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Older Driver Self-Screening Based on Health Concerns

Volume II:

Appendices

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Jesse Blatt and Alan Block from NHTSA were the project's Task Order Managers

16. Abstract

The objective of this project was to create a valid and effective self-screening instrument that provided individualized information for older adult drivers. The project intended to improve upon existing self-screening instruments by focusing on health concerns rather than the medical condition or medications that produced the concern, allowing for a much more comprehensive self-screening than has been possible previously. By linking the severity of health concerns to their effect on critical driving skills, the instrument provides five types of individualized feedback: general awareness; self awareness; individualized recommendations for behavioral changes; individualized recommendations for further evaluation; and individualized recommendations for vehicle modifications. Development involved a literature review, expert panel, focus groups, workbook logic, and programming the instrument. The evaluation portion of the study involved administering a questionnaire to 68 older adult participants after they had completed the self-screening instrument. The validation portion of the activity involved statistically comparing participants' results from the self-screening instrument to results from an on-road driving assessment and a series of clinical tests to evaluate cognitive, visual, and psychomotor abilities. Both the clinical evaluation and on-road driving assessment were administered through a driving assessment program operated by the University of Michigan. The results showed that more than three-fourths of subjects indicated that the workbook made them more aware of how changes can affect driving and more than 90 percent thought the workbook information was useful as a reminder. More than one-third of subjects discovered a change in themselves for which they were previously unaware. Large percentages of subjects indicated plans to engage in behaviors to maintain safe transportation with 42 percent planning to change how they drive; 33 percent planning to take a driving refresher course; and 53 percent planning to talk with a doctor. More than three-fourths would use it again in the future; more than 90 percent would recommend it older family members and friends; and 94 percent thought the workbook would serve as a useful way to discuss driving concerns with family members. Overall, subjects' scores on the workbook were significantly correlated with the clinical evaluation scores and on-road driving performance scores. In conclusion, the *SAFER Driving: Enhanced Driving Decisions Workbook* is a useful, valid, and effective self-screening instrument for older adult drivers. The tool is free and in the public domain at: http://www.um-saferdriving.org.

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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

CONTENTS

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APPENDIX A: Annotated References

Alvarez, F.J., & Del Rio, M.C. (1997). Prescribing medication for the driver: Informing the patient on the effect of medication on driving ability. *Proceedings of the 14th International Conference on Alcohol, Drugs, and Traffic Safety*, Mercier-Guyon, C. ed., Annecy, France: Centre d'Etudes et de Recherches en Medecine du Trafic, 1283-1296.

The aim of this paper was to examine the complex relationship between medication and driving ability from the viewpoint of the physicians and pharmacists responsible for treating patients who drive. An overview of assessment procedures for the effects of medication on driving ability is followed by a consideration of how medications are labeled with regard to their effects on driving performance. There is also a focus on factors related to the driver the taking of medication, which define the final relationship between medication and driving performance. The overview discussed a three-tiered system to classify the overall potential for risk of any given medication. This was determined the most promising assessment tool and contained the levels: presumed to be safe or unlikely to produce an effect; likely to produce minor to moderate effects; and likely to produce severe adverse effects or presumed to be potentially dangerous. It was suggested that labeling of these medications should directly coincide with the three-tiered system, and the warning should be indicated according to the specific drug and dosage. The factors that define the relationship between medication and driving performance consist of the person's state of health and driving patterns, while those related to the actual taking of the medication include the appearance of undesirable effects, dosage, polypharmacy, self-medication, and drugs and alcohol which, in combination, determine an individual's overall fitness to drive. The conclusion drawn from the information discussed was that even though there may be warnings on medication packaging or inserts, it is necessary for the physician and pharmacist to offer the patient clear, detailed and comprehensible oral information, concerning not only the pathological process, but also the medication prescribed, possible side effects, and possible interactions with other substances.

American Thoracic Society. (1994). Sleep apnea, sleepiness, and driving risk. *American Journal of Respiratory and Critical Care Medicine*, 150, 1463-1473.

This report reviews evidence related to sleep apnea as a potential risk factor for motor vehicle crashes, and provides recommendations for the roles of physicians, licensing agencies, and drivers in identifying and reducing unintended injury or death. Each member of the Committee on Behavioral Morbidity and Sleep Apnea compiled reference materials relevant to the assessment of driving risk in sleep apnea. A literature search based primarily on MEDLINE was used as an additional information collection method for the report. The report states that the level of apneic activity by itself is not a factor that increases risk.. The risk for impaired driving was highest among sleep apnea patients with both severe excessive daytime sleepiness and historic evidence of motor vehicle crash. Referenced studies addressed various forms of cognitive impairment associated with sleep apnea: general intellectual ability, memory, attention and concentration, complex problem solving, visual and psychomotor performance, and delayed reaction times. There is evidence in the non-demented elderly population that increasing numbers of abnormal respiratory events during sleep are correlated with poor performance in cognitive function. Reviews of automobile accident rates among patients with sleep apnea syndrome concluded that such patients have higher automobile accident rates than other drivers. The Committee came to the conclusion that an ideal evaluative system should be designed to recognize cases of excessive sleepiness as a potential source of impaired driving risk and to facilitate a quantitative assessment of the risk posed by a person who is experiencing excessive sleepiness, including persons with apnea.

Ball, K., Owsley, C., Stalvey, B., Roenker, D.L., Sloane, M.E., & Graves, M. (1998). Driving avoidance and functional impairment in older drivers. *Accident Analysis and Prevention*, 30(3), 313-322.

The purpose of this study was to examine the association between visual and cognitive impairment in older drivers and their avoidance of potentially challenging driving situations. A group of 257 older drivers participated in assessments of visual sensory function, eye health, and cognitive functioning, including the useful field of view test, and completed a structured questionnaire on driving exposure and how frequently they avoided challenging driving situations. The results of the assessments replicated the findings from earlier studies showing that many older drivers limit their exposure to driving situations which are generally believed to be more difficult (e.g. rain, night, heavy traffic, and rush hour). Furthermore, older drivers with objectively determined visual and/or attentional impairments reported more avoidance than those free of impairments; those with the most impairment reported avoiding more types of situations than

other less impaired or non-impaired drivers. Older drivers with a history of at-fault crashes in the preceding five years reported more avoidance than those who had crash-free records. The conclusion made by the authors was that future research should evaluate the potentially beneficial role of self-regulation in enhancing older driver safety, particularly in those older drivers with visual and attentional processing impairments who have elevated crash risk.

Ball, K., & Rebok, G. (1994). Evaluating the driving ability of older drivers. *The Journal of Applied Gerontology,* 13(1), 20-38.

The article focuses on the importance of society's recognition of the risks related to transportation and the growing population of older adults, and how society will meet the needs of that population through training. A study with the goal of testing the original predictive model of crash frequency in older drivers on the basis of visual, cognitive, and attentional measures is utilized. The article includes an empirical evaluation of risk factors from a study involving a sample of participants in seven age groups between 56 and 90 years of age (with a mean age of 71), and in three categories of crash involvement (0, 1-3, 4+ crashes). The participants completed the five parts of the protocol: a battery of visual sensory function measures, a battery of mental status measures, Useful Field of View (UFOV) assessment, a driving habits questionnaire, and an eye health examination. Only two variables, UFOV and mental status, had direct effects on crash frequency, jointly accounting for 28% of its variance. The study's results demonstrate that the effect of visual impairment in the elderly on crash frequency is indirect, mental status does not successfully identify drivers at-risk for crash involvement, and chronological age itself does not successfully distinguish between older drivers having a history of crash problems and those who were crash free. The authors draw the conclusion that any policy to restrict driving privileges based solely on age is not scientifically well-founded. The study suggests that if older adults were better informed about their vision problems, some older adults might voluntarily impose restrictions on their driving behavior, thus lowering their crash risk.

Barbas, N. R., & Wilde, E. A. (2001). Competency issues in dementia: medical decision making, driving, and independent living. *Journal of Geriatric Psychiatry and Neurology*, 14, 199-212.

The purpose of the article was to discuss the physician's role in competency determination of dementia patients, as well as their role in assessment of patients' capacity in decision making related to medical issues, driving, and independent living. After reviewing general ethical principles in medicine and the loss of specific abilities in dementia patients, specific guidelines for physicians were reviewed. These guidelines included cognitive assessment using neuropsychological testing measures to assess visuospatial skills, attention and executive functioning, judgment, memory, and visual attention. In determining driving ability, an occupational therapist who specializes in assessing driving skills was identified as a resource to assist the physician. Using both a driving simulator and road test were considered attractive methods due to their ability to address task-specific characteristics of driving. An assessment of driving knowledge and skill using this type of testing is currently considered the "gold standard" for assessment of driving. This assessment may be challenging for physicians on a moral and ethical level when the physician must balance what may become competing obligations to promote the patient's independence, preserve the fiduciary nature of the physician-patient relationship, and promote the safety of the patient and the public. In addition, many physicians do not know their medicolegal responsibilities in advising patients with suspected dementia regarding driving safety; physicians may receive little or no formal training in regard to the assessment of driving capacity, making it a challenging task. The article looks forward, concluding that work continues in refining neuropsychometric measures, functional assessment instruments, and driving simulators that help assess capacity.

Bauer, M.J., Adler, G., Kuskowski, M.A., & Rottunda, S. (2003). The influence of age and gender on the driving patterns of older adults. *Journal of Women and Aging*, 15(4), 3-16.

The purpose of this study was to investigate the influences of age and gender on the driving patterns of older adults. The method used in this study consisted of having participants age 62 years or older, and were licensed to drive, complete surveys containing 37 questions about driving history, frequency of driving, trip-making behaviors, current driving habits, changes in driving patterns, and two general questions about their overall health. Demographic characteristics included age, gender, residence, living arrangement, and education. The study found that the odds of driving less than every day increased significantly with age and female gender, however no differences were found in the reduction of overall driving. Females were also more likely than men to have stopped or reduced driving under certain adverse conditions, and for elective purposes. The conclusion was that the gender gap may be

narrowing, with social and cultural issues such as security, safety, and identity with driving explaining the existing gender differences.

Bedard, M., Molloy, D.W., & Lever, J.A. (1998). Factors associated with motor vehicle crashes in cognitively impaired older adults. *Alzheimer Disease and Associated Disorders*, 12(3), 135-139.

This study was designed to examine which patient characteristics might be associated with motor vehicle crashes. The method used was that of a retrospective study of driving history over a five year span, for all applicable new referrals to a geriatric clinic specializing in memory and behavior problems. Other information collected included demographics, data from physical exams, data from the Standardized Mini-Mental State Examination (SMMSE), diagnosis using standardized diagnostic criteria, drinking behavior, caregiver information, and patients' driving experience as noted by the caregivers. The following patient variables were chosen for the analysis based on the literature and potential association: gender, age, duration of symptoms, SMMSE, Alzheimer's disease diagnosis, "unsafe" driving (crashes) as reported by the caregivers, "drives alone," "drinks alcohol," and pattern of alcohol drinking. The results of the study showed that 25% of patients who drove alone in the last five years had caregiver-reported crashes, compared to 13% of those who drove only with a passenger. Patients who drove alone were more likely to have spousal caregivers than patients who drove only with a passenger. Thus, cognitively impaired patients allowed to drive alone were more likely to have been involved in crashes than patients not driving by themselves. However, the causal nature of this association cannot be established with this design, so it was noted that prospective studies are required to determine if the presence of a co-pilot represents a safe strategy to extend driving privileges in cognitively impaired older drivers.

Bishu, R.R., Tarawneh, M., McCoy, P.T., & Foster, B. (1992). A predictive model for elderly drivers. Washington, D.C.: 71st Annual Meeting of the Transportation Research Board, January 1992.

This study assesses the relationships of the perceptual, cognitive, and functional abilities of the elderly to driving performance and accident situations in which elderly drivers are over represented. The procedure study administered a battery of psychometric, cognitive, psychomotor, and driving knowledge tests to 109 drivers over the age of 65. Their on-the-road performance was evaluated, and predictive models linking driving performance with the measured variables were developed. The results revealed that peripheral vision, spatial relation, visual memory, and trail-making tests appear to be good predictors of driving ability. The conclusions of this study were that this model is complex and has to be validated with a larger sample size before any generalizations can be made, and that further research is needed to understand the cognitive dimensions of driving.

Bogner, H.R., Straton, J.B., Gallo, J.J., Rebok, G.W., & Keyl, P.M. (2004). The role of physicians in assessing older drivers: Barriers, opportunities, and strategies. *J Am Board Fam Pract*, 17(1), 38-43.

The purpose of this study was to investigate the physician-perceived barriers to assessing older drivers in primary care practice. The procedure used was to have 20 family physicians, whose patients had completed a clinical questionnaire and neuropsychological tests, participate in one of two focus groups. Physicians were asked about barriers to assessing older drivers in primary care and the usefulness of neuropsychological tests for assessing driving ability. A number of themes emerged from the focus groups related to barriers in the assessment of the older driver. Major themes included concerns about being liable for the results of driving related screening, and about patients reacting unfavorably to a driving assessment, including cognitive tests. Physicians uniformly agreed that a protocol to guide driving assessment would be useful. The conclusion of this article was that physicians encounter a number of barriers to assessing older drivers, but recognize the importance of driving within the context of geriatric functional assessment.

Borromei, A., Caramelli, R., Chieregatti, G., d'Orsi, U., Guerra, L., Lozito, A., & Vargiu, B. (1999). *Functional Neurology,* 14(4), 227-234.

The purpose of the study was to examine the fitness and driving ability of Parkinson's disease (PD) patients, and to explore the need for adequate legislation on driving for PD patients. The study included 204 idiopathic PD patients, comprised of 173 men and 31 women (average age 70.6 and 74.2 years, respectively) of whom 51 still drove. Reasons for those who did not drive included concerns of risk expressed by family members and friends, or recommendations of GPs or specialists. The sample was divided into three age groups, and the subjects' reaction times to simple visual and aural stimuli were measured. Scores for various clinical diseases were also examined to determine if an association

between the variables and the number of accidents incurred by PD patients existed, when compared with the healthy population, and with a control group of healthy age-matched subjects (Italian State Statistics Bureau data). The subjects' Webster scale and Crichton Geriatric Behavioral Scale scores, as well as their reasons for using or not using a car were considered. Results showed that the disease stage was markedly more advanced and serious in the group of non drivers than the drivers. The authors suggest that the clinical form of PD, akinetic-hypertonia, is the most disabling symptom as far as driving is concerned. The study concludes that there is a need for precise regulation of the conditions governing the renewal of driving licenses to sufferers of PD. However of all PD patients, only those whose clinical conditions are relatively stable under treatment should be considered as possibly fit to hold a driving license.

Brouwer, W. H., & Ponds, R. W. H. M. (1994). Driving competence in older persons. *Disability and Rehabilitation*, 16 (3), 149-161.

The article's objective was to explore possible changes to reduce aging-related accidents and to make driving more user-friendly for older drivers. Studies of accident characteristics and driving skill in relation to aging and impaired perceptual and cognitive function are referenced as the primary data source. Research results show that there is a distinct increase of fatalities and injuries in drivers over 65 years due to the increase of physical vulnerability with aging, and to the higher incidence of certain types of accidents with severe consequences. Aging-related inadequacies in driving skill and aging-related impairments of sensory, perceptual, cognitive and motor abilities often play a role in the involvement of older drivers in serious accidents. These inadequacies include changes in driving competence (which encompasses driving skill and fitness to drive), aging-related eye diseases, and higher-order visual and cognitive impairments (those include selective attention, visual search and analysis, divided attention, flexibility of attention, and dementia). In the analysis of driving competence of older people, time pressure and requirements for simultaneous activities were singled out as task features which are particularly problematic. Infrastructure modifications beneficial to drivers are those which reduce the speed of cross traffic at intersections, make traffic situations as predictable as possible, and design intersections such that decisions are required sequentially. Measures aimed at the car include side protection, with special attention given to passive safety measures which are optimally sited to the protection of frail elderly. Measures designed to improve older people's driving, such as training, information, counseling, and selection, should be addressed at the individual, or in small groups of people with comparable characteristics. The article concludes that due to older drivers' increased accident and fatality rates, measures need to be taken to reduce aging-related accidents and make driving more safe and user-friendly.

Brown, L.B., & Ott, B.R. (2004). Driving and dementia: A review of the literature. *Journal of Geriatric Psychiatry and Neurology*, 17(4), 232-240.

The purpose of this article was to review the literature on the ability of individuals with dementia to drive. Several factors were identified that may be useful in differentiating between people with dementia who presently remain safe drivers, from those who have progressed to impaired driving. These factors include disease duration and severity, sex, patient self-assessment, family assessment, neuropsychological measures, findings on road evaluations, and driving simulator testing. The approach of the physician to driving and dementia is addressed, including in-office screening, referral for on-road driving assessments, and the potential for physician reporting to state agencies. The conclusion of the authors is that the lack of research regarding intervention because of driving impairment due to dementia is striking. This is particularly so compared to the amount of research that focuses on determining the appropriate timing to terminate driving. Studies are needed to address ways to intervene in the deterioration of such a critical functional ability. The possibility of training very mildly demented drivers should be explored. Taken together, the existing research addresses driving ability in dementia, but does not offer any information on slowing the onset of driving impairment or improving driving abilities.

Carr, D.B. (1993). Assessing older drivers for physical and cognitive impairment. *Geriatrics*, 48(5), 46-51.

This article describes a comprehensive approach to aid in answering the question of whether or not it is safe for an older driver to continue driving. Three skill sets are identified which are needed to be considered a safe driver, including: perception (static visual acuity, the ability to hear, appropriate musculoskeletal movement, and good neuropathic sensory), cognition (consciousness, short-term memory, attention, and visuospatial skills and neglect), and execution (motor skills, coordination skills, joint function, and muscle strength). Medications that could affect driving performance in older drivers are described, such as antihistamines, ophthalmic agents, skeletal muscle relaxants, antihypertensives,

antipsychotics, analgesics, barbiturates, anxiolytics, hypnotics, and narcotics, as well as the use of alcohol. Guidance in identifying an unsafe driver by means of obtaining a driving history, assessing the driving environment, determining the severity of impairment, and intervention with the individual in question is also provided. The conclusion is that even though the automobile is a vital link in maintaining independence, acquiring goods, and socializing, physical or cognitive impairments linked to aging or disease may imperil the driver, passengers, and others on the road. For conditions that cannot be treated successfully enough to permit full driving privileges, modification of the driving environment might be necessary to reduce risk. If that risk is still unacceptable, then one should seek alternate modes of transportation.

Carr, D.B., Duchek, J. & Morris, J.C. (2000). Clinical investigation: Characteristics of motor vehicle crashes of drivers with dementia of the Alzheimer's type. *Journal of the American Geriatrics Society*, 48(1), 18-22.

The objective of this study was to determine whether there is a difference in crash rates and characteristics between drivers with dementia of the Alzheimer's type (DAT), and non-demented older persons. A pilot study using a five-year retrospective analysis of state-recorded crash data and crash characteristics, followed by patient enrollment into a study of road test skills, was employed by the researchers at the Alzheimer's disease Research Center at Washington University in St. Louis. One hundred twenty-one subjects (58 non-demented, older drivers and 63 drivers with DAT) with a mean age of 77 years met the inclusion criteria for this study. DAT was diagnosed using validated clinical diagnostic criteria and was staged by the Clinical Dementia Rating (CDR) scale. All subjects with DAT were in the very mild (CDR = 0.5) or mild (CDR = 1) stages. The main outcome measure was state-recorded traffic crashes. Also, a daily driving diary was completed by each subject and used to estimate miles traveled per year. The results showed that subjects diagnosed with mild DAT reported less roadway exposure than did drivers with very mild DAT or controls. Crashes in both groups were infrequent, with 0.07 state-recorded crashes per driver per year in the non-demented group, 0.06 in the very mild DAT group, and 0.04 in the mild DAT group. There was no statistical difference in the crash frequency between groups, even when adjusting for exposure. Drivers with DAT showed trends toward more at-fault crashes, crashes with injuries, and crashes in which the officer on the scene cited failure to yield. The conclusions of this study were that there may be significant differences between the causes and the consequences of crashes involving drivers with DAT when compared with cognitively intact age-matched controls, but none were found in this pilot study. Further research on crash characteristics is needed in larger samples of community-based drivers with DAT across wider ranges of dementia severity to address issues such as driving competency and public safety.

Christ, R. (1996). Aging and driving: Decreasing mental and physical abilities and increasing compensatory abilities? *IATSS Research*, 20(2), 43-52.

The aim of this study was to describe the suitability to drive of older people, as well as risk factors increasing with age and compensatory strategies. The method for this study was to analyze results of psychophysiological performance tests and driving tests; present guidelines for performance assessment; and propose personality assessment as a necessary information supplement to performance data. The results suggest that under favorable circumstances, the reduction of performance abilities can be compensated for by driving experience, but whether these prerequisites are available or not has to be investigated by means of a comprehensive examination. Traffic psychological performance tests represent a valid tool for assessing the suitability of senior citizens for driving, wherein they are characterized by high discrimination within age groups and show high degrees of correlation with corresponding conspicuous driving behavior. Personality traits can give rise to risks in advanced age as well, but are important prerequisites for compensating for declines in performance. The conclusion reached by this literature review was that more attention has to be paid to the subject of older drivers because their numbers are increasing, and social changes are making this issue more and more important.

Coeckelbergh, T.R.M., Brouwer, W.H., Cornelissen, F.W., van Wolffelaar, P., & Kooijman, A.C. (2002). The effect of visual field defects on driving performance. *Archives of Ophthalmology*, 120, 1509-1516.

The objective of this study was to investigate the effect of visual field defects on driving performance, and to predict practical fitness to drive. This study's methods consisted of the assessment of driving performances of 87 subjects with visual field defects due to ocular abnormalities by way of driving simulation and during an on-road driving test. Outcome measures included the final score on the on-road driving test and simulator indices, such as driving speed, viewing behavior, lateral position, time-

headway, and time to collision. The results gathered from this investigation determined that subjects with visual field defects showed differential performance on measures of driving speed, steering stability, lateral position, time to collision, and time-headway. Effective compensation consisted of reduced driving speed in cases of central visual field defects, and increased scanning in cases of peripheral visual field defects. The authors concluded that subjects with visual field defects demonstrated differential performance on several driving simulator indices, and that reduced speed and increased scanning were valid compensation for central and peripheral visual field defects, respectively. A final note was that predicting practical fitness to drive was improved by taking driving simulator indices into account.

Coeckelbergh, T.R.M., Cornelissen, F.W., Brouwer, W.H., & Kooijman, A.C. (2002). The effect of visual field defects on eye movements and practical fitness to drive. *Vision Research*, 42, 669-677.

This study was designed to measure the relationship between eye movement behavior and practical fitness to drive, to determine whether eye movement characteristics can be used to predict at-risk drivers. The eye movements of subjects with visual field defects due to ocular pathology were monitored while they performed a dot counting task and a visual search task. The results showed that subjects with peripheral field defects required more fixations, longer search times, made more errors, and had shorter fixation durations than control subjects. Subjects with central visual field defects performed less well than control subjects, although no specific impairment could be pinpointed. In both groups a one-to-one relationship was observed between the visual field impairment and eye movement parameters. The conclusion drawn from this study was that the use of eye movement to predict viewing behavior in a complex task (e.g. driving) was limited because none of the eye movement parameters were significantly related to viewing behavior while performing an on-road driving test.

Cohen, H.S., Wells, J., Kimball, K.T., & Owsley, C. (2003). Driving disability and dizziness. *Journal of Safety Research*, 34, 361-369.

The purpose of this study was to examine the relationship between dizziness and difficulty driving as it applies to older drivers with vestibular disorders. The Driving Habits Questionnaire was used in structured interviews with people of several different vestibular disorders, and with healthy subjects. all participants attended the senior author's laboratory, and were diagnosed with either impairments of the peripheral vestibular system and had complained of vertigo, or normal subjects who had accompanied the previously mentioned participants there. The results revealed that patients reported reduced driving skills, especially when visual information is reduced, rapid head movements are used, and specific path integration or spatial navigation skills are needed. People with Meniere's disease and chronic vestibulopathies were most affected by these problems, however participants in all groups reported having to pull off the road due to vertigo. The conclusion of this study was that in general, people with this disorder were aware that their driving performance was not optimal, although some continue to drive even when advised not to by their physicians, because that they had no alternative means of transportation.

Cushman, L.A., (1996). Cognitive capacity and concurrent driving performance in older drivers. *IATSS Research*, 20(1), 38-45.

This study's purpose was to address the question of assessment of older drivers' driving skills and, more specifically, the evaluation of change in drivers' cognitive abilities and how this impacts driver safety. One hundred twenty-three subjects were evaluated by means of detailed laboratory and on-road driving evaluations. Ninety-one subjects were volunteers and reflected the general driving population over the age of 55, while 32 subjects had probable Alzheimer-type dementia (DAT) and were referred by specialty clinics. A series of computer-administered cognitive tests applied to the subjects were found to correlate significantly with driving performance. Most of the same measures were also correlated with age. Among these, a type of selective visual attention (useful field of view) emerged as the best single predictor of driving performance. Other indices of driving difficulty included driver reports of low annual mileage, and drivers' receipt of a recommendation (from anyone) to stop driving. The oldest drivers more frequently failed to meet road-test driving standards, drove fewer annual miles, and used more compensatory strategies. The conclusion from this information is that the safety of older drivers, and of all drivers on the road, is connected at some level to assessment of cognitive functioning and the detection of potential driving problems before a crash occurs.

Decarlo, D.K., Scilley, K., Wells, J., & Owsley, C. (2003). Driving habits and health-related quality of life in patients with age-related maculopathy. *Optometry and Vision Science*, 80(3), 207-213.

The purpose of this study was to characterize the driving habits of people with age-related maculopathy who present to a low-vision rehabilitation clinic, and to examine how driving status relates to vision-specific health-related quality of life. Questionnaires were administered via telephone interview with 126 patients presented to the clinic during the previous year, and were either past or current drivers. Twenty-four percent of the sample reported being a current driver. Compared to those who stopped driving, current drivers were more likely to be male, younger, have better visual acuity and higher scores on the vision questionnaire. The aforementioned drivers drove an average of four days and 10 miles per week, and 50% reported that because of their vision, they had difficulty, or did not drive at all, in the rain, at night, on freeways or interstate highways, in heavy traffic areas, or during rush hour. The conclusion was that some individuals who present to a low-vision clinic with age-related maculopathy do drive, although their driving exposure is low, and they report avoiding challenging on-road situations. Driving status in age-related maculopathy appears to be related to better eye visual acuity and vision-specific health-related quality of life.

Dischinger, P. C., Ho, S. M., & Kufera, J. A. (2000). Medical conditions and car crashes. *44th Annual Proceedings - Association for the Advancement of Automotive Medicine*, October 2-4, 335-346.

The purpose of the study was to identify various conditions which are associated with an increased risk of crash culpability. The researchers obtained documentation of injuries to all drivers hospitalized in the state of Maryland during the period 1994-1996, using hospital discharge records obtained from the Health Service Cost Review Commission (HSCRC), and police reports obtained from the Maryland Automated Accident Report System (MAARS). These data were linked, using probabilistic linkage techniques, to obtain data on all drivers of cars, trucks, or vans admitted to acute care hospitals during this period. A determination of crash culpability is included as part of each police report, and is based on an assessment by the investigating officer. Driver condition, including drinking/drugged status, was also based on police perception. The article also sites previous studies on various conditions that impair drivers such as the prevalence of chronic disease in older drivers. Results show that 17.5% who were hospitalized were aged 60 or older. The diagnostic categories showing positive associations between driver culpability and both blood diseases and genitourinary disorders. The article concludes that though crash risk increases among older drivers, it is not known to what extent this increase is a function of age-related sensory impairments (e.g., decreased vision and hearing) versus medical conditions which are a function of age.

Donnelly, R. E., & Karlinsky, H. (1990). The impact of Alzheimer's disease on driving ability: a review. *Journal of Geriatric Psychology & Neurology*, 3 (2), 67-72.

The objective of the article is to outline potential inadequacies in driving skills that may occur with elderly people in general, and more specifically those with Alzheimer's disease (AD), by reviewing studies that focus on AD and driving. The authors reported that some of the most important age-related changes occur in the visual domain. Static visual acuity drops from an average of 20/30 for 65-year-olds to an average of 20/70 for those older than 65, with a further drop to 20/140 during night driving. Dynamic visual acuity appears to be closely related to an individual's driving record. Among individuals with AD, reduced sensitivity to spatial contrast has been found, even when defects in vision were not primary symptoms. Slower information processing and psychomotor skills, with reaction time as the most important psychomotor factor in driving competency, affect the older driver's responses. In a reviewed study on risk perception, the oldest (and youngest) drivers in the study underestimated driving dangers and overestimated their driving abilities. Another reported area of concern with elderly drivers is the high level of coexisting medical problems and use of multiple medications. Potential inadequacies in the literature related to driving and older individuals with AD specifically, include areas of memory performance, behavioral and cognitive changes, and visual scanning behaviors. Memory problems impact the retention of important knowledge related to driving. In one reported study, most of the crashes involving Alzheimer's disease patients occurred because of mistakes made at intersections, traffic signals, or changing lanes. These types of crashes are often secondary to lapses in attention, errors in judgment, and slowed reaction times, as well as actual perceptual distortions or defects. In another referenced study, where 53 patients were given questionnaires, researchers found that 30% had crashes that had occurred since the original diagnosis of dementia, with an additional 11% causing crashes that they were not physically involved in. Two referenced studies found evidence that almost half of the AD patients and other demented patients they investigated (41% in one study and 47% in the other)

demonstrated decrements in driving skills as measured by crash involvement. The article concludes that the physician's decision regarding older drivers and driving should be taken seriously, and an important recommendation that is fair to the needs, rights, and safety of the patient and society should be made.

Donnelly, R.E., Karlinsky, H.J., Young, M.L., Ridgley, J.N., & Lamble, R.W. (1992). Fitness to drive in elderly individuals with progressive cognitive impairment. Research and Evaluation. Ontario: Road User Safety Office - Safety Planning & Policy Branch, September, 1992.

The purpose of this study was to provide empirical evidence of the driving ability of individuals who are in the mild to moderate stages of progressive dementia, especially Alzheimer's disease. Because there is little research on this problem for guidance, a battery of neuropsychological tests was designed that appeared to be related to abilities necessary for driving a motor vehicle (e.g., maze completion, dementia rating). Such tests might be useful for physicians in assessing the driving abilities of patients with dementia. The battery of tests, a written test of rules of the road, and an on-road driving test were administered to a group of individuals diagnosed as "likely suffering from a progressive dementia," and to a group of healthy elderly control subjects. The mean age for both groups was 70 years. The results exhibited no correlation between any of the carefully selected cognitive function tests and driving performance in either the patients or the healthy elderly control group. The single variable that appeared to predict driving performance was age, but this was true only for the control group. The only reliable predictor of driving performance in the cognitively impaired patients appeared to be the driving performance itself. The conclusion the authors made was that it was recommended that a road test be required when there is concern about a patient's ability to drive. It was also recommended that serious consideration be given to requiring an in-person license renewal, perhaps beginning as early as fifty years of age. The intent is not to penalize the individual driver solely because of group membership, but to systematically evaluate and reeducate according to individual need.

Dubinsky, R.M., Stein, A.C., & Lyons, K. (2000). Practice parameter: Risk of driving and Alzheimer's disease (an evidence-based review). *Neurology*, 54, 2205-2211.

The purpose of this study was to develop a practice parameter regarding driving and Alzheimer's disease (AD), to determine the risk of crashes among those afflicted with the AD. A systematic review of the literature was employed by the authors, wherein they identified well-designed, controlled studies of driving and AD using the National Library of Medicines MEDLINE database. The authors also compared the relative rates of crashes and other performance measurements of driving ability in the populations studied. The results found that driving was mildly impaired in those with probable AD at a severity of Clinical Dementia Rating (CDR) 0.5. This impairment was no greater than that tolerated in other segments of the driving population (e.g. drivers aged 16 to 21, and those driving under the influence of alcohol at a BAC < 0.08%). Drivers with AD at a severity of CDR 1 were found to pose a significant traffic safety problem both from crashes and from driving performance measurements. The conclusion rendered was that in patients with AD who continue to drive, there is clear evidence that there is an increased risk of crashes compared to age-matched controls. The cost to society of driving by individuals with mild dementia needs to be determined. Whether periodic testing of cognitive decline in older individuals can reduce such costs is another question for future research.

Duchek, J. M., Carr, D. B., Hunt, L., Roe, C. M., Xiong, C., Shah, K., & Morris, J. C. (2003). Longitudinal driving performance in early-stage dementia of the Alzheimer type. *Journal of the American Geriatrics Society*, 51, 1342-1347.

The objective of this study is to longitudinally assess on-road driving performance in healthy older adults, and those with early-stage dementia of the Alzheimer type (DAT). The prospective longitudinal study, set in a large urban medical center and its surrounding area, used a sample of 58 healthy controls (CDR = 0), 21 participants with very mild DAT (CDR = 0.5), and 29 participants with mild DAT (CDR = 1). DAT was diagnosed using validated clinical diagnostic criteria and staged according to the Clinical Dementia Rating (CDR) Scale. All participants were administered a standardized on-road driving assessment over repeated times of testing. Results of the study demonstrated that subjects with mild DAT received a rating of not safe on the driving test faster than subjects in the healthy control group, and the survival function of the very mild DAT group fell between those of the mild DAT and healthy groups. A Cox proportional hazards model indicated a significant difference in survival functions between the healthy control group and the mild DAT group after baseline age was controlled for ($P < .001$). Cox regression analysis also indicated that baseline age was a significant risk factor for a rating of "not safe" ($P = .002$). The articles concludes that the study provides longitudinal evidence for a decline in driving performance over time, primarily in early-stage DAT, and supports the need not only for driving assessment, but also for reevaluation of individuals with very mild and mild DAT.

Eddington, D. W., & Frier, B. M. (1989). Type 1 diabetes and driving experience: an eight-year cohort study. *Diabetic Medicine*, 6(2), 137-141.

The driving habits of 250 drivers with Type 1 diabetes were reviewed 8 years after a previous assessment (in 1979), to examine the factors which make diabetic patients cease driving, and to assess the frequency and causes of road traffic crashes in this group of patients. The 187 surviving members of the original 250 were sent a postal questionnaire and asked to provide information about their present driving practices. Fifty-six patients (34%) still held an unrestricted driving license. Twenty-four patients had ceased driving, with 22 of the 24 choosing to do so voluntarily, as their driving skills had diminished with advancing age and ill health. Twenty-five men and 9 women admitted to one or more episodes of hypoglycemia while driving during the 8-year study period. Thirty-nine patients admitted to a total of 55 road traffic crashes since 1979; 9 crashes (16%) were attributed to hypoglycemia. Although dependent on patients' honesty and accuracy of recall, the disclosed crash rates of 4.9 per million miles driven for male drivers, and 6.3 per million miles for female drivers are comparable to the crash rate of non-diabetic driving population of similar age. The re-evaluation also indicated an apparent improvement in the declaration rate of diabetes for driving licenses compared with 1979. The review revealed that diabetic drivers in general have the common sense and social responsibility to stop driving voluntarily as their health declines and diabetic complications progress.

Freedman, M., Decina, L.E., & Knoebel, K.Y. (1986). Analysis of Pennsylvania's driver re-examination program: Final report. Report RR 84-7. Harrisburg, PA: Pennsylvania Department of Transportation: Office of Research and Special Studies.

The purpose of this report is to assess the driver re-examination program which attempts to discover medical and vision conditions that require remediation, restrictions on driving, or withdrawal of operating privileges, especially among drivers age 60 and older. As of 1986, Pennsylvania's driver re-examination program has required physical reexamination and vision tests of approximately 6,000 license holders over age 45 each month. Drivers are selected on a prioritized basis, using age and years since last reexamination as the principal criteria. Vision problems are the most frequent reasons for new restrictions and reexamination failure. Vision testing as part of license renewal at photo license centers was pilot tested and found to be feasible. Improved computer procedures for selection of drivers for reexamination, and for the analysis of reexamination program statistics, were developed and presented in a training session. The conclusion of this report states that the driver reexamination program is effective in discovering medical and vision conditions that require some form of remedial attention, restrictions on driving, or withdrawal of operating privileges, among drivers age 45 and older. The final recommendation is that this program continues to be used in the state of Pennsylvania.

Galski, T., Williams, J.B., & Ehle, H.T. (2000). Effects of opioids on driving ability. *Journal of Pain and Symptom Management*, 19(3), 200-208.

This pilot study was designed to determine the effects of medically prescribed, stable opioid use on the driving abilities of patients with persistent, nonmalignant pain. The research method consisted of sixteen patients with chronic nonmalignant pain on chronic opioid analgesic therapy (COAT), who met criteria for participation in the study. They went through an off-road driving evaluation consisting of a pre-driver evaluation, a simulator evaluation, and behavioral observation (which has been shown to be sensitive to predicting on-road driving performance). Patients in the COAT group were compared to a historical control group of cerebrally compromised patients who had undergone the same evaluation and then passed or failed an on-road, behind the wheel evaluation. Results revealed that COAT patients generally outperformed the cerebrally compromised patients as a group, however, COAT patients had a generally poorer performance on specific neuropsychometric tests in the pre-driver evaluations, even though the scores were not statistically significant and did not reflect domain-specific deficits. Behaviorally, the COAT patients were superior, however they had greater difficulty in following instructions as well as a tendency toward impulsivity. The conclusion that was reached from this research was that while there was general support for the notion that chronic opioid analgesic therapy did not significantly impair the perception, cognition, coordination, and behavior measured in off-road tests (that have been regarded as requisite for on-road driving), methodological problems may limit the generalizability of results. Recommendations were also made for future research beyond a pilot study.

George, C. F. P., & Smiley, A. (1999). Sleep apnea and automobile crashes. *Sleep*, 22(6).

The study objective was to determine the rate of automobile crashes in a large population of obstructive sleep apnea (OSA) patients, using objective data from the Ministry of Transportation of Ontario (MTO). Cases of OSA patients from an academic sleep disorders clinic and laboratory were a priori divided into

groups based on apnea-hypopnea index (AHI), and driving records were obtained from the MTO. Age and sex matched controls were selected at random from drivers in the MTO driver database who hold passenger vehicle licenses. Analysis was restricted to drivers with the same license class. The primary outcome measure was a crash in the five years preceding diagnosis, and the secondary outcome measure was a citation during the same period. Resulting figures report that there were 155 of 460 OSA patients with one or more crashes, compared with 150 of 581 controls for the same time period. The rate of crashes per year, for the preceding five years, was 0.7±0.14 for controls, versus 0.09±0.14 for OSA patients. This difference could be accounted for by an increased crash rate in OSA patients with the highest AHI. OSA patients had twice as many citations as controls, although the types of citations were the same. The study confirmed that OSA patients have more crashes than age and sex matched controls. Increased automobile crashes in OSA patients may be restricted to cases with more severe apnea.

Gilhotra, J.S., Mitchell, P., Ivers, R., & Cumming, R.G. (2001). Impaired vision and other factors associated with driving cessation in the elderly: the Blue Mountains eye study. *Clinical and Experimental Ophthalmology*, 29, 104-107.

The aim of this study was to review vision and other factors associated with the cessation of driving. Methods for the study included gathering detailed demographic information, driving status, and medical history, as well as measuring visual acuity during a standardized refraction test, while also documenting visual fields. The results showed that among the 3,654 eye study participants, 77.5% had driven a motor vehicle in the past, of whom 84% said they were current drivers, and 16% said they had stopped driving. Older people and women were found to be more likely to have stopped driving. After adjusting for age and sex, sensory impairment affecting vision and hearing, plus chronic medical conditions and benzodiazepine use, were significantly associated with cessation of driving. In conclusion, it was found that sensory impairment, especially when vision is affected, was associated with the decision to stop driving by older subjects.

Grellner, W., Rettig-Stürmer, A., Kühn-Becker, H., & Wilske, J. (2002). Daytime sleepiness and traffic-relevant psychophysical capability of patients with chronic pain under long-term therapy with opioids. Montreal: Proceedings of the 16th International Conference on Alcohol, Drugs, and Traffic Safety, 2002.

The purpose of this study was to determine whether patients under long-term therapy with oral opioids suffer from impairments related to driver fitness. Twenty ambulant patients with malignant and mainly non-malignant pains, 12 males and 8 females, with an average age of 50.6 (± 10.4 years) were included on a voluntary basis. They were treated with opioids of the WHO-stages II (n = 9) and III (n = 11). The test persons were required to pass a computer-assisted test battery examining psychophysical parameters such as capacity, reaction time, and alertness. Pupillographic sleepiness testing (PST) was performed twice (for the objective evaluation of daytime sleepiness), before and after the test battery. The test group of opioid patients showed significantly below average results in correct and omitted reactions in the determination test, as well as in reaction time and motor time (in the complex reaction test), when compared to that of normal persons. Patients under opioids WHO III exhibited test results that were significantly below the average in a greater number of testing methods than persons with opioids WHO II. The results suggest that patients under long-term opioid therapy show a significantly elevated daytime sleepiness that increases after permanent performance. Psychophysical testing showed considerable prolongation, especially in complex reaction tests, with marked deficits in patients under opioids of WHO-stage III. Some of the patients tested may therefore tend to fail in critical traffic situations or may not be able to meet all driving requirements. The conclusions stated that driver fitness of opioid patients should be finally judged only after careful additional examinations in each single case.

Gudgeon, A.C., & Hindmarch, I. (1980). The effects of 1,4 and 1,5 benzodiazepines on aspects of car driving behavior: A preliminary investigation. *Human Factors in Transport Research*, Academic Press, London, England, 305-310.

The purpose of this study was to compare the effects of repeated doses of clobazam, a 1,5 benzodiazepine derivative, and lorazepam, a 1,4 benzodiazepine derivative, against a placebo on objective tests of psychomotor performance, “on road” assessments of car driving skills, and subjective evaluations of mood and drug induced side effects. The subjects in this study took the medications three times daily for three days, then on the fourth day took a dose one half hour before tests took place. The study found that the lorazepam produced a significant impairment on car driving tasks, and analogue rating scales of subjective alertness, while the Clobozam produced deficiencies in neither. These findings

indicate that there are important differences in these two drugs related to aspects of psychomotor performance and car driving behavior.

Hakamies-Blomqvist, L., Sirén, A., & Davidse, R. (2004). Older drivers – a review. VTI rapport 497A, 2004. Swedish National Road and Transport Research Institute.

This report provides a review of older drivers, with special emphasis on older drivers' needs for safety and mobility, issues of the older driver population heterogeneity, infrastructure developments, and specifically of the older old drivers (aged 75+). The segment of the population over age 65 will grow from about 15% in 2000 to about 30% in 2050; however, older drivers as a group, are driving equally as safe as younger, experienced drivers, and therefore do not constitute an increased risk for their fellow road users. The authors do not believe that screening older drivers based on age is an effective measure for increasing traffic safety. Rather they believe that compared to other modes of transportation, driving is safe. Traffic safety should be viewed in a public health perspective in order to balance the legitimate demands of the aging citizens, concerning both mobility and safety, because due to their frailty, there is an increased risk of injury or death among older drivers when a traffic crash occurs. The final suggestion from the authors is that mobility of aging citizens can be improved by supporting continuation of driving, especially for older women, as well as by improving the design of cars and roads.

Homann, C. N., Suppan, K., Homann, B., Crevenna, R., Ivanic, G., & Ruzicka, E. (2003). Driving in Parkinson's disease - a health hazard? *Journal of Neurology,* 250, 1439-1446.

The objective of the study was to determine whether Parkinson's disease (PD) patients in general, and those on dopaminergic medication in particular, are especially prone to cause severe automobile crashes, and whether there are PD symptoms or dopaminergic side effects with the potential to compromise driving safety. A literature search utilizing several biomedical databases, the Cochrane Controlled Trials Register, and reference lists of located articles served as the study's data collection method. Data from the identified articles were analyzed in an attempt to draw conclusions relevant to the general PD population. The study suggested that carrying out tasks simultaneously (which tax impaired short-term and non-verbal precognitive memory), as well as their impaired visual, visuospatial and visuoperceptual functions were particularly troublesome for PD patients while driving. The patients' self-perceived problems included motor fluctuations, dyskinesias, difficulty managing pedals, and assessing distance proportions. Conversely, patients often claimed that tremor and dyskinesias reduced in intensity when they focus their attention on driving, thus making driving less difficult and safer. Results showed that despite frequent occurrence of potentially hazardous dopaminergic side effects, such as sleep attacks, and disabling Parkinsonian non-motor and motor disabilities, the analyzed studies suggested that PD patients were not more prone to cause automobile crashes than the rest of the population.

Hunt, L. (2003). Driving and dementia. *Generations*, 27(2), 34-38.

This article provides a summary of the effects that dementia has on the older driver, and how the patient, their family, and their health care professional are required to work together to assess, intervene, and counsel. Demands on attention, memory, problem solving, and information processing make driving a motor vehicle a complex cognitive activity. People with dementia of the Alzheimer's type (DAT) show impairments in these critical areas that make it unsafe for them to drive. Patients suffering from DAT who continue to drive have an annual crash rate of 2.5 times higher than that of older drivers who do not have dementia. The high prevalence of dementia in the growing aging population suggests that increased numbers of cognitively impaired drivers will be on the road. Healthcare and social service professionals need to begin a dialogue with their elderly clients about whether or not they can still drive. They must be knowledgeable regarding state requirements for reporting impaired drivers, and provide counseling to clients and families regarding transportation options. Most importantly, families must be brought into the discussion to develop the best plan that promotes mobility and provides emotional support to the individual.

Hunt, L, Morris, J.C., Edwards, D., & Wilson, B.S. (1993). Driving performance in persons with mild senile dementia of the Alzheimer type. *Journal of the American Geriatrics Society*, 41, 747-753.

The objective of this study was to assess the effect of mild senile dementia of the Alzheimer type (SDAT) on driving ability. A cross-sectional study was used as the experimental design, and healthy subjects, subjects with very mild and mild dementia, as rated by the Washington University Clinical Dementia Rating, were recruited. The methods for measurement were an on-road driving test, scored independently by an instructor blind to the study design and dementia diagnosis of the subjects, and interview based-perceptions of driving ability from the subjects and their collateral sources. Attentional

and visuospatial performances of the subjects were also assessed prior to the road test. The results rendered all of the control and very mild SDAT as "safe" drivers (i.e. passed the on-road test), but 40% of the mild SDAT subjects had driving impairment sufficient to "fail" the road test. Neither subject self-assessment nor caregiver perceptions of driving ability consistently predicted driving performance, while the attentional task performance correlated well with road test results. The conclusions stated that some SDAT subjects retain "safe" driving skills, however, the greater the dementia severity, the greater the likelihood of poor driving ability. A final recommendation was that performance-based evaluations are necessary to properly determine driving skills at present, but attention and other cognitive screening measures should be developed.

Janke, M. K. (1993). Reportable medical conditions and driver risk. *Alcohol, Drugs and Driving*, 9 (3-4), 167-183.

The purpose of the article is to describe the California law requiring physicians to report to the Department of Motor Vehicles (DMV) cases of lapse of consciousness or dementia, and to present the percentage representation of specific conditions reported by physicians. Additionally, literature on the crash risk and driving-related performance of patients with epilepsy, diabetes, sleep disorders, or dementia is reviewed. Lapses of consciousness which may recur have been reportable by law in California since 1939. Reportable conditions include epilepsy, cardiac arrhythmias causing syncope, sudden drug withdrawal, alcoholic blackouts, narcolepsy, and diabetic hypoglycemia, among others. Amendments in 1991 authorized physicians to report any condition, without liability, if they feel that the report would be in the public interest, and amendments in 1998 included Alzheimer's disease and related dementias in the law. Study results show that overall the most commonly reported condition is seizure disorder. Among patients aged 65 or older, seizures and dementia are reported most commonly, with approximately equal frequency. Standardized and unstandardized crash rates prior to departmental hearing show that the crash risk of medically impaired drivers is markedly elevated (generally by a factor of 2 or more) over that of the driving population as a whole. The reviewed literature shows that the accident rate of drivers with epilepsy is approximately twice that of the population as a whole. The anticonvulsant medications taken by epilepsy patients may also impair driving. In a study on driving and patients with diabetes mellitus, it was found that moderate hypoglycemia disrupted steering ability. Sleep disorders are another reportable cause of lapse of consciousness while driving. "Sleep drunkenness" can occur in all excessive sleep disorders causing lack of coordination that and can seriously impair driving ability. Sleep apnea patients tend to have delayed reaction times and difficulty maintaining concentration. Reviewed data on dementia suggest that dementia patients commit driving errors which healthy elderly drivers would be expected to make only rarely, if at all. The DMV guidelines for seizures and dementia will be evaluated to determine their traffic safety and operational effects, with the recognition that inevitably errors will be made in determining who is capable of safe driving, and improvement in assessment methods will lead to a better system of decision making.

Janke, M.K. (1994). Age-related disabilities that may impair driving and their assessment: Literature review. RSS-94-156. Sacramento, CA: California Department of Motor Vehicles, July 1994.

This review, covering literature on age-related disabilities, their assessment, and their effects on driving, represents the initial step in developing an assessment system for identifying and evaluating the driving competency of older drivers with dementia or age-related frailty. Because frailty can be defined as a result of the combined effect of various pathologies superimposed upon the normal physiological changes of aging, emphasis is given to medical conditions which are more characteristic of elderly people. The relationships of these conditions to driving performance and safety are discussed, and non-driving and driving tests relevant to identifying and licensing frail or elderly with early onset dementia are described. There is a brief discussion of licensing and post-licensing control programs for elderly drivers in several jurisdictions, including graded licensing. The conclusion was to suggest a preliminary assessment protocol for identifying medically impaired elderly drivers and evaluating their driving ability.

Keeffe, J.E., Jin, C.F., Weih, L.M., McCarty, C.A., & Taylor, H.R. (2002). Vision impairment and older drivers: Who's driving? *British Journal of Ophthalmology*, 2002, 86, 1118-1121.

The aim of this study was to establish the association between impaired vision and drivers' decisions to stop driving or voluntarily restrict driving, as well as motor vehicle accidents. The study involved a population based survey of driving related questions that determined the prevalence and incidence of eye disease. Eligible participants aged 44 and over were interviewed and underwent a comprehensive ophthalmic examination. The mean age of eligible participants was 62.5 years. The outcomes of interest were the decision to stop driving, limiting driving in specified conditions, and automobile crashes. The

associations between these outcomes and the legally prescribed visual acuity 6/12 (20/40) for a driver's license were investigated. The results showed that people with 6/12 vision were no more likely to have a crash than those with better vision, while older drivers with impaired vision restrict their driving in visually demanding situations, when compared to younger drivers,. The risk of having a crash increased with distance driven, but not with age. The conclusion was that there was no greater likelihood of self reported driving crashes for drivers with impaired vision than those with good vision. While many older drivers with impaired vision limit their driving in adverse conditions, and some drivers with impaired vision stop driving, there are a significant number of current drivers with impaired vision.

Klein, R. (1991). Age-related eye disease, visual impairment, and driving in the elderly. *Human Factors*, 33(5), 521-525.

The aim of this article was to examine age-related eye functioning and disorders, how they affect the visual acuity of the older driver, and to encourage the further development of studies that examine these events effects on driving performance. Decline in visual acuity with aging occurs even in the absence of ocular disease; this decline can be explained by senile miosis, increased light scattering, decreased retinal illumination, and loss of neural cells in the retina and cerebrum. There is also a constriction in the peripheral visual field associated with increased age, which has been attributed to the position of the upper eye lids, eye, and nose; senile miosis; yellowing of the lens; dropout of neuronal cells in the retina and brain; and a delay in reaction time. However, the most important causes of significant decline in visual acuity and visual field are age-related ocular disorders, in which cataract, age-related macular degeneration, open-angle glaucoma, and diabetic retinopathy are most common. These diseases are frequent, and their prevalence increases with increasing age. The conclusion was that most elderly drivers have good visual acuity, however, a number of functional changes occur that may affect driving performance even in the absence of disease. Changes in street sign size, better lighting, and precautions about driving in the dark or in strange environments may benefit these drivers, though costs involved with the environmental changes are uncertain. Periodic driving tests and restrictions on licensure may be indicated for people with age-related eye disease associated with a decrease in visual acuity or visual field,. Finally, more epidemiologic research is needed to describe the incidence, progression, and risk factors for age-related eye disease that affects visual function and ability to drive.

Klein, B.E.K., Klein, R., Knudtson, M.D., Lee, K.E., Danforth, L.G., Reinke, J.O., & Adler, A.M. (2003). Associations of selected medications and visual function: The Beaver Dam Eye Study. *Br J Ophthalmol*, 87, 403-408.

The aim of this study was to investigate the association of drug use and visual function. The procedure was to carry out a cross-sectional population-based study on participants in the 1993-5 examination phase of the Beaver Dam Eye Study. All drugs in current use by study participants were recorded, while performance-based and self-assessed visual functions were obtained at the time of the study evaluation. The main outcome measure was the relation of levels of visual functions to the use of specific drugs. The results showed that many classes of drugs were associated with decreases in at least two performance based visual functions. For example, high blood pressure drugs were significantly associated with poorer best corrected visual acuity, poorer near vision, and poorer contrast sensitivity. Patterns of association for self-assessed visual functions were not as strong, however, use of glaucoma drops and benzodiazepines were associated with poorer self-assessed visual functions in most circumstances cited. The conclusion drawn from these results was that many commonly used medications are inversely associated with visual functions in a middle and older aged population. This may influence the ability to perform complex tasks and quality of life.

Lings, S. (2002). Driving accident frequency increased in patients with multiple sclerosis. *Acta Neurol Scand*, 105, 169-173.

The objective of this study was to assess the influence of multiple sclerosis (MS) on the ability to drive safely. The method was a 10-year historical cohort register-study on 197 patients with MS, and 545 controls individually matched on age, gender, place of residence, and exposure period. The outcome measure was treatment at the emergency department following a crash as a driver of a car. The results revealed that 5 patients and 4 controls had been treated, at the rate per 1000 person-years with exposure being 3.4 times higher in the patients than in the control cohort. The conclusion was that drivers with MS were treated more often than healthy controls at a casualty department after having a road traffic crash. However, drastic consequences regarding the patients' automobile driving should be avoided until these results have been substantiated by further investigation.

Lloyd, S., Cormack, C. N., Blais, K., Messeri, G., McCallum, M. A., Spicer, K., & Morgan, S. (2001). Driving and dementia: a review of the literature. *Canadian Journal of Occupational Therapy*, 68 (3), 149-156.

The article's objective was to explore the effects of normal aging and cognitive impairment on driving safety, and to offer suggestions to improve the overall approach to evaluating driving safety. A literature review and an examination of assessment tools used to assess driving ability was conducted. The role of health professionals in driver assessment was also reviewed. The researchers found that normal age-related changes such as slowed reaction time, decreased attention, changes in vision, reduced strength, and hearing difficulties may all have an impact on driving safety. Higher numbers of chronic conditions such as arthritis, dementia, respiratory difficulties, diabetes, stroke, Parkinson's disease and arrhythmias increase the incidence of automobile crashes in older adults. Specific drugs such as benzodiazepines and tricyclic antidepressants are often used to treat common ailments in the elderly; these drugs as well as polypharmacy can contribute to poor driving performance. The specific driving-related deficits associated with dementia include deficits in memory, visual perception and visuo-spatial skills, impairments of visual information processing, as well as attention, judgment, and lack of insight into impairments. The assessments used to examine driving ability in people with dementia included S.A.F.E.D.R.I.V.E (Safety record, Attention, Family members' report, Ethanol use, Drug profile, Reaction time, Intellectual impairment, Visual acuity and Executive functioning), Folstein Mini Mental State Exam (MMSE), tests of spatial relations, tests of attention, tests of judgment, driving simulators, on-road tests, and DriveABLE. Of these tests, DriveABLE was the most effective driving evaluation to date to predict driving safety in this population. The article concludes that there is little correlation between the in-office tests (paper and pencil, computerized and driving simulators) and driving safety. It is imperative that health care professionals find methods to identify at-risk drivers with dementia and link them with alternative forms of transportation.

Lundberg, C., Caneman, G., Samuelsson, S-M., Hakamies-Blomqvist, L., & Almkvist, O. (2003). The assessment of fitness to drive after a stroke: The Nordic Stroke Driver Screening Assessment. *Scandinavian Journal of Psychology*, 44, 23-30.

This study was designed as the Scandinavian equivalent to the British Stroke Driver Screening Assessment (SDSA), which is a set of four simple cognitive tests to evaluate driving fitness in stroke patients. To test its usefulness in a Scandinavian context, tests were adapted and a group of 97 stroke patients from Sweden and Norway were assessed using a driving test as the criterion. When results were calculated according to the original method, based on a discriminant function, less than 70% of the participants were correctly classified. To improve the predictive power, a new discriminant function was performed using the scores of a sub-sample of 49 patients and validated on the remaining 48. In total, 78% of the patients were correctly classified, but specificity was superior to sensitivity. The conclusion was that the Nordic version of the SDSA is a useful instrument, provided that the test scores are interpreted in a balanced manner, taking into account the possibility of compensatory traffic behavior.

Lundberg, C., Hakamies-Blomqvist, L., Almkvist, O., & Johansson, K. (1998). Impairments of some cognitive functions are common in crash-involved older drivers. *Accident Analysis and Prevention,* 30(3), 371-377.

The study's purpose was to investigate the relationship between limitations in different cognitive functions (measured with a neuropsychological test battery), and traffic moving violations among older drivers. Thirty-seven drivers aged 65 years or more, with temporarily suspended driving licenses were identified; 23 were crash-involved and 14 were not. When compared to 31 controls with clean driving records, crash-involved suspended drivers performed less well on tests of visuoconstructive ability ($p=0.008$), psychomotor speed ($p=0.019$), and visuospatial memory ($p=0.036$). Non-crash-involved suspended drivers did not differ from controls. A combination of three tests (visuoconstructive ability, visuospatial memory, and verbal episodic memory) succeeded in correctly classifying 65.2% of the crash-involved suspended drivers. The results support the idea of cognitive decrements as an important causal factor in crashes of older drivers. The main finding of this study is that drivers who have incurred license suspensions because of crashes have a pattern of selective cognitive deficits, as compared to controls with clean driving records recruited from the general older driving population.

Lundqvist, A. (2001). Cognitive functions in drivers with brain injury: Anticipation and adaptation. Linköping University Medical Dissertations No. 678. Linköping, Sweden: The Swedish Institute for Disability Research, 2001.

The purpose of this thesis was to improve the understanding of which cognitive functions are important for driving performance, investigate the impact of impaired cognitive functions on driving, and study

adaptation strategies for maintaining driving performance after brain injury. Finally, the predictive value of a neuropsychological test battery for driving performance was evaluated. The methods for data collection in this study were test results, rating scales, and questionnaires. In two studies, a qualitative research approach was used to describe the content in the empirical findings. Data were then collected by open-ended interviews. The results deemed cognitive functions, in terms of attentional and dynamic working memory-related functions, relevant for driving performance. Neuropsychological impairments in information processing speed, divided and focused attention, and working memory were associated with limitations in driving performance, especially after brain injury. Qualitative aspects of driving problems, such as impaired orientation, decision-making, confidence, and especially impaired anticipatory attention, appeared to constrain driving performance. A neuropsychological test battery assessing speed of information and attention in terms of working memory predicted driving performance rating. Adaptive strategies, in terms of driving speed adjustments and anticipatory attention, were salient for driving performance after brain injury. In addition, interest in driving, motivation for driving safely, and driving experience appeared relevant for driving performance after brain injury. The conclusion from these results was that cognitive functions, in terms of attentional and dynamic working memory-related functions, are relevant for driving performance. Anticipatory attention was considered a working memory based attentional system, directing the processing resources appropriately between the different information processing components during driving. Thus, anticipatory attention demonstrated qualitatively that working memory is a prominent function in a real driving context.

Lyman, J.M., McGwin, G. Jr., & Sims, R.V. (2001). Factors related to driving difficulty and habits in older drivers. *Accident Analysis and Prevention*, 33, 413-421.

The purpose of this study was to evaluate the association between chronic medical conditions, and functional, cognitive, and visual impairments; as well as driving difficulty, and habits among older drivers. The design of the study was cross-sectional, which utilized participants aged 65 or older who possessed a driver's license in 1996. Information on demographic characteristics, functional limitations, chronic medical conditions, driving habits, and cognitive function were collected via telephone. The three dependent variables used in this study were difficulty with driving, defined as any reported difficulty in three or more driving situations, low annual estimated mileage, defined as driving less than 3000 miles in 1996, and amount of days (three or less) driven per week. The results showed that a history of falls, kidney disease, or stroke was associated with difficulty driving. Low annual mileage was also associated with cognitive impairment. In general, older drivers with a functional impairment were more likely to drive less than four days per week, as well as those older drivers with a history of cataracts and hypertension. Subjects with visual impairments were not only at an increased risk of experiencing difficulty driving, but also drove a low number of days per week. The conclusion was that the results underscore the need to further understand the factors negatively affecting driving independence and mobility in older drivers, as well as the importance of improved communication between older adults and health care professionals regarding driving.

MacLeod, K. M. (1999). Diabetes and driving: towards equitable, evidence-based decision-making. *Diabetic Medicine*, 16. 282-290.

The article draws from the British Diabetic Association's report examining and interpreting the available evidence of crash risk in insulin-treated diabetic patients, particularly relating to unexpected hypoglycemia, to evaluate the need for further driving restrictions on these patients. Several articles and studies were reviewed and served as the primary data collection method for the article. Results demonstrated that the acute metabolic disturbances of hyperglycemic or hypoglycemic decompensation and the diabetes-specific small vessel complications (diabetic retinopathy, nephropathy, and peripheral neuropathy) or diabetes-accelerated large vessel complications (ischemic heart disease, peripheral vascular disease and cerebrovascular disease) can all impact driving performance. Moderate but not mild hypoglycemia was associated with disrupted steering ability. Patients with diabetes, and particularly those treated with insulin, are at increased risk of hypoglycemia, and hypoglycemia can result in road traffic accidents. However, in multivariate analyses, the crash rates did not differ significantly between the diabetic and non-diabetic groups, possibly due to self-imposed driving restrictions by diabetics. The article's review of available evidence suggests that increasing the driving restrictions imposed on all insulin-treated diabetic drivers is unlikely to result in a significant improvement in road-safety. The extension of a blanket-restriction to all drivers with insulin-treated diabetes is not supported by the available scientific evidence.

Maes, V., Grenez, C., Charlier, C., Smet, H., Verstraete, A., & Wennig, R. (1999). Classification of medicines according to their influence on driving ability. *Acta Clinica Belgica*, Supplement 1999-1, 82-88.

The purpose of this paper was to classify certain prescription drugs that could impair driving performance, to serve as a scientific base for health care professionals to guide their patients. To begin the procedure, 179 medicinal drugs from nine therapeutic groups were selected: hypnotics-sedatives-anxiolytics, anticonvulsants, antidepressants, neuroleptics, narcotics, antihistamines, beta-blockers, central stimulants, and antidiabetics. Thereafter, a search for literature data in scientific papers or reviews, and in proceedings of international congresses was initiated. The categorization of the data consisted of a system with seven classes ranging from no effect (I), minor effect (II.1) and moderate effect (II.2), to severe effect (III), completed with respective * categories (I*, II*, III*) for presumed classes with insufficient scientific data. The study's results determined that 24% of all the drugs had effects considered severe, while only 16% were classified as having no effect on driving. Furthermore, in the "no effect" group there were no hypnotic-sedatives, anticonvulsants, antidepressants, neuroleptics, nor narcotic analgesics and antitussives. Effects from seven of the 24 antihistamines, 12 of the 20 beta-blockers, and 9 of the 10 central stimulants were considered negligible. Antidiabetics were not classified however, because of the risk of hypoglycemia with inadequate use. Physicians and pharmacists should use this proposed categorization as a scientific base for guiding their patients, but should also take into account the factors involved for each patient when estimating their driving ability.

Marottoli, R.A., & Richardson, E. (1998). Confidence in, and self-rating of, driving ability among older drivers. *Accident Analysis and Prevention*, 30(3), 331-336.

The aim of this study was to begin exploring the relationship of confidence and awareness, and how those two interact to affect driving safety within a community-based cohort group of older drivers. The procedure in this study was to interview a cohort of older individuals age 77 and older in New Haven, Connecticut, in which different driving situations, self-rating of driving ability, and driving patterns were assessed. A history of crashes, moving violations, and being stopped by the police was available for the preceding six years. Concurrent driving performance was assessed in a sub-sample of 35 participants. Analysis of the information consisted of determining the relationship of confidence and self-rating of driving ability to: (1) each other; (2) driving patterns; (3) adverse driving events; and (4) driving performance. The results found that all participants rated themselves as being average or above average drivers compared to others of their age, with the majority rating themselves as above average. Individuals who rated themselves as "much better" drivers than their peers tended to have higher confidence levels than those who rated themselves as a "little bit better" or the "same" as other drivers. On-road driving performance and history of adverse events were not associated with self-ratings of driving ability. Confidence was associated with driving frequency and mileage, however, it was not associated with age or education. No relationship was found between confidence and driving performance, or a history of adverse driving events. The conclusion drawn was that understanding the relationship of confidence and self-rating of driving ability to driving patterns, adverse events, and driving performance may provide additional insights into identifying older drivers at increased risk for problems, and formulating intervention strategies to help lower risk.

Marottoli, R.A., Richardson, E.D., Stowe, M.H., Miller, E.G., Brass, L.M., Cooney, Jr., L.M., & Tinetti, M.E. (1998). Development of a test battery to identify older drivers at risk for self-reported adverse driving events. *Journal of the American Geriatrics Society*, 46, 562-568.

The objective of this study was to develop a battery of tests that assessed a wide range of functional abilities relevant to driving, yet could be performed in a clinician's office, and to determine which of these tests were most closely associated with self-reported adverse driving events. A probability sample of participants from an urban cohort group was drawn and referred to as Project Safety. The test battery assessed visual, cognitive, and physical abilities potentially relevant to driving, and was administered to the participants at their homes. Outcome measures included the self-report of a crash, moving violation, or being stopped by the police since the inception of the cohort group. The data was analyzed by comparing performance on the elements of the test battery with participants' histories of adverse driving events. The results showed that of the 125 drivers tested, 40% had reported an adverse event in a mean period of 5.76 years before the interview. The elements of the test battery independently associated with a history of events, adjusting for driving frequency, included near visual acuity worse than 20/40, limited neck rotation, and poor performance on a test of visual attention. These findings suggest that it may be possible to identify individuals potentially at risk for self-reported adverse driving events using simple tests of functional ability.

Mayo Clinic. (2003). How aging affects your driving. (November, 2003). *Mayo Clinic Women's Healthsource*, Mayo Clinic.

This article discusses the effects of aging on the body and mind, how that concurrently affects one's ability to drive a motor vehicle, and what aging motorists can do to protect themselves. It is reported that for every mile driven in the United States, people age 65 and older are involved in more accidents than are individuals in any other age group except teenagers, and are 17 times more likely to sustain fatal injuries as a result (when compared to 25 to 64 year olds). Effects of aging on the body that impair driving skills include weaker muscles, stiff joints, and reduced flexibility, which, in turn, makes turning the steering wheel, accelerating or braking, and looking over the shoulder more difficult. Hearing acuity also declines, which can impair the ability to perceive an emergency vehicle's siren or a train at an unmarked crossing. In addition, visual deficits are often the result of cataracts, glaucoma, and macular degeneration, which can make night vision, peripheral vision, and central vision difficult, respectively. The mind also loses acuity as age increases, reducing the ability to concentrate and react quickly, while more serious conditions, such as Alzheimer's disease, make judging space, distance, and the ability to plan ahead problematic. Protective measures for older drivers are provided as well as a checklist to aid in determining the safety risks of a driver if any of the adverse driving situations noted therein are apparent.

McGregor, D. (2002). Driving over 65: Proceed with caution. *Journal of Gerontological Nursing*, August 2002, 22-26.

The purpose of this article was to present findings from recent studies focusing on driving and older adults; physiological changes associated with senescence and how these changes affect driving ability; assessment strategies and areas for in-depth clinical examination; and implications for health care providers. A review of recent studies revealed that the Mini Mental-State Exam (MMSE) might not be enough to assess one's cognitive ability, but that several other problems, such as memory impairment and visuoconstructive impairments, could be equally responsible. The studies also showed that visual acuity, hearing impairments, poor visual attention, limited range of motion, and other health problems as a result of aging could be responsible for a decline in driving performance, however there is no official consensus on what attributes lead to adverse driving events. An easy assessment tool suggested by the author was the mnemonic SAFE DRIVE, which can serve as an initial checklist for assessing the driving capabilities of an older driver. SAFE DRIVE stands for: Safety record, Attention skills, Family reporting, Ethanol (alcohol), Drugs (medications), Reaction time, Intellectual impairment, Visuospatial function, and Executive functions. As a driver ages, there are implications for geriatric nurses and health care providers to ensure that impairments that might affect safe driving are corrected when possible, and if not correctible, proper steps are taken to lessen the social and emotional impact of restricted or prohibited driving. It is also important that geriatric nurses facilitate family discussions about transportation options and support efforts to provide safe, convenient, alternative transportation that meets the needs of the older population. The author concludes that although aging alone does not infer poor driving ability, senescence includes a host of physiological changes that may influence one's driving performance. It is the duty of health care providers to encourage and support the development of accurate methods of evaluation for older drivers and discuss adaptive strategies with older drivers in an effort to maintain their independence while promoting public safety.

McGwin, Jr., G., Chapman, V., & Owsley, C. (2000). Visual risk factors for driving difficulty among older drivers. *Accident Analysis and Prevention*, 32. 735-744.

The study sought to evaluate associations between visual function and self-reported difficulty with driving tasks. Three hundred eighty-four drivers between the ages of 55 and 85 were selected from ophthalmology practices and optometry clinics and formed two groups: a group with cataracts and a group cataract-free. Information on driving exposure and difficulty was obtained via self-report on the driving habits questionnaire (DHQ). Visual functional status of all participants was measured with respect to acuity, contrast sensitivity, disability glare and useful field of view. Cognitive impairment was evaluated using the Mattis Organic Mental Syndrome Screening Examination. The results showed a pattern of difficulty in high-risk driving situations among those with decreased visual acuity and contrast sensitivity, even after adjustmenting for age, gender, weekly mileage, and cognitive impairment. In analyzing the associations between difficulty with driving tasks and visual characteristics, impaired disability glare demonstrated associations with difficulty driving on high traffic roads, during rush hour, when driving alone, and when making left hand turns. Difficulty driving in the rain was the only driving situation associated with impaired UFOV.

McGwin, G. Jr., Sims, R.V., Pulley, L., & Roseman, J.M. (2000). Relations among chronic medical conditions, and automobile crashes in the elderly: A population-based case-control study. *American Journal of Epidemiology*, 152(5), 424-431.

This population-based case-control study was designed to identify medical conditions and medications associated with risk of at-fault crashes among older drivers. The method for this study included 901 drivers aged 65 years and older, 244 of whom were at-fault drivers involved in crashes, 182 not at-fault drivers involved in crashes, and 475 drivers not involved in crashes. Information on demographic factors, chronic medical conditions, medications, driving habits, visual function, and cognitive status was collected. The results showed that older drivers with heart disease or stroke were most likely to be involved in at-fault automobile crashes. Use of non-steroidal anti-inflammatory drugs, angiotensin converting enzyme inhibitors, and anticoagulants was also associated with an increased risk. Arthritis was found to be associated with an increased risk among females as well. On the contrary, calcium channel blockers and vasodilators were found to be related to a reduced risk of crash involvement. The conclusion reached was that the identification of medical conditions and medications associated with risk of crashes is important for enhancing the safety and mobility of older drivers.

Mehta, K.M., Simonsick, E.M., Penninx, B.W.J.H., Schulz, R., Rubin, S.M., Satterfield, S., & Yaffe, K. (2003). Prevalence and correlates of anxiety symptoms in well-functioning older adults: Findings from the Health Aging and Body Composition Study. *Journal of the American Geriatrics Society*, 51, 499-504.

The aim of this study was to determine the prevalence and correlates of anxiety symptoms in the absence of depression in older black and white people. This was a cross-sectional study that utilized a baseline assessment of a biracial cohort of 3,041 community-resident well-functioning men and women aged 70 to 79. The mean age was 74 years, with 52% women and 58% white. Participants were asked about three major anxiety symptoms (feeling fearful, tense/keyed-up, or shaky/nervous) derived from the Hopkins Symptom Checklist. Those who reported at least two anxiety symptoms “a little,” or one symptom “quite a bit” in the past week were considered to have anxiety symptoms. The results showed that anxious symptoms occurred in 15% of older people without depression and 43% of those with depression. Of non-depressed older people, women were more likely to have anxiety symptoms than men, especially white women. After multivariate adjustment, the chronic conditions of urinary incontinence, hearing impairment, hypertension, and poor sleep were associated with a high prevalence of anxiety symptoms. Persons with poorer psychophysical functioning, low personal mastery and the need for more emotional support also had higher rates of anxiety symptoms. The conclusion was that anxiety symptoms are common in depressed and non-depressed older people. Given the high prevalence and coexistence with depressive symptoms, it will be important to conduct longitudinal studies that assess depressive and anxiety symptoms to clarify the direction and influence, and disentangle the health-related consequences of these two conditions.

Mercier, C.R., Mercier, J.M., O’Boyle, M.W., & Strahan R.F. (1997). Validation of relationship of cognitive skills losses to driving performance. Final Report. Ames, IA: Midwest Transportation Center.

The purpose of this project was to validate results of an earlier study of older drivers (Phase 1) by comparing the results of testing drivers (Phase 2) age 20 through 64 with the test results of the older drivers from Phase 1 using the same methodology. Research results from the first phase showed that hypothesized relationships between selected cognitive skills and driving performance were correlated with one another, using a sample of 100 drivers aged 65 and older,. This study utilized a sample of 62 Iowa drivers, age 20 through 64, selected randomly. The participants completed a 114 item questionnaire, plus a 100 item self-report instrument used to develop personality scales. All subjects were also tested for their spatial processing and selective attention skills, which are subsets of cognition. The third part of the study was a driving test on a closed course consisting of a variety performance tasks, planned as part of a continuous sequence of driving situations. The results exhibited enough significant correlations between the cognitive skills tests used, and the driver task performance variables from both studies, to confirm the portion of the study hypothesis relating to cognitive skills. That diminished cognitive skills scores were related to diminished driving safety, and that driving variables that correlated significantly with lower cognitive skill test scores were clearly associated with the potential for crashes, especially at intersections, where a high percentage of crashes involving older drivers occur. Based on this study’s findings, the researchers recommend the use of the Embedded Figures Test (EFT) by trained driver examiners, because it is a reasonable predictor of driving problems that could have serious consequences. EFT also tests a cognitive skill that has a strong age-related component, in that it significantly correlated with age in both studies.

Mori, Y., & Mizohata, M. (1995). Characteristics of older road users and their effect on road safety. *Accident Analysis and Prevention*, 27(3), 391-404.

This paper reports the results of several field surveys on the characteristics of older road users in Japan, and of their traffic crash statistics, along with a systematic and comprehensive approach, based on survey results, for prevention of traffic crashes involving elderly people. The focus of the surveys was the relationship between age and physical/mental functioning; traffic crash characteristics of elderly drivers; driving characteristics of elderly drivers and their intentions to quit driving; feelings of elderly drivers; and characteristics of elderly bicycle riders and pedestrians. The results obtained therein were as follows: the reduced physical and mental functions with advancing age reslulted in inappropriate driving characteristics in elderly drivers, but were not deterministic factors of driving cessation. The driving characteristics have some relation with traffic crashes, as problematic drivers seem to emerge among older drivers. Reduced functions are also related to the occurrence of crashes among elderly people in bicycle riding and walking. As a result of these findings, a systematic and comprehensive approach, consisting of improving road structures, improving road facilities, revising educational systems for traffic safety, and revising the driver's license renewal system was suggested. This approach should be built on two basic concepts: improving the environment and systems so that people can continue to drive as long as possible, and setting up a social system in which quitting driving can be compensated for in some other way. The final note was that cooperation between governmental organizations, within and without the direct administrative authorities and the private sector, are suggested and expected.

Nouri, F. M., Tinson, D. J., & Lincoln, N. B. (1987). Cognitive ability and driving after stroke. *International Disability Studies*, 9(3), 110-115.

The study investigated the relationship between cognitive ability and driving after suffering a stroke. The aim of the study was to produce a screening assessment of cognitive ability which could be carried out on all stroke patients wishing to return to driving. Forty stroke patients who were at least six weeks post-onset were assessed using a battery of cognitive tests, followed by a road test over a set route. Subjects were graded into Pass, Borderline, or Fail categories on the basis of the road test. Cognitive test results were compared across grades of driving performance. The cognitive tests which were most highly related to driving performance were those that involve complex reasoning skills. The tests of vision, visual fields, and choice reaction time do not appear to be related to driving performance. A cognitive screening assessment was suggested that could be used to differentiate between those stroke subjects who would, and those who would not be safe to be tested on the road. Patients who "pass" according to the assessment procedures may not need a road test and can be assumed to be safe to drive. The road test in the form used for the study requires some alteration. It can be seen from the results of the independent researcher's road assessment that a more detailed assessment would differentiate better between the three grades of driving performance. If problem areas for stroke drivers can be identified, then more emphasis could be placed on those in the road test.

Nuthall, A., & Anthony, P. (2003). Road safety and the driver with dementia: shifting the debate up a gear. *Nursing Older People*, 15(1).

The article discusses factors influencing the risk of older drivers with dementia, and poses strategies for managing and minimizing that risk. The article consults existing information from studies related to driving and dementia. The findings indicated that the risk of serious road traffic crashes is increased if an older driver has dementia. The older driver with dementia may face challenges associated with loss of insight into their condition, and its effect on functioning. Dementia affects the ability to judge, respond, and acknowledge hazards or deficits. Some medications used to treat dementia can also create risks. Additional areas of particular importance are processing skills, such as selective visual attention and frontal lobe function. It is crucial that mental health practitioners acknowledge, assess, and address these risks when working with clients and their families. This can be facilitated by the development of policies and guidelines that highlight the issue, structured approaches to risk assessment, and the implementation of practical risk management measures. Strategies to manage risk should be underpinned by a collaborative person-centered approach that balances the rights and autonomy of the individual with the clear need to minimize risk to the driver and other road users.

O'Brien, H.L., Tetewski, S.J., Avery, L.M., Cushman, L.A., Makous, W., & Duffy, C.J. (2001). Visual mechanisms of spatial disorientation in Alzheimer's disease. *Cerebral Cortex*, 11, 1083-1092.

The purpose of this article was to determine whether or not impaired global processing reflects hippocampal damage in early Alzheimer's disease (AD), and whether or not impaired motion processing

reflects later posterior cortical involvement in AD. Subject selection for this study consisted of recruiting patients with probable AD from clinical programs of the University of Rochester Alzheimer's Disease Center, healthy elderly individuals, and healthy students from local colleges. The first set of tests administered were those related to visual discrimination stimuli, in which white dots, manipulated in 6 different motion patterns and 2 types of static patterns, where placed against a black background. The subjects had two buttons to depress to signify motion of the stimulus or positioning of the target feature. The next protocol was psychophysical testing, in which subjects were seated in a dark room and fitted with electro-oculogram electrodes to monitor their eye movement, as visual stimuli were projected onto a screen. The last set of tests was three performance tests, which included a neuropsychological test, an on-the-road driving test, and a useful field of view test. The neuropsychological test was a battery of written examinations relating to general measure of AD, a topographic orientation in simulated route following, and two tests taken from the Wechsler Memory Scale. The on-the-road driving test was applied to AD subjects who held a valid driver's license and had driven in the past 6 months. It consisted of a written road signs test and a driving performance test, conducted by certified driving evaluators who had no prior knowledge of the subjects' diagnosis. The useful field of view test measured visual attention relevant to driving in subjects undergoing driving testing. The results revealed that 36% of AD patients have elevated perceptual thresholds for left/right radial optic flow discrimination which, in turn, is correlated with greater difficulty in visuospatial function and on-the-road driving tests. When local motion cues are removed from optic flow, subjects must rely on the global pattern of function, where it was revealed that 85% of AD patients and 21% of healthy elderly subjects have deficits. This impairment might combine with impaired local motion processing to undermine the alternative perceptual strategies for visuospatial orientation. The conclusion was that the greater prevalence of global pattern deficits suggests that it might precede local motion processing impairments, possibly relating to the sequence of early hippocampal and later posterior cortical damage that is typical of AD.

Ostrow, A. C., Shaffron, P., & McPherson, K. (1992). The effects of a joint range-of-motion physical fitness training program on the automobile driving skills of older adults. *Journal of Safety Research*, 23, 207-219.

The purpose of this study was to investigate the effects of a physical fitness training program on the automobile driving performance of older adults. The research method involved a group of 32 older adults who were assigned randomly, stratified by gender, to either an experimental group who participated in an eight week range-of-motion exercise training program, or a control group. A two (Experimental group/Control group) × three (Testing Session) repeated measures experimental design was used to examine the effects of the eight week training program on subject range of motion, and a field-based assessment of automobile driving skill. Results show that none of the obtained F-ratio values for the interaction of group and test session were statistically significant except for subjects' trunk rotation to the right and shoulder flexibility; the obtained F-ratio for trunk rotation to the left approached statistical significance. Subjects in the experimental group improved on trunk rotation during the first 6 weeks, but showed less improvement during the latter two weeks of intervention. Conversely, the control group deteriorated on trunk rotation during the first 6 weeks. Also, while the control group improved slightly on shoulder flexibility during the course of investigation, subjects in the experimental group improved significantly on shoulder flexibility. For the Automobile Driving On-Road Performance Test (ADOPT), statistically significant interactions were obtained for handling position and for observing. For observing, experimental subjects improved and control subjects declined during the last two weeks of intervention. In conclusion, the eight week program was effective in improving trunk rotation and shoulder flexibility among older drivers.

Ott, B.R., Heindel, W.C., Whelihan, W.M., Caron, M.D., Piatt, A.L., & DiCarlo, M.A. (2003). Maze test performance and reported driving ability in early dementia. *Journal of Geriatric Psychiatry and Neurology*, 16(3), 151-155.

This study was undertaken to explore the utility of specific tests of executive function, attention, and visual perception as predictors of driving impairment in cognitively impaired older people. A battery of standard neuropsychological tests examining various features of executive function, attention, and visual perception was administered to 27 subjects with questionable to mild dementia, and compared to a four-point caregiver rating scale of driving ability. Based on the results of this study, a computerized maze task, employing 10 mazes, as administered to a second sample of 40 normal elders and questionably and moderately demented drivers. Comparisons were made to the same caregiver rating scale, as well as to crash frequency. In the first study of neuropsychological tests, errors on Porteus Mazes emerged as the only significant predictor of driving ability in a stepwise regression analysis. In the follow-up study employing the computerized mazes, all 10 mazes were significantly related to driving ability ratings. As a

conclusion to these findings the authors submit that computerized tests of maze performance offer promise as a screening tool to identify potential driving impairment among cognitively impaired elderly and demented drivers.

Owsley, C., Stalvey, B.T., Wells, J., Sloane, M.E., & McGwin, G. Jr. (2001). Visual risk factors for crash involvement in older drivers with cataract. *Archives Ophthalmology*, 119, 881-887.

The objective of this study was to examine what types of visual impairments serve as a basis for the increased crash risk of older drivers with cataract. The methods consisted of a cross-sectional analysis performed on 274 older drivers with cataract, and 103 older drivers free of cataract, recruited through 12 eye care clinics for the purposes of the Impact of Cataracts on Mobility project (a prospective study on driving mobility in older adults with cataract). Tests measured visual acuity, contrast sensitivity, and disability glare for each eye separately using habitual distance correction. The dependent variable was involvement in at least one state-recorded, at-fault vehicle crash during the five years prior to study enrollment. The results of this study revealed for both better and worse eye models, contrast sensitivity was independently associated with crash involvement, whereas visual acuity and disability glare were not. Drivers with a history of crash involvement were eight times more likely to have a serious contrast sensitivity deficit in the worse eye than those who were crash free; this association was weaker for the better eye but still statistically significant. Crash-involved drivers were six times more likely to have severe contrast sensitivity impairment in both eyes than crash-free drivers, however a severe contrast deficit in only one eye was still significantly associated with crash involvement. The conclusion to these findings was that severe contrast sensitivity impairment due to cataract elevates at-fault crash risk among older drivers, even when present in only one eye.

Parasuraman, R., & Nestor, P.G. (1991). Attention and driving skills in aging and Alzheimer's Disease. *Human Factors*, 33(5), 539-557.

This paper proposes, on both theoretical and empirical grounds, that attentional skills in relation to driving should be examined in older adults with and without dementia of the Alzheimer's type (DAT). Such investigations should focus on normal older adults and those in the mild, early stages of dementia because the latter are the most likely among the dementia population to still be driving. Evidence is presented indicating that motor vehicle crash rates are related to performance on information-processing measures of different components of attention; that this relationship is greatest for switching of selective attention and less for that of divided and sustained attention (vigilance); and that many of these same attentional functions, and particularly the switching of visual selective attention, are impaired in the early stages of DAT and thus may contribute to increased accident risk. The conclusion is that although many factors contribute to motor vehicle crashes, and attentional measures only account for some of the variance in crash risk, the evidence suggests that selective attention may be one of the more important factors, particularly in special populations of drivers such as the elderly and those with dementia.

Parker, D., MacDonald, L., Sutcliffe, P., & Rabbitt, P. (2001). Confidence and the older driver. *Ageing and Society*, 21, 169-182.

The aim of this study was to assess the relationship between confidence, ability, and self-reported driver behavior using a large sample of older drivers. The method for this study consisted of 555 drivers aged 50 or older who were tested in terms of their confidence in a range of driving situations, self-ratings of their driving ability, self-reported driving behavior, and personality. The results consisted of surprisingly low levels of nervousness when driving, particularly because there was no evidence of unrealistic self-ratings of driving ability. Female drivers reported significantly fewer errors and intentional violations than male drivers. Female drivers were also found to score higher on the Extroversion, Neuroticism, and Lie scales than males, however the male sample scored higher on the Psychoticism scale than the females. Using these results, the authors concluded that driving confidence was associated with the following: a low level of lapses and errors and a high level of violations; a low score on the Neuroticism scale and a high score on the Extroversion scale; and being male and having high annual mileage.

Parnes, L.S., & Sindwani, R. (1997). Impact of vestibular disorders on fitness to drive: A census of the American Neurotology Society. *The American Journal of Otology*, 18, 79-85.

The objectives of this study were to learn more about the critical issues and current practices of neurotologists regarding reporting of vestibular patients, and to make recommendations for reporting patients with vestibular disorders. The study consisted of a questionnaire based on a modified Dillman Total Design Survey Method, mailed to a census of members of the American Neurotology Society. The results from this study revealed that most respondents were aware of the potential safety risks of patients who drive with vestibular diseases, most notably those with Tumarkin's attacks; however, most did not

report having Tumarkin's attacks. Additionally, there was no consensus of opinion on how to report a patient as unfit-to-drive. The conclusion reached was that at the present time, given that there was no consensus on how to report patients with vestibular disorders, and relatively low safety risks in comparisons to other disorders, there should not be mandatory reporting of these patients.

Patat, A. (1998). Driving, drug research, and the pharmaceutical industry. *Human Psychopharmacology: Clinical and Experimental*, 13, S124-S132.

This paper presents an overview of some assessment methods and experimental designs developed to determine a drug's behavioral toxicity as it applies to driving. Methods that are discussed are those related to laboratory performance tests, such as adaptive or critical tracking tasks and divided attention tasks; electrophysiological techniques which include spectral analysis of resting EEG, measurement of saccadic eye movements, and the multiple sleep latency task; driving simulation; and on-road driving tests (either on a closed course or in normal traffic conditions). Results are documented for several groups of drugs, such as ethanol (the toxic ingredient in alcoholic beverages), antihistamines (commonly found in allergy medications), hypnotics (including benzodiazepines, non-benzodiazepine drugs, and barbiturates), anxiolytics (Diazepam and Lorazepam), and antidepressants. The conclusion drawn in this paper is that many psychoactive drugs produce sedation, impair psychomotor functioning, and impair cognitive functioning which suggests that such drugs may increase the risk of traffic accident involvement. Therefore, drug registration procedures should be improved by including behavioral toxicity data in the drug registration file, and post-marketing surveys on the incidence of drug-related automobile crashes should be a natural conclusion to drug development research.

Petch, M.C. (1998). Driving and heart disease. *European Heart Journal*, 19, 1165-1177.

The objective of this article was to examine a set of cardiovascular events, and their precursors, which could likely lead to a collapse behind the wheel of an automobile. Heart disease and its effect on driving cannot be considered in isolation, other allied cardiovascular conditions, for example intermittent claudication, which may serve as markers for potential incapacity, must also be evaluated. Angiography remains the gold standard in assessment of strategies for patients with heart disease, but there is very good evidence that clinical assessment, coupled where indicated with exercise testing, will provide equally good risk stratification. In parallel to that information, there are known powerful predictors of cardiovascular collapse which include heart failure and poor left ventricular function, unstable cardiac syndromes due to coronary heart disease, and poor performance on exercise testing. The conclusion of this article states that a previous recommendation for a cardiovascular standard for drivers should be adopted by the European Union, and that these guidelines be disseminated to the member states through the national societies and individual cardiologists, who are in a position to influence the Government ministries and departments.

Phillips, W. T., Broman, T. E., Burkett, L. N., & Swann, P. D. (2003). Single set strength training increases strength, endurance and functional fitness in community living older adults. Activities, Adaptation & Aging, 27 (3/4).

The purpose of this study was to assess the effects of a 12-week 'single set' strength training program, conducted according to American College of Sports Medicine (ACSM) guidelines, on strength, endurance, and functional fitness in community-living older adults. The study gathered 15 men and women (with a mean age of 76±8.3 years, and a range of 65-91 years) who performed a 12-week single set strength training program designed to increase strength (1RM), endurance/training volume (VOL), and Functional Fitness (FF). The study did not include a control group due to a majority of the participants' refusal to be a control group member. Training sessions took place three times a week for approximately 30 minutes per session. Results for the tests demonstrated that the subjects' 1RM increased by 9% ($p=0.04$) for Leg Press and by 5% ($p=0.15$) for Bench Press. VOL increased by 36% ($p<0.001$) for Leg Press and by 26% ($p<0.001$) for Chest Press. FF improved for Chair Stand (21%, $p=0.06$), Up and Go (20%, $p=0.018$), and Lift and Reach (13%, $p=0.03$). Though a control group was not present in this study, drawing comparisons with existing studies regarding strength training and the elderly, the study draws the conclusion that, due to the participants' clinically important improvements of 13-21% and 15-25 percentile points in the normative database, single set strength training appears to be a viable approach to increasing strength, endurance and functional fitness in older adults.

Quinnell, T.G., & Smith, I.E. (2004). Obstructive sleep apnea in the elderly: Recognition and management considerations. *Drugs and Aging*, 21(5), 307-322.

In this article, the pathophysiology, clinical impact, diagnosis, and management of obstructive sleep apnea (OSA) are discussed, with particular emphasis on the importance of recognizing the condition in

older people. Obstructive sleep apnea is characterized by repetitive interruptions of breathing during sleep due to upper airway collapse. It is associated with increased cardiovascular morbidity and mortality, and increased risk of road traffic accidents. This is an especially severe condition for older individuals because of a physiological decline in sleep quality with age, and the increasing frequency of other comorbidities with increasing years that affect both sleep and daytime function. Treatment is aimed at minimizing upper airway obstruction during sleep and the most effective therapy is continuous positive airway pressure. Weight loss can also be effective. Other management options including surgery, mandibular advancement devices, and drug treatment, are less effective, but there are interesting advances in the understanding of the pharmacology of the upper airway. It is concluded that specific serotonergic agonists hold the greatest potential for a useful drug treatment for this widespread and debilitating condition.

Radford, K.A., Lincoln, N.B., & Lennox, G. (2004). The effects of cognitive abilities on driving in people with Parkinson's disease. *Disability and Rehabilitation*, 26(2), 65-70.

The aim of this study was to develop a cognitive screening procedure that could be used to identify cognitive problems in patients with Parkinson's disease that may affect their safety to drive. The method assembled two groups for comparison, those found safe to drive and those found unsafe to drive, from people living in the community. The sample was drawn from those who were attending an outpatient Movement Disorders clinic or who had been referred to a Regional Mobility Center. The assessment measures used in this experiment were Webster's Rating Scale, the Unified Parkinson's Disease Rating Scale motor examination, the Stroke Drivers Screening Assessment, the Adult Memory and Information Processing Battery, the Stroop Task, the Paced Auditory Serial Addition Task, and a tapping task. The results revealed that the unsafe drivers were significantly more disabled, as assessed on Webster's Scale, than those who were found safe to drive, although there were no significant differences in the cognitive abilities of safe and unsafe drivers. The most common faults, which caused drivers to be judged unsafe, were lack of observations to the side at junctions, poor positioning on the road, and poor driving on roundabouts. The conclusions from this study were that cognitive abilities were not found to be associated with fitness to drive in people with Parkinson's disease, however Webster's Rating Scale differentiated between safe and unsafe drivers. This could be used to determine who to refer to a mobility center for advice on fitness to drive.

Reger, M.A., Welsh, R.K., Watson, G.S., Cholerton, B., Baker, L.D., & Craft, S. (2004). The relationship between neuropsychological functioning and driving ability in dementia: A meta-analysis. *Neuropsychology*, 18(1), 85-93.

The purpose of this study was to quantitatively summarize the literature on the relationship between neuropsychological functioning and driving ability in participants with dementia. An additional purpose was to provide a unified analysis of the functional utility of using cognitive testing to make recommendations about a patient's fitness to drive safely. A meta-analysis of 27 primary studies was conducted to examine the aforementioned relationship. When studies using a control group were included, the relationship between cognitive measures and on-road or non-road driving measures was significant for all reported domains. Mean correlations ranged from .35 to .65. Caregiver reports of driving ability and cognitive variables were correlated significantly only on measures of mental status and visuospatial skills. When studies using a control group were excluded, moderate mean correlations were observed for visuospatial skills, on-road or non-road measures, and for mental status with non-road tests. Other effects were small or insignificant. The authors concluded that the importance of correctly estimating driving ability will only grow with the burgeoning older population and improving methods for early diagnosis. This study indicated that neuropsychological testing makes a significant contribution to predicting driving ability, however they do not indicate at what level of impairment a specific patient is unfit to drive. Additional research is needed in this area to assist neuropsychologists in fulfilling their role in the risk assessment process.

Richardson, E.D., & Marottoli, R.A. (2003). Visual attention and driving behaviors among community-living older persons. *Journal of Gerontology*, 58(9), 832-836.

This study was designed to specify those cognitive variables associated with specific on-road driving behaviors in a sample of older, non-clinic-referred individuals. The procedure in this study was to evaluate community-residing active drivers aged 72 years or older using a standardized, on-road driving test involving parking lot maneuvers, and urban, suburban, and highway driving. Participants were also administered tests of visual attention, executive function, visuospatial cognition, and memory. The results demonstrated that driving score was significantly correlated with visual attention, visual memory, and executive function. Visual attention was associated with 25 of 36 driving behaviors, including those

involving scanning the environment, interaction with traffic or pedestrians, and distance judgments. Executive function and visual memory were associated with fewer maneuvers, most of which were a subset of maneuvers that correlated with visual attention. The study concluded that visual attention (a cognitive function involving search, selection, and switching), plays an important role in driving risk among older drivers. Key driving maneuvers involving interaction with other vehicles/pedestrians, such as yielding right of way and negotiating safe turns or merges, have the greatest association with visual attention. Specification of both the cognitive risk factors and their impact on problematic driving maneuvers may provide guidelines for developing targeted interventions to reduce risk among older adults.

Rosnick, C. B., Small, B. J., Graves, A. B., & Mortimer, J. A. (2004). The association between health and cognitive performance in a population-based study of older adults: the Charlotte County Healthy Aging Study (CCHAS). *Aging Neuropsychology and Cognition,* 11(1), 89-99.

The study examined the relationship between self-reports and objective measures of health status and measures of cognitive performance. Participants consisted of 437 persons (*M*=72.91 years) from the Charlotte County Healthy Aging Study, a population-based sample of older adults. Cognitive performance was assessed by tests of episodic memory, perceptual speed, and attention. Health status was indexed by subjective ratings, self-reports, and two objective measures: blood pressure and grip strength. The health measures accounted for significant variance on both the Trailmaking A and B tests, which were used to test perceptual speed, accounting for a modest amount of variance (4.4% and 1.1%, respectively). The health measures were not significantly associated with performance on the measures of attention or episodic memory. The results suggest that health status is associated with processing speed to a greater degree than higher order cognitive processes, and that multiple aspects of health status should be used when assessing cognitive performance. The research also suggested that health may have a stronger association with processing speed than other memory tasks, but also indicated that among healthy older adults, the impact of health status on cognitive function is relatively small.

Sabatowski, R., Schwalen, S., Rettig, K., Herberg, K.W., Kasper, S.M., & Radbruch, L. (2003). Driving ability under long-term treatment with transdermal fentanyl. *Journal of Pain and Symptom Management*, 25(1), 38-47.

This paper describes a study in which patients received a stable dose of transdermal fentanyl for continuous non-cancer pain, and were evaluated to provide data on the impact of fentanyl on complex psychomotor and cognitive performance that is thought to be related to driving ability. In trial, patients who had received stable doses of fentanyl for at least two weeks completed a series of computerized tests to measure attention, reaction, visual orientation, motor coordination, and vigilance. Data from healthy patients were matched and none of the performance measures for the fentanyl patients was significantly inferior to the healthy group. It was concluded that stable doses of transdermal fentanyl for the treatment of chronic non-cancer pain were not associated with significant impairments in psychomotor and cognitive performance.

Sanders, S.H. (2001). The effects of opioids on driving ability in patients with chronic pain. *American Pain Society Bulletin*, 11(1).

This article summarizes the history of the research on the effects of opioid use on driving. The article also gives an in-progress look at the research the author is conducting regarding the matter. There are six sections in this article which illustrate the past, present, and future of this research. The first describes the risks one faces if they drive while taking an opioid medication, due to the fact that there is little research on how much this medication will impair a driver, and that if one is in an accident while taking the medication they can conceivably be arrested for driving under the influence. Research pertaining to the time it takes for the onset of effects from variable doses of opioids is summarized, and this section concludes that if there is a stable dose of the medication being administered, then there is little chance of effects that would be hazardous in traffic. Patients who were being treated with stable, long-term opioid therapy, and experienced driving in chronic nonmalignant pain were discussed in short because that in this study, there was no control group on which to test the effects of the medication. The next two sections described the author's ongoing research on the subject, and gave some results from the study. The results stated that there was not consistent, significant differences between the non-pain and chronic pain populations, regardless of whether the latter were taking opioids. The author suggested that future research should more precisely determine what effect taking opioids has on driving performance, including the exact skills effected, the effects of different opioids and dose levels, interactions with other medications or alcohol, and individual difference variables.

Schlag, B. (1993). Elderly drivers in Germany: Fitness and driving behavior. *Accident Analysis and Prevention*, 25(1), 47-55.

The aim of this study was to examine the fitness and driving behavior of older drivers in Germany. The method was to test 30 middle-aged motorists against 80 elderly drivers in visual acuity by daylight and in the dark, performance in a traffic-related perception test, and time needed in tracking and reaction tests, as well as on-the-road driving tasks. The results showed that elderly drivers did worse in all of the laboratory tasks, however, in driving tests that examined performance in a number of traffic situations, the elderly did not differ unfavorably from the middle-aged drivers. The conclusions was that it is possible that psychophysical performance exposes differences in its field more accurately than driving tests are able to, because driving tests are incapable of measuring psychophysical performance as it relates to adverse driving events. The authors also suggested that capacities measured in the laboratory are less relevant to normal driving demands, and in most cases may be compensated by adequate ability to adapt.

Shaffron, P., Ostrow, A., & McPherson, K. (1991). Older driver performance and joint flexibility. *Journal of Traffic Safety Education*, January 1991, 10-14 & 21.

This article compares young adults and older adults on various measures of driver performance and joint flexibility. The method employed was a cross-sectional developmental research design in which 43 subjects aged 20 to 35 years and 63 subjects aged 60 to 75 years took part. The subjects were administered a field-based assessment of driver performance using a modified version of the Automobile Driving On-Road Performance Test (ADOPT), and a joint flexibility test. The Joint Range-of-Motion Test measured the degrees of rotation from an anatomical standard for the following twelve skeletal joints: neck rotation, torso rotation, right shoulder flexion, left shoulder flexion, right elbow flexion, left elbow flexion, right hip flexion, left hip flexion, right knee flexion, left knee flexion, right ankle dorsiflexion and plantar flexion, left ankle dorsiflexion and plantar flexion. The findings indicated that older drivers had less upper body flexibility (shoulders, torso, and neck) than younger drivers. Furthermore, older drivers performed more poorly than young drivers on observing, vehicle handling, safe practices, driver processing, and maneuvers. It was also indicated that these subjects' joint range-of-motion scores were positively correlated with their ADOPT scores. The conclusion drawn from the data was that the probable cause for the relation of flexibility to driving ability is that the safe operation of an automobile requires freedom of body motion. Restricted joint movement makes driving difficult on the older driver because basic vehicle control and guidance operations, such as steering around a corner or observing behind before changing lanes, require quick movement and ample range of joint motion.

Sims, R.V., McGwin, G. Jr., Pulley, L., & Roseman, J.M. (2001). Mobility impairments in crash-involved older drivers. *Journal of Aging and Health*, 13(3), 430-438.

The objective of this study was to evaluate potential associations of impairments in physical function with motor vehicle crash involvement in older drivers. The method for this study was to randomly select case participants who were 65 or older and had sustained an at-fault motor vehicle crash in 1996. Similarly selected crash-free controls were frequency-matched to cases on gender and age. Self-reported data on demographic variables, medical conditions, medications, driving exposure, and function were collected by telephone interviewers. Results from this study showed that relative to crash-free subjects, crash-involved drivers were significantly more likely to report difficulty walking ¼ mile and moving outdoors. Marginally significant associations were found for reporting trouble carrying a heavy object 100 yards and for the occurrence of falls in the prior year. Increasing numbers of functional limitations were directly related to the odds of crash involvement. The conclusion was that in comparison to crash-free controls, crash-involved older drivers are more likely to report other mobility-related impairments, possibly including falls.

National Sleep Foundation. Sleep and aging. Retrieved August 25, 2000 from the World Wide Web: http://www.sleepfoundation.org/publications/sleepage.html

This article discussed sleep problems and conditions, with a section focusing on sleep changes as they relate to aging and dementia, and the potential affects sleep pattern changes have on driving. Older people are likely to suffer both medical disorders that disrupt sleep, and specific sleep disorders, with Alzheimer's disease and senile dementia characterized by frequent sleep disturbance. Elevated levels of sleep disturbances among the elderly are also attributed to a number of medications that older people are more likely to take than younger people. The impact of sleep problems have several measurable negative effects including reduced energy, greater difficulty concentrating, diminished mood, and greater risk for automobile crashes, including fall-asleep crashes. Sleep apnea, which occurs in 28% of males

and 24% of females over age 65, increases the risk of falling asleep at the wheel three to seven times. Sleep problems should be evaluated and necessary precautions taken to eliminate sleepiness while driving and to ensure safe driving.

Smith, J.A., & Walker, L.L. (1977). Medical evaluation of the high risk driver. *The Journal of the South Carolina Medical Association*, 73(5), 224-225.

This article examined the process in which the State of South Carolina determines whether an individual is fit to possess a driver's license. The method used in reaching this decision begins when a potentially dangerous person is reported by a civilian or patrolman, after which the reported driver and their physician must provide a complete medical history. If there are questionable medical conditions, the driver's application is set before the Medical Advisory Board who, when necessary, can limit or completely restrict driving for that individual. There are six categories of medical conditions that can potentially restrict an individual's driving credentials: heart and cardiovascular, cerebrovascular, neurological, psychiatric, vision, and metabolic. The conclusion of this article was that a driver license is a privilege, and for physicians who note conditions worthy of restricted driving, it is their responsibility to their fellow citizens to encourage the aforementioned high-risk driver to limit or discontinue driving.

Staplin, L., Lococo, K.H., Stewart, J. & Decina, L.E. (1999). Safe mobility for older people notebook. DOT HS 808 853. Washington, D.C.: National Highway Traffic Safety Administration, April 1999.

The *Safe Mobility for Older People Notebook* is a research product of the "Model Driver Screening and Evaluation Program" project sponsored by NHTSA, and is intended as a resource to support program initiatives promoting the safe mobility of older persons across all States and Provinces. This document represents a snapshot of current knowledge and practices at the State and Provincial level. Topics include the identification of high-risk older drivers; the counseling and remediation of at-risk drivers; public information and educational tools to support program implementation; and mobility options and alternatives to transportation for seniors. Coverage of these topics is provided in 70 subtopic discussions, containing three sections each: a summary of outcomes in relevant research studies and implementation efforts; conclusions/preliminary recommendations pertinent to the development of a national Model Program; and references identifying data sources. A final note in the introduction of this report states that this reference document is, and should remain, a work-in-progress as jurisdictions throughout North America prioritize local issues relating to seniors' mobility needs, and implement the best solutions that are feasible at the time.

Stefano, M. D., & MacDonald, W. (2003). Assessment of older drivers: Relationships among on-road errors, medical conditions and test outcome. *Journal of Safety Research,* 34, 415-429.

This study sought to find information about the nature of driving errors during license review tests designed to evaluate older drivers' continuing competence, and about relationships between error type and test outcome for older drivers. The study method included analyzing data from licensing authority files from 533 road tests during a 12-month period, with medical and other referral information included. Average driver age was 76 years. Most of the participants were included in the sample because their driving competence was in question, with 63% of the total having been reported by the police. Performance scores were generated for intersection negotiation, lane changing, low speed maneuvers, positioning and speed control, safety margin, and car control. Results demonstrated that the two most frequent error types related to driver observation were failure to look back over the shoulder when needed to ensure safety, and failure to check mirrors; the third most frequent was failure to use indicators. Maintaining appropriate position and lane keeping, as well as traveling too slowly for the conditions, were other reported error types. The results of logistic regression analyses showed that test outcome was well predicted by a subset of driving performance scores; adding driver age to the model explained very little variance. Age alone was strongly associated with outcome.

Stutts, J. C., Stewart, J. R., & Martell, C. (1998). Cognitive test performance and crash risk in an older driver population. *Accident Analysis and Prevention,* 30 (3), 337- 346.

This paper reported on the usefulness of five brief tests of cognitive function for identifying older drivers who may be at increased risk of crash involvement. It also examined the broader issue of whether impaired cognitive function is associated with increased crash risk in the older driver population. Data for the study were collected from 3,238 drivers aged 65 and older applying for renewal of their North Carolina driver's license. The specific cognitive assessments examined during the study included the Trail Making Test parts A and B, the Short Blessed Orientation-Memory-Concentration test of cognitive impairment, a modification of the American Association of Retired Persons 'Reaction Time' test, and a timed Traffic Sign

Recognition test. Information on crash involvements during the 3-year period prior to testing was obtained by linkage with the North Carolina driver history file. Although the individual tests were not found to be particularly effective screening tools for identifying subsets of high risk drivers, cognitive test performance remained significantly associated with crash risk even after controlling for driver age, race, and measures of driving exposure. Drivers who scored in the lowest 10% on the cognitive tests were approximately 1.5 times more likely to be in crashes than were drivers who scored in the highest 10%. Implications for the counseling and licensing of older drivers was discussed, suggesting that any use of cognitive assessments should require minimal additional time and resources, and should be limited to identifying those drivers in need of further evaluation. The paper concludes with suggestions to expand educational and counseling activities to make older drivers more aware of the apparent increase in crash risk associated with cognitive loss.

Stutts, J. C., & Wilkins, J. W. (2003) On-road driving evaluations: a potential tool for helping older adults drive safely longer. *Journal of Safety Research*, 34, 431-439.

The purpose of this paper was to explore the potential use of on-road driving evaluations as a tool for helping older adults extend their safe driving years. The data collection method was carried out in three separate research activities through a project awarded to the University of North Carolina Highway Safety Research Center entitled "The Premature Reduction and Cessation of Driving by Older Men and Women." The primary goals of the project were to identify potentially remediable factors associated with premature driving reduction or cessation (and to explore possible interventions for counteracting that reduction or cessation), and extending the period during which older adults are able to provide for their own mobility needs with safety and confidence. The first research activity was a national telephone survey of current and former drivers age 65 or older, encompassing a broad range of driving and mobility topics. The results of this survey provided information relevant to the potential market for on-road driving evaluations; 49.6% agreed that there was a need for a place other than driver license offices where seniors could voluntarily go to be road-tested. The second was a series of focus groups with potential stakeholders in the process: driver educators, occupational therapists, and physicians. These groups explored the feasibility and requirements of offering on-road driving evaluations to the wider public. Supplemental data were also collected from a mail survey of driving schools nationwide. Seventy-four of the schools surveyed reported not providing driving evaluations to seniors, with 17% saying they did not have the perquisite information or skills to do so. The article concludes that a primary role of driving schools should be to evaluate, counsel, and train the "well elderly" and that driving schools should form cooperative relationships with occupational therapists, with each freely referring to the other. The study made it clear that many older adults and family members wanted an objective, professional source of advice when faced with the decision of whether to continue or stop driving.

Suthers, K., & Seeman, T. (2004). The measurement of physical functioning in older adult populations. Performance Measurement Workshop Consensus Document, December 12, 2003. http://www.nia.nih.gov/research/extramural/behavior/performance.pdf.

This article provided a summary of the background information on the assessment of physical functioning through performance protocols, discussed at a meeting on physical performance measurement sponsored by The Behavioral and Social Research Program at the National Institute on Aging. The summary stated that physical functioning is distinguished from disability, such that older adults may have difficulty performing specific physical tasks, yet experience no interference in their daily life. This period may be identified as "pre-clinical disability." The authors also noted that self-reported measures of physical functioning assess a different, but related, construct from performance-based measures. Whereas self-reported measures discriminate among poorly functioning older adults, they do not adequately distinguish older adults with high levels of functioning ability. Likewise, compared to self-rated measures, performance-based measures have superior sensitivity and specificity in discriminating among older adults with very low levels of physical functioning. It is suggested in closing that future development in research in this area should include: internet-based training to streamline test administration across studies; initiatives to develop research protocols to determine how compensatory mechanisms and modifications affect the period of pre-clinical disability and the onset of disability; a qualitative, anthropological study of the pathway to disability; and the development of age-sensitive measures to increase understanding of trajectories of physical functioning across the life course.

Van Laar, M. W., Van Willigenburg, A. P. P., & Volkerts, E. R. (1995). Acute and subchronic effects of nefazodone and imipramine on highway driving, cognitive functions, and daytime sleepiness in healthy adult and elderly subjects. *Journal of Clinical Psychopharmacology*, 15 (1), 30-40.

The objective of this study was to determine the effects of nefazodone and imipramine on highway driving, cognitive functions, and daytime sleepiness in adults. The acute and subchronic effects of two dosages of a new serotonergic antidepressant, nefazodone, and those of the tricyclic imipramine were examined in a double-blind, crossover, placebo-controlled study. Twenty-four healthy subjects from two age groups (12 adults and 12 elderly from both sexes) received the four treatments (nefazodone, 100 and 200 mg twice daily; imipramine, 50 mg twice daily; and placebo) for seven days, with a seven-day washout period. Measurements were performed after the morning doses on day one and day seven. These included a standard over-the-road highway driving test, a psychomotor test battery, and sleep latency tests. Blood samples were taken on both days and analyzed to determine concentrations of parent drugs and their major metabolites. The results showed that the reference drug, imipramine, had a detrimental effect after a single dose on lateral position control in the driving test, primarily in the adult group, that diminished after repeated dosing. Minor impairment on psychomotor test performance was found with both days. On the other hand, a single administration of both doses of nefazodone did not impair highway driving performance (even showed some improvement) and had no or only minor effects on psychomotor performance. After repeated dosing, nefazodone 200 mg twice daily (but not the 100-mg dose) produced slight impairment of lateral position control; dose-related impairment of cognitive and memory functions was found. The effects of nefazodone were generally the same in both age groups. Significant correlations were found between steady-state concentrations of nefazodone in plasma (200-mg, twice-daily condition) as well as imipramine, and reaction time changes in a memory scanning task. Neither drug appeared to induce daytime sleepiness as measured by the sleep latency tests. The study concludes that nefazodone in doses of 100 and 200 mg twice daily is relatively safe with respect to lateral position and speed. Nefazodone has the potential to impair cognitive and memory functions especially with increased dosages and prolonged use. Nefazodone has some “alerting” effects after a single dose, but not after repeated dosing, and the elderly do not show an increased sensitivity to the effects of nefazodone when compared with other adults.

Verster, J.C., Volkerts, E.R., & Verbaten, M.N. (2002). Effects of alprazolam on driving ability, memory functioning and psychomotor performance: A randomized, placebo-controlled study. *Neuropsychopharmacology*, 27(2), 260-269.

This study was conducted to determine the effects of alprazolam (1mg) on driving ability, memory, and psychomotor performance. Healthy volunteers participated in a randomized, double-blind, placebo-controlled crossover study. One hour after administration, subjects performed a standardized driving test on a primary highway during normal traffic. They were instructed to drive with a constant speed while maintaining a steady lateral position within the right traffic lane. After the driving test, subjective driving quality, mental effort, and mental activation during driving were assessed. At 2 ½ hours after treatment, administration of a laboratory test battery was performed comprised of the Sternberg Memory Scanning Test, a continuous tracking test, and a divided attention test. Results showed that relative to placebo, alprazolam caused serious driving impairment which was confirmed by subjective assessments showing significantly impaired driving quality, decreased activation, and increased mental effort during driving. Furthermore, alprazolam significantly impaired performance on the laboratory tests. In conclusion, alprazolam users must be warned not to drive an automobile or operate potentially dangerous machinery.

Verster, J.C., Volkerts, E.R., Schreuder, A.H.C.M.L, Eliken, E.J.E., van Heuckelum, J.H.G., Veldhuijzen, D.S., Verbaten, M.N., Paty, I., Darwish, M., Danjou, P., & Patat. A. (2002). Residual effects of middle-of-the-night administration of zaleplon and zolpidem on driving ability, memory functions, and psychomotor performance. *Journal of Clinical Psychopharmacology*, 22(6), 576-583.

The objective of this study was two-fold. The first objective was to demonstrate the ecological validity of the possible residual effects of zaleplon and zolpidem by measuring the impairing effects of ethanol on actual driving, memory, and psychomotor performance (part 1). The second objective was to examine the effects of zaleplon and zolpidem four hours after middle-of-the-night administration on the aforementioned tasks, using the same subject sample (part 2), and to compare these effects with the obtained results in the first objective. Part 1 was a single-blind, two-period crossover design to determine the effects of a single low dose of ethanol (0.03% < BAC < 0.05%) or ethanol-placebo on driving ability, memory, and psychomotor performance. Part 2 was a double-blind, five-period crossover design to measure the effects of a middle-of-the-night administration of zaleplon 10 or 20 mg, zolpidem 10 or 20 mg, or placebo on driving ability, four hours after administration, and memory and psychomotor performance six hours after administration. The standard deviation of lateral position (SDLP) was the primary performance parameter of the driving test. The results showed that zaleplon 10 and 20 mg did not significantly impair driving ability four hours after the middle-of-the-night administration. Relative to

placebo, after zolpidem 10mg, SDLP was significantly elevated, but the magnitude was small and not likely to be of clinical importance. Memory and psychomotor performance was unaffected after both doses of zaleplon and zolpidem 10 mg. In contrast, zolpidem 20 mg significantly increased SDLP and speed variability, and impaired all memory and psychomotor tests. Finally, driving performance, a digit symbol substitution task, a divided attention task, and immediate and delayed free recall of a word learning task were all impaired after ethanol. The conclusion from this information was that zaleplon 10 and 20 mg is a safe hypnotic devoid of next-morning residual impairment when used in the middle of the night.

Verster, J.C., & Volkerts, E.R. (2004). Antihistamines and driving ability: evidence from on-the-road driving studies during normal traffic. *Annals of Allergy, Asthma, & Immunology*, 92, 294-304.

The objective of this study was to summarize the effects of antihistamine drugs on driving from a review of previously published articles. The literature search produced 16 studies using on-the-road driving tests during normal traffic. All the studies were double-blind, placebo-controlled, and included a positive control. The results of the meta-analysis showed that first-generation antihistamines (diphenhydamine, triprolidine, terfenadine, dexchloropheniramine, clemastine) significantly impair driving performance after both a one-time and repeated (daily) administration. Second-generation antihistamines (setrizine, loratadine, ebastine, mizolastine, acrivastine, emedastine, mequitazine) may also impair driving performance, but the magnitude and extent of impairment depend on the administered dose, sex, and time between testing and treatment administration. Tolerance develops four to five days after administration, but impairment is not absent. Third-generation antihistamines (fexofenadine and levocetirizine) have been shown to produce no driving impairment after both a one-time and repeated administration. The conclusion to this study is that first- and second-generation antihistamines may significantly impair driving performance, and treating patients with third-generation antihistamines such as fexofenadine and levocetirizine is advised.

Waller, J.A., (1992). Research and other issues concerning effects of medical conditions on elderly drivers. *Human Factors*, (34)1, 3-15.

This article provided recommendations to improve research and screening programs with regard to medical impairment and driving. At the time of the study, the current research was considered to be limited by the inability to define certain conditions, inadequate sample selection, poor definition of excessive crash risk, ignoring comorbid conditions or human-environmental interactions, and failure to examine the interaction of aging and medical conditions; all of which were considered in this article. Also outlined is the knowledge about specific medical conditions as they apply to driving, including cardiovascular diseases, diabetes mellitus, alcoholism, seizures and other syncopal episodes. The recommendation that better criteria must be developed for the medical aspects of driver licensing and training programs to permit more people to continue driving is made in closing.

Wang, C.C., Kosinski, C.J., Schwartzberg, J.G., & Shanklin, A.V. (2003). *Physicians Guide to Assessing and Counseling Older Drivers.* Chicago, IL: American Medical Association.

The information in this guide is provided to assist physicians in evaluating the ability of their older patients to operate a motor vehicle safely as part of their everyday, personal activities. The guide provides information about: specific red flags for medically impaired driving; a test battery, the Assessment of Driving-Related Skills (ADReS) to assess the key areas of function; how to interpret performance on the test battery through scoring cut-offs; examples of interventions to help physicians manage and treat identified functional deficits; driving rehabilitation specialists and how they can be of help; how to counsel drivers who should no longer be driving; physicians' legal and ethical responsibilities; state-by-state licensing requirements, licensing renewal procedures, reporting procedures, and contact information for each state's driver licensing agency and medical review board; a reference list of medical conditions and medicines that may impair driving skills; and consensus recommendations for each condiction regarding driving restrictions. The reference list is grouped into several broad areas: vision; cardiovascular diseases; cerebrovascular diseases; neurologic diseases; medications; psychiatric diseases; metabolic diseases; peripheral vascular diseases; renal diseases; respiratory diseases; effects of anesthesia and surgery; and miscellaneous conditions. The guide represents a resource for physicians and other health professionals and provides practical and up-to-date information for assessing older drivers.

Wild, K., & Cotrell, V. (2003). Identifying driving impairment in Alzheimer disease: A comparison of self and observer reports versus driving evaluation. *Alzheimer Disease and Associated Disorders*, 17(1), 27-34.

This study examined the relationship between driving behaviors and awareness of deficit in patients with Alzheimer's disease (AD). A series of questionnaires concerning daily functioning and driving performance were administered to healthy elderly controls, and mildly impaired AD patients. All subjects were also evaluated on a standardized road test. Self-report and caregiver/informant responses were compared with determined levels of discrepancy in ratings, while comparisons of AD and healthy elderly controls revealed group differences. Actual driving performance was considered the standard by which to determine accuracy of perceptions. The results of the driving test, as reported by an independent evaluator, showed that the drivers with AD scored significantly worse than their healthy elderly peers on nine of 10 driving behaviors. AD patients' self reports of driving ability were significantly better than the evaluator's ratings on seven of 10 items, whereas the healthy drivers rated themselves as better than the evaluator on one item. Although caregivers were likely to acknowledge a general concern with their AD patients' driving, they underreported specific driving problems when their ratings were compared with those of an independent evaluator. These findings have implications for the development of caregiver-based modifications of driving behavior.

Woo, E., & Sharps, M. J. (2003). Cognitive aging and physical exercise. *Educational Gerontology,* 29, 327-337.

Sixty young adults and sixty older adults with different current patterns of exercise were recruited for a study to explore links between successful cognitive aging and physical exercise. A standard test of cognitive abilities, the Kaufman Brief Intelligence Test (KBIT), was administered, together with an evaluation of free recall of pictorial and verbal stimuli, under conditions which either maximized or minimized the opportunity for respondents to use semantic support. These manipulations made it possible to evaluate the relationship between exercise and cognitive performance in several relevant areas of cognition simultaneously. As expected, the pattern of results obtained was complex; the influence of exercise on cognitive performance proved to be highly domain-specific. Exercise was not related to the intellectual abilities evaluated by the KBIT, but did have effects on recall. Specifically, exercise in young adults resulted in better recall of categorized stimuli than did its relative absence. No such effects of semantic support were found with older adults; however, relatively high levels of exercise did result in better recall of verbal stimuli, but not pictorial stimuli, for older adults. Results indicate that salutary effects of exercise on cognitive functioning across the adult lifespan exist, but that these influences are confined to specific areas of cognitive performance.

Wood, J.M. (1999). How do visual status and age impact on driving performance as measured on a closed circuit driving track? *Ophthal Physiol Opt*, 19(1), 34-40.

The aim of this study was to determine the effects of age and visual impairment on driving performance as measured on a closed circuit course. Sixty-two subjects were tested, including "young visual normals" (under 30 years old), "old visual normals" (over 60 years old), and "old subjects with early visual impairment" (over 60 years old). All subjects had a binocular visual acuity of 6/12 (metric) or better, and were legally eligible to drive in Australia. Driving performance was assessed on a closed course (with no other drivers present) for sign detection and recognition, driving reaction times, speed estimation, and driving time. The results showed that age and early visual impairment had significant effects on sign detection and recognition, peripheral reaction times, and driving time. It was also revealed that high contrast visual acuity is a poor predictor of the driving performance skills measured for licensed drivers in this age range. The conclusion was that older subjects, with either normal vision or impaired vision, had significantly worse performance than young visual normal subjects, for many of the aspects of driving assessed on a closed circuit driving course. This was found despite the fact that all of the older subjects had visual acuity equal to or greater than 6/12.

APPENDIX B: Background Materials for Expert Panel Meeting

Development of an Older Driver Self-Screening Guide Based on Health Concerns Associated with Aging

Social and Behavioral Analysis Division,
University of Michigan Transportation Research Institute

Background Materials for: September 8-9, 2005 Expert Meeting Ann Arbor, Michigan

Study Background

Safe and efficient mobility for older people has become a challenging social problem for the United States and other countries, due to the increasing number of older drivers, their relatively high crash rate per mile driven, and their increased likelihood of injury. As solutions are identified and investigated, there is general agreement among researchers that assessment of drivers can play a key role. Self-screening has shown promise. Older drivers may be more willing to self-screen than to be professionally assessed, they may discover declines at an earlier stage, and a wide variety of people can be reached by such instruments because they are easily distributed. While there are several self-screening instruments available for older drivers, this study is intended to improve upon these existing instruments by focusing on health concerns or symptoms; that is, the perceivable changes in an individual caused by medical conditions, drug use, and the aging process. A major contribution of this study is that it attempts to simplify the self-screening process by focusing on the symptoms that directly affect driving. It follows the logical assumption that while there are a myriad of medical conditions, medications, and age-related declines, they produce a relatively small number of symptoms that can vary in severity, and can affect driving.

The specific project objective is to create an easy-to-use scaled symptom checklist or inventory that includes clear information on what limitations one should place on driving and offers suggestions on what kinds of adaptive devices and other accommodations might be useful in overcoming driving-related problems. This objective is being met by: 1) conducting two extensive literature reviews to identify common health concerns/symptoms and critical driving tasks, respectively; 2) convening an expert panel to determine, based on the results of the literature reviews, how symptom severity relates to driving skills and what are appropriate accommodations for declines in these skills; 3) developing a draft self-screening instrument guided by input from focus groups conducted with older drivers; and 4) conducting an evaluation/validation study of the self-screening instrument with a sample of older drivers.

Purpose of expert meeting

The purpose of the expert meeting will be to discuss issues related to the development of the self-screening instrument, including how the severity of health concerns or symptoms relates to unsafe performance of critical driving tasks, and which adaptive devices, if any, might be useful in improving the safety of older drivers. Based on discussion at the meeting, a summary will be prepared that includes an outline of symptoms, how different levels of severity of these symptoms are related to unsafe performance of critical driving tasks, and what adaptive devices can be useful for improving safe driving.

Background materials provided for experts

The following information is provided for your review prior to the meeting:

1. Preliminary table of health concerns/symptoms that affect driving, developed from review of the relevant literature.
2. Table of health concern/symptom definitions.
3. Preliminary table of critical driving tasks, developed from literature review.
4. Set of worksheets for linking health concerns/symptoms to critical driving tasks.

Responsibilities of participants prior to meeting:

1. Review preliminary table of health concerns/symptoms that can affect driving. Provide feedback on completeness of list. Are there health concerns not on the list that should be added? Are there health concerns/symptoms on the list that should be omitted?

2. Review preliminary table of critical driving tasks. Provide feedback on which critical driving tasks are most important for safe driving among the older driver population. Are there driving tasks not on the list that should be added? Are there driving tasks on the list that should be omitted?

3. Using the worksheets provided, link each health concern/symptom to the critical driving tasks that you think are affected. Rate the strength of each link (weak, moderate, or strong).

4. Be prepared to discuss your thoughts (at the meeting) on: a) the appropriate levels of severity for each health concerns/symptom and how best to measure them (e.g., in some cases, a scale might be useful in getting at frequency or duration; in some cases, some type of scale measuring intensity may be useful; in other cases, some combination may be useful); b) relative to each symptom, the severity level at which crash risk becomes a serious problem for each driving task; and c) vehicle adaptations that might help drivers overcome or compensate for driving-related declines.

Please send feedback and completed worksheets to Lisa Molnar at ljmolnar@umich.edu by August 24, 2005. Questions can be directed to either David (eby@umich.edu) or Lisa (phone 734-763-2466 for both).

Preliminary Table of Health Concerns That Can Affect Driving*

Ability Area	Health Concern	Causes	Selected Citations with Symptom Mentioned
C	**Attention deficits (selected, divided, sustained)**	AD, dementia, DAT, brain injury, degenerative joint diseases, PD, stroke, medications/drugs (e.g., opioids)	Ball et al., 1998; Bogner et al., 2004; Brouwer & Ponds, 1994; Donnelly & Karlinsky, 1990; Galski et al., 2000; Hunt, 2003; Hunt et al, 1993; Lloyd et al., 2001; Lundberg et al., 2003; Lundqvist, 2001; McGregor, 2002; McGwin, Sims et al., 2000; Mercier et al., 1997; Ott et al., 2003; Parasuraman & Nestor, 1991; Patat, 1998; Reger et al., 2004; Rosnick et al., 2004; Sabatowski et al., 2003; Stutts et al., 1998; Stutts & Wilkens, 2003; Wild & Cotrell, 2003
C	**Cognitive rigidity**	General aging, medical conditions	Brouwer & Ponds, 1994
C	**Confusion**	General aging, medical conditions (e.g., AD, dementia), medications	Carr et al., 2000; Dubinsky et al., 2000; Hakamies-Blomqvist et al., 2004; Nuthall & Anthony, 2003; Wang et al., 2003
C	**Difficulty following directions**	Medications (e.g., opioids)	Galski et al., 2000
C	**Anxiety**	Med conditions that disturb sleep; medications	Maes et al., 1999; Mehta et al., 2003; National Sleep Foundation, 2000; Parker et al., 2001; Wang et al., 2003
C	**Depression**	Med conditions, medications	
C	**Getting lost**	AD/dementia; stroke	Bédard et al., 1998; Marottoli & Richardson, 1998; Smothers et al., 2003
C	**Impulsivity**	Meds – opioids	Galski et al., 2000
C	**Lack of driving confidence**	Multiple conditions/medications	Parker et al., 2001
C	**Language impairment**	AD/dementia; general aging/med conditions; stoke	Barbas & Wilde, 2001; Bogner et al., 2004; Janke, 1994; Lundberg et al., 2003; Reger et al., 2004
C	**Memory deficits**	AD/Dementia; General aging/med conditions; Med conditions – neurologic; Meds – benzodiazepines	Barbas & Wilde, 2001; Carr et al., 2000; Donnelly et al., 1992; Donnelly & Karlinsky, 1990; Dubinsky et al., 2000; Freedman et al., 1986; Hunt, 2003; Lundberg et al., 1998; McGregor, 2002; McGwin, Sims et al., 2000; Nuthall & Anthony, 2003; Reger et al., 2004; Rosnick et al., 2004; Schreuder, et al., 2002; Stutts et al., 1998; Verster & Vokerts, 2004; Verster, Vokerts, & Verbaten, 2002; Wild & Cotrell, 2003; Woo & Sharps, 2003
C	**Slowed information processing**	Meds – opioids; brain injury; general aging; med conditions; meds – benzodiazepines	Bauer et al., 2003; Donnelly & Karlinsky, 1990; Galski et al., 2000; Lundqvist, 2001; McGwin, Mori & Mizohata, 1995; Sims et al., 2000; Stefano & MacDonald, 2003; Stutts, Stewart, Martell, 1998
C	**Drowsiness/sleepiness**	Med conditions that disturb sleep; Meds-nefazodone, opoids, benzodiazepines; alcohol abuse	Alvarez & Del Rio, 1997; American Thoracic Society, 1994; Freedman et al., 1986; George & Smiley, 1999; Grellner et al., 2002; Gudgeon & Hindmarch, 1980; National Sleep Foundation, 2000; Quinnell & Smith, 2004; Sanders, 2001; Van Laar et al., 1995; Wang et al., 2003
C	**Lapses in consciousness**	Diabetes, epilepsy, heart disease, neurologic disorders, sleep disorders, PD	Carr, 1993; Dischinger et al., 2000; Freedman et al., 1986; Homann et al., 2003; Janke, 1993; McGwin, Sims et al., 2000; Petch, 1998; Radford et al., 2004; Staplin et al., 1999; Waller, 1992; Wang et al., 2003
C	**Seizures**	med conditions, medications	Carr, 1993; Wang et al., 2003
C	**Impaired judgment**	AD - early stage, Dementia, general aging, brain injury.	Ball et al., 1998; Barbas & Wilde, 2001; Brown & Ott, 2004; Hunt, 2003; Lundqvist, 2001; Ostrow et al., 1992; Ott et al., 2003; Reger et al., 2004; Richardson & Marottoli, 2003; Stutts et al., 1998
P	**Hearing loss**	General aging, med conditions	Lloyd et al., 2001; Mayo Clinic, 2003
P	**Extreme pain**	Med conditions - cardiovascular, metabolic; Med conditions that disturb sleep	Freedman et al., 1986; National Sleep Foundation, 2000
P	**Double vision**	MS, antihistimines, myasthena gravis	Alvarez & Del Rio, 1997; Janke, 1993; Lings, 2002; Verster & Volkerts, 2004; Wang et al., 2003
P	**Increased sensitivity to glare**	General aging, glaucoma, cataracts	Ball & Rebok, 1994; Stutts & Wilkens, 2003; Wood, 1999
P	**Poor depth perception**	AD, general aging	Donnelly et al., 1992; Stutts & Wilkens, 2003
P	**Reduce contrast sensitivity**	General aging, cataracts, other vision disorders, some medications	Ball & Rebok, 1994; Decarlo et al., 2003; Klein et al., 2003; McGwin et al., 2000; Owsley et al., 2001
P	**Reduced night vision**	General aging, various vision disorders, various medications.	Brouwer & Ponds, 1994; Donnelly & Karlinsky, 1990; Klein, 1991; Stutts & Wilkens, 2003; Wang et al, 2003; Wood, 1999

P	**Reduced peripheral vision**	Diabetes; general aging	Bishu et al., 1992; MacLeod, 1999
P	**Reduced visual acuity**	General aging, diabetes, most vision disorders	Brouwer & Ponds, 1994; Carr, 1993; Decarlo et al., 2003; Donnelly & Karlinsky, 1990; Eddington & Frier, 1989; Gilhotra et al., 2001; Keeffe et al., 2002; Klein, 1991; Klein et al., 2003; Lloyd et al., 2001; Marottoli, Richardson, et al., 1998; McGwin et al., 2000; Stutts & Wilkens, 2003; Wood, 1999
P	**Visual attention deficits**	General aging, some medical conditions, vision disorders, stroke	Ball & Rebok, 1994; Coeckelbergh, Brouwer, et al., 2002; Cushman, 1996; Hakamies-Blomqvist et al., 2004; Klein, 1991; McGregor, 2002; Nouri et al., 1987; Richardson & Marottoli, 2003
P	**Visuospatial deficits**	AD General aging/med conditions	Bishu et al., 1992; Donnelly & Karlinsky, 1990; O'Brien et al., 2001
M	**Limitations in ADLs**	AD/Dementia	Carr et al., 2000; Dubinsky et al., 2000
M	**Dizziness/vertigo**	vestibular disorders, MS, various other medical conditions, various medications	Carr, 1993; Cohen et al., 2003; Janke, 1993; Lings, 2002; McGwin, Sims, et al., 2000; Parnes & Sindwani, 1997; Wang et al., 2003
M	**Slowed physical movements**	Stoke, PD, anxiety/panic disorder, various medications	Borromei et al., 1999 ; Janke, 1993; Lundberg et al., 2003 ; Radford et al., 2004; Verster, Volkerts, Schreuder, et al., 2002 ; Verster, Volkerts, & Verbaten, 2002
M	**Shortness of breath**	Heart disease; various other medical conditions	Mori & Mizohata, 1995
M	**Slowed reaction time**	AD, DAT, Degenerative joint diseases, PD, General aging; Some Medications	Bauer et al., 2003; Borromei et al., 1999; Christ, 1996; Donnelly et al., 1992; Donnelly & Karlinsky, 1990; Duchek et al., 2003; Hakamies-Blomqvist et al., 2004; Lloyd et al., 2001; Mayo Clinic, 2003; McGregor, 2002; McGwin, Sims, et al., 2000; Sabatowski et al., 2003; Schlag, 1993; Stutts & Wilkens, 2003
M	**Falls/fractures**	Various medical conditions	Lyman et al., 2001; Marottoli, Richardson, et al., 1998; McGregor, 2002; Sims et al., 2001; Staplin et al., 1999
M	**Physical rigidity**	PD	Borromei et al., 1999; Janke, 1993; Radford et al., 2004
M	**Impaired balance**	General aging, various medical condition, various medications	Alvarez & Del Rio, 1997; Borromei et al., 1999; Janke, 1994
M	**Impaired coordination**	General aging, various medical condition, various medications	Alvarez & Del Rio, 1997; Sabatowski et al., 2003
M	**Tremors**	PD, General aging, other medical conditions, some medications	Borromei et al., 1999; Freedman et al., 1986; Janke, 1994; Lings, 2002; Staplin et al., 1999; Wang, et al, 2003
M	**Reduced flexibility**	General aging, various medical conditions	Bauer et al., 2003; Carr, 1993; Mayo Clinic, 2003; McGregor, 2002; McGwin, Sims et al., 2000; Mori & Mizohata, 1995; Ostrow et al., 1992; Seeman, 2004; Shaffron et al., 1991; Suthers & Stutts & Wilkens, 2003
M	**Reduced strength**	Degenerative joint diseases, PD, other medical conditions, general aging.	Bauer et al., 2003; Freedman et al., 1986; Lloyd et al., 2001; Mayo Clinic, 2003; McGregor, 2002; Mori & Mizohata, 1995; Phillips et al., 2003; Sims et al., 2001; Stutts & Wilkens, 2003
M	**Stiffness**	General aging, some medical conditions	Janke, 1994; Mayo Clinic, 2003
M	**Excessive fatigue**	General aging, metabolic disorders, MS, various medications	Freedman et al., 1986; Lings, 2002; McGwin, Sims et al., 2000; Wang et al., 2003

* C=cognitive, P=perceptual, M=motor.

Health Concern Definitions

Health Concern	Definition
Attention deficits (selected, divided, sustained)	A deficiency or impairment in the ability to focus upon an object or to closely/carefully observe and/or listen.
Cognitive rigidity	Associated with an inability to focus away from a dominant stimulus or to focus on more than one stimulus at a time.
Confusion	Inability or delay in ability to process information and make critical judgments.
Difficulty following directions	Difficulty with following an instruction or series of instructions for doing or finding something.
Anxiety	Feelings of nervousness and/or fear, as a reaction to a stressful situation.
Depression	A disorder characterized by an inability to concentrate, insomnia, loss of appetite, feelings of extreme sadness, guilt, helplessness and hopelessness, and thoughts of death.
Getting lost	Unable to navigate or find one's way.
Impulsivity	Trait associated with lack of control over emotions, especially anger, difficulty delaying gratification, and novelty seeking.
Lack of driving confidence	Lack of assurance or certainty in one's ability to safely and properly operate a motor vehicle.
Language impairment	Weakening, damage, or deterioration of one's ability to verbally communicate thoughts and feelings.
Memory deficits	A deficiency or impairment in the capacity or duration of one's ability to store and/or retrieve information from the brain.
Slowed information processing	The delay or reduction in the ability of one's mind to consistently monitor what is going on in the environment and one's body to react appropriately.
Drowsiness/sleepiness	A state of impaired awareness associated with a desire or need to sleep.
Lapses in consciousness	Gradual or temporary loss of awareness of self and/or one's environment.
Seizures	A sudden attack, spasm, or convulsion.
Impaired judgment	Diminished ability to assess condition(s) and draw reasonable conclusion(s).
Hearing loss	A reduction or complete lack of ability to hear what should or can be heard.
Extreme pain	Intense suffering or unpleasant sensation occurring at varying degrees of severity as a consequence of injury or disease.
Double vision (Diplopia)	A vision disorder in which a single object appears to be two objects.
Increased sensitivity to glare	Reduction in ability to see an object as a result of a light source in one's visual field.
Poor depth perception	Diminished ability to determine spatial relationships, namely distances between objects, in three dimensions.
Reduce contrast sensitivity	Diminished ability to distinguish differences between an object(s) and its background.
Reduced night vision	Diminished ability too see clearly when light is dim.
Reduced peripheral vision	Diminished ability to see objects at the edges of one's field of view.
Reduced visual acuity	Reduction in the eye's ability to see fine details and a measure of the eye's ability to see an in-focus image at a certain distance.
Visual attention deficits	A deficiency or impairment in the ability to maintain visual focus upon an object(s)
Visuospatial deficits	Diminished ability to visually perceive spatial relationships among objects.
Limitations in ADLs	Impaired ability, whether cognitive or physical, to perform everyday tasks such as manage medications, manage finances, or to use the telephone.
Dizziness/vertigo	A disorienting sensation characterized by faintness, light-headedness, or unsteadiness.
Slowed physical movements	Delay or reduction in one's ability to change the direction or motion of one's body parts.
Shortness of breath	Feeling of difficulty in breathing that does not match one's level of physical activity.
Slowed reaction time	Delay or reduction in one's ability to respond to a stimulus.
Falls/fractures	The sudden loss of an upright or erect position or a break, rupture, or crack in one's bone(s) or cartilage.
Physical rigidity	Stiffness or inflexibility in the movement of one's body or body part(s).

Impaired balance	Diminished ability to keep one's equilibrium.
Impaired coordination	Weakened functioning in the harmonious movement of muscles or groups of muscles.
Tremors	An involuntary trembling or quivering often caused by nervous agitation or weakness.
Reduced flexibility	Decrease in ability to bend or perform certain repeated movements without injury or damage to the body.
Reduced strength	Decrease in ability to resist strain or stress, or exert physical force.
Stiffness	Decrease in ability to easily or comfortably move.
Excessive fatigue	Exceeding a normal limit of physical or mental weariness resulting from exertion.

Worksheet for Linking Health Concerns and Critical Driving Tasks

For EACH critical driving task that you think is affected by the health concern identified on this page, please indicate the strength of the effect by clicking on the appropriate box. If you think that the concern has no affect on the task, leave all boxes blank for that task.

Health Concern: Attention deficits

Planning/planning routes:	☐ Weak	☐ Moderate	☐ Strong
Use of medications/supplements/drugs:	☐ Weak	☐ Moderate	☐ Strong
Self care for physical/emotional conditions:	☐ Weak	☐ Moderate	☐ Strong
Navigation/way finding:	☐ Weak	☐ Moderate	☐ Strong
Yielding/yielding right of way:	☐ Weak	☐ Moderate	☐ Strong
Intersection negotiation:	☐ Weak	☐ Moderate	☐ Strong
Turns:	☐ Weak	☐ Moderate	☐ Strong
Responding appropriately to traffic signs/signals:	☐ Weak	☐ Moderate	☐ Strong
Backing up:	☐ Weak	☐ Moderate	☐ Strong
Changing lanes:	☐ Weak	☐ Moderate	☐ Strong
Passing:	☐ Weak	☐ Moderate	☐ Strong
Maintaining lane position/lane:	☐ Weak	☐ Moderate	☐ Strong
Following/gap acceptance/judging distances:	☐ Weak	☐ Moderate	☐ Strong
Maintaining attention:	☐ Weak	☐ Moderate	☐ Strong
Observing/observing behind:	☐ Weak	☐ Moderate	☐ Strong
Negotiating curves:	☐ Weak	☐ Moderate	☐ Strong
Signaling:	☐ Weak	☐ Moderate	☐ Strong
Use of headlights:	☐ Weak	☐ Moderate	☐ Strong

Note: An identical page included for each of the 30 health concerns. Only one page is included here for brevity.

