

Does Monitoring Naturalistic Driving through Vehicle Instrumentation Make a Difference in Decision-Making for Fitness to Drive in Early Stage Dementia? An Intervention Study.

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Abstract

Latest technologies are used in the vehicle to collect detailed information on ability and performance of drivers in early-stage dementia in an on-going collaboration involving the University of Michigan Transportation Research Institute (UMTRI), the University of Massachusetts Boston, and the University of Houston. With funding from the Alzheimer's Association (2006-2009), the collaborative is exploring the perspectives of three of the stakeholder groups (persons with dementia, family members, and specialists in driving assessment) and will compare their assessments with empirical data on on-road performance gained through in-vehicle monitoring. Funding is now sought for a control group of drivers that have not been monitored with the in-vehicle instrumentation to treat the instrumentation as an intervention and to test its effects related to decision-making among drivers with dementia and their family members. Pre and post test survey instruments have already been developed for the experimental group through the Alzheimer's Association funding. The scope of the proposed research is to utilize the research tools developed for the experimental group and obtain and analyze the control group data. With our contribution, the collaborative will be able to achieve the following goals that reinforce and in some instances may go beyond their initial project:

1) Compare the validity of multiple forms of assessment of driving skills with naturalistic driving in persons with early stage-dementia and a control group; 2) Inform decision-makers about appropriate intervals for checking driving competency; 3) Bring greater visibility to deficits in driving performance unique to people with early-stage dementia; 4) Understand behaviors and issues of older drivers with dementia and their families; and 5) Assess the attitudes, knowledge, and activities of occupational therapists and driver rehabilitation specialists as they relate to older drivers with dementia.

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1.-Statement of Project Objectives

- - What is the specific transportation problem or policy issue to be addressed and what is the scope of the proposed research? How does it specifically contribute to the UMass Center theme?

The specific problem to be addressed in this proposal is the transportation mobility and safety for drivers with early stage dementia. Dementia affects many critical skills needed for driving including memory, judgment, psychomotor abilities (Adler, Rotunda, and Dysken 2005), perception and visual processing, selective attention on a specific stimulus for extended periods of time, multiple attention, and abilities to make accurate decision and to control impulses under pressure by a traffic situation (Janke 1994). Physicians and other healthcare professionals are faced with making recommendations about their patients' fitness to drive based on driver's self-screening, family members recommendations, and if available, inputs from driving assessment specialists. Follow-up then occurs at various periodic intervals, ranging from 3 months to a year. Mobility and safety of the affected drivers and the general-public safety depend heavily on an accurate decision-making process on fitness to drive in persons with early-stage dementia. While information on the driver's performance between assessment intervals plays a very important role in that decision-making process, it is not currently available. Providing compelling data on driving performance in naturalistic settings will help those involved with the driving cessation decision to plan a timely and appropriate transition toward community mobility options. With funding from the Alzheimer's Association (2006-2009), an on-going collaboration involving the University of Michigan Transportation Research Institute (UMTRI), the University of Massachusetts Boston, and the University of Houston is using the latest technology installed in the vehicle to collect detailed information on ability and performance of drivers in early-stage dementia. The collaborative will explore the perspectives of three of the stakeholder groups (persons with dementia, family members, and specialists in driving assessment) and compare their assessments with empirical data on on-road performance gained through in-vehicle monitoring. An interdisciplinary approach will examine the complexity of the criteria considered in this highly-charged, emotional, and life-changing decision. The research team draws on expertise from gerontology, psychology, social work, and transportation engineering and technology.

Funding is now sought for a control group of drivers that have not been monitored with the in-vehicle instrumentation to treat the instrumentation as an intervention and to test its effects related to decision-making among drivers with dementia and their family members. Pre and post test survey instruments have already been developed for the experimental group through the Alzheimer's Association funding. The scope of the proposed research is to utilize the research tools developed for the experimental group and obtain and analyze the control group data. With our contribution, the collaborative will be able to achieve the following goals that reinforce and in some instances may go beyond their initial project:

- 1) Compare the validity of multiple forms of assessment of driving skills with naturalistic driving in persons with early stage-dementia and a control group;
- 2) Inform decision-makers about appropriate intervals for checking driving competency;
- 3) Bring greater visibility to deficits in driving performance unique to people with early-stage dementia;
- 4) Understand behaviors and issues of older drivers with dementia and their families; and
- 5) Assess the attitudes, knowledge, and activities of occupational therapists and driver rehabilitation specialists as they relate to older drivers with dementia.

