Information Collection Request: Older Drivers' Self-Regulation and Exposure

Supporting Statement B

B. Collections of Information Employing Statistical Methods

NHTSA is seeking approval to conduct a study to gather objective data regarding the extent to which older drivers appropriately regulate their driving habits in response to age-related functional changes.

Twenty participants aged 60-69, 20 participants aged 70-79, and 20 participants aged 80 and older will be recruited to participate in this study and complete a clinical functional evaluation, a driving evaluation, and allow data collection devices to be installed in their personal vehicles to collect driving exposure data for one month.

All participants will be recruited through public solicitations to residents of one or more residential communities in the vicinity of Raleigh/Durham/Chapel Hill/Burlington, North Carolina. Solicitations will be in the form of flyers posted at a senior center, library, or other location; announcements in newsletters and on community listservs; and/or sign-ups at local gatherings such as health fairs and farmer's markets. Interested residents will contact a designated NHTSA research team member through a toll-free telephone number to enroll or will be interviewed in person at meetings or events. During the brief interview, a researcher will explain the study and ask the questions listed below to determine if the person is eligible to participate.

To ensure prospective participants meet the study needs, we propose to ask each respondent to the solicitation questions to determine that they meet age and other inclusion criteria, that they have access to a vehicle and can legally drive it, and that they drive often enough to provide adequate exposure data to support analyses.

Once a participant agrees to participate, he or she will be asked to do or agree to each of the following activities:

1) Sign an informed consent
2) Have a data acquisition system (DAS) installed in their vehicle
3) Drive their vehicle in their customary manner for a period of one month
4) Complete a confidential clinical assessment of their cognitive and physical abilities
5) Complete a confidential on-road driving assessment by a CDRS
6) Allow the research team to remove the DAS.

Data Analysis Plan

The objectives of this project are to assess the extent to which older drivers appropriately regulate their driving habits in response to or in anticipation of age-related functional changes. Interview responses will be used to establish participants' eligibility for the study and will also serve as grouping variables for analyses to examine differences in driving behavior measures, clinical assessment measures, and naturalistic driving measures by age and other characteristics of interest from the screening interview responses.

Driving exposure measures will include number and duration of trips during a one-month period, including average and maximum trip length, categorizing trips according to the amount of mileage spent on various road types (residential, arterial, freeway, and/or by posted speed limit), and under differing weather/visibility conditions (wet/dry, day/dusk/night).

The clinical assessment (Appendix G, Justification for Instruments, provides details regarding the clinical battery) will include measures of:

- Visual acuity and Contrast sensitivity
- Brake response time (simple and choice RT)
- Working memory (cued recall)
- Visualizing missing information (MVPT-visual closure)
- Visual attention (Useful Field of View subtests 1 and 2)
- Visual search (Trail-making Test)
- Route planning (maze completion).

Driving behaviors observed/scored during the CDRS evaluation will include:

- Maintenance of speed and lane position
- Exhibiting hazardous driving behaviors (e.g., running stop signs or cutting off other drivers)
- Driving substantially over or under the posted speed, slowing or stopping at inappropriate times or locations
- Accelerating and braking smoothly
- Signaling turns
- Turning into the proper lane
- Managing lane changes and merges, including checking blind spots
- Selecting appropriate gaps when turning across traffic
- Navigating intersections correctly and performing properly at other decision points.

Many of the analyses will be descriptive in nature and focused on examining possible associations among driver age and the clinical, on-road, and naturalistic driving measures. Inferential statistics will be applied where appropriate given these associations and the study's sample size. It is important to note that sophisticated statistical analyses involving multiple predictors and outcome variables in a single model will have limited validity given the proposed sample size for this study. The power analysis suggests, however, the sample size will be sufficient when more basic analyses (e.g., one-way ANOVA, chi-square) are utilized to examine group differences for individual measures of interest. Statisticians will assess the need for more stringent statistical significance thresholds depending on the number of comparisons made. In addition, the total number of comparisons will be limited to reduce the likelihood of Type I error.

