 m (3.28 feet); mark with masking tape
- Place occluder and BAT nearby
- Measure and record luminance

Cognition

- UFOV Subtest #2: set up laptop and open UFOV Subtest #2 program
- Trail Making Test: place templates on table with pencil and stop watch nearby

Psychomotor Skills

- Rapid Paced Walk: Measure 10ft walking path and mark with masking tape
- Brake Reaction Time:
    - Set up equipment and make sure time display is facing away from the participant.
    - Measure and place foot pedals a distance of 3 feet from the light stimuli (also mark the distance with masking tape

C. Orientation and Consent

- Introductions and collect completed questionnaires.
- Review study purposes (as in information letter) and sequence of day's events
- Explain consent forms and provide an opportunity for questions. Remind that consent forms will be kept secure and separate away from the study results. Collect consent form and ensure that participant has provided signature.
- Explain feedback sheet (to be given at end of session).
- Ask if there are any further questions or concerns.

D. Physical Assessment

Record Start Time:______________________

VISION

luminance of chart plane: ____________

1. Visual Acuity (VA)

A. **Monocular VA Right Eye:** ETDRS Chart 1

- Instruct participant to stand at 4 m marker and put occluder over left eye. Make sure participant is wearing habitual spectacle correction.
- Rationale*: "This test measures your distance visual acuity which allows you to see road signs and spot hazards on or near the road"*
- Instructions: "*Start with the smallest row of letters that you can see and read the letters out loud. If you are unsure of a letter, try to guess and go on to the next one."*
- Circle letters that are read correctly on the score sheet (below)
- The measurement is stopped when the participant incorrectly reads a line of letters (all letters on the line are read incorrectly).
- Repeat for **Left Eye**, use ETDRS Chart 2

Right Eye

20/200	D	S	R	K	N	1.0
20/160	C	K	Z	O	H	0.9
20/125	O	N	R	K	D	0.8
20/100	K	Z	V	D	C	0.7
20/80	V	S	H	Z	O	0.6
20/63	H	D	K	C	R	0.5
20/50	C	S	R	H	N	0.4
20/40	S	V	Z	D	K	0.3
20/32	N	C	V	O	Z	0.2
20/25	R	H	S	D	V	0.1
20/20	S	N	R	O	H	0.0
20/16	O	D	H	K	R	-0.1
20/12.5	Z	K	C	D	N	-0.2
20/10	C	R	H	D	V	-0.3

Left Eye

20/200	N	C	K	Z	O	1.0
20/160	R	H	S	D	K	0.9
20/125	D	O	V	H	R	0.8
20/100	C	Z	R	H	S	0.7
20/80	O	N	H	R	C	0.6
20/63	D	K	S	N	V	0.5
20/50	Z	S	O	K	N	0.4
20/40	C	K	D	N	R	0.3
20/32	S	R	Z	K	D	0.2
20/25	H	Z	O	V	C	0.1
20/20	N	V	D	O	K	0.0
20/16	V	H	C	N	O	-0.1
20/12.5	S	V	H	C	Z	-0.2
20/10	O	Z	D	V	K	-0.3

Visual Acuity: ________________________ Visual Acuity: ________________________

Habitual Correction Worn? _____________ Habitual Correction Worn?_______________

B. **Binocular VA** – ETDRS Chart 3

- Same procedure as above except do not use occluder.
- Instructions: "*Now we will do the same thing, except both eyes at the same time.*"
- Circle letters that are read correctly on the score sheet.

20/200	H	V	Z	D	S	1.0
20/160	N	C	V	K	D	0.9
20/125	C	Z	S	H	N	0.8
20/100	O	N	V	S	R	0.7
20/80	K	D	N	R	O	0.6
20/63	Z	K	C	S	V	0.5
20/50	D	V	O	H	C	0.4
20/40	O	H	V	C	K	0.3
20/32	H	Z	C	K	O	0.2
20/25	N	C	K	H	D	0.1
20/20	Z	H	C	S	R	0.0
20/16	S	Z	R	D	N	-0.1
20/12.5	H	C	D	R	O	-0.2
20/10	R	D	O	S	N	-0.3

Visual Acuity: _______________________ Habitual Correction Worn? ____________

<u>Scoring</u>

Use interpolated LogMAR score: each letter read correctly is worth 0.02 LogMAR units

Step 1 Determine the last row where the participant correctly identified all 5 letters.