By determining whether monitoring naturalistic driving through vehicle instrumentation makes a difference in decision-making for fitness to drive in early stage dementia this proposal will contribute to improving mobility and safety for older drivers, and the general public. Latest technologies are being used for in-vehicle monitoring instrumentation. We will be participating in an interdisciplinary multi-year collaborative project funded by the Alzheimer Association. The proposed project of adding a control group of drivers who do not undergo the instrumentation builds upon the current study by offering an opportunity for greater analysis. Specifically, the original project will be looking at the feasibility of instrumenting the vehicles of drivers with dementia to monitor specific behaviors that already have been identified through Phase 1 of our collaborative research (Silverstein et. al, 2007). This current proposal seeks to view the instrumentation itself as an intervention. In addition to the experimental group undergoing instrumentation for a month, that group will also benefit from a debriefing summary of what was learned through the naturalistic driving month. The control group that we are proposing, will not benefit from the instrumentation or the debriefing, thus it is a great opportunity to measure the effects of that intervention and the timing would work out well as the instrumentation data collection will be through late 2008. The project will be supervised and coordinated from the University of Massachusetts Boston by Dr. Tomas Materdey (Engineering) and Dr. Nina Silverstein (Gerontology), data will be collected from the University of Houston by Dr. Geri Adler (Graduate School of Social Work), in consultation with Drs. David Eby and Lisa Molnar at UMTRI. This proposal closely supports the UMass University Transportation Center's theme of *Improving Transportation Mobility and Safety with Innovative Technologies and Strategies*.

2.- Research Contribution

- - How is the proposed research innovative, unique and a contribution to current work in the field of investigation?

Although research provides insights into why driving is difficult for those with dementia, it has yet to determine the level of cognitive impairment associated with an unacceptable driving risk (Vegega, 1990, Carr, Duchek, & Morris, 2000). Thus, while many persons with early stage dementia drive, their ability to drive safely, particularly as the disease progresses, remains unclear.

Physicians and other health care professionals are often faced with making recommendations about their patients' fitness to drive, based on driver self-screening, recommendations by family members, and, if available, formal driving assessment. Follow-up as the disease progresses occurs at various periodic intervals, ranging from 3 months to a year. The same intervals may be used for all patients without consideration of the variations within stages of the disease or the idiosyncratic rate of disease progression. Yet, no one really understands how the real-life driving performance of an individual changes within the assessment intervals. If the interval is too short, it places an undue burden on the individual and his or her family members. If it is too long, the individual may pose a serious threat to public safety as well as to his or her own safety. In many instances, professionals may recommend geographic or other restrictions with the expectation of the driver's adherence or ability to comply with such recommendations. What is the driver's experience in following the recommendations? Is he or she getting lost in familiar

areas, taking more time to get to and from a familiar location, displaying confusion at intersections, not following road signs, driving at inappropriate speeds, or stopping for no apparent reason in the middle of a roadway? Recent advances in technology provide a method for automatically collecting detailed information about a person's driving ability. This technology can be used to monitor the driving behavior of individuals diagnosed with early stage dementia and provide guidance on how often these drivers need to be assessed, and investigate the validity of recommendations of clinicians, family members, and self-screening.

This project has significance for individuals, their families, their health care providers, licensing authorities, and policy-makers. Providing compelling data on driving performance in naturalistic settings will help those involved with the driving cessation decision to plan a timely and appropriate transition toward community mobility options. The collaborative will explore the perspectives of three of the stakeholder groups (persons with dementia, family members, and specialists in driving assessment) and compare their assessments with empirical data on on-road performance gained through in-vehicle monitoring.^a An interdisciplinary approach will examine the complexity of the criteria considered in this highly-charged, emotional, and life-changing decision. The research team draws on expertise from gerontology, psychology, social work, and transportation engineering and technology. The team has met monthly through telephone conference calls and in-person meetings at national conferences. It is a dynamic research endeavor. The current proposal expands the range of analysis that will be possible by adding a control group of drivers with dementia who will not undergo instrumentation.

3.- Technical Approach or Methodology

- - What are the proposed methodology, analytical techniques, data sources, etc.?

We will first describe the Alzheimer's Association-funded study of which the current proposal will build upon. Please note that Dr. Silverstein's tasks related to this study are currently under review through UMBs IRB as the surveys of the triads will begin in fall 2007.

The currently funded study is designed around the recruitment of "triads" consisting of a licensed older driver with a diagnosis of early-stage dementia, a family member involved in the care of the driver, and a Certified Driving Rehabilitation Specialist (CDRS) who will assess the driver. We anticipate having up to 24 triads participate in the study.^b We plan to recruit triads from the eligible "clients" who are normally referred to the University of Michigan's Drive-Ability program (located within the Occupational Therapy Division, Department of Physical Medicine and Rehabilitation). This program provides comprehensive pre-driver evaluations designed for individuals with physical, visual/perceptual, and/or cognitive defects. Services are coordinated with CDRSs, equipment vendors, and the Michigan Secretary of State. A client will be considered eligible for study recruitment only after the OT has made a recommendation that the client may continue driving until the next re-assessment period.

Potential subjects and their family members who qualify for participation in the study will be informed of the study by Drive-Ability staff and asked about their willingness to participate. The third member of the triad will be a Drive-Ability CDRS. The driver, the family member, and the

^a Conducted at University of Michigan Transportation Research Institute (UMTRI) and approved by their IRB

^b Recruitment of subjects is being conducted by UMTRI and has been approved by their IRB.

CDRS will complete the required University of Michigan and University of Massachusetts IRB consent forms.

Clinical and on-road Drive-Ability assessment data of recruited subjects will be collected directly from the Drive-Ability program. Included in this assessment will be recommendations and restrictions on driving from a Drive-Ability CDRS. Recruited subjects will be contacted by UMTRI staff and an appointment will be scheduled for the driver and family member to come to the UMTRI building with the primary vehicle being used by the driver with early-stage dementia. The in-vehicle monitoring technology will be installed at the UMTRI building's service bays. While the equipment is being installed, the driver and family member will complete separate questionnaires^c. The driver questionnaire will explore the drivers' self-assessment of their driving competence, habits, and experiences and driving history. The family members' questionnaire will explore their assessment of the driver's competence in driving, validation of similar items asked of the driver, and other salient issues as identified from the focus groups. Both the driver and family member will be given information about the in-vehicle technology. Such instrumentation will be non-intrusive and not involve training. They will also be told that an UMTRI staff member will periodically contact them to answer any questions they may have.

At the end of the 1-month period, subjects will return to UMTRI to have the equipment removed. The data reduction and analysis procedures will be refined so that summary data on driving performance and supporting video-clip highlights over the 1-month period can be obtained within 2 weeks from the end of the data collection period.

The triad will then meet again at the Drive-Ability program office. At this meeting, each member of the triad will be shown the driving-performance summary derived from the in-vehicle data. Findings from the summary will be supported by video clips showing the driver's competence as well as lack of competence for some critical driving skill if necessary and appropriate. The CDRS will then be asked to revisit his or her previous assessment and recommendations and make any revisions to these that he or she deems appropriate based on the summary data. The CDRS may also choose to not make a revision if the in-vehicle monitoring data confirms his or her initial assessment. The driver and his or her family member will complete the same questionnaires that they completed when the technology was installed in the driver's vehicle^d. The final stage of data collection will be telephone follow-up with the family member approximately one month following the summary visit to Drive-Ability.^e The purpose of the follow-up call will be to assess whether any changes were made in the driver's status as a result of the added information on in-vehicle behaviors.

We anticipate having three triads participating simultaneously. Allowing 2 weeks between each set of triads for equipment maintenance and subject recruiting activities, we expect to have six triads participating each 3-month period or 24 triads during the 12-month data collection period.

The following charts developed by David LeBlanc, PhD at UMTRI (August, 2007) reflect outcomes of Phase 1 of the study, specifically the results of literature review, expert panel, and

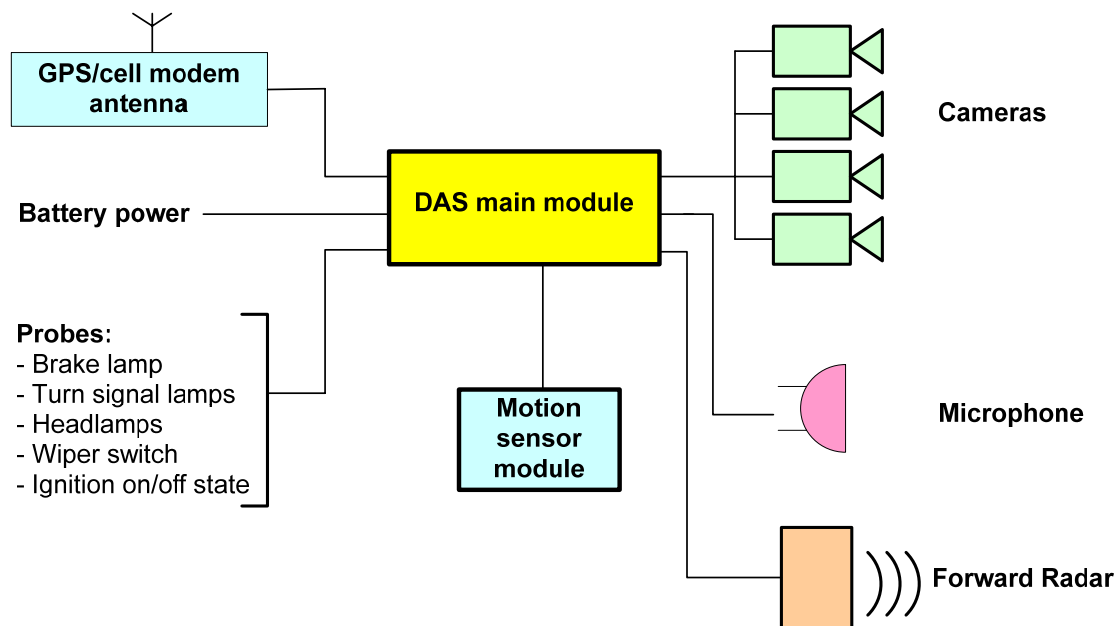
^c These questionnaires will be designed by Dr. Silverstein, UMB but administered by UMTRI research staff members

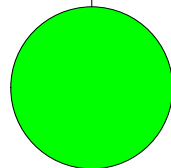
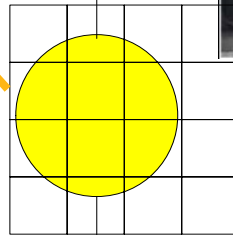
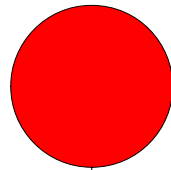
^d (ibid)

^e This follow-up survey was also designed by Dr. Silverstein and telephone interviews will be conducted by a Research Assistant

focus groups. They illustrate the behaviors that will be measured through the instrumentation and the algorithms that engineering has developed to address the critical driving skills through instrumentation: Under the column of “not addressing” are still very important behaviors and skills, however, resources limited what could be measured through this project.

<p>Addressing:</p> <ul style="list-style-type: none"> • Way finding • Seat belt use • Interaction with traffic control devices • Lane change • Left turns – gaps rejected • Appropriate speeds & stopping • Excessive lane wandering • Headways • Signaling (selected) • Gear & pedal errors • Impacts & bumps • Co-pilots & navigation aids 	<p>Not Addressing:</p> <ul style="list-style-type: none"> • Backing maneuvers • Passing on 2-lanes • Left turns – gaps accepted • Lane-keeping except as noted • Steering – fine control • Headlight use • Alcohol use • Accommodating pedestrians & pedal cyclists
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Our sub-recipient, Dr. Geri Adler, Principal Investigator at the University of Houston will be responsible for oversight of recruitment and data collection in Texas. Specifically her target will be 20 drivers with early stage dementia and the related 20 family members. Similarly to experimental group participants, control group subjects will also include “triads” consisting of a licensed driver with early-stage dementia, a family member involved in the care of the driver, and a Certified Driving Rehabilitation Specialist (CDRS) who will assess the driver. Twenty triads will be recruited. After Institutional Review Board (IRB) approval for the study is obtained, participants will be recruited from the Houston Veterans Affairs Medical Center’s (VAMC) Driver Rehabilitation Center. The Houston VAMC program provides comprehensive pre-driving clinical evaluations as well as behind-the-wheel assessments and training for persons with medical conditions that may affect their driving capacity and safety. Drivers will be considered eligible for study recruitment only after the Certified Driving Rehabilitation Specialist (CDRS) has made a recommendation that they may continue driving until the next re-assessment period. Drivers must also have a family member available to participate in the study to be eligible.

- A formal invitation to participate in this study will be extended to all candidates who meet selection criteria. Interested candidates will be approached by a project staff member who will describe the study. If interested, participants will be asked to provide written consent prior to questionnaire completion. Participants will complete an investigator-

designed survey. The initial survey, completed shortly after CDRS assessment, will obtain information about the driver's driving history, driving habits, driving patterns, health status and demographic characteristics. Similar information will be collected from the driver's family member. A second survey will be administered approximately one month after initial survey completion to further explore any changes made to driving based on the prior driving evaluation

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- Carr, D.B., Duchek, J., & Morris, J.C. (2000). Characteristics of motor vehicle crashes of drivers with dementia of the Alzheimer's type. *Journal of the American Geriatrics Society*. 48(1), 18-22.
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- Silverstein, N.M., Adler, G., Eby, D., Molnar, L., & LeBlanc, D. (2007) Am I Safe to Drive? What Drivers with Dementia, their Family Members, and Driving Rehabilitation Specialists Think. Paper presented at the 15th Annual Dementia Care Conference. August 27, 2007, Chicago, IL.
- Vegega, M. (1990). The Effect of Aging on the Cognitive and Psychomotor Abilities of Older Drivers: A Review of the Literature. National Highway Traffic Safety Administration Office of Driver and Pedestrian Research.
- Wild, K., & Contrell, V. (2003). Identifying driving impairment in Alzheimer's disease: A comparison of self and observer reports versus driving evaluation. *Alzheimer's Disease and Associated Disorders*. 17(1) 27-34.

4.- Anticipated Results

- - What does the respondent anticipate to be the results of the research? Can any of the projected results be of immediate application to transportation firms, government agencies or providers?

Providing compelling data on driving performance in naturalistic settings will help government agencies and providers involved with the driving cessation decision to plan a timely and appropriate transition toward community mobility options. The addition of a control group raises the specter of the role of vehicle instrumentation for monitoring drivers with early stage dementia and will potentially add greatly to thoughtful and timely decision-making among all stakeholders involved in fitness to drive decisions among persons with dementia.

5.- Technology Transfer

Results will be presented at conferences and published in peer-reviewed journals in the areas of mobility and safety in older drivers.

6.- Principal Investigator and Other Staff

Dr. Tomas Materdey

(a) Professional Preparation

University of Granada, Spain, Electronics-Physics, BS, summa cum laude, 1990
University of Granada, Spain, Computational Electromagnetics, Ph.D., 1994
Cornell University, Physics, Ph.D., 2001
Cornell University, Beam Physics Simulation, post-doc., 1994-95
Northeastern University, Physics Education, post-doc., 2000

(b) Appointments

Assistant Professor:

Engineering Program/Department of Physics, Univ. of Massachusetts, Boston, MA, 9/2000-
Department of Physics, Wheaton College, Norton, MA, 1/2000-6/2000

Research Associate:

Department of Physics, Northeastern University, Boston, MA, 7/2000-8/2000
Department of Applied Physics, University of Granada, Spain, 6/1996-6/1998
Laboratory of Nuclear Studies, Cornell University, Ithaca, NY, 1/1994-6/1994

Graduate Research Assistant:

Laboratory of Plasma Studies, Cornell University, Ithaca, NY, 1/1998-12/1999
Department of Applied Physics, University of Granada, Spain, 6/1990-12/1993

Graduate Teaching Assistant:

Department of Physics, Cornell University, Ithaca, NY, 1/1996-12/1999

Visiting Scholar:

Department of EECS, University of Illinois-Chicago, 10/1991-1/1992

(c) Publications

1. T. Materdey, "Grand Canonical Mixed-State Wigner Function in a Magnetic Field: de Haas-van Alphen Oscillations", *Int. J. Modern Physics B* (2007), vol. 21, no. 6, 829 (2007)
2. T. Materdey and C. Seyler, "The Quantum Wigner Function in a Magnetic Field", *Int. J. Modern Physics B*, vol. 17, no. 25, 4555 (2003)
3. T. Materdey and C. Seyler, "Wigner Function in the Symmetric Gauge: de Haas-van Alphen Oscillations, Magnetic Field Localization and Uncertainty Principle", *Int. J. Modern Physics B*, vol. 17, no. 26, 4683 (2003)
4. M. Palmoor, M. Karouani, G. Deepu, T. Materdey, "The Wigner Function in Signal Processing of Nanostructures", *Proc. of SPIE*, Vol. 6370, 63701G, 2006
5. T. Materdey, S. Gonzalez, B. Garcia, R. Gomez, "FDTDG3D: a 3D Software Package for the Propagation of Electromagnetic Waves in Complex Media", developed for CASA, Electromagnetic Group, University of Granada (Spain), 1991

(d) Synergistic Activities

1.- **UMass Collaborative on Intelligent Transportation System:** The University of Massachusetts President's Office of Science and Technology Program has allocated \$160,000 to establish a Multi-campus UMass Collaborative for Intelligent Transportation Systems (UMass-ITS). The Collaborative's mission is to build an infrastructure for the mobilization of transportation professionals in the Commonwealth's private and public sectors as well as the academic community. The Collaborative was established in April 2007 by four faculty members encompassing four UMass campuses: Marguerite Zarrillo of UMass Dartmouth, Nathan Gartner of UMass Lowell, John Collura of UMass Amherst and Tomas Materdey of UMass Boston.

2.- **Summer Transportation Institute:** as its director since 2004. The \$50,000 per-year-grant-based Institute provides science and engineering immersion experiences as related to transportation careers for middle and high school students during four weeks in the Summer. The Institute encourages participation from minority, women, and students with disabilities. Activities include invited speakers, teamwork, field trips, enhancement workshops, and sports and recreations. <http://www.sti.umb.edu>

3.- **Transportation Information Network for Accessibility (TINA):** TINA's goal is to develop a critical partnership to provide a smart database for independent transportation for older Americans and people of all abilities. Current partners include: Institute for Community Inclusion, Ross Center for Disability, BATEC (Boston Area Advanced Technological Education Connections), Aviation Planning (Mass. Port Authority), The Massachusetts Executive Office of Transportation (Civil Rights Office), the Gerontology Institute (UMass Boston), and the Independent Transportation Network of America.

NINA MELNICK SILVERSTEIN, PhD

EDUCATION:

1980 Ph.D. Florence Heller Graduate School for Advanced Studies in Social Welfare, Brandeis University, Administration on Aging Training Grantee, 1975.

Dissertation: Informing the Elderly About Public Services: The Relationship Between Sources of Knowledge and Service Utilization.

RECENT RESEARCH AND PROFESSIONAL EXPERIENCE:

Sept. 2006- Professor of Gerontology and Undergraduate Program Director, Gerontology

Present University of Massachusetts Boston, College of Public and Community Service, Boston, MA.

Sept. 2004- Gerontology Research Fellow, Department of Transportation, National Highway Traffic &

July 2005 Safety Administration, & Consultant to the Alzheimer's Association Public Policy Division, Washington, DC (sabbatical from University of Massachusetts Boston).