Specifically, researchers plan first to calculate simple correlations among the age, clinical, on-road, and naturalistic driving measures to determine how age, and cognitive and physical decline, are associated with driving performance as measured during the on-road evaluation and naturalistic driving. The next step will be to conduct separate one-way ANOVAs for each of the clinical measures and on-road assessment variables to determine if there are differences in the means for these continuous data by driver age group. These analyses primarily serve to assess whether the current study's sample of drivers demonstrates age related declines in cognitive and physical capabilities as found among the general older driver population in prior studies. Should these analyses show results similar to prior studies of older drivers, it would provide support for moving to the next set of analyses focused on age group differences in driving exposure and self-regulation since driver age would be the primary indicator of declines in cognitive and physical capabilities. As such, the clinical and on-road assessment measures would not need to be included as covariates in the next set of analyses.

Researchers plan to use one-way ANOVA and chi-square analyses to look for age group differences in the naturalistic driving data collected. For example, a 3 (age group) x 2 (day/night) chi-square analysis could be used to examine counts of trips by age group and time of day. Prior research suggests the oldest drivers may drive less at night, but it is not known if they compensate for this reduced night driving with more trips, or a greater percentage of their trips, during daylight hours. Similar analyses of count data will focus on measures such as road type driven on, weather conditions, and other measures of interest. Other analyses will focus on age group differences in continuous measures such as total driving time or average trip length through the use of ANOVA. Again, statisticians will assess the need for statistical significance threshold adjustments based on the number of comparisons to be made.

B.1. Describe the potential respondent universe and any sampling or other respondent selection to be used.

The potential respondent universe is comprised of all drivers age 60 and older who reside in or near Raleigh/Durham/Chapel Hill/Burlington, NC, have access to a motor vehicle for which they are the primary driver, and hold a valid driver's license. From this universe, estimated based on 2010 Census data for Raleigh, Durham, Chapel Hill, and Burlington, NC, the new data collection (qualification interview) will qualify a sample of 60 volunteer drivers, 20 of whom are aged 60-69, 20 of whom are aged 70-79, and 20 of whom are age 80 or older.

Table 1. Potential Respondent Universe

Driver Age Group	Universe	Number Screened	Expected Selection Rate	Sample
60-69	46,128	60	33%	20
70-79	22,769	60	33%	20
80 +	17,414	60	33%	20

Power Analysis

Researchers first reviewed prior research on older drivers to determine the magnitude of effect sizes found by somewhat similar studies that examined differences by various driver age categories. Prior research suggests medium to large effect sizes for measures such as visual acuity, contrast sensitivity, useful field of view, number of driving trips per week, and miles driven.[1,2] The outcome variables of most interest are those related to actual on-road driving, and the differences appear to be quite large based on driver age cohort. For example, based on Nationwide Personal Transportation Survey (NPTS) data reported in Rosenbloom (2004), licensed older drivers aged 65-69 averaged 4.3 trips per day (129 trips per 30-day month) and drivers aged 85+ averaged 2.3 trips per day (69 trips per 30-day month) (Table 2). This suggests the 65-69 year olds are taking about 87% more trips on average than the 85+ year old drivers.

Table 2. Trips per day for licensed drivers

Age Cohort	Trips Per Day
65–69	4.3
70–74	4.1
75–79	3.5
80–84	3.5
85+	2.3

Adapted from Rosenbloom (2004). Unpublished data from the 1995 NPTS.

Similarly, Rosenbloom (2004) reported that 65-69 year old drivers drove more miles per day than other older driver age cohorts and males tended to report driving more miles than females in the same age cohort (Table 3). For example, 65-69 year old males drove approximately 185% more miles than did 85+ year old males. The differences are even greater for females with 65-69 year old women driving approximately 241% more miles than 85+ year old women. Taken together, these self-reports of trips per day and miles driven per day suggest substantial differences in driving exposure that should be detectable in the current study that aims to measure actual exposure rather than self-reported exposure.

[1] Rosenbloom, S. (2004). Mobility of the Elderly: Good News and Bad News in *Transportation in an Aging Society*. Transportation Research Board Conference Proceedings (2004). Washington, DC: TRB.
[2] Staplin, L., Ball, K., Park, D., Decina, L.E., Lococo, K.H., Gish, K.W., & Kotwal, B. (1998). *Synthesis of Human Factors Research on Older Drivers and Highway Safety; Volume I: Older Driver Research Synthesis*. McLean, VA: U.S. Department of Transportation, Federal Highway Administration.

Table 3. Miles driven per day

Age Cohort	Sex	Miles Per Day
65–69	Male	37.4
	Female	24.9
70–74	Male	34.5
	Female	20.6
75–79	Male	23.8
	Female	16.4
80–84	Male	19.0
	Female	13.0
85+	Male	13.1
	Female	7.3

Adapted from Rosenbloom (2004). Unpublished data from the 1995 NPTS.

For the current power analysis, researchers used G*power®[3] to conduct three power analyses using *Effect Size f* estimates of.45, .35 and .25 respectively for a one-way ANOVA with 2 degrees of freedom (3 participant groups based on driver age), an alpha of .05, and power of .80. Table 1 shows a summary of the sample sizes required (N) to detect the desired effect sizes with the given parameter inputs. Figure 1 shows the G*power® output for each of the effect size estimates separately.

Table 4. Required Sample Size for a Given Effect Size

*Effect Size f**	Required Sample Size (N)
0.45	51
0.35	84
0.25	159

Note: α = .05, Power = .80, 3 groups of participants
*Multiply *Effect Size f* by two for equivalent Cohen's D value.

[3] Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191.

1. Effect size f = 0.45

F tests - ANOVA: Fixed effects, omnibus, one-way

Analysis:	A priori: Compute required sample size		
Input:	Effect size f	=	0.45
	α err prob	=	0.05
	Power (1-β err prob)	=	0.80
	Number of groups	=	3
Output:	Noncentrality parameter λ	=	10.3275000
	Critical F	=	3.1907273
	Numerator df	=	2
	Denominator df	=	48
	Total sample size	=	51
	Actual power	=	0.8026588

2. Effect size f = 0.35

F tests - ANOVA: Fixed effects, omnibus, one-way

Analysis:	A priori: Compute required sample size		
Input:	Effect size f	=	0.35
	α err prob	=	0.05
	Power (1-β err prob)	=	0.80
	Number of groups	=	3
Output:	Noncentrality parameter λ	=	10.2900000
	Critical F	=	3.1093105
	Numerator df	=	2
	Denominator df	=	81
	Total sample size	=	84
	Actual power	=	0.8118799

3. Effect size f = 0.25

F tests - ANOVA: Fixed effects, omnibus, one-way

Analysis:	A priori: Compute required sample size		
Input:	Effect size f	=	0.25
	α err prob	=	0.05
	Power (1-β err prob)	=	0.80
	Number of groups	=	3
Output:	Noncentrality parameter λ	=	9.9375000
	Critical F	=	3.0540042
	Numerator df	=	2
	Denominator df	=	156
	Total sample size	=	159
	Actual power	=	0.8048873

Figure 1. G*power® outputs for effect size estimates

As can be seen in Figure 1, a sample size of 51 would be sufficient to detect an *Effect Size f* of 0.45. This effect size estimate indicates that the outcome measure (driving exposure measures for this study) of the average person in the group of interest needs to be about 0.80 to 0.90 standard deviations above (or below) the same measure of the referent group for a statistically significant difference to be observed. According to the 2009 National Household Transportation Survey, daily vehicle trips per driver 65 and older was an average of 2.7 trips, and daily vehicle miles traveled by driver 65 and older was 20 miles. Given the expected distribution of these variables based upon Tables 2 and 3, only differences of about one standard deviation or greater would be of substantive interest and would represent a meaningful change in driver behavior.

As such, the project proposes to collect data from 60 participants to allow for lost data and to detect a slightly smaller effect size if present. As can be seen in Error: Reference source not found and Figure 1, a larger sample of 84 is required to detect an *Effect Size f* of .35, and a sample of 159 is required for an *Effect Size f* of .25. Increasing the sample to these levels would require an increase in project funding and time to collect the additional data with little added benefit given the expected differences in the measures of interest.

1. Effect size f = 0.45
F tests - ANOVA: Fixed effects, omnibus, one-way

Analysis:	A priori: Compute required sample size		
Input:	Effect size f	=	0.45
	α err prob	=	0.05
	Power (1-β err prob)	=	0.80
	Number of groups	=	3
Output:	Noncentrality parameter λ	=	10.3275000
	Critical F	=	3.1907273
	Numerator df	=	2
	Denominator df	=	48
	Total sample size	=	51
	Actual power	=	0.8026588

2. Effect size f = 0.35
F tests - ANOVA: Fixed effects, omnibus, one-way

Analysis:	A priori: Compute required sample size		
Input:	Effect size f	=	0.35
	α err prob	=	0.05
	Power (1-β err prob)	=	0.80
	Number of groups	=	3
Output:	Noncentrality parameter λ	=	10.2900000
	Critical F	=	3.1093105
	Numerator df	=	2
	Denominator df	=	81
	Total sample size	=	84
	Actual power	=	0.8118799

3. Effect size f = 0.25
F tests - ANOVA: Fixed effects, omnibus, one-way

Analysis:	A priori: Compute required sample size		
Input:	Effect size f	=	0.25
	α err prob	=	0.05
	Power (1-β err prob)	=	0.80
	Number of groups	=	3
Output:	Noncentrality parameter λ	=	9.9375000
	Critical F	=	3.0540042
	Numerator df	=	2
	Denominator df	=	156
	Total sample size	=	159
	Actual power	=	0.8048873

B.2. Describe the procedures for the collection of information.

NHTSA's research team will coordinate with social, recreational, and directors at communities in the Raleigh/Durham/Chapel Hill/Burlington NC, vicinity, to utilize community newsletters and other community media to advertise the opportunity to participate in this research project. These media will invite interested residents to attend recruiting events or contact a designated research team member for more information, using a toll-free number or e-mail address. Solicitations will be in the form of flyers posted at a senior center, library, or other location; announcements in newsletters and on community listservs; and/or sign-ups at local gatherings such as health fairs and farmer's markets. A sample flyer is contained in Appendix H. When such individuals inquire about the study, we will conduct the planned interview to determine whether they qualify for study participation.

B.3. Describe methods to maximize response rates.

Participation in this study is voluntary. To maximize response rates we will rely on the active support of cooperating individuals in communities who direct social, recreational, and other programs who will promote study participation. These individuals will understand that this research will support their mission to help the residents of their communities remain safely mobile, which is vital to healthy aging. At the same time, their existing relationships with their residents, in familiar and trusted roles, should help maximize response rates.

We also will attempt to maximize response rates by offering financial incentives to respondents if they qualify for study participation. We will pay $50 to all study participants for allowing instruments to be placed in their own cars for a month to monitor their driving habits and travel patterns. Participants will receive another $150 upon completion of the 30-day driving period, clinical assessment, and driving evaluation. Participants will also receive confidential feedback on the driving evaluation results at no cost to themselves (a $350 value). Older drivers tend to be hesitant to participate in studies that include functional and driving performance measures because they believe, sometimes accurately, that poor scores on these measures may be reported to their State licensing agency. This could lead to license restriction or revocation. Experience in previous NHTSA studies of older drivers' performance, including *Older Drivers and Navigation Devices, Mild Cognitive Impairment and Driving Performance, and Older Drivers' Compliance with License Restriction*, has shown that this level of incentive is necessary to successfully recruit participants in a study such as this one.

Additionally, we will provide written assurances of confidentiality, such that no individual will be identified in reports of the study's findings, nor will any driver's data be shared with any licensing regulatory authority.

B.4. Describe any tests of procedures or methods to be undertaken.

We do not anticipate substantive changes to the planned interview method that we expect to average 5 minutes in length across respondents. However, we intend to remain sensitive to the nature of responses we receive and will respond with modest changes as needed to meet our participant counts with the fewest possible interviews.

B.5. Provide the name and telephone number of individuals consulted on statistical aspects of the design

The following individuals have reviewed technical aspects of this research plan:

Kathy Sifrit, PhD

Research Psychologist, NHTSA
202-366-0868

Dennis Thomas, PhD
Vice President, Dunlap and Associates, Inc.
203-323-8464 (ext. 104)

Richard Blomberg
President, Dunlap and Associates, Inc.
203-323-8464 (ext. 101)

Kristopher Korbelak, PhD
Senior Research Scientist, Dunlap and Associates, Inc.
203-323-8464 (ext. 103)