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Changes in Driving Patterns and Worsening Depressive Symptoms Among Older Adults

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Objectives. This study examined whether changes in driving patterns—driving cessation and reduction—have negative consequences for the depressive symptoms of older Americans and whether these consequences are mitigated for people with a spouse who drives.

Methods. The project used data from 3 waves of the Asset and Health Dynamics Among the Oldest Old (AHEAD) study. Depressive symptoms were assessed with an abbreviated Center for Epidemiologic Studies-Depression scale. Using 2 models, the project examined how driving cessation and reduction that occurred between Waves 1 and 2 contributed to increases in depressive symptoms between Waves 2 and 3. The first model included the entire sample (N = 5,239), and the second model focused on drivers only (n = 3,543). A third model added interaction terms to the analysis to consider whether respondents who stopped driving but had a spouse who drove were less at risk of worsening depressive symptoms.

Results. Respondents who stopped driving had greater risk of worsening depressive symptoms. Drivers who restricted their driving distances before the study began also had greater risk of worsening depressive symptoms, but seemingly less so than the respondents who stopped driving altogether. For respondents who stopped driving, having a spouse available to drive them did not mitigate the risk of worsening symptoms.

Discussion. Changes in driving patterns can be deleterious for older people's depressive symptoms. Initiatives for assisting older people should focus on strategies that help them retain driving skills, that prepare them for the possible transition from driver to ex-driver, and that ensure that they have access to mental health therapies if driving changes are imminent.

THE percentage of Americans aged 65 and older is projected to increase from 12.8% in 2000 to 20.7% by 2040 (U.S. Bureau of the Census, 1993). Concomitantly, the proportion of elderly drivers and ex-drivers will increase as well. This anticipated trend has led to tremendous interest in such topics as the safety of older drivers (Cox, Quillian, Thorndike, Kovatchev, & Hanna, 1998; Odenheimer et al., 1994; Owsley et al., 1998; U.S. Department of Transportation, 1997), programs providing older people with alternative means of transport (Freund & McKnight, 1997), reasons for why older people stop driving (Campbell, Bush, & Hale, 1993; Forrest, Bunker, Songer, Coben, & Cauley, 1997; Kington, Reuben, Rogowski, & Lillard, 1994; Marottoli et al., 1993), and the consequences of driving cessation for older adults' quality of life (Carp, 1971; Cutler, 1972, 1975; Marottoli et al., 1997). In this study we addressed whether and how changes in older adults' driving patterns affect a specific aspect of their quality of life—their depressive symptoms. Despite growing awareness that depression and depressive symptoms are a widespread public health quandary for older adults (Lebowitz et al., 1997), there are few recent studies of this issue.

There are a variety of reasons to expect that changes in driving patterns are associated with worsening depressive symptoms among older adults. One is that driving cessation and reduction lower people's mobility (Burkhardt, Berger, & McGavock, 1996). Loss of mobility, in turn, probably reduces older people's access to resources known to protect their quality of life, such as paid and volunteer work, religious communities, friends, and health care services (Cutler, 1974; Marottoli et al., 2000). Another explanation is based on evidence that loss of the ability to perform everyday self- and home-care tasks increases depