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Navigation and the Mobility of Older Drivers

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Objectives. Age related difficulties in navigating are believed to restrict driving mobility. A decline in mobility can have negative implications for peoples' well-being and independence. This problem may be more serious than the increased risk of collision that occurs with old age. The aim of this research was to determine the extent to which age-related difficulties in navigating restrict car travel.

Methods. A postal questionnaire survey of 1,186 United Kingdom (U.K.) motorists (aged 21 to 85 years) was conducted to determine more about people's mobility, the restrictions to their driving, and their driving experience.

Results. As predicted, respondents were found to report more navigation problems with increasing old age. Hierarchical regression analyses indicated that navigation problems relate to reduced mobility (miles per week, trips per week, and average driving frequency) when controlling for other predictors of mobility (age, gender, employment, health, residential location, fitness, and ability to afford driving).

Discussion. This research highlights the need to have better navigational support for drivers, particularly elderly drivers. Improved roads signs and in-vehicle navigation aids are two solutions that might help enhance the mobility of elderly drivers.

THERE has been an escalation in the amount of interest in elderly drivers prompted by population and travel trends. Elderly people are driving more, and the population of elderly motorists is increasing (e.g., Rosenbloom, 1993). At the same time, concern has also been expressed about the safety of elderly drivers because with old age there is an increase in the risk of collision and injury when one considers exposure (i.e., risk in relation to distance traveled or time spent driving; Evans, 1994; Stamatiadis & Deacon, 1995). Even though driving can be a riskier activity for elderly drivers, this risk may not exceed the problems caused by a reduction in mobility (Barr, 1991; Carp, 1971; Evans, 1994).

Mobility is a major contributor to the well-being of elderly people (Carp, 1988). Well-being is dependent on the fulfillment of needs, and mobility contributes to this by helping people to obtain their needs (e.g., shopping, medical appointments, socializing). Mobility can refer to the amount of traveling people do in terms of distance or frequency. It can also refer to people's ability to travel (Robson, 1982) or the freedom, independence, and convenience of movement.

Driving a car is the most common method of traveling for elderly people in the United States (Federal Highway Administration [FHA], 1997), Canada (Ministry of Transportation, Ontario [MTO], 1994; Rothe, Cooper, & de Vries, 1990) and the United Kingdom (Department of Transport [DOT], 1994). "A driver's license not only means independence and convenient transportation, it symbolizes autonomy and competence" (Persson, 1993, p. 88). Furthermore, driving can provide "mobility, sociality, economic gain, existential meaning, and social status" (Rothe et al., 1990, p. 159). Consequently, elderly drivers depend on car travel for as long as possible, and although they tend to reduce their frequency of driving, they resist any change to this preferred mode of travel (Jette & Branch, 1992).

Despite the importance of driving, elderly people drive less with increasing old age. In the United States, they travel less than half as many miles as the average for all age groups (National Research Council [NRC], 1988). This reduction is attributed to an absence in work-related mileage, an increasing proportion of women (who drive less) in the population of elderly drivers, and the recognition of decreased driving performance (Bly, 1993; Rosenbloom, 1988).

Elderly drivers compensate for age-related declines in performance by changing the patterns of their driving behavior. For example, many elderly drivers avoid driving at night or on unlit roads because they have poorer night vision and experience problems with headlight glare (British Automobile Association [BAA], 1988). The most commonly avoided situations are night driving, rush hours, turning across traffic, city centers, highways, long trips, bad weather, and unfamiliar routes or areas (BAA, 1988; Carp, 1971; MTO, 1994; Rothe et al., 1990; Simms, 1993; Yee, 1985). Navigation difficulties were the most widely mentioned of three main problem areas identified in discussion groups with elderly drivers (Sixsmith & Sixsmith, 1993) and may contribute to the cessation of driving (Rabbitt, Carmichael, Jones, & Holland, 1996). The two other main problem areas were night driving and declining abilities. The combination of busy, fast roads and poor sign posting is sufficient to make the experience of wayfinding so difficult it can deter elderly drivers from traveling on unfamiliar journeys (Sixsmith & Sixsmith, 1993).

This article focuses on the relationship between navigation problems and driver mobility. Navigation involves route planning and wayfinding. *Route planning* refers to the navigational preparations people make before driving an unfamiliar route. *Wayfinding* can be defined as the decision-making process that is required to negotiate a route to a destination (Golledge, 1992; Passini, 1984). The main purpose for driving is to travel safely, conveniently, and independently from one point to another. Difficulty in finding one's intended destination decreases the functionality of this form of transportation and threatens the mobility of its users.

Age-related declines in rate of information processing (McDowd & Birren, 1990), vision (Kosnik, Winslow, Kline, Rasinski, & Sekuler, 1988), and spatial ability (Simon, Walsh, Regnier, & Krauss, 1992) may make wayfinding more difficult for elderly drivers. It is believed that, as a consequence of poorer spatial ability, elderly people are more inclined to have problems with extracting information from road maps and their cognitive maps of the environment (e.g., Kirasic, 1985). They may take longer to read maps, miss information on road signs, and fail to gain information from landmarks as a consequence of the decline in their visual acuity and restricted visual field. Lastly, with fewer attentional resources and slower psychomotor performance, it is suspected that elderly drivers have more trouble making navigation decisions while maintaining a safe level of driving performance.

The impact wayfinding problems have on elderly drivers' mobility is difficult to isolate because there are many other factors associated with normal aging that also have a negative impact on mobility. The financial cost of driving is a barrier to mobility (NRC, 1988), and costs of running a car become more significant with reductions in income after retirement. The availability of a car also has an obvious impact on mobility: "Absence of an automobile for available use tends to be reflected in a low mobility rate, rather than in use of a different form of transportation, and in dissatisfaction with the ability to get about" (Carp, 1971, p. 183).

Employment can influence mobility through the need to drive and by providing an income to afford driving (Marottoli, Ostfield, Merrill, Perlman, Foley, & Cooney, 1993). Health and fitness are also strong predictors of mobility. Drivers who consider themselves to be in poor health restrict their driving frequency and the distances they drive (BAA, 1988; Carp, 1971; Marottoli et al., 1993; Rabbitt et al., 1996; Schlag, 1993).

The amount of driving people do and their need to drive also vary depending on where they reside. Elderly drivers living in rural areas drive longer distances and more frequently than elderly drivers living in cities (Gelau, Metker, & Traenkle, 1992). This is primarily due to inadequate public transport and the distances between resources being much greater in rural areas (Everitt & Gfelliner, 1997). Furthermore, there are fewer home services available to rural residents (e.g., Meals on Wheels).

The hypothesis of the present study is that wayfinding problems are substantial in old age, and that they contribute to reduced mobility even when accounting for these major predictors. Other factors could also have an impact on driver mobility (e.g., ethnicity, education). However, it is believed they influence mobility indirectly through the factors already described in this article. For example, education would affect ability to afford the costs of driving because it is strongly linked to employment and income.

Method

Sample and Data

A questionnaire survey was mailed to a sample of U.K. motorists in 1996. A random selection of licensed drivers was obtained from a motoring organization's direct marketing system. Half of the sample were members of the motoring organization and half were nonmembers. As this research was particularly interested in elderly drivers, a sample was selected that overrepresented their proportion in the driving population. Half of the sample (n = 1,000) were 60 years of age and older.

The total number of respondents was 1,186 from the 1,950 questionnaires sent out. Seventy responses were considered invalid because the addressee had moved, died, or stopped driving. Thus, the response rate was calculated from a total of 1,880 potential respondents, which yielded a response rate of 63%. The initial mailing had a 53% response rate and a reminder letter encouraged another 10% to reply.

Respondents' ages ranged from 21 to 85 years with a median age of 61 years (SD = 16.8). There were 575 (48.5%) drivers younger than 60 and 611 (51.5%) older than 60. There were 363 (63.1%) male and 212 (35.9%) female respondents younger than 60 years of age and 488 (79.9%) male and 123 (20.1%) female respondents 60 years of age or older. In 1991, 40% of all licensed drivers in the United Kingdom were female (DOT, 1993). In that same year, 33% of 60–69-year-old women and 15% of women 70 years of age and older held drivers licenses. For men these values were 78% and 58%, respectively. Therefore, although the number of female respondents was low, it was close to the actual proportion in the population.

The distribution of respondents closely matched the population of drivers in the marketing database by membership, age, and gender, which suggests the nonrespondents had similar characteristics. Little else can be said about the 696 people who did not respond to the survey.

Questionnaire

The mailed questionnaire had 160 questions and took approximately 20 minutes to complete. It was designed from information gathered during focus group discussions with drivers and pilot testing. Part of the questionnaire sought to determine more about people's mobility, the restrictions to their driving, and their driving experience. For restrictions to mobility, questions were designed to measure respondents' access to cars, the impact costs had on their driving, and reductions in their driving. They were also asked about their amount of driving, driving activities, the importance of driving, and transportation alternatives. Questions about when they had obtained their driver's license and how long respondents had been driving regularly were included to indicate their driving experience. Another set of questions asked about wayfinding abilities and problems. In the last section of the questionnaire, drivers were asked to indicate their gender, age, employment status, and residential setting. Questions about general health and fitness were also included in this section. Drivers were not asked about their history of collisions or citations. Although this information would have been interesting, there was concern that the sensitive nature of these questions could have discouraged people from responding.

RESULTS

The Results section is organized as follows: The first three subsections describe the different sets of variables in the hierarchical regression analysis: the first set of predictors, the second set of predictors, and the criterion variables. The order of these topics matches their presentation in Table 1. Results from the regression analysis are presented at the end of this section.

First Set of Regression Variables: Standard Predictors of Driving Mobility

Details about the age and gender of respondents were provided earlier (see the Methods section). The next variable in the regression equation was employment: 64% of drivers younger than 60 years of age and 9% of those 60 years and older were employed full-time; 12% of drivers younger than 60 and 7% of those 60 years and older were employed part-time; 78% of respondents 60 years and older were retired; 87% of drivers younger than 60 and 18% of those 60 and older were working in some capacity (reasons for not working included retirement, housewives/husbands, students, and sick leave).

Nonelderly drivers rated themselves as having better than average health for the self-reported ratings of present health. In an analysis of variance, there was a significant main effect for age, $F(5,1159) = 15.26$, $p < .001$, $\eta^2 = .06$, such that mean health decreased across age group on a 5-point scale ranging from "very poor" to "very good." Six age groups were used: younger than 35 years; 35–44 years; 45–54 years; 55–64 years; 65–74 years; and 75 years and older. Eta-squared (η^2) is a measure of the strength of association representing the percentage of total criterion variability that is explained by a predictor variable (Keppel & Zedeck, 1989; Tabachnick & Fidell, 1989). In this case, 6% of self-reported health ratings can be predicted by age.

In terms of the percentage of respondents by residential setting, most lived in towns or suburban areas (58%). Thirteen percent of respondents lived in cities, 16% in villages, and 12% in rural areas. There were no apparent age differences in terms of residential setting. Similarly, there were no significant differences across age groups, or gender, in the frequency with which respondents exercised.

Respondents were asked to report how much the cost of running their car influenced the amount they drove. Seventy-two percent said cost had no impact on their amount of driving, 23% said it decreased the amount they drive, and 5% said it increased their driving. There were no gender differences, but the costs of driving had an impact on the amount elderly respondents drove, $F(5,1168) = 3.90$, $p < .005$, $\eta^2 = .02$. Eighteen percent of nonelderly drivers (< 60 years) and 28% of elderly drivers (≥ 60 years) reported costs had a negative influence on their amount of driving.

Second Set of Regression Variables: Measures of Wayfinding Problems

Respondents were also asked to rate how difficult they found five different wayfinding scenarios on a 5-point scale ranging from "very easy" to "very difficult." The five scenarios were a motorway, major road, minor road, city driving, and finding an unfamiliar location (e.g., a house). "Difficulties wayfinding" is the mean of the 5-item scale. Higher mean scores represent more wayfinding difficulties. Cronbach's Alpha was also 0.86 for this measure. An analysis of variance (ANOVA) was conducted on "difficulties wayfinding" for gender and age group. Both main effects were significant. People rate wayfinding as being more difficult with age, $F(5,1105) = 6.19$, $p < .001$, $\eta^2 = .03$, and women rate wayfinding as being more difficult than men, $F(1,1105) = 30.39$, $p < .001$, $\eta^2 = .03$. This trend by age and gender also appeared for each of the five questions contributing to this scale. "Finding your way through an unfamiliar city" was considered to be most difficult on average (mean = 3.5, *SD* = 0.8) and "finding your way on an unfamiliar motorway" was the least difficult (mean = 2.5, *SD* = 0.9).

There were seven questions relating to wayfinding abilities: sense of direction, reading signs while stopped and moving, identifying compass and left-right directions, reading maps, and wayfinding. Respondents rated their different abilities on a 5-point scale ranging from "very poor" to "very good." Higher mean scores for the seven questions represent better wayfinding abilities. Cronbach's Alpha for this scale was 0.86. There were significant age, $F(5,1132) = 3.34$, $p < .01$, $\eta^2 = .01$, and gender effects, $F(1,1132) = 37.49$, $p < .001$, $\eta^2 = .08$, for wayfinding abilities such that nonelderly and male drivers rated their abilities as being better. This trend appeared for each of the seven questions contributing to this scale. Respondents rated their ability to "distinguish between right- and left-hand directions" as being highest (mean = 3.2 on the 5-point scale, *SD* = 0.8) and "telling which direction was north" as being lowest (mean = 2.6, *SD* = 1.0).

"Preference to avoid unfamiliar routes" is a composite measure consisting of two items from the questionnaire. Higher scores indicate a greater preference to avoid unfamiliar routes and places. The internal reliability of this composite scale, as measured by Cronbach's Alpha, was 0.93. An ANOVA indicated a trend to avoid these situations more with increasing age, $F(5,1155) = 23.60$, $p < .001$, $\eta^2 = .02$. Also, female drivers avoid unfamiliar routes and places more than male drivers, $F(1,1155) = 12.51$, $p < .001$, $\eta^2 = .05$.

Criterion Variables: Measures of Driving Mobility

Respondents were asked to rate how many miles they drive in an average week (see Figure 1). An ANOVA was conducted on weekly mileage for gender and age group. Both main effects were significant. People drive less with age, $F(5,1158) = 21.32$, $p < .001$, $\eta^2 = .08$, and women drive less than men on average, $F(1,1158) = 114.24$, $p < .001$, $\eta^2 = .08$. The apparent interaction between age group and gender was nonsignificant at a critical $\alpha = 0.01$.

The x-axis in Figure 1 has been transformed to represent equal units of mileage, whereas the ANOVA described in the preceding paragraph is based on the scale for weekly

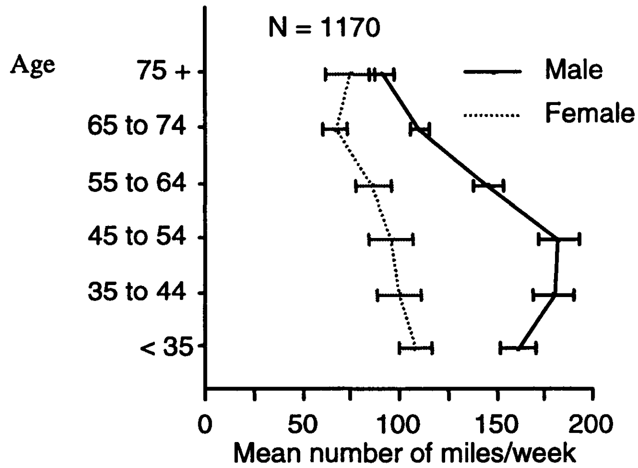

Figure 1. Mean number of miles per week by age (± 1 standard error).