Step 2 Determine the log score for that row (scores are shown in the margin of the ETDRS chart). A lower LogMAR score denotes better visual acuity.

Step 3 Subtract 0.02 log units for every letter that was correctly identified beyond the last row for which all letters were correctly identified. For example, if the participant reads all letters correctly on the row with LogMAR score +0.2, and 2 letters correctly on the row with LogMAR score +0.1, the interpolated LogMAR score is calculated as follows: +0.2 – [2 X 0.02] = +0.16

2. Contrast Sensitivity (CS)

A. **Binocular CS:** PR Chart 1

- Instruct participant to stand at 1 m mark
- Rationale: "*This test measures your contrast sensitivity which affects how well you are able to drive in fog, haze at dusk and at night*"
- Instructions: "*Read the letters, starting in the top left-hand corner and working across (left to right) and down. If you are unsure about a letter, give your eyes about 20 seconds to adjust. If you are still unsure, try to guess and go on to the next one.*"
- Circle letters that are read correctly on the score sheet (below)
- The measurement is stopped when all letters in a given triplet are incorrectly identified.

0.00	V	R	S	K	D	R	0.15
0.30	N	H	C	S	O	K	0.45
0.60	S	C	N	O	Z	V	0.75
0.90	C	N	H	Z	O	K	1.05
1.20	N	O	D	V	H	R	1.35
1.50	C	D	N	Z	S	V	1.65
1.80	K	C	H	O	D	K	1.95
2.10	R	S	Z	H	V	R	2.25

Log Contrast Sensitivity: ___________ Habitual Correction Worn? __________

Scoring:
Use by-letter scoring system: each letter read correctly is given 0.05 log units. A high score on the test indicates a high contrast sensitivity (i.e. a low contrast threshold).

3. Disability Glare

A. **Monocular CS RIGHT Eye with BAT OFF**: PR Chart 2

- Procedures are the same as for binocular CS except that the BAT is held over one eye while the other eye is occluded.
- Instruct participants to put eye patch over Left eye and hold BAT over Right Eye. Provide option to use occlude if uncomfortable about using the eye patch.
- Rationale and Instructions: "*Now we will do the same thing, except one eye at a time. This instrument is called a Brightness Acuity Tester and it assesses your ability to see in various glare producing conditions such as headlights from oncoming cars at night or bright sun during the day. Hold this over your eye and look through the small hole to see the chart. First, we will do the test with the Brightness Acuity Tester OFF. Next, we will do the test with it ON.*"
- Circle letters read correctly on the score sheet

B. **Monocular CS RIGHT Eye with BAT ON:** Pr Chart 1

- Prepare them: "*When I turn the BAT ON it will produce a bright light. It will not harm your vision, but you may need a few seconds for your eyes to adjust*."
- Turn on the BAT to the MEDIUM setting.

R BAT OFF

0.00	H	S	Z	D	S	N	0.15
0.30	C	K	R	Z	V	R	0.45
0.60	N	D	C	O	S	K	0.75
0.90	O	Z	K	V	H	Z	1.05
1.20	N	H	O	N	R	D	1.35
1.50	V	R	C	O	V	H	1.65
1.80	C	D	S	N	D	C	1.95
2.10	K	V	Z	O	H	R	2.25

Log Contrast Sensitivity: _______________
Habitual Correction Worn? _____________

R BAT ON

0.00	V	R	S	K	D	R	0.15
0.30	N	H	C	S	O	K	0.45
0.60	S	C	N	O	Z	V	0.75
0.90	C	N	H	Z	O	K	1.05
1.20	N	O	D	V	H	R	1.35
1.50	C	D	N	Z	S	V	1.65
1.80	K	C	H	O	D	K	1.95
2.10	R	S	Z	H	V	R	2.25

Log Contrast Sensitivity: _______________
Habitual Correction Worn? _____________

Scoring:
Scoring for the PR Chart is the same as above. Disability Glare is computed as follows:

Disability Glare = PR Score without BAT – PR Score with BAT

C. **Monocular CS LEFT Eye with BAT OFF & ON**

- BAT OFF: Use PR Chart 2
- BAT ON: Use PR Chart 1

L BAT OFF

0.00	H	S	Z	D	S	N	0.15
0.30	C	K	R	Z	V	R	0.45
0.60	N	D	C	O	S	K	0.75
0.90	O	Z	K	V	H	Z	1.05
1.20	N	H	O	N	R	D	1.35
1.50	V	R	C	O	V	H	1.65
1.80	C	D	S	N	D	C	1.95
2.10	K	V	Z	O	H	R	2.25

Log Contrast Sensitivity: _______________
Habitual Correction Worn? _____________

L BAT ON

0.00	V	R	S	K	D	R	0.15
0.30	N	H	C	S	O	K	0.45
0.60	S	C	N	O	Z	V	0.75
0.90	C	N	H	Z	O	K	1.05
1.20	N	O	D	V	H	R	1.35
1.50	C	D	N	Z	S	V	1.65
1.80	K	C	H	O	D	K	1.95
2.10	R	S	Z	H	V	R	2.25

Log Contrast Sensitivity: _______________
Habitual Correction Worn? _____________

PSYCHOMOTOR SKILLS

1. **Brake Reaction Time (BRT)**

- Explanation: *"This test measures your brake reaction time, which is the time it takes for you to move your foot from the gas to the brake pedal."*
- Instructions: (Demonstrate while providing the instructions)
  - "*When I say "GO" push down the gas pedal (on the right)"*
  - *"On top of the box you will see a Red or a Green light" (show both)*
  - *"When you see the Red Light push down the brake as fast as you can"*
  - *"When you see the Green Light don't move your foot*"
- Demonstrate both sequences.
- Instruct the participant to sit in the chair and adjust so that can comfortably reach the pedals.
- Do Five Practice Trials
- Practice Trial Sequence
  - 1 = Red
  - 2 = Red
  - 3 = Green
  - 4 = Red
  - 5= Green
- If no further practice is needed, start testing and record scores.
- Record if participant chose the correct response to the stimuli (i.e. hit the brake when the light was red; did not move foot if light was green) by putting a check in the column labeled "Correct".

Test Trials

Trial	Light	Correct	RT	MT	BRT	Notes
1	Red					
2	Red					
3	Green					
4	Red					
5	Green					
6	Red					
7	Green					
8	Red					

Trial	Light	Correct	RT	MT	BRT	Notes
9	Red					
10	Red					
11	Green					
12	Red					
13	Red					
14	Green					
15	Red					

RT = Reaction Time; MT = Motor Time; BRT = Brake Reaction Time

Average Time: ________________________ Pivot or Lift Leg? __________________

2. **Rapid Paced Walk**

- Rationale: "*This next test measures your length strength and general mobility which is important for controlling the gas and brake pedal and for safely getting in and out of the car"*.
- Participants begin standing at marker. Instructions: "*When I say "GO", walk as fast as you comfortably can to the other marker, turn around and walk back to the starting point Do not stop in between.*" Demonstrate for them.

Time: ___________________ Walker or Cane used? ______________________

<u>COGNITION</u>

1. **Trail Making Test**

- o Rationale: "*This next test is called the Trail Making Test and it measures a group of skills called "executive skills" which help you to make quick driving decisions and adapt to different driving conditions*".
- o **Part A Instructions**: "*On this page are numbers from 1 to 25. Begin at Number 1 (point to 1) and draw a line from 1 to 2 (point to 2), 2 to 3 (point to 3) 3 to 4 point to 4), and so on, in order until the reach the circle marked "end" (point). Do not skip around but go from one number to the next in the proper order. If you make a mistake, mark it out and continue going. Remember to work as fast as you can. Do you have any questions? When I so go, you can begin. GO!"*
- o Start Timing
- o If the participant makes an error, call it to his attention immediately and have him proceed from the point the mistake occurred. Do not stop timing. Errors count only in the increased time of performance.

Part A Time:____________

- **Part B Instructions:** "*On this page are some numbers and letters. Begin at Number 1 (point) and draw a line from 1 to A (point), A to 2 (point to 2), 2 to B (point to B), B to 3 (point to 3), 3 to C (point to C), and so on, in order until you reach the end (point to circle marked "end"). Remember, first you have a number (point to 1), then a letter (point to A), then a number (point to 2), then a letter (point to B), and so on. Do not skip around but go from one circle to the next in the proper order. Draw the lines as fast as you can. Do you have any questions? When I say Go you may begin. GO!*"

Part B Time:____________

2. **Useful Field of View Subtest 2**
   - Rationale: "*This next test measures your visual attention which makes it possible for you to pay attention to what is right in front of you) while also detecting safety threats at the edge of your field of view.*"
   - Assure the participant that level of experience in using computer or mouse will not affect their results on the test
   - **Instructions:** *For this test, you will be asked to do two things:*
     - *(1) Identify whether a car or a truck is shown in the centre of the screen*
     - *(2) Indicate where another figure appears at the edge of the screen.*
     - *Both objects will be shown at the same time and only for an instant*"
   - Go through examples and show them how to use the mouse to select the car or the truck and the location of the object.
   - **Remind the participant:** *You do not have to identify WHAT the figure is on the edge of the screen, JUST WHERE it appears. You have seen examples of the car and truck figures and the locations where they may appear. You will practice this several times before the real test begins."*
   - **Warn the participant:** *the test will get faster and faster as it goes on until you will not be able to see both objects*
   - Start practice trials. Repeat practice if necessary.

Score: ______________

Record End Time: ______________________

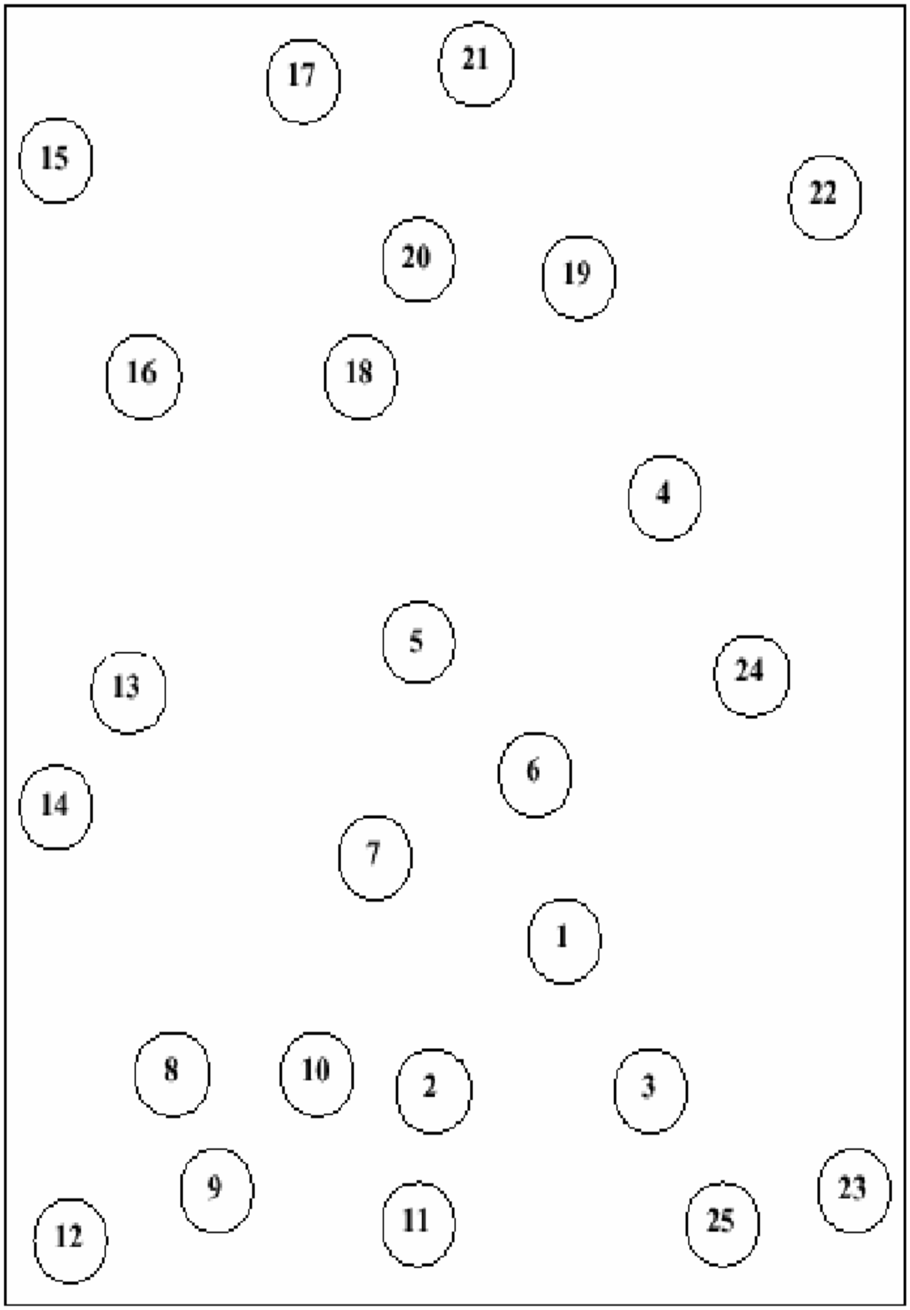
E. Wrap Up:

1. Give the participant his/her results sheet and discuss and questions/concerns. If driving home is a concern, call a taxi, friend or relative to pick them up.
2. Explain consent forms for Permission for Future Studies.
3. Ask if there are any further questions and thank the participant for his/her time.

Appendix M: The Trail Making Test

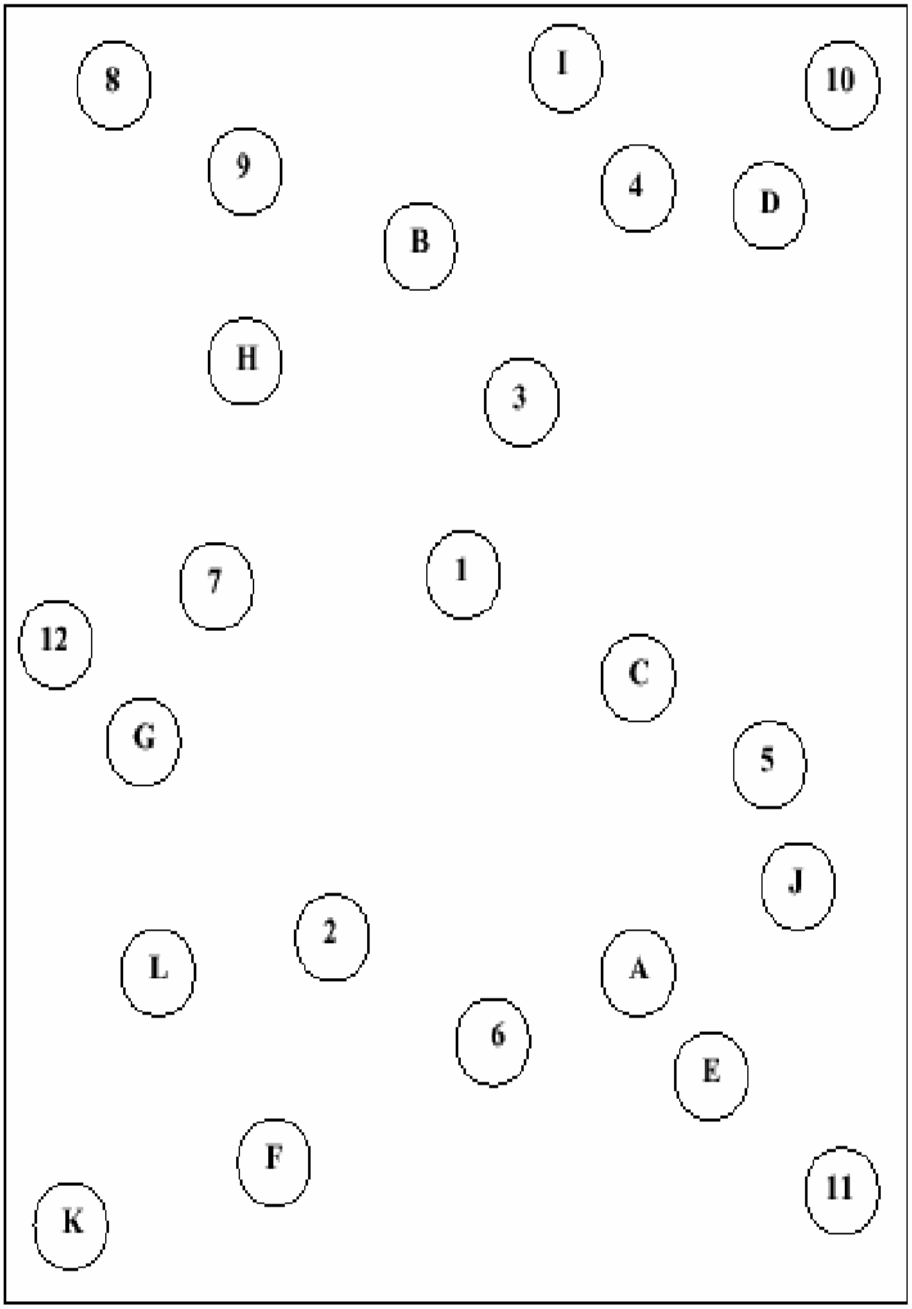
Trail Making (Part A)

Patient's Name: ______________________________ Date: ____________________



Trail Making (Part B)

Patient's Name: ______________________________ Date: ____________________



Appendix N: Results Sheet for Physical and Cognitive Assessments

University of Waterloo Driving Comfort Study

Individual Assessment Results

Measure*	Score	Standard for Comparison
1. Vision – Acuity		20/50 or better
2. Vision - Contrast Sensitivity		Better than 1.25
3. Vision – Glare Sensitivity *contrast sensitivity with glare*		Not Available
4. Brake Reaction Time		Not Available
5. Walk Speed (*lower body mobility*)		9 seconds or faster
6. Executive Skills *(connect numbers & letters)*		180 seconds or faster
7. Visual Attention *(car & truck task)*		353 milliseconds or faster

*Please see below for the name of the assessment tool used for each measure

IMPORTANT: The standard for visual acuity is based on the Ministry of Transportation's guidelines, while the others come from research studies with older drivers, where available. In any case, these field tests are preliminary and do <u>not</u> substitute for complete evaluations by eye care professionals, driving specialists or physicians. If you have concerns in any of these areas, you should see one of these specialists for a more thorough assessment. You will be given a copy of these results to take home.

Assessment Tools:

1. ETDRS Chart
2. Pelli-Robson Chart
3. Brightness Acuity Tester
4. Brake Reaction Time Device
5. Rapid Paced Walk
6. The Trail Making Test
7. UFOV Subtest 2