BOOKS:

Silverstein, N.M., & Maslow, K. (Co-Editors) (2006). *Improving Hospital Care for Persons with Dementia*. Springer Publishing Company: NY

Silverstein, N.M., Flaherty, G. & Tobin, T.S. (2002). *Dementia and Wandering Behavior: Concern for the Lost Elder*. Springer Publishing Company: NY (2002 American Journal of Nursing Book of the Year Awardee). Re-released in 2006.

SOME BOOK CHAPTERS:

Silverstein, N.M., & Peters-Beumer, L. (2007). Community Mobility and Dementia in Cox, C. (Ed.) *Handbook for Social Work Practice and Dementia* (Springer Publishing Company: NY)

Van Ranst, E., Silverstein, N.M., & Gottlieb, A.S. Developing a video to increase elders' awareness of safety features for driving. (2005). In R. Bushko (Ed): *Future of Intelligent and Extelligent Health Environment*, IOS Press, Amsterdam.

SOME WEB PUBLICATIONS:

Vanderbur, M., & Silverstein, N.M. (2006). Community Mobility and Dementia, A Review of the Literature. The Alzheimer's Association Public Policy Division and the National Highway Traffic Safety Administration, U.S. Department of Transportation, Washington, DC DOT HS 810 684

<http://www.nhtsa.dot.gov/people/injury/olddrive/CommMobilityDementia/index.htm>

Silverstein, N.M. (November 10, 2004). Dementia and Driving: Issues and Resources. Series on Safe Mobility and Aging. Live web seminar recorded and available through www.asaging.org

SOME REFEREED JOURNAL PUBLICATIONS:

Caspi, E., Silverstein, N.M., Porell, F.W., & Kwan, N. (under review). Physician outpatient contacts and hospitalizations among cognitively-impaired elderly. *Alzheimer's & Dementia*.

Dickerson, A.E., Molnar, L.J., Eby, D., Adler, G., Bédard, M. Berg-Weger, M., Classen, S., Foley, D., Horowitz, A., Kerschner, H., Page, O., Silverstein, N.M., Staplin, L., & Trullillo, L. (in press).

Transportation and Aging: A Research Agenda for Advancing Safe Mobility. *The Gerontologist* (pages pending).

Silverstein, N.M., Gottlieb, A.S. & Van Ranst, E. (2005). Use of a video intervention to increase elders' awareness of low-cost vehicle modifications to enhance driving safety and comfort. *Transportation Research Record series, Journal of the Transportation Research Board*. 1922,15-20.

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Silverstein, N.M., & Hyde, J. (1987). Utilizing an existing service system to aid Alzheimer's clients and their families. *The American Journal of Alzheimer's Care and Research*, 2(2): 30-36.

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GRANT AWARDS:

2006-09 Eby, D., Silverstein, N.M., Adler, G., Molnar, L., & LeBlanc, D. *Fitness to Drive in Early Stage Dementia: An Instrumented Vehicle Study*. Dr. Silverstein is a co- investigator.

Gerri Adler, PhD

EDUCATION:

- 2001 Ph.D., Social Work, University of Minnesota, Minneapolis, MN.
Dissertation: Longitudinal Study of Driving Habits and Cessation in Older Adults with Dementia
- 1982 MSW, Social Work, University of Minnesota, Duluth, MN
- 1979 BS, Rural Sociology, University of Wisconsin, Madison, WI

RECENT RESEARCH AND PROFESSIONAL EXPERIENCE:

- 9/06-present Assistant Professor, Graduate College of Social Work, University of Houston, Houston, TX
- 9/03-8/06 Director, University of South Carolina Center for Gerontology, Columbia, SC

SELECTED REFEREED JOURNAL PUBLICATIONS:

Dickerson, A.E., Molnar, L.J., Eby, D., Adler, G., Bédard, M. Berg-Weger, M., Classen, S., Foley, D., Horowitz, A., Kerschner, H., Page, O., Silverstein, N.M., Staplin, L., & Trullillo, L. (in press, *The Gerontologist*). Transportation and Aging: A Research Agenda for Advancing Safe Mobility.

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