APPENDIX C: Expert Panel Agenda

UMTRI Expert Meeting Agenda
September 8-9, 2005

Michigan League
Kalamazoo Room (2nd Floor)
911 N. University St.
Ann Arbor, Michigan
734-XXX-XXXX

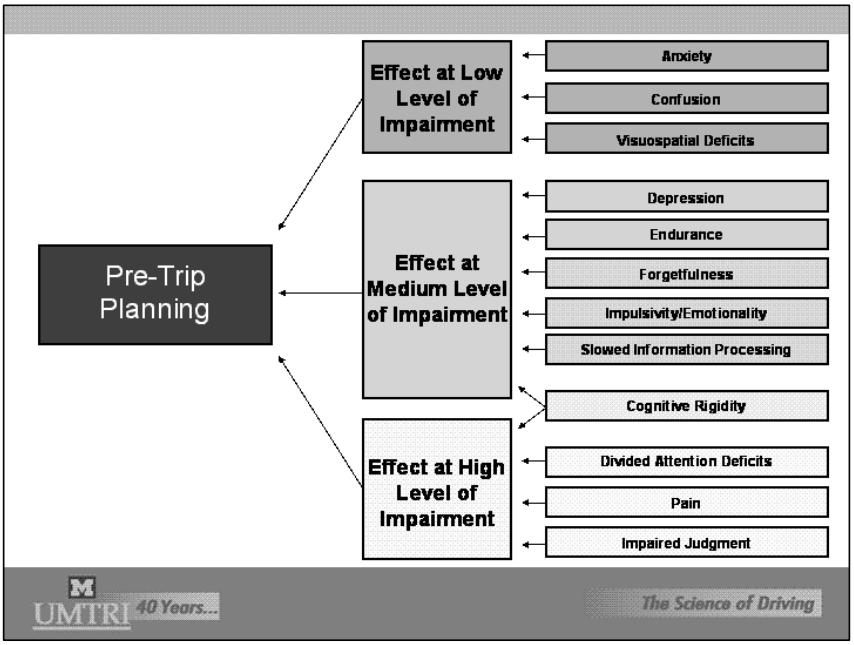
Thursday, September 8

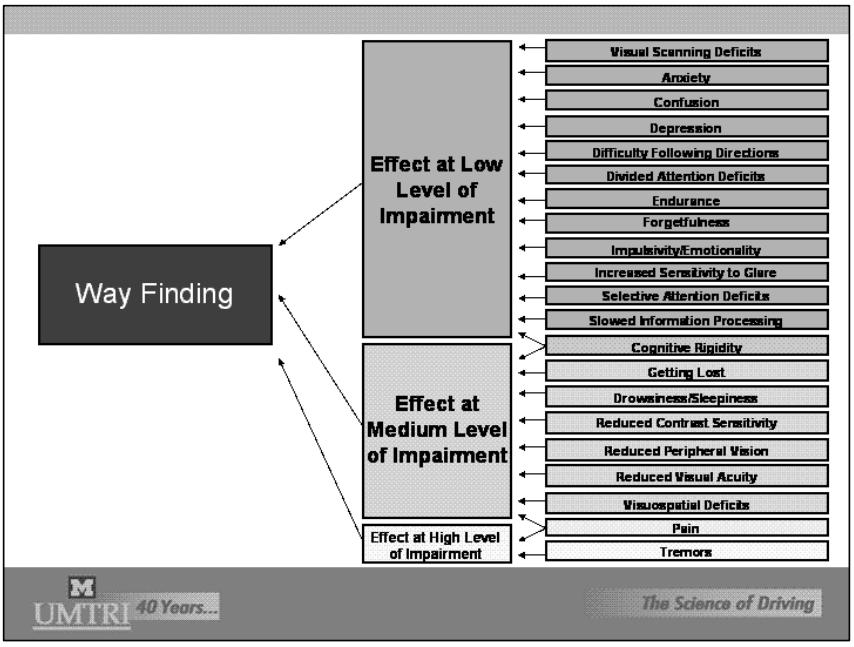
8:30-9:00 AM	**Welcome and introductions** **Welcome from UMTRI Director - Peter Sweatman** **Project background - Jesse Blatt** **Project/meeting overview - David Eby**
9:00-9:30 AM	**Final health concerns**
9:30-10:00 AM	**Final critical driving skills**
10:00-10:15 AM	**Break**
10:15-12:15 AM	**Breakout sessions on concern severity**
12:15-1:15 PM	**Lunch**
1:15-2:15 PM	**Session reporting** **General discussion of concern severity**
2:15-3:15 PM	**Breakout sessions on concern-driving skill linkages**
3:15-3:30 PM	**Break**
3:30-4:30 PM	**Continued breakout sessions on concern-driving skill linkages**
4:30-4:45 PM	**Next steps**

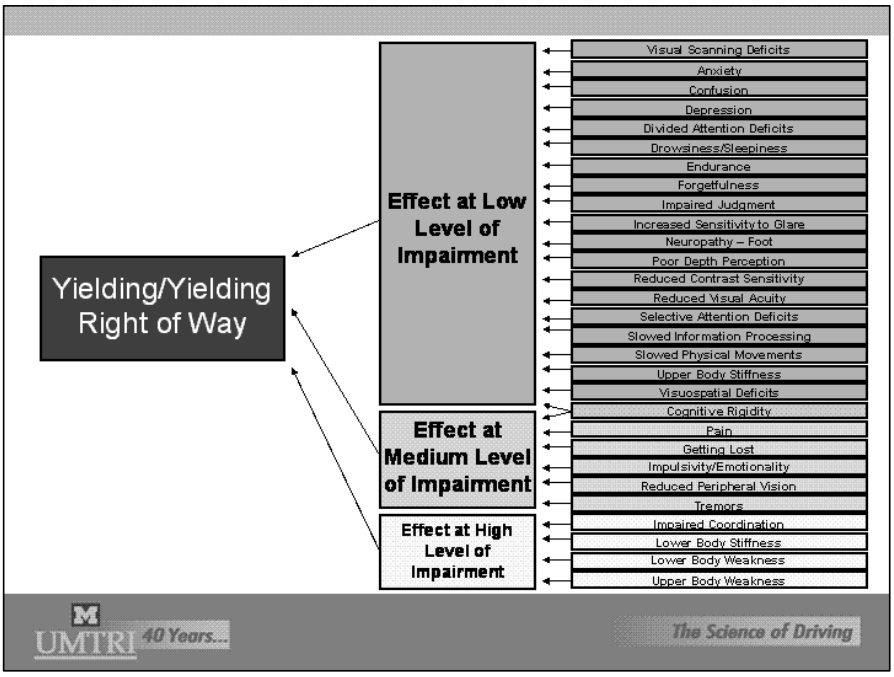
Friday, September 9

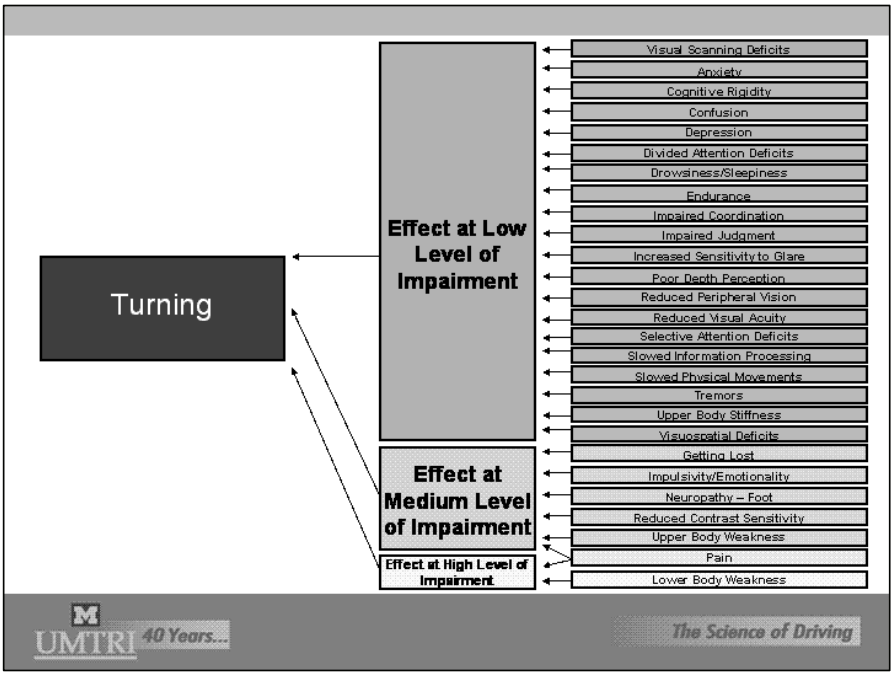
8:30-10:00 AM	**Session reporting** **General discussion of linkages**
10:00-10:15 AM	**Break**
10:15-11:15 AM	**Brainstorming on vehicle adaptations**
11:15-11:30 AM	**Wrap-up**

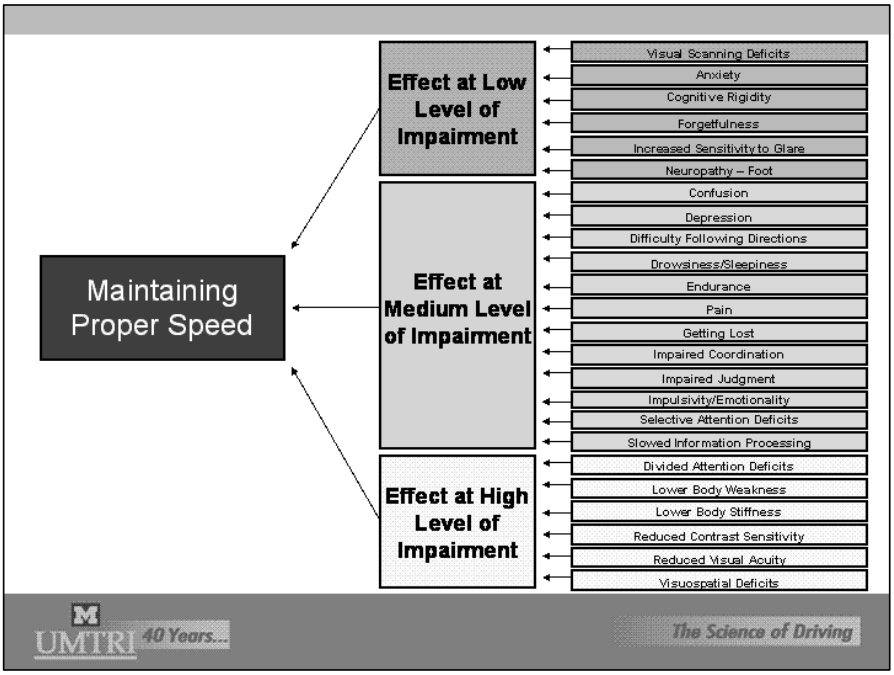
APPENDIX D: PowerPoint Summary of Expert Panel Outcomes

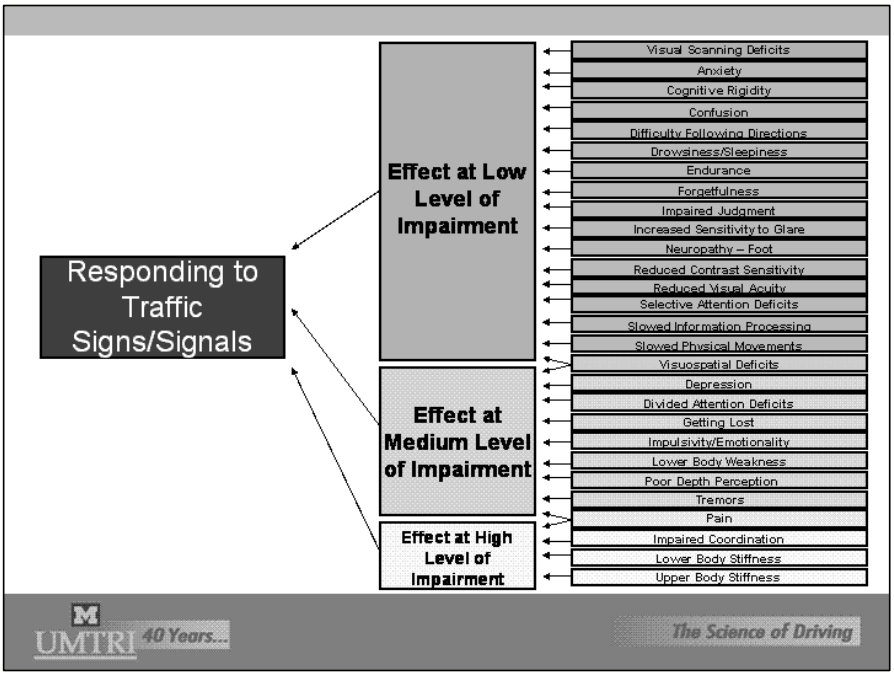


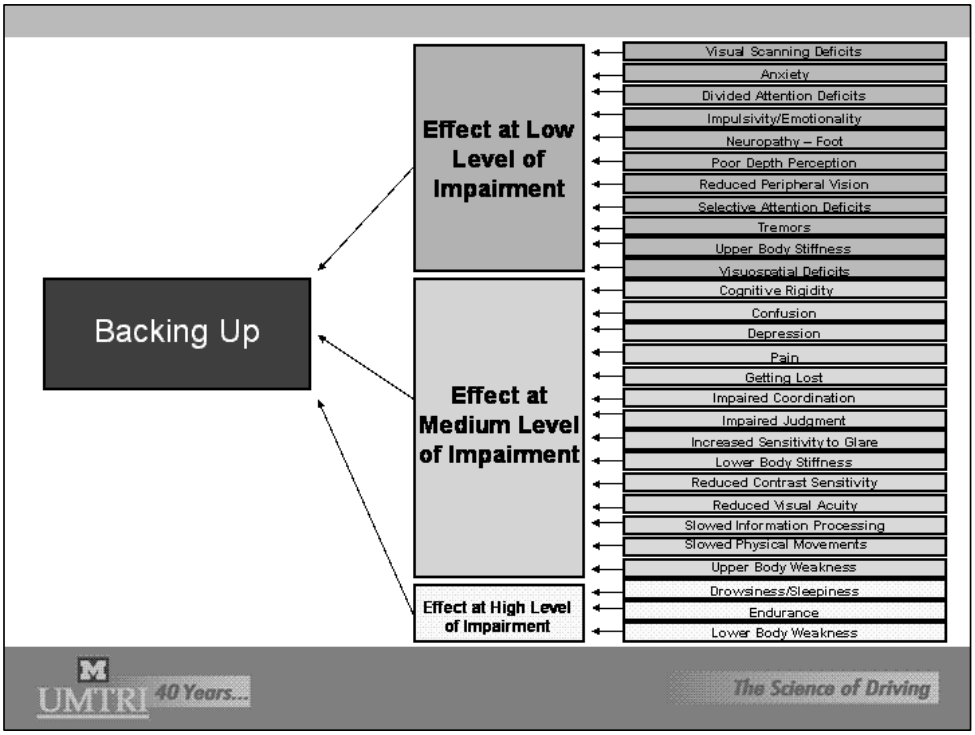



Yielding/Yielding Right of Way
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Visual Scanning Deficits
Anxiety
Confusion
Depression
Divided Attention Deficits
Drowsiness/Sleepiness
Endurance
Forgetfulness
Impaired Judgment
Increased Sensitivity to Glare
Neuropathy – Foot
Poor Depth Perception
Reduced Contrast Sensitivity
Reduced Visual Acuity
Selective Attention Deficits
Slowed Information Processing
Slowed Physical Movements
Upper Body Stiffness
Visuospatial Deficits
Cognitive Rigidity
Pain
Getting Lost
Impulsivity/Emotionality
Reduced Peripheral Vision
Tremors
Impaired Coordination
Lower Body Stiffness
Lower Body Weakness
Upper Body Weakness
UMTRI 40 Years...
The Science of Driving


Turning
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Visual Scanning Deficits
Anxiety
Cognitive Rigidity
Confusion
Depression
Divided Attention Deficits
Drowsiness/Sleepiness
Endurance
Impaired Coordination
Impaired Judgment
Increased Sensitivity to Glare
Poor Depth Perception
Reduced Peripheral Vision
Reduced Visual Acuity
Selective Attention Deficits
Slowed Information Processing
Slowed Physical Movements
Tremors
Upper Body Stiffness
Visuospatial Deficits
Getting Lost
Impulsivity/Emotionality
Neuropathy – Foot
Reduced Contrast Sensitivity
Upper Body Weakness
Pain
Lower Body Weakness
UMTRI 40 Years...
The Science of Driving


Maintaining Proper Speed
Effect at Low Level of Impairment
Visual Scanning Deficits
Anxiety
Cognitive Rigidity
Forgetfulness
Increased Sensitivity to Glare
Neuropathy – Foot
Effect at Medium Level of Impairment
Confusion
Depression
Difficulty Following Directions
Drowsiness/Sleepiness
Endurance
Pain
Getting Lost
Impaired Coordination
Impaired Judgment
Impulsivity/Emotionality
Selective Attention Deficits
Slowed Information Processing
Effect at High Level of Impairment
Divided Attention Deficits
Lower Body Weakness
Lower Body Stiffness
Reduced Contrast Sensitivity
Reduced Visual Acuity
Visuospatial Deficits
UMTRI 40 Years...
The Science of Driving


Responding to Traffic Signs/Signals
Effect at Low Level of Impairment
Visual Scanning Deficits
Anxiety
Cognitive Rigidity
Confusion
Difficulty Following Directions
Drowsiness/Sleepiness
Endurance
Forgetfulness
Impaired Judgment
Increased Sensitivity to Glare
Neuropathy – Foot
Reduced Contrast Sensitivity
Reduced Visual Acuity
Selective Attention Deficits
Slowed Information Processing
Slowed Physical Movements
Visuospatial Deficits
Effect at Medium Level of Impairment
Depression
Divided Attention Deficits
Getting Lost
Impulsivity/Emotionality
Lower Body Weakness
Poor Depth Perception
Tremors
Pain
Effect at High Level of Impairment
Impaired Coordination
Lower Body Stiffness
Upper Body Stiffness
UMTRI 40 Years...
The Science of Driving


Backing Up
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Visual Scanning Deficits
Anxiety
Divided Attention Deficits
Impulsivity/Emotionality
Neuropathy – Foot
Poor Depth Perception
Reduced Peripheral Vision
Selective Attention Deficits
Tremors
Upper Body Stiffness
Visuospatial Deficits
Cognitive Rigidity
Confusion
Depression
Pain
Getting Lost
Impaired Coordination
Impaired Judgment
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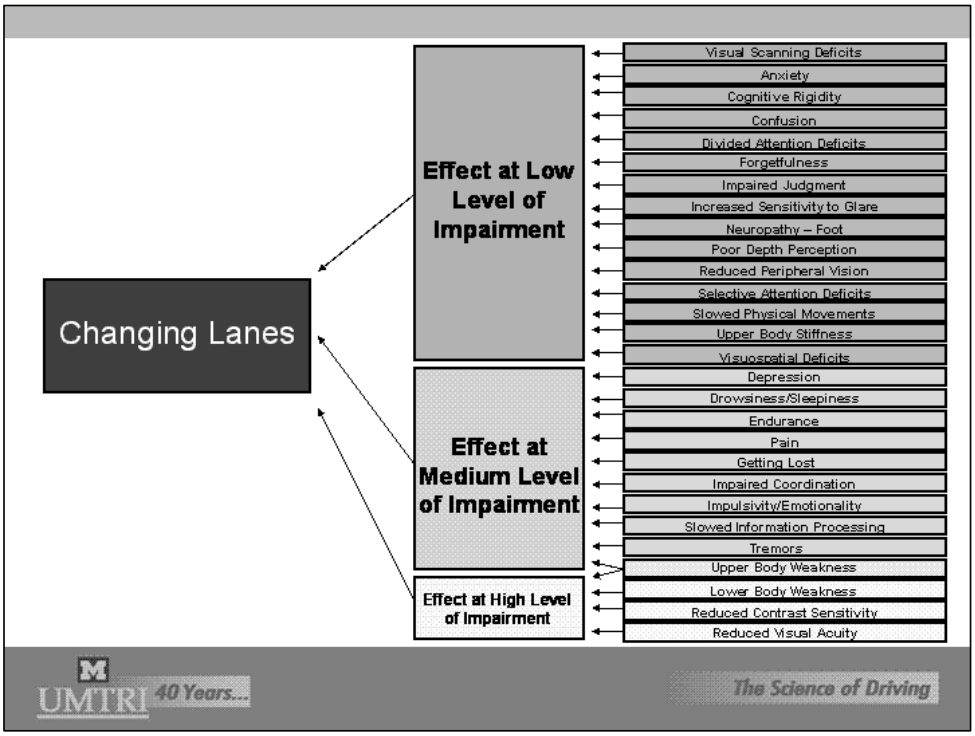
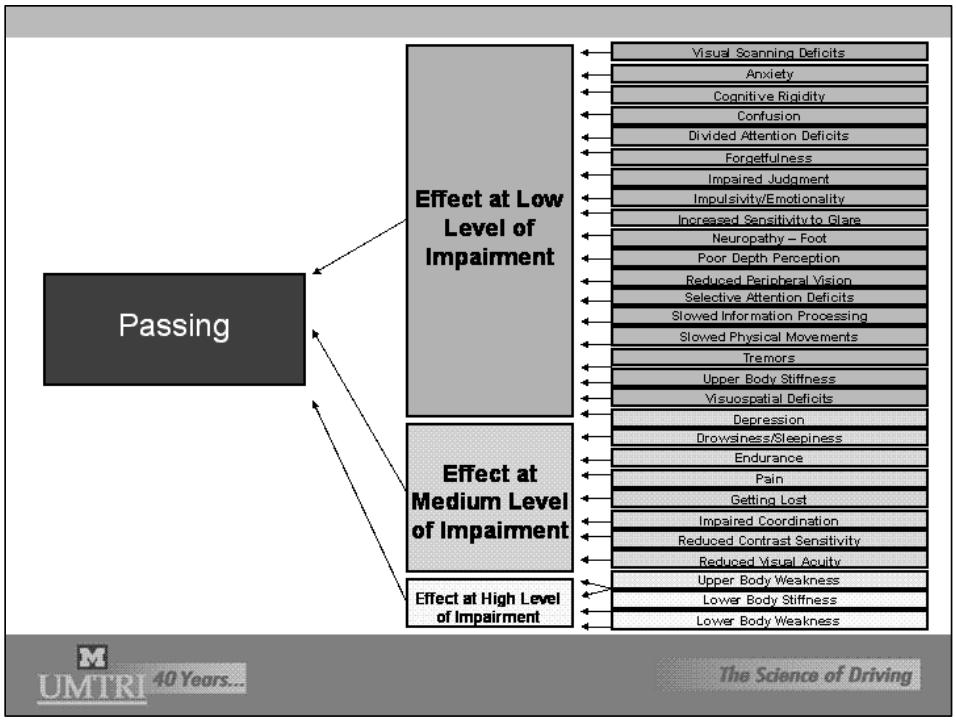
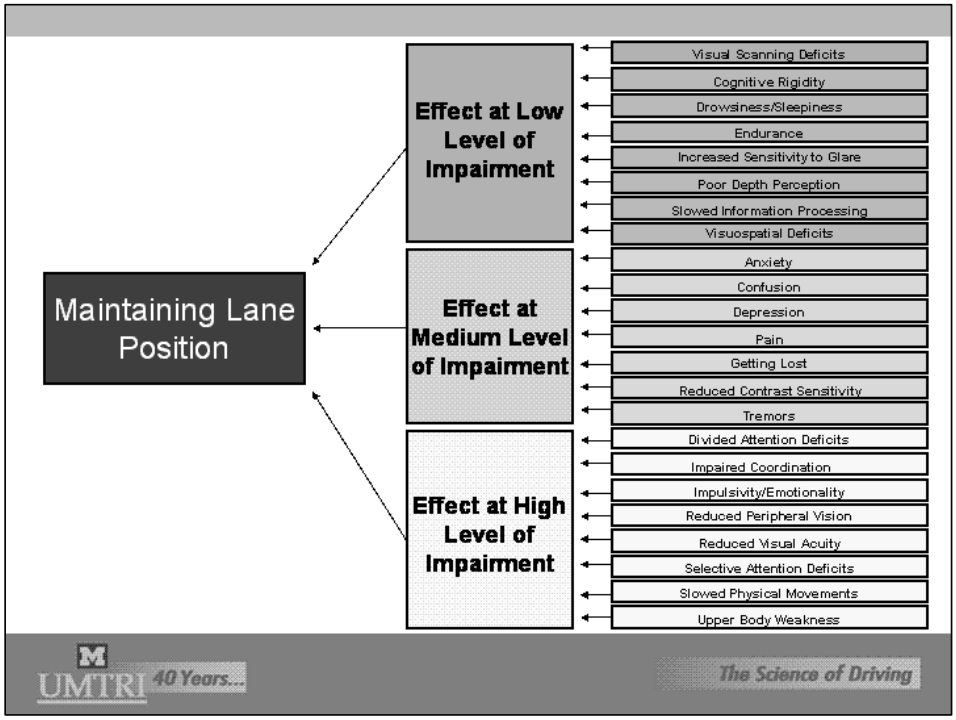
Reduced Contrast Sensitivity
Reduced Visual Acuity
Slowed Information Processing
Slowed Physical Movements
Upper Body Weakness
Drowsiness/Sleepiness
Endurance
Lower Body Weakness
UMTRI 40 Years...
The Science of Driving


Changing Lanes
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Visual Scanning Deficits
Anxiety
Cognitive Rigidity
Confusion
Divided Attention Deficits
Forgetfulness
Impaired Judgment
Increased Sensitivity to Glare
Neuropathy – Foot
Poor Depth Perception
Reduced Peripheral Vision
Selective Attention Deficits
Slowed Physical Movements
Upper Body Stiffness
Visuospatial Deficits
Depression
Drowsiness/Sleepiness
Endurance
Pain
Getting Lost
Impaired Coordination
Impulsivity/Emotionality
Slowed Information Processing
Tremors
Upper Body Weakness
Lower Body Weakness
Reduced Contrast Sensitivity
Reduced Visual Acuity
UMTRI 40 Years...
The Science of Driving


Passing
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Visual Scanning Deficits
Anxiety
Cognitive Rigidity
Confusion
Divided Attention Deficits
Forgetfulness
Impaired Judgment
Impulsivity/Emotionality
Increased Sensitivity to Glare
Neuropathy – Foot
Poor Depth Perception
Reduced Peripheral Vision
Selective Attention Deficits
Slowed Information Processing
Slowed Physical Movements
Tremors
Upper Body Stiffness
Visuospatial Deficits
Depression
Drowsiness/Sleepiness
Endurance
Pain
Getting Lost
Impaired Coordination
Reduced Contrast Sensitivity
Reduced Visual Acuity
Upper Body Weakness
Lower Body Stiffness
Lower Body Weakness
UMTRI 40 Years...
The Science of Driving


Maintaining Lane Position
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Visual Scanning Deficits
Cognitive Rigidity
Drowsiness/Sleepiness
Endurance
Increased Sensitivity to Glare
Poor Depth Perception
Slowed Information Processing
Visuospatial Deficits
Anxiety
Confusion
Depression
Pain
Getting Lost
Reduced Contrast Sensitivity
Tremors
Divided Attention Deficits
Impaired Coordination
Impulsivity/Emotionality
Reduced Peripheral Vision
Reduced Visual Acuity
Selective Attention Deficits
Slowed Physical Movements
Upper Body Weakness
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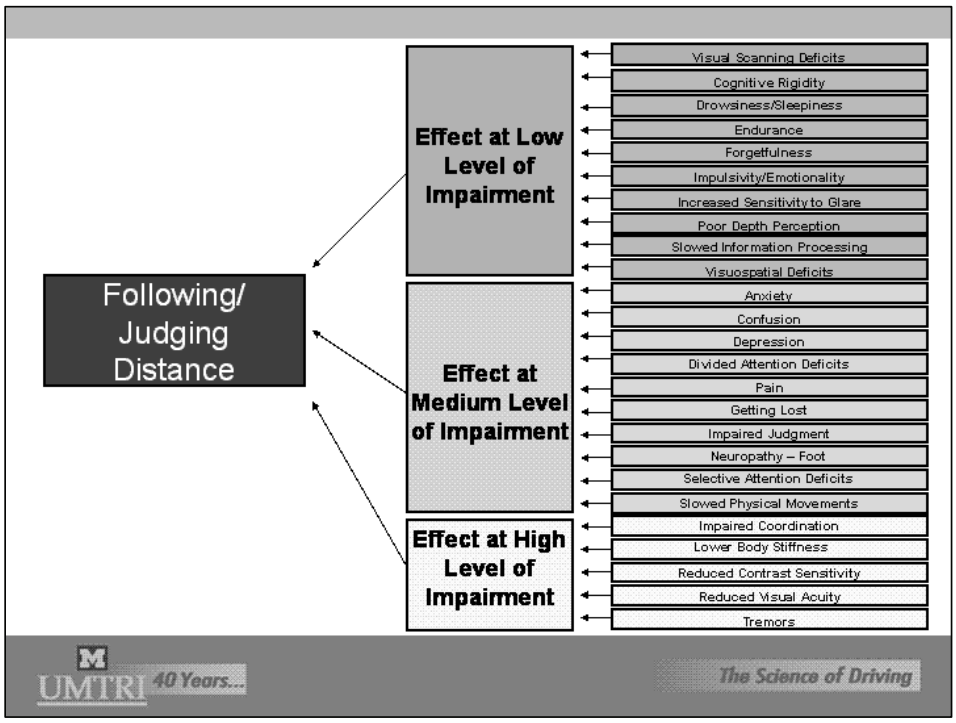
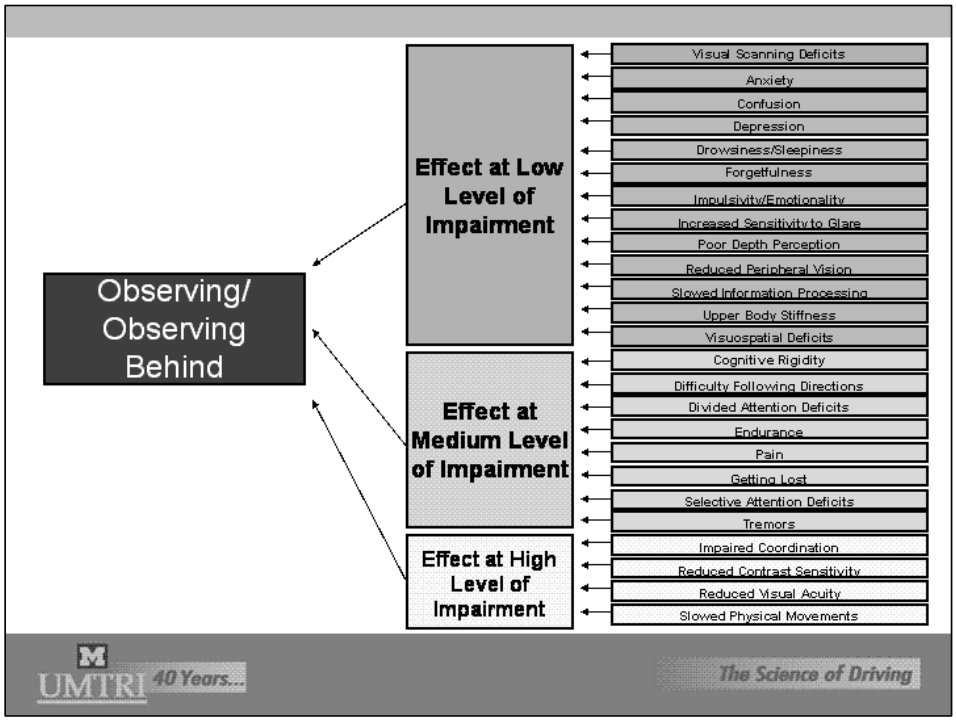

Following/ Judging Distance
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Visual Scanning Deficits
Cognitive Rigidity
Drowsiness/Sleepiness
Endurance
Forgetfulness
Impulsivity/Emotionality
Increased Sensitivity to Glare
Poor Depth Perception
Slowed Information Processing
Visuospatial Deficits
Anxiety
Confusion
Depression
Divided Attention Deficits
Pain
Getting Lost
Impaired Judgment
Neuropathy – Foot
Selective Attention Deficits
Slowed Physical Movements
Impaired Coordination
Lower Body Stiffness
Reduced Contrast Sensitivity
Reduced Visual Acuity
Tremors
UMTRI 40 Years...
The Science of Driving


Observing/ Observing Behind
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Visual Scanning Deficits
Anxiety
Confusion
Depression
Drowsiness/Sleepiness
Forgetfulness
Impulsivity/Emotionality
Increased Sensitivity to Glare
Poor Depth Perception
Reduced Peripheral Vision
Slowed Information Processing
Upper Body Stiffness
Visuospatial Deficits
Cognitive Rigidity
Difficulty Following Directions
Divided Attention Deficits
Endurance
Pain
Getting Lost
Selective Attention Deficits
Tremors
Impaired Coordination
Reduced Contrast Sensitivity
Reduced Visual Acuity
Slowed Physical Movements
UMTRI 40 Years...
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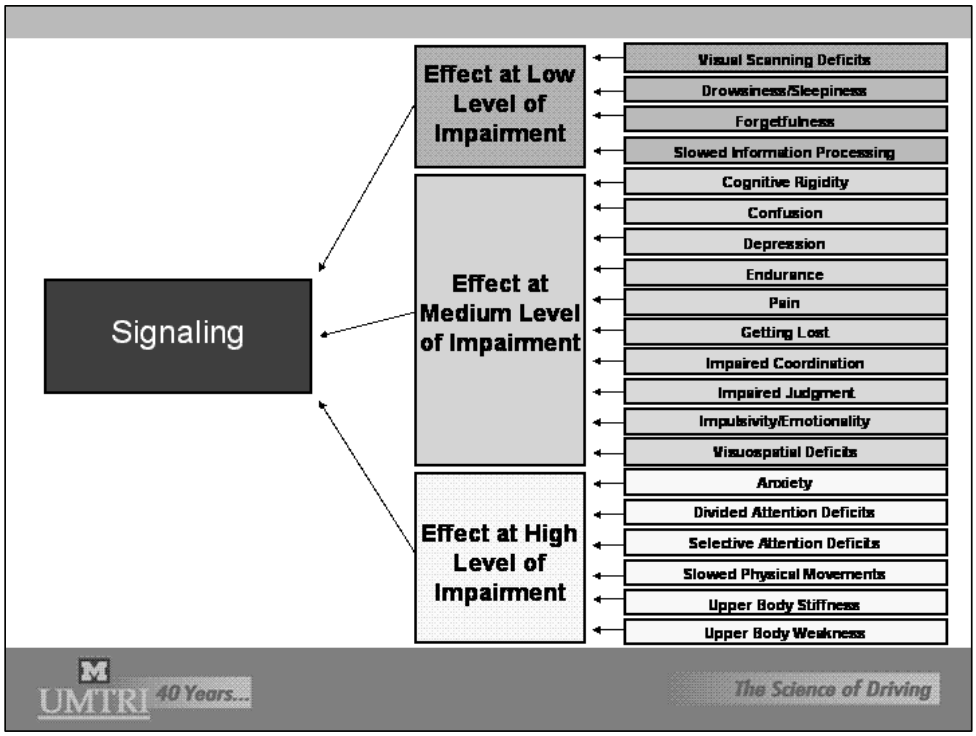
Signaling
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Visual Scanning Deficits
Drowsiness/Sleepiness
Forgetfulness
Slowed Information Processing
Cognitive Rigidity
Confusion
Depression
Endurance
Pain
Getting Lost
Impaired Coordination
Impaired Judgment
Impulsivity/Emotionality
Visuospatial Deficits
Anxiety
Divided Attention Deficits
Selective Attention Deficits
Slowed Physical Movements
Upper Body Stiffness
Upper Body Weakness
UMTRI 40 Years...
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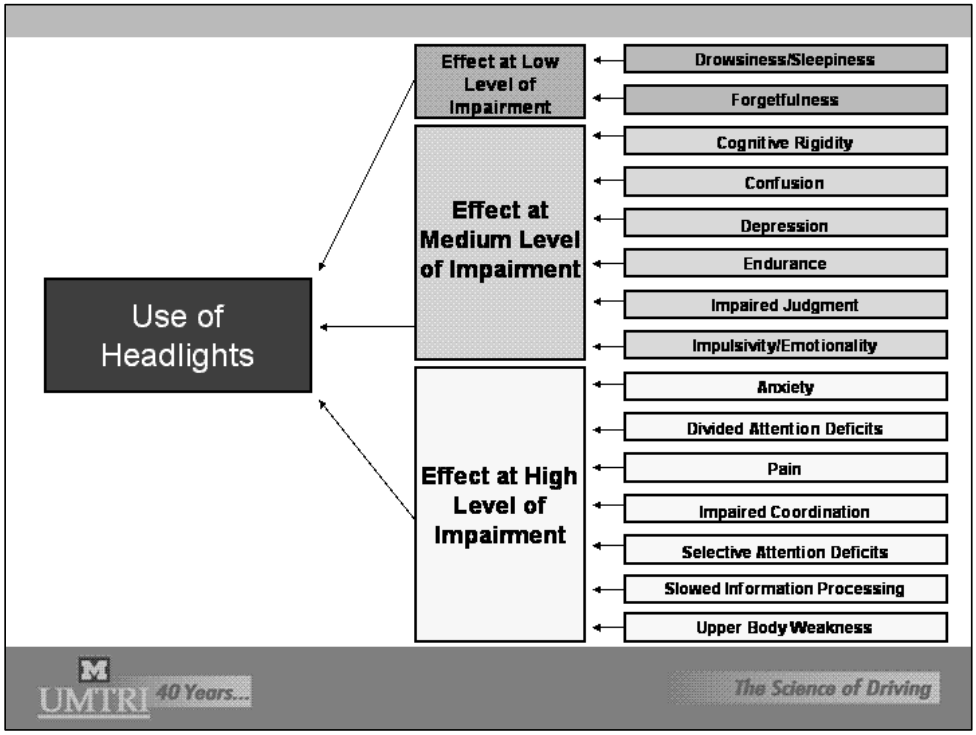
Use of Headlights
Effect at Low Level of Impairment
Effect at Medium Level of Impairment
Effect at High Level of Impairment
Drowsiness/Sleepiness
Forgetfulness
Cognitive Rigidity
Confusion
Depression
Endurance
Impaired Judgment
Impulsivity/Emotionality
Anxiety
Divided Attention Deficits
Pain
Impaired Coordination
Selective Attention Deficits
Slowed Information Processing
Upper Body Weakness
UMTRI 40 Years...
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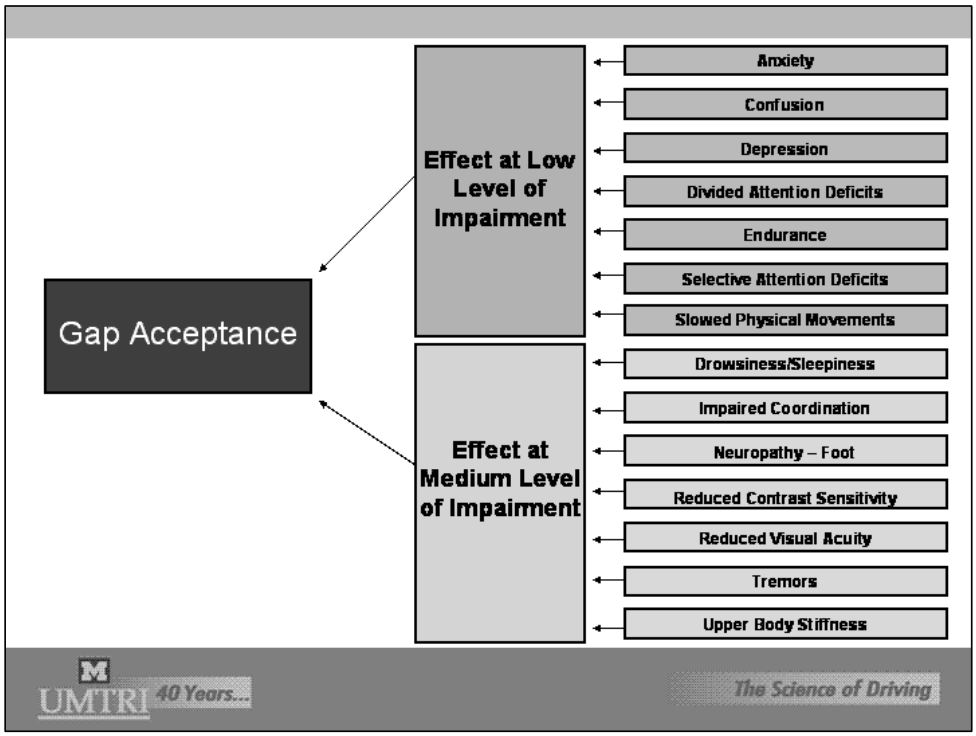
Gap Acceptance
Effect at Low Level of Impairment
Anxiety
Confusion
Depression
Divided Attention Deficits
Endurance
Selective Attention Deficits
Slowed Physical Movements
Effect at Medium Level of Impairment
Drowsiness/Sleepiness
Impaired Coordination
Neuropathy – Foot
Reduced Contrast Sensitivity
Reduced Visual Acuity
Tremors
Upper Body Stiffness
UMTRI 40 Years...
The Science of Driving

APPENDIX E: Moderator's Guide and Summary for 1st Set of Focus Groups

Focus Group Moderator's Guide

Development of an Older Driver Self-Assessment Guide Based on Health Concerns Associated with Aging

Good morning/afternoon and welcome. Thank you for taking the time to join our discussion. My name is (project team member), and I'm from the University of Michigan Transportation Research Institute. Assisting me is (project team member) from the University of Michigan.

We are in the process of developing an interactive computer program that will help senior drivers assess their driving and provide feedback on what they can do to continue driving safely. The computer program would be set up to ask senior drivers about different health concerns or symptoms they might be experiencing that could affect safe driving. Based on their answers, they would be given feedback about how these concerns or symptoms affect driving skills such as yielding right of way, passing, or negotiating intersections. Seniors would also be given feedback on what steps they might take to deal with these concerns or symptoms. For example, if someone was experiencing shoulder or neck stiffness, recommendations might include scheduling an appointment with a doctor, enrolling in a fitness/flexibility class, and/or adding special mirrors to the car to aid in observing behind.

The benefits of this kind of self-assessment are that it can be done in the privacy of one's own home, it can provide confidential information about one's ability to drive, and it can be used as a basis for discussion with other family members.

We are interested in your thoughts about this kind of self-assessment for senior drivers, and your reactions to different features that an interactive computer program for self-assessment might have. My role here is to ask questions, listen, and encourage discussion. In answering my questions, please think about your own experiences and share what you're comfortable with, as well as how you think others in your age group might feel. Before we get started, do you have any questions?

1. What do think about this kind of self-assessment – do you think people in your age group would find it useful or helpful?

2. Do you think that such a self-assessment program would be practical? [PROMPT FOR WHY OR WHY NOT]

3. How do you think a computer program like I described should be made available to people? [PROMPT FOR CD VERSUS INTERNET-BASED IF NOT MENTIONED]

   Follow-up:
   3a. What led you to suggest that?
   3b. What are the pros and cons of (suggested method)? [PROMPT FOR INTERNET PRIVACY CONCERNS]

4. In designing a computer program for senior drivers, what things would be important to include? [LIST ON FLIPCHART]

5. Let's prioritize these. Which is the most important? Next important? Etc. [RECORD ON FLIPCHART; PROMPT FOR DISCUSSION ON INSTRUCTIONS, PROBLEMS]

Let's talk briefly about your computer experience.

6. How many of you use a MAC or an Apple computer? How many of you use a PC or windows-based computer?

7. How often do you use it?

8. During times when you have problems with the computer, is there someone you typically call to help you?

9. How many of you have installed software from a CD before?

10. How many of you use the internet at least once a week? What kind of access do you have to the internet? [PROBE for dial-up access versus DSL]

Now let's talk about some general features of the program – regardless of how it would be made available. As we envision it, the program would be divided into three sections. One section would ask about health concerns or symptoms related to physical movement such as upper and lower body weakness or stiffness, tremors, and impaired coordination. A second section would ask about concerns or symptoms related to thinking such as getting lost, confusion, and memory problems. A third section would ask about concerns or symptoms related to seeing such as poor night vision, sensitivity to glare, and poor depth perception. In each section there would be a series of questions to see if seniors are experiencing the concerns or symptoms. Here's an example of what the program might look like. [SHOW POWER POINT EXAMPLE]

11. Does the order of the three main sections matter to you? What order would you prefer?

12. How about the layout of the questions? Would you prefer to see each question on a separate page or would you rather just scroll down the list of questions with no clear page breaks? [SHOW EXAMPLES OF EACH CHOICE]

13. We would like to give people the option of enlarging the size of the letters in the computer program. Would you prefer a feature that would let you choose the letter size when you first began the program, or would you prefer a feature that would let you zoom in and out at any point during the program? [SHOW EXAMPLES]

14. Do you have any other thoughts about the layout?

Now, I'd like to hear your thoughts on the time required for the program.

15. If you were using the program, would you prefer to complete it in one sitting or would you prefer to be able to come back to it on one or more occasions?

16. How much time would you be willing to spend on the program in one sitting?

17. How much time would you be willing to spend to complete the entire program?

An important part of the program would be to give feedback on how people's health concerns and symptoms relate to safe driving and what people might do to drive safely. Here's an example of what some feedback might look like. [SHOW EXAMPLE]

18. In general, what kind of feedback would be most useful to seniors? [PROMPT FOR GENERAL AWARENESS/KNOWLEDGE, RECOMMENDATIONS FOR CLINICAL FOLLOW-UP, CHANGES TO DRIVING, VEHICLE ADAPTATIONS] [PROMPT FOR LEVEL OF DETAIL DESIRED]

19. How likely do you think seniors would be to act on this information?

20. How useful would it be for seniors to be able to repeat the program and monitor their results over time?

21. When do you think seniors would want to get feedback during the program? Just at the end? Or after each section? [PROMPT FOR THOUGHTS ON DUPLICATED FEEDBACK]

Clearly, no matter how great this program might be, people have to know about it to use it.

22. What would be an effective way to tell seniors about the program and how they could get it?

23. If you were to use a program like this, would you be more likely to use it by yourself or with someone else? Who would that be?

24. That's the end of my formal questions. Do you have any other thoughts about or reactions to the program?

Prompts that could be used during discussion as necessary:

- Please talk in a voice at least as loud as mine.
- Only one person should talk at a time because we're tape-recording the session so we don't miss any of your comments.
- You will not be identified in any of our reports. We'll be on just a first name basis.
- We've placed name cards on the table in front of you to help us remember each other's names.
- There are no right or wrong answers – just differing points of view. So, please share your thoughts even if you don't think anyone will agree with you.
- Feel free to make positive or negative comments about any of the things we will be discussing.
- It's important to hear from each of you because you have each had different experiences. We'd like to hear from everyone.

Development of an Older Driver Self-Assessment Guide Based on Health Concerns Associated with Aging: Summary of Findings from First Set of Focus Groups

Two sets of focus groups were conducted to get feedback on the idea of an interactive computer program for self-assessing driving ability for seniors (see table for participant characteristics). One group included drivers age 65-74, and one group included drivers age 75 and older. Discussion in each group was guided by the same set of questions, with discussion led by a moderator. The groups were lively and all participants contributed to the discussion. Responses to the focus group questions are summarized below. Unless otherwise noted, responses did not markedly differ by age group.

Characteristics of Focus Group Participants		
	Number	Percentage
Sex		
Male	3	27.3%
Female	8	72.7%
Age		
65 to 74	5	45.5%
75 or older	6	54.5%
Education		
High school or GED	1	9.1%
Some college	2	18.2%
College degree	3	27.3%
Graduate degree	5	45.5%
Race		
White/Caucasian	10	90.9%
African American/Black	1	9.1%
Ethnicity		
Hispanic	0	0
Non-Hispanic	11	100%
Income		
Less than $20,000	1	9.1%
$20,000 to $49,999	5	45.5%
$50,000 to $79,999	5	45.5%
Marital Status		
Single	0	0
Married	7	63.6%
Divorced	3	27.3%
Widow(er)	1	9.1%

1. *What do think about this kind of self-assessment – do you think people in your age group would find it useful or helpful?*

Most participants responded favorably to the idea of an interactive computer program for self-assessment. Several mentioned the importance of making seniors more aware of areas in which they "might be slipping" or of things they weren't previously aware of. One participant thought it would make

her more confident about renewing her driver license, another liked the fact that it would be private, and another mentioned that "anything to stay independent is great." One participant voiced concern that such a program might have trouble picking up "attitudinal problems" that contribute to unsafe driving and another pointed out that seniors would need to have a computer to use the program.

2. Do you think that such a self-assessment program would be practical?

Discussion focused on how such a program would be presented to seniors. A few participants recommended making it available as part of the driver license renewal process (either mailing it out along with the renewal notice or giving it out at secretary of state office when someone comes in) to increase its likelihood of use. Another suggested distributing it through the library. One participant noted that "people who are stubborn won't do it" and one participant voiced concerns about how people's privacy would be protected.

3. How do you think a computer program like I described should be made available to people?

Participants did not understand what they were being asked and had to be prompted about the two likely options for making the program available – either providing it on a CD or having it on a website on the internet. Responses were mixed although more people preferred the internet-based version than CD version. Among the reasons for liking the internet-based version were that "it's the way the world is going," and that it would be much easier than having to put in a CD. Some of the participants who preferred the CD version voiced concerns about privacy on the internet. Other reasons for preferring the CD version included lower costs (for one person who paid for internet access by the minute) and the ability to stop and restart the program more easily if it were on a CD. (In regard to the latter, however, all participants agreed later in the discussion that they would want to complete the program in one sitting and not go back to it.) One participant did not see much difference between the two options, and two participants stated that they would prefer a paper and pencil assessment if given the choice.

4. In designing a computer program for senior drivers, what things would be important to include?

The following ideas were mentioned:

- Make as easy as possible.
- Simplicity and brevity.
- Avoid asking for intrusive, unnecessary, or personal information.
- Provide assurance that it is safe, secure, and private.
- Trust is key – use UM logo and make sure comes from trustworthy source (e.g., senior center).
- Provide information up-front on goals of program and how long it will take.
- If internet version, use short address (not too complicated to get to; e.g., UMseniordrivers.org).
- If CD version, make sure it starts up automatically and have clear instructions (otherwise if it fails to start, people will say "forget it.")
- Use graphics to break up text.

5. Let's prioritize these. Which is the most important? Next important?

Among the 65-74 year-old age group, accessibility to the program was considered to be the top priority; accessibility for a CD version meant that it would be self-starting, for an internet-based version, it meant that it would be easy to get to the website. The second priority was making sure the program was as easy as possible to use. Among the 75 and older age group, all ideas were thought to be important with the need for graphics being the least important.

Let's talk briefly about your computer experience.

6. How many of you use a MAC or an Apple computer? How many of you use a PC or windows-based computer?

Among the 65-74 year-old age group, all but one participant reported using a PC. Among the 75 and older age group, all participants reported using a PC. Among both groups, all but one participant said they owned their own computer. The one person who did not own a computer used one at the library.

7. How often do you use it?

All but one participant (the one who did not own a computer) reported using the computer daily, with several people using it several times a day. Checking and sending e-mail was the most frequently reported reason for using the computer. Other reasons included playing games, looking for information on various topics (e.g., craft ideas, medical problems, genealogy, progress of stocks), word processing, and downloading tax forms.

8. During times when you have problems with the computer, is there someone you typically call to help you?

Among the 65-74 year-old age group, all participants reported having a relative who helps them when problems come up. Many of these relatives were reported to have some professional connection with computers (e.g., son who is a software manager, cousin who is a systems analyst, son who is a mechanical engineer and loves computers). Among the 75 and older age group, two participants reported having a child who worked in the computer industry and the remaining participants reported calling their internet or telephone provider for technical support.

9. How many of you have installed software from a CD before?

All but three of the participants had installed software from a CD. No problems with CD installation were mentioned.

10. How many of you use the internet at least once a week? What kind of access do you have to the internet?

All but one participant reported using the internet at least once a week and most reported using it daily. Most participants reported having some type of dial-up access (primarily AOL). One had DSL, one broadband, and the person who used the library's computer was not sure.

11. Does the order of the three main sections matter to you? What order would you prefer?

The order of the three main sections did not make a difference to any of the participants.

12. How about the layout of the questions? Would you prefer to see each question on a separate page or would you rather just scroll down the list of questions with no clear page breaks?

Among the 65-74 year-old age group, all participants preferred the option of scrolling down the list of questions. Among the reasons given were that it would be easier to move back and forth among the questions and would take less time. Among the 75 and older age group, responses were mixed. Two participants preferred the option of seeing each question on a separate page – one thought this would make it easier to concentrate on each question, the other thought it would make it less likely to miss a question. One participant pointed out that "previous" and "next" buttons could be added for the single

question option to make it easier to go back and forth. Among those who preferred the scrolling option, one mentioned that being able to see all the related questions together would make a person think more carefully about the answers. One participant commented that she would prefer the scrolling option if the questions were separated from each other by a small band of white space.

13. We would like to give people the option of enlarging the size of the letters in the computer program. Would you prefer a feature that would let you choose the letter size when you first began the program, or would you prefer a feature that would let you zoom in and out at any point during the program?

Most participants preferred the option of choosing the letter size at the onset of the program (with text being re-formatted to fit on the page). These participants thought this would be easier and take less time than zooming in and out. A few participants suggested limiting the number of font choices to just a few.

14. Do you have any other thoughts about the layout?

General suggestions for the layout included: using boldface to highlight key words or phrases in the text; keeping the alternating color backgrounds for questions but choosing colors that contrasted more with lettering (e.g., not the mustard yellow); using a color other than green for the answer buttons if using the color-change option when selecting a response category (e.g., possibly red).

15. If you were using the program, would you prefer to complete it in one sitting or would you prefer to be able to come back to it on one or more occasions?

All participants agreed that they would want to complete the program in one sitting. Illustrative of the reasons for this position were the comments "When I sit down, I want to complete it" and "I have a short attention span." One participant mentioned that if the program were on a CD, completing it in more than one sitting would be too time consuming because of the need to reload the CD each time.

16. How much time would you be willing to spend on the program in one sitting?

Everyone in the 65-74 year-old age group agreed that 15 minutes was about all they would want to spend on the program. One participant likened the program to a survey they might be asked to fill out and stated that typically one should be able to finish a survey in less than 10 minutes. Among the 75 and older age group, responses were more varied, ranging from 20 minutes, to under a half hour, to under an hour, to "time is not an object if I see that it benefits me." One participant wondered if it might be possible to start with a short set of screening questions to determine whether the user was experiencing a problem with driving, and if so, he or she would be directed to a fuller set of questions. However, another participant countered that she preferred to jump right into it without pre-screening.

17. How much time would you be willing to spend to complete the entire program?

Because every participant stated they would want to complete the program in one sitting, the responses to question 16 also reflect participants' views relative to this question.

18. In general, what kind of feedback would be most useful to seniors?

Participants responded favorably to having a mix of feedback (including general awareness, knowledge, and recommendations). However, all but one participant thought that the recommendations or "safety tips" were the most important and should come first in the feedback section. The perceived usefulness of such safety tips was reflected in comments such as "tips are the bottom line as far as helpfulness is concerned" and "tips give immediate hands on information about what to do if big problems." At the same time, participants liked the idea of making the "background" information (general awareness and knowledge) available to those who wanted to "go in deeper" and get more information, once the tips were presented.

19. How likely do you think seniors would be to act on this information?

In general, participants thought that if people were interested enough in and willing to take the time to complete the program, they would be likely to listen to the feedback. One participant commented that older people are more sensible than younger people and another commented that older people would be more likely to act on such information than teenagers. A few mentioned that they might share the safety tips with other seniors There was some renewed discussion of how the program should be made available to increase its likelihood of use (e.g., through senior centers and libraries) and one participant commented that use of the program would increase if people found out that it helped. In later discussion among the 75 and older age group, however (in response to question 20), a few participants questioned the ability of people to act on the information and make changes, noting that "people are creatures of habit."

20. How useful would it be for seniors to be able to repeat the program and monitor their results over time?

Although some participants saw value in repeating the program, most doubted that they or other seniors would actually go back and complete it again after the first time. Comments included "by and large, people won't go back a second time because of basic laziness," "if you're going to make changes, you'd do it after the first one," and "it might be helpful a year later, but I don't know that I would." One participant noted that if the program were on a CD, "discs have a tendency to get lost." Two participants suggested that they might consider repeating the program if something had changed in their driving (e.g., "something that triggered a need"), and one participant thought it unlikely that people would repeat unless prompted (e.g., by licensing agency). Among the few who thought they might repeat the program, three to five years was considered an appropriate interval.

21. When do you think seniors would want to get feedback during the program? Just at the end? Or after each section?

Among the 65-74 year-old age group, responses were mixed. Some participants liked the idea of getting feedback just at the end because it would take less time go through, and information would all be on one screen (for printing) and not be duplicated. Those who preferred feedback after each section were not concerned with possible duplication and thought that it might actually reinforce the message. Among the 75 and older age group, all agreed that they preferred the feedback to be at the end because it would be less confusing and would give "an overall picture of yourself."

22. What would be an effective way to tell seniors about the program and how they could get it?

Participants mentioned a variety of ways that seniors could be told about the program, including writing articles in local newspapers or magazines such as AARP's (which according to one participant, "everyone reads"), and publicizing and/or distributing the program through senior centers, libraries, churches, and organizations such as AARP and AAA. One participant suggested that the program could be made

available through licensing agencies when people renewed their license (either in-person or through the mail). One participant noted the importance of personal presentations to groups (e.g., American Association of University Women, senior centers) rather than just sending out information.

23. If you were to use a program like this, would you be more likely to use it by yourself or with someone else? Who would that be?

Most participants agreed that they would want to complete the program alone, although several said they would tell others about it or share information after they had completed it. Comments included "definitely alone but tell others," "alone because could be influenced by what others say," "alone (so I could) focus on answers without someone looking over my shoulder or giving their two cents," "alone especially not with my husband." One participant mentioned that she would complete it herself but then have someone else review it with her because they might see something that she's doing wrong and tell her.

24. That's the end of my formal questions. Do you have any other thoughts about or reactions to the program?

Other thoughts about the program included:

- Information on rules of the road or a link to such information should be included in the feedback section.
- Vehicle design has important implications for seniors and should be addressed (e.g. some headrests in backseat block view, ability to enter/exit vehicle affected by arthritis). Feedback on what to think about when choosing a vehicle and what vehicle models/types are best for different conditions such as arthritis, might be helpful in addition to suggestions for after market vehicle modifications.
- Insurance companies might be a good way to distribute information on program (e.g., through a brochure) and would be non-threatening.
- Seniors may be more likely to complete program if they learn about it in a personal setting from a trustworthy source (e.g., at senior center or library) and choose to do it, rather if they just receive information about the program through an impersonal source (e.g., mass mailing).
- Program should either allow users a response option of "don't know" or force users to choose a category before moving on. Otherwise, there may be confusion about what a question left unanswered means (inadvertent or intentional) and how that gets integrated into feedback.
- Providing feedback on "where you are in relation to the average person" might make people more likely to act on the recommendations. Ideally, this could be provided graphically to make it more visual.
- Find ways to break up large areas of text to make it more readable and keep people's interest.
- Eliminate redundancies in list of recommendations in feedback section (e.g., "see your doctor"). Summaries of recommendations, particularly when they are long, may end up being boring and hard to get through.
- Find ways to describe things in a positive way – e.g., point out that it has been a long time since seniors took driver education if took it at all and program can serve as gentle reminder.

APPENDIX F: Moderator's Guide and Summary for 2nd Set of Focus Groups

Focus Group Moderator's Guide

NHTSA Self-Screening

August 2006

Good morning and welcome. Thank you for taking the time to join our discussion. My name is (project team member), and I'm from the University of Michigan Transportation Research Institute. Assisting me is (project team member) from the University of Michigan.

We are in the process of developing an interactive computer program that will help senior drivers assess their driving and provide feedback on what they can do to continue driving safely. The computer program will be available on a website on the internet and will be set up to ask senior drivers about different health concerns they might be experiencing that could affect safe driving. Based on their answers, they will be given feedback about how these concerns affect driving skills such as yielding right of way, passing, or negotiating intersections. Seniors will also be given feedback on what steps they might take to deal with these concerns. For example, if someone was experiencing shoulder or neck stiffness, recommendations might include scheduling an appointment with a doctor, enrolling in a fitness/flexibility class, and/or adding special mirrors to the car to aid in observing behind.

The benefits of this kind of self-assessment are that it can be done in the privacy of one's own home, it can provide confidential information about one's ability to drive, and it can be used as a basis for discussion with other family members.

We are interested in your thoughts about our self-assessment program for senior drivers. My role here is to ask questions, listen, and encourage discussion. In answering my questions, please think about your own experiences and share what you're comfortable with, as well as how you think others in your age group might feel.

First, let's talk about some general features of the self-assessment program. The program is divided into three sections. One section includes health concerns related to physical movement such as upper and lower body weakness or stiffness, tremors, and impaired coordination. A second section includes concerns related to thinking such as getting lost, confusion, and memory problems. A third section includes concerns related to seeing such as poor night vision, sensitivity to glare, and poor depth perception. In each section there is a series of questions to see if seniors are experiencing the concerns.

Before we actually look at the computer program on the website, I'd like to get your reaction to the questions themselves that are contained in the program to make sure they are clear and understandable. The best way to do that is to give you a paper copy of the self-assessment questionnaire to complete and discuss.

HAND OUT SELF-ASSESSMENT QUESTIONS AND HAVE PARTICIPANTS COMPLETE.

1. Were there any items that stood out as being confusing or difficult to understand?

2. Were there any items that were worded in a way that was awkward or vague or unclear for you?

3. Were there any items that were hard for you to answer? Why was that?

4. Were there any items that you think others might have a problem with even though you did not?

5. Did the order of the questions make it easy for you to follow, hard for you to follow, or have no effect?

Now, I'd like to ask you some questions about the response categories we used.

6. For some items, we gave you a choice of "none, a little, some, a lot, or extreme." Did these categories make sense to you? Was it easy to decide which category to choose?

7. For some items, we gave you a choice of "not at all, a little bit, moderately, quite a bit, or extremely." Did these categories make sense to you? Was it easy to decide which category to choose?

8. For some items, we gave you a choice of "never, rarely, sometimes, often, or always." Did these categories make sense to you? Was it easy to decide which category to choose?

COLLECT COMPLETED SELF-ASSESSMENTS.

Now, let's take a look at the actual website program. If it's OK with the group, I'll randomly pick one of the self-assessment questionnaires you've just completed to help walk us through the program (without identifying who completed it of course). CHOOSE A SELF-ASSESSMENT RANDOMLY.

COMPLETE THE COMPUTER PROGRAM SELF-ASSESSMENT USING RESPONSES FROM RANDOMLY SELECTED QUESTIONNAIRE.

Now I'd like to get your reactions to the computer program.

9. Were the instructions clear? Did they give you enough information to complete the program? What other information would you have liked?

10. What did you think about the general layout? [PROMPT FOR REACTIONS TO FONT ADJUSTMENT FEATURE, PAGE LAYOUT, RESPONSE PROTOCOL, ETC.]

My final questions have to do with the feedback provided by the computer program.

11. The feedback provided by the program is organized around the health concerns that senior drivers might be experiencing. How well did this organization work for you? Was it easy for you to follow, hard for you to follow or have no effect on you?

12. Was the information about critical driving skills helpful to you?

13. The feedback itself is divided into three categories – see a professional, modify your vehicle, and consider these safety tips. Do these categories make sense to you?

14. Were there any feedback items that stood out as being confusing or difficult to understand?

15. Were there any feedback items that were worded in a way that was awkward or vague or unclear for you?

16. In general, did the feedback items give you information you did not already know? Did you learn something new?

Well, that's the end of my formal questions. Do you have any other thoughts about or reactions to the program?

Thanks again for your participation.

Prompts that could be used during discussion as necessary:

- Please talk in a voice at least as loud as mine.
- Only one person should talk at a time because we're tape-recording the session so we don't miss any of your comments.
- You will not be identified in any of our reports. We'll be on just a first name basis.
- We've placed name cards on the table in front of you to help us remember each other's names.
- There are no right or wrong answers – just differing points of view. So, please share your thoughts even if you don't think anyone will agree with you.
- Feel free to make positive or negative comments about any of the things we will be discussing.
- It's important to hear from each of you because you have each had different experiences. We'd like to hear from everyone.

Development of an Older Driver Self-Assessment Guide Based on Health Concerns Associated with Aging: Summary of Findings from Second Set of Focus Groups

One focus group was conducted to get feedback on SAFER Driving, the interactive computer program for self-assessing driving ability for seniors (see table for participant characteristics). The group included 8 drivers aged 67 to 77. Discussion in the group was guided by a set of questions, with discussion led by a moderator. The group was lively and all participants contributed to the discussion. Responses to the focus group questions are summarized below.

Characteristics of Focus Group Participants		
	Number	Percentage
Sex		
Male	3	37.5%
Female	5	62.5%
Age		
65 to 74	7	87.5%
75 or older	1	12.5%
Education		
Some college	1	12.5%
Technical or trade school	1	12.5%
College degree or higher	6	75%
Race		
White/Caucasian	8	100%
Ethnicity		
Hispanic	0	0
Non-Hispanic	8	100%
Income		
Less than $20,000	1	12.5%
$20,000 to $49,999	5	62.5%
$50,000 to $79,999	1	12.5%
$80,000 to $99,000	1	12.5%
Marital Status		
Single	0	0
Married	2	25%
Divorced	4	50%
Widow(er)	2	25%

1. *Were there any items that stood out as being confusing or difficult to understand?*

Most of the items did not cause a problem for the focus group members. There were issues with a few items specifically and in general. One item ("How often have you not recognized a familiar face?") sparked discussion as to whether it was referring to vision or cognition. The survey is relating to cognition so one suggestion was to re-word the question and instead of "recognized" have it read "How often have you had difficulty retrieving the name of a familiar person." Another issue was that they felt some of their responses to questions were not age related and were a condition they had forever, for example, finding

your car in the parking lot may be inattention to detail, not memory loss. People wanted to factor in change over time rather than just answering the question. They were critical of the question "How much difficulty do you have finding something on a crowded shelf?**":** they questioned how high was the shelf, how crowded was the shelf, where was the shelf. They also felt that their answer would depend on if they were compensating for the action/condition, again, rather than answering in the present moment and in general.

2. *Were there any items that were worded in a way that was awkward or vague or unclear for you?*

   One member thought that the response choices were confusing: If you did something once should you choose never or rarely?

3. *Were there any items that were hard for you to answer? Why was that?*

   One group member had trouble with the question "How often have you avoided driving because you were too physically fatigued?" She said "always" because that is the right thing to do and who would drive when fatigued, but we were looking for the frequency of times that fatigue caused the decision to not drive. She interpreted it hypothetically. One group member had a problem with the question, "How much difficulty do you have seeing something when lights are being reflected from it (for example, watching television when the room lights are shining on the screen)?" She was confused by the question and wondered who would shine a light on the television. Other group members thought the question was clear.

4. *Were there any items that you think others might have a problem with even though you did not?*

   One group member was concerned with the question regarding how much bodily pain respondents had had. She felt that the response would depend on if the individual was treating the pain or not. (This sparked one member to say that medication was a big issue and that it should be included in some of the questions.) Another respondent was concerned with the question, "Do you feel that your reactions are quick enough to handle a dangerous driving situation?" She felt that an individual would not drive if s/he felt s/he could not handle a dangerous driving situation. This sparked the discussion as to whether this question was referring to confidence or ability.

5. *Did the order of the questions make it easy for you to follow, hard for you to follow, or have no effect?*

   There was agreement that the order made it easy to follow.

6. *For some items, we gave you a choice of "none, a little, some, a lot, or extreme." Did these categories make sense to you? Was it easy to decide which category to choose?*

   There were differing opinions on the response categories. One member did not like them and thought that they were arbitrary. Some members would have wanted an array or a numeric scale. One member liked having 5 choices. One group member noted that each person's spectrum is different and suggested giving an explanation of the response categories at the beginning of the program. Discussion also revolved around the issue of time and a time frame that the questions were relating to. They wanted a specified time frame, for example, in the last 5 years or in the last 1-2 years. (*Questions 6. 7. 8. all relate to response categories and the above answer covers 7. and 8.)*

7. *For some items, we gave you a choice of "not at all, a little bit, moderately, quite a bit, or extremely." Did these categories make sense to you? Was it easy to decide which category to choose?*

   Answered above in question 6.

8. *For some items, we gave you a choice of "never, rarely, sometimes, often, or always." Did these categories make sense to you? Was it easy to decide which category to choose?*

   Answered above in question 6.

   9. Were the instructions clear? Did they give you enough information to complete the program? What other information would you have liked?

They felt that instructions were clear. They would have liked a more detailed introduction specifying the time frame they should be considering, or "in general". Also in the introduction, let them know that this is a 1st tier assessment and that they should follow up with the feedback/recommendations.

10. *What did you think about the general layout? [REACTIONS TO FONT ADJUSTMENT FEATURE, PAGE LAYOUT, RESPONSE PROTOCOL, ETC.]*

    The group did not understand or like that they had to go to the bottom of the page to return to the feedback. They did not like the method of saving feedback results. They did not understand that once the results were saved that they would have to bookmark the link. Directions should be more specific and read, "Save will be successful once you…" One group member kept saying that the program was elitist because the wording was at too high of a level and that not everyone could access this program. They liked the option to enlarge the font size, but would have liked to be able to make it even bigger.

11. *The feedback provided by the program is organized around the health concerns that senior drivers might be experiencing. How well did this organization work for you? Was it easy for you to follow, hard for you to follow or have no effect on you?*

    They liked that you clicked on a health concern for more information, but that direction should be clearer. For example, "Click on a health concern to learn more about what it is and how it affects you." Navigation in the feedback sections is very problematic. We have multiple ways to get back to the feedback and it causes confusion that the "printable version" pops up in its own window and that there is no "Back" button to return to the feedback.

12. *Was the information about critical driving skills helpful to you?*

    The critical driving skills information was useful.

13. *The feedback is divided into three categories – see a professional, modify your vehicle, and consider these safety tips. Do these categories make sense to you?*

    The categories make sense. One suggestion was to have the "see a professional" section come last because it is threatening to consider seeing a doctor. Another suggestion was to add gerontologist as a potential professional. The "see a professional" section should also include instructions as to what to tell the doctor if/when you make an appointment.

14. *Were there any feedback items that stood out as being confusing or difficult to understand?*

    Some group members felt that the terms and health concerns were daunting.

15. *Were there any feedback items that were worded in a way that was awkward or vague or unclear for you?*

    Again, the terms were daunting.

16. *In general, did the feedback items give you information you did not already know? Did you learn something new?*

    Yes.

    Any other thoughts about or reactions to the program?

    One member was hearing impaired and would like to see questions about hearing in the program. Also, in the beginning (introduction) include a section on navigation tools to get through the program.

APPENDIX G: Recruitment Letter Text for Referring Physicians

Dear Referring Physician:

I am writing to inform you about a change that has occurred recently with reimbursement by Medicare for clinical driving evaluations. As you know, these evaluations have been conducted by occupational therapy driver rehab specialists through our Drive-Ability Program at MedRehab for the last 15+ years. Unfortunately, Medicare does not feel that these services are reasonable and necessary for beneficiaries and they will no longer cover the cost of this occupational therapy evaluation. Due to this change, we have been forced to condense our evaluation to two hours instead of three and change our billing to a self pay charge of $264. We attempted to keep this charge as low as possible for our patients while still covering our expenses to provide it.

I am excited to share with you an opportunity that exists for patients requiring this service through the end of 2006. As part of a research study, we are recruiting participants who would undergo the normal comprehensive assessment and have all of the associated costs covered by the study. Please see attached flyer for contact information and share with your patients.

We hope that you will agree that this is a critical service to be able to offer our patients and will continue to refer them to us. We thank you for allowing us to participate in your patient's care.

Sincerely,

Paula Kartje, OTR
Manager & Driver Rehabilitation Specialist
Occupational Therapy & Drive-Ability Program

APPENDIX H: Text of Recruitment Posting

Recruitment Posting
Development of an Older Driver Self-Assessment Guide
Based on Health Concerns Associated with Aging

UNIVERSITY OF MICHIGAN
TRANSPORTATION RESEARCH INSTITUTE
& UMHS DRIVE-ABILITY PROGRAM

RESEARCH PARTICIPANTS WANTED

AGE 65 AND OLDER

We are conducting research to create and test an interactive computer program to help older drivers assess their driving. The results of the computer-based self assessment will then be compared with results from a clinical and on road driving evaluation. Licensed drivers, age 65 and older, who are willing to participate in 3-3.5 hours of testing, are eligible. Participants will be provided with feedback and recommendations about their health concerns and driving abilities. You will receive a confidential evaluation free of charge ($400 value) Please contact [project staff] at (734)XXX-XXXX.

APPENDIX I: Telephone Screening Questionnaire

Telephone Screener

Development of an Older Driver Self-Assessment Guide

Based on Health Concerns Associated with Aging

RESPONSE TO INQUIRIES ABOUT STUDY PARTICIPATION

Telephone Script

Hi. My name is (project staff) and I'm calling from the University of Michigan. I'm calling to see if you would be interested in participating in a research study that we are conducting regarding health concerns associated with aging and their possible effect on driving.

Would you like to hear more about it?

Yes- continue with script below. No- terminate (Okay, thank you for your time.)

The project takes place at MedRehab, our outpatient rehabilitation facility by Briarwood Mall. It involves about 3-3.5 hours of your time during which you would complete three different evaluations:

1) A computer-based self assessment of health concerns (15-30 minutes)- You would receive feedback about the possible impact of your concerns on driving, as well as helpful safety tips and recommendations.
2) A clinical driving evaluation with an occupational therapist (2 hours)- This would involve screening your vision and evaluating your spatial perception, physical abilities and cognitive skills as they relate to driving. You would receive feedback about the results during and following this test.
3) An on road driving evaluation with a certified driving instructor/occupational therapist.(45-60 minutes)- This would involve driving a mid-size training car with the instructor in the passenger seat. You do not have to be familiar with the area as you would be directed where to go by the instructor. You would receive feedback about your performance after the evaluation.

Study Volunteers- Your results are strictly confidential and will not be shared with anyone unless you provide permission for us to share results.

Study Participants referred by their doctors- Your results remain confidential, however they are reported back to your physician and further follow up may be warranted due to medical concerns. This group of participants would be handled with our normal procedures with the UMHS Drive-Ability Program.

You will not be paid any cash for your participation. However, you will receive a comprehensive evaluation at no charge. This service would normally cost about $400.

Does this project sound like something that you would like to participate in?

Yes- Very good. In order to get started, I need to ask you a few questions to make sure that you are eligible to participate. If you're eligible, then I'd like to ask you some demographic questions and we can get you scheduled for the evaluation.

Eligibility Questions

1. Are you age 65 or older?

   Yes – continue. No – terminate ("I'm sorry you don't meet the requirements for our study. Thank you for your interest").

2. Do you have a valid driver license?

   Yes – continue. No – terminate ("I'm sorry you don't meet the requirements for our study. Thank you for your interest").

I have a few more questions to help us get a better understanding of our study participants.

Demographic/Background Questions

3. Record sex: [ ] Male [ ] Female

4. What is the highest grade or year of school you completed?
   - [ ] 8th grade or less
   - [ ] Some high school or GED
   - [ ] High school or GED
   - [ ] Technical or trade school
   - [ ] Some college
   - [ ] College graduate or higher

5. Which of the following racial categories best describes you?
   - [ ] White/Caucasian
   - [ ] African American/Black
   - [ ] Asian
   - [ ] Native American
   - [ ] Other, please specify _____

6. Which of the following ethnic categories best describes you?
   - [ ] Hispanic
   - [ ] Non-hispanic

Demographic/ Background Questions (continued)

7. Which of the following best describes your total household income?
   [ ] Less than $20,000
   [ ] $20,000 to $49,999
   [ ] $50,000 to $79,999
   [ ] $80,000 to $99,999
   [ ] $100,000 or more

8. What is your marital status?
   [ ] Single
   [ ] Married
   [ ] Divorced
   [ ] Separated
   [ ] Widow(er)

9. In what type of housing do you live?
   [ ] Own house/apartment/condominium
   [ ] Senior apartment or housing
   [ ] Relative's home
   [ ] Other, please specify _____)

10. What is your employment status?
   [ ] Working full-time
   [ ] Working part-time
   [ ] Homemaker
   [ ] Retired, not working
   [ ] Volunteer worker
   [ ] Other, please specify _____

11. What is your age in years?
   _____

12. How many days per week do you typically drive?
   [ ] 1 [ ] 5
   [ ] 2 [ ] 6
   [ ] 3 [ ] 7
   [ ] 4

13. About how many miles do you drive in a typical week?
   [ ] 10 or less
   [ ] 11-30
   [ ] 31-50
   [ ] 51-100
   [ ] More than 100

14. In the past three months, what modes of transportation other than your personal vehicle have you used?
   [ ] Driven with friend or relative in their vehicle

[ ] Public transportation (bus, train, subway, etc,)
[ ] Senior van or volunteer's vehicle
[ ] Taxi
[ ] Walk
[ ] Other, please specify _____

15. How confident are you driving in the following situations? Are you "very confident," "moderately confident," or "not at all confident"?

	Very	Moderately	Not at all
Unfamiliar areas	[ ]	[ ]	[ ]
At night	[ ]	[ ]	[ ]
In bad weather	[ ]	[ ]	[ ]
Making left turns	[ ]	[ ]	[ ]
In high traffic/rush hour	[ ]	[ ]	[ ]
On the expressway	[ ]	[ ]	[ ]
Alone	[ ]	[ ]	[ ]

16. How often do you pass up opportunities to go shopping, visit friends, etc. because of concerns about driving?

[ ] None of the time
[ ] Some of the time
[ ] All of the time

17. Whose advice would you be likely to follow regarding making changes in your driving habits (check all that apply)?

[ ] Spouse
[ ] Non-spouse same age family member
[ ] Son or daughter
[ ] Friend
[ ] Family doctor
[ ] Eye doctor
[ ] Occupational therapist/certified driving rehabilitation specialist
[ ] Area agency on aging or AARP representative
[ ] Other, please specify _____

18. If for some reason you could not drive yourself in the future, how would you get around (check all that apply)?

[ ] Drive with friend or relative in their vehicle
[ ] Public transportation (bus, train, subway, etc,)
[ ] Senior van or community volunteer's vehicle
[ ] Taxi
[ ] Walk
[ ] Other, please specify _____
[ ] Don't know

NOTE: If recruiter has concerns about caller's ability to participate (e.g., serious cognitive impairment), terminate.

Thank you for answering my questions.

Can we go ahead and schedule a time for you to come in and complete the three part evaluation?

Yes – continue. No – terminate.

Scheduling

- Find out if certain days of the week are better and if an am or pm appointment would be preferred.
- Using the provided paper schedule with available time blocks, offer the study participant a choice of days/times that might be convenient for them.
- Document their name and phone number on the schedule and complete the study participant spreadsheet with their scheduled appointment date/time and their contact information.
- Ask if they are familiar with MedRehab (UM Briarwood Bldg #4). Provide directions if needed.
- Let them know that they can check in at the front desk upon arrival for their appointment. They should identify themselves as a research volunteer for the driving project.

Closing

We appreciate your interest and willingness to participate in this research project. Once again, we have you scheduled for (appointment date/time) at Briarwood Bldg #4. If for some reason you are unable to keep that appointment, we would appreciate at least a 24 hour notice. I can give you a phone number to reach Paula Kartje, our OT researcher. Please call her if you have questions or need to reschedule your appointment. The number is (734) XXX-XXXX

APPENDIX J: Post Workbook Questionnaire

Code_____

Feedback Questionnaire for Workbook

Development of an Older Driver Self-Assessment Guide

Based on Health Concerns Associated with Aging

We are interested in your thoughts about the internet-based self-assessment workbook. For each item below, please check the box that best reflects your thinking now that you have completed the workbook.

	Strongly Agree	**Agree**	**Disagree**	**Strongly Disagree**
The workbook made me more aware of changes that can affect driving.	[ ]	[ ]	[ ]	[ ]
I discovered changes in myself that I had not been aware of before.	[ ]	[ ]	[ ]	[ ]
The feedback served as a useful reminder of things I already knew.	[ ]	[ ]	[ ]	[ ]
As a result of the workbook, I plan to make changes in the way I drive.	[ ]	[ ]	[ ]	[ ]
As a result of the workbook, I plan to consider modifying my vehicle.	[ ]	[ ]	[ ]	[ ]
I am thinking about taking a driver refresher course or how a course might benefit me.	[ ]	[ ]	[ ]	[ ]
I am now more likely to discuss health concerns I am experiencing with my doctor.	[ ]	[ ]	[ ]	[ ]
If available, I would be likely to use the workbook in the future.	[ ]	[ ]	[ ]	[ ]
I would recommend the workbook to older adult friends or family members.	[ ]	[ ]	[ ]	[ ]
The workbook would help older adults talk about driving concerns with their families.	[ ]	[ ]	[ ]	[ ]

Overall, I would rate the usefulness of the workbook as:	**Extremely Useful**	**Moderately Useful**	**Somewhat Useful**	**Not at All Useful**
	[ ]	[ ]	[ ]	[ ]

APPENDIX K: Clinical Evaluation Form

Date(s) Tested: _____
Total Evaluation Time:_____
Procedure Code: 17728 □ Research participant

Background Information

Referred By: _____
□ Medical record □Information Obtained From: Patient Observation□ Family/SO :_____□
Diagnoses: _____
Date of Onset:_____ ICD9: _____
PMH: _____
_____
_____
PLOF:_____
Medications: _____
_____

Driving History: License / Permit / Pre-Drivers Ed
DL#: _____ Expiration Date:_____
Total Driving Experience: _____
Last Time You Drove?_____
□ Residential □Types: Expressway□Business □ Rural □ Unrestricted □ Formally Restricted □ **Self Restricted**
How Familiar Areas Only□ Local Only □: No Night□ □ Bad Weather □ No□ Left Turns □High Traffic / Rush Hour Expressway Alone□ Transporting Others□
Current Frequency: _____/ day - wk
Driving Needs:_____
_____
Alternative Transportation Options:_____
_____
Total Violations / Accidents / Restrictions- Last 5 Years:
_____
_____
_____
Vehicle Information: _____
_____
Other: Motorcycle: _____ CDL: _____ Class: A B C

Visual Screening: Optec 2000 / Snellen Eye Chart

Uncorrected / Corrected: near / far glasses / contacts
Visual History: Last Exam: _____
_____
_____

Acuity: Far - B _____ Near - B _____
R _____ R _____
L _____ L _____
_____

Depth Perception: _____ Intact _____ Impaired
_____
Color Awareness: _____ Intact _____ Impaired
_____
Peripheral Fields / Confrontations:
_____ Intact _____ Impaired: _____ (norm - 140°)
_____
Lateral Fixation / Saccades / Pursuits :
_____ Intact _____ Impaired
_____
Visual Scanning: _____ Intact _____ Impaired
_____
_____
Night Vision: _____ Intact _____ Impaired ___NA
_____
Glare: _____ Intact _____ Impaired ___NA
Glare Recovery: _____ Intact _____ Impaired ___NA
_____

Visual Perception:
Motor Free Visual Perception Test: Score- _____/36__
(<30 = impaired) _____
_____
Spatial Reasoning: _____ Intact _____ Impaired
_____
Directional Concepts: _____ Intact _____ Impaired
_____ _____
Topographical Orientation: _____ Intact _____ Impaired
_____
_____

Physical Status: Dominance: □ Right □ Left
AROM / Strength:
RUE _____ Intact _____ Impaired: _____
_____
RLE _____ Intact _____ Impaired: _____
_____
LUE _____ Intact _____ Impaired: _____
_____
LLE _____ Intact _____ Impaired: _____
_____

Spasticity / Spasms: _____
_____

Physical Status Continued:

Sensation / Proprioception: _____ Intact_____ Impaired

_____

UE Coordination: _____ Intact _____ Impaired

_____

LE Coordination/Speed: _____ Intact _____Impaired

_____

□ Right □AAA Reaction Timer Score: □Left Both Feet

_____ seconds average response speed -_____

Head/Neck Position and Motion:

_____ Intact _____ Impaired

_____

Trunk Balance: _____ Intact _____ Impaired

_____

Endurance: _____ Intact _____ Impaired

_____

Mobility: _____ Intact _____ Impaired:_____

_____

Equipment Used:_____

Transfer Status: _____ Intact _____Impaired

_____

Cognitive Skills:

Attention/Orientation: _____

_____

Divided Attention: UFOV (Useful Field of View) Test:

_____

_____

_____

Processing of Information: _____

_____

Memory: Intact□ □ Impaired _____

_____

_____

Reasoning/Problem Solving Ability: _____

_____

_____

Judgement: _____

_____

Awareness of Impairment: _____

_____

Affect/Behavior: _____

_____

_____

Written Test of Driving Skills: ____/ 20 correct

_____

_____

Sign Identification: ____/ 15 correct

Driver Performance Test (DPT): _____Not Appropriate

_Score__ __Interpretation____

Searching: _____

Identifying: _____

Predicting: _____

Deciding: _____

Executing: _____

Total Score: _____

Communication: _____ Intact _____ Impaired

_____

Functional Prognosis: Anticipated changes in next yr?

_____ No major changes anticipated

_____ Functional ability is expected to improve in the next months.

_____ Functional ability may decrease in the months ahead

_____ Due to the deteriorating nature of this condition, a periodic re-evaluation would be recommended.

Assessment Summary:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Initial Equipment Recommendations:_____

_____

_____

Education Provided to Patient / Family:_____

_____

_____

Plan / Follow Up:

On Road Assessment with A□ & A Driving School

□ On Road Test/Re-Exam with Driver Assessment

□ Sent DI4P To Be Completed by Physician

□ Patient to Obtain Restricted License to Drive w/CDI

□ Van Evaluation

□ Recommended for Driver's Education

□ Other:_____

_____

Therapist Signature / Date

CC: _____

APPENDIX L: On-Road Driving Assessment

Drive-Ability/A&A Driving Behind-the-Wheel Route Performance Rating

1. Pre-Ignition -adjust seat/mirrors/seatbelt, etc.	1 2 3 4 5	_____
2. Back out Med-Rehab parking space -use of mirrors, hazard awareness	1 2 3 4 5	_____
3. Right Briarwood Circle -lane selection, signals, hazard awareness	1 2 3 4 5	_____
4. Right on Main -lane selection, ped x-walk, signals, etc…	1 2 3 4 5	_____
5. Right Eisenhower -lane selection, ped x-walk, signals, etc…	1 2 3 4 5	_____
6. Right Stone School -right on red, ped x-walk, signals, etc…	1 2 3 4 5	_____
7. Left Ellsworth -controlled arrow, entry into L turn lane, etc…	1 2 3 4 5	_____
8. Left Platt -entry L lane, lane change, school zone speed	1 2 3 4 5	_____
9. Right Packard -signal, lane selection, lane change	1 2 3 4 5	_____
10. Left at Light into The Village -residential speed, hazard awareness, school…	1 2 3 4 5	_____
11. Right Washtenaw -lane selection, ped x-walk	1 2 3 4 5	_____
12. Enter Expressway – US 23 South -merging, awareness, speed, lane placement	1 2 3 4 5	_____
13. Merge Onto I-94 West -merging, awareness, speed, lane placement	1 2 3 4 5	_____
14. Exit State Street/Turn Right -maintenance of lane, note lane end merge L	1 2 3 4 5	_____
15. Left Hoover -left w/no arrow, pedestrians, RR x'ing, speed	1 2 3 4 5	_____
16. Left Green -unmarked 2-way, speed control	1 2 3 4 5	_____
17. Right Main -blind intersection, lane selection, lane change	1 2 3 4 5	_____
18. Left Pauline -left on hill w/no arrow, speed control	1 2 3 4 5	_____
19. Left South Seventh -left w/no arrow, residential speed	1 2 3 4 5	_____
20. Left Stadium -lane selection, lane change, school zone	1 2 3 4 5	_____
21. Right Main -no turn on red, lane selection, lane change	1 2 3 4 5	_____
22. Left to Continue on Main -2 lanes turn L/maintain lane placement	1 2 3 4 5	_____
23. Left Briarwood Circle -3-way stop, lane selection	1 2 3 4 5	_____
24. Left Med Rehab Parking Lot -unprotected left/hazard awareness	1 2 3 4 5	_____
25. Parking/exiting procedures -hazard ID, shift into Park, turn off ignition	1 2 3 4 5	_____

TOTAL POINTS (125 max. achievable) : _____

KEY
1-Poor/Physical Intervention Required
2-Marginal/Continual Verbal Direction Required to Complete
3-Fair/Reduced Defensive Driving Skills Noted
4-Good/Minor Lapses in Consistent Defensive Driving Strategies
5-Consistent Defensive Driving Strategies Exhibited

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