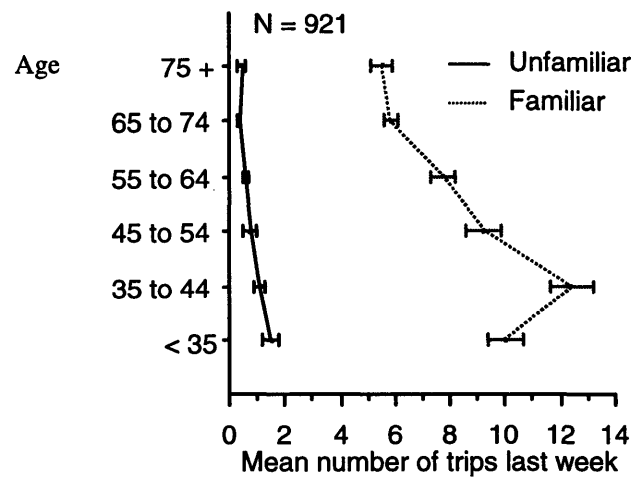

Figure 2. Mean number of familiar and unfamiliar trips per week by age (± 1 standard error).

mileage used in the questionnaire. It should be noted here that the weekly mileage measure employed a scale with six unequal intervals. The range was selected according to values reported in focus group discussions with drivers (Burns & Galer Flyte, 1996). The interval size increases from "less than 10 miles" for the first point to "more than 300 miles" for the last point. This was done to accommodate the skewed distribution that would have arisen with an open-ended question about weekly mileage. Although this type of scale is not ideal for parametric statistics, it was found to be normally distributed. Furthermore, it must be noted that some people have trouble answering open-ended questions about driving mileage (Burns & Wilde, 1995).

Respondents were asked to estimate the number of trips they had taken in the previous week. They were then asked to estimate if this amount was less than usual, about average, or more than usual. For most respondents (n = 952), the amount of driving was about average. The others (less, n = 95; more, n = 127) were excluded from this analysis because this did not represent their typical behavior. Figure 2 displays the mean number of trips per week in relation to age group. Both of these variables had highly skewed distributions. The familiar trips measure could be made normal with a log transformation but the unfamiliar trips measure could not. An ANOVA was conducted on the number of familiar trips for gender and age group. There was a significant main effect for age group indicating that people travel on fewer familiar trips with age, $F(5,909) = 18.45$, $p < .001$, $\eta^2 = .09$.

The same analysis could not be conducted on the number of unfamiliar trips because the dependent measure violated the assumption of normality. Separate nonparametric analyses were used instead. A Mann-Whitney U test indicated that elderly (≥ 60 years) drivers drove on significantly fewer unfamiliar trips than nonelderly (< 60 years) drivers ($Z_{obs} = 5.7$, $p < .001$). No significant difference was found for gender.

Respondents indicated how often they drive for certain activities (recreation, errands, work, holidays, social visits, and shopping) on a 7-point scale ranging from "never" to "most days." Elderly respondents drove significantly less frequently for every activity except shopping. The largest difference between age groups was for work (includes volunteer work). There is a decline in driving frequency in older age. An ANOVA was conducted to determine whether driving frequency differed across age group and gender. People drive less frequently with increasing age, $F(5,1022) = 48.68$, $p < .001$, $\eta^2 = .19$. There was no difference between men and women for the mean total driving frequency. The analysis was conducted again for the frequency of the five nonwork activities. People also drove less frequently for nonwork activities with increasing age, $F(5,1035) = 9.01$, $p < .001$, $\eta^2 = .04$. There was also no gender difference in driving frequency for nonwork activities.

Multiple Regression Analysis

A hierarchical regression analysis was conducted to determine whether wayfinding problems were related to reduced mobility. A description of these factors appears in Table 1. All variables were examined for their fit with the assumptions of multiple regression analysis. The predictor variable that was intended to measure driving experience was dropped from the analysis because of concerns about collinearity. It was very highly correlated with the age variable ($r = .83$, $p < .01$). Fifteen cases were identified as having extreme residual values ($Z > 3$) or multivariate outliers using Mahalanobis' distance ($p < .001$). These cases were omitted from the analysis.

Factors known to influence mobility were simultaneously entered into the first analysis. These variables were age, gender, health, employment, frequency of exercise, area of residence, and impact of driving expenses. Variables intended to measure wayfinding problems were entered in the second analysis. These variables were hypothesized to predict variations in mobility that could not be explained by the first set of variables. These composite measures were: difficulties wayfinding, wayfinding abilities, and preference to avoid unfamiliar routes.

Table 1. Hierarchical Regression Analysis Predicting Mobility (miles/week, n = 526)

	Description	R^2	b[a]	$SE\ b$[b]
First Set of Predictors				
Age	21–85 years		–.010*	.003
Male	Female = 0, Male = 1		.738*	.105
Employment	Unemployed/retired = 0, employed = 1		.333*	.113
Health	5-point Likert scale: 1 (very poor) to 5 (very good)		.207*	.086
Rural/urban	0 = Urban, 1 = rural		.360*	.095
Experience	Years of driving regularly[c]			
Costs of driving	5-point Likert scale: 1 (decreases a lot) to 5 (increases a lot)		.050	.058
Exercise	5-point Likert scale: 1 (never) to 5 (most days)		.025	.032
Second Set of Predictors				
Difficulties wayfinding	Mean rating for 5 items on a 5-point scale ranging from 1 (very easy) to 5 (very difficult)		–.022	.094
Wayfinding abilities	Mean rating for 7 items on a 5-point scale ranging from 1 (very poor) to 5 (very good)		.240*	.093
Preference to avoid unfamiliar routes	Mean rating for 2 items on a 5-point scale ranging from 1 (do not avoid) to 5 (avoid completely)		–.218*	.082
Intercept			2.438*	.563
Total		.239*		
Cross Validation (n = 519)		.203*		

[a]Unstandardized regression coefficients for the final analysis with all predictor variables included in the equation.
[b]Standard error of the regression coefficient.
[c]Dropped because of collinearity problems.
*$p < .01$.

Results of the hierarchical regression analysis are presented in Table 1. The first set of variables significantly predict weekly driving mileage (R^2 = .20, p < .001). The variables with significant unstandardized regression coefficients (b), with all of the variables included, are age, gender, employment, health, and residential location. The squared multiple correlation increases significantly when the second set of predictors is entered into the regression equation (R^2 change = .039, p < .001). Therefore, there is a significant relationship between wayfinding problems and mobility when controlling for the first set of variables. In the second set of predictor variables, wayfinding abilities and the preference to avoid unfamiliar routes have significant regression coefficients.

This analysis was done on half of the sample taken from a random split of the cases. This was done to validate the regression equation (Stevens, 1992). The regression equation was derived on the first sample (N = 526) and the prediction equation was applied to the second sample (N = 519) to determine how well it predicts the criterion scores there. The correlation between mileage, as predicted by the first equation, with actual mobility is presented at the bottom of Table 1. The equation significantly predicted variations in amount of weekly driving for the other sample of respondents (R^2 = .20, p < .001).

These analyses were replicated using different dependent measures of mobility. Significant relationships were also found between both these measures of mobility and wayfinding problems when controlling for the same set of predictor variables. The first replication used the number of familiar trips in the preceding week as the dependent measure of mobility (R^2 = .13, p < .001). This variable was positively skewed and was given a log transformation to make the distribution normal for the analysis. Among the first set of variables, only age and employment had significant regression coefficients. The second set of predictor variables also made a significant contribution to the equation (R^2 change = .02, p < .001). Wayfinding abilities and the preference to avoid unfamiliar routes had significant regression coefficients.

The second analysis used average driving frequency across shopping, social visits, holidays, errands, and recreation (work was excluded) as the dependent measure of mobility (R^2 = .10, p < .001). Again, the second set of variables made a significant contribution to the analysis (R^2 change = .03, p < .001) with wayfinding abilities and the preference to avoid unfamiliar routes having significant regression coefficients. Gender, age, and frequency of exercise had significant regression coefficients in the first set of variables.

Discussion

The principal aim of this research was to determine whether navigation problems have an impact on driver mobility. Results indicate navigation problems do indeed have a negative impact on mobility. This occurs even when controlling for standard predictors of mobility (age, gender, employment, health, fitness, and costs of driving). Similar results occurred for three different measures of mobility (weekly mileage, weekly number of trips, and average driving frequency for nonwork activities).

The amount of driving varied with residential location. Drivers living in more urban areas drove less than those in rural areas. This effect applied across age groups and gender. It is consistent with Gelau and colleagues' (1992) observation that elderly rural drivers drive longer distances and more frequently than their urban counterparts. It is likely that amount of driving is related to the availability of public transportation and the proximity of resources and work. This highlights the importance of having access to a car in rural areas where there tends to be less adequate public transport and fewer home support services (Everitt & Gfelliner, 1997).

Nonelderly drivers drove more frequently than elderly drivers, even when commuting travel was factored out. This is consistent with other reports (e.g., Rothe et al., 1990). Age differences in trip frequency are also reflected in reports of number of trips per week and miles driven per week. People drive significantly less with age and women drive less than men. Furthermore, elderly drivers go on significantly fewer familiar and unfamiliar trips per week. This lower frequency of unfamiliar trips may not relate to age differences in employment because commuting generally constitutes familiar travel. Although there would certainly be instances of work-related unfamiliar travel, it is believed the majority of professions would not require it.

It has been well documented in the literature that elderly drivers prefer to avoid certain driving situations more than their younger counterparts do (e.g., Simms, 1993). Consistent with other research (e.g., Rabbitt et al., 1996), drivers prefer to avoid unfamiliar places and routes more as they age.

Respondents rated the perceived difficulty of wayfinding in different locations (city, minor road, major road, motorway, and finding a location). As predicted, people rated wayfinding as being more difficult with increasing age. Female drivers found wayfinding more difficult than male drivers and rated their wayfinding abilities as being poorer. Similar perceptions of abilities have been reported in studies of wayfinding on foot (Devlin & Bernstein, 1995). Women also rated driving in unfamiliar areas as being a more serious problem than did men (FHA, 1997).

There are quantitative and qualitative components to mobility. Quantitatively, mobility can refer to the amount of traveling people do in terms of distance or frequency. Qualitatively, it can describe the independence and convenience of this movement. This research did not investigate this latter component of mobility. Although it is clear that navigation problems restrict mobility in terms of the amount of driving, it is uncertain whether they infringe on the quality of this mobility because independence and convenience were not assessed in the survey. Future research needs to investigate the relationship between navigation problems and these subjective aspects or qualities of mobility.

There are other reasons to be concerned about navigation performance aside from mobility. Road safety is one powerful reason. Driving is not a cognitively demanding task in most instances (Näätänen & Summala, 1976); however, navigating a car on unfamiliar roads can be very demanding (Wierwille, Antin, Dingus, & Hulse, 1988). Rothe and colleagues (1990), from interviews on the collision experiences of elderly drivers, reported it was relatively common for the victim to be searching for certain streets, road signs, or addresses when the collision occurred.

In addition to these effects on mobility and road safety, wayfinding problems can lead to wasted time and fuel, and they can also contribute to traffic congestion. Navigational waste or excess travel "is the difference between the amount of travel that actually occurs on the network and the amount that would occur if every vehicle trip followed the desired optimum route" (Bovy & Stern, 1990, p. 265). Navigational waste is considered to be a significant problem by transport researchers. It is estimated that 4% of travel in the United Kingdom is navigational waste (Jeffery, 1981). The experience of navigation problems can also be irritating, frustrating, and embarrassing to drivers (Burns, 1998).

The results of this research, and the many potential negative implications of navigation problems, evince the need to understand these problems and find solutions. Solutions such as better road signage and other navigational aids could enhance the mobility of elderly drivers (e.g., maps and in-vehicle route guidance systems). However, the needs of all road users, particularly elderly and female motorists, would have to be given careful consideration when implementing these solutions.

There are a number of limitations to the research described in this article. A typical problem with mailed questionnaire surveys is the high rate of nonresponse. It should be noted that results might have differed if there had been a perfect response rate. Another problem is the study's total reliance on self-report data. The reader can only assume that respondents were capable of providing accurate responses because no external criteria for the validity of the data could be supplied. Lastly, the study was unable to consider all possible factors that affect driver mobility. Conditions such as physical disability and incontinence are also known to reduce driver mobility but were not specifically addressed in this study.

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A copy of the questionnaire is available from the author upon request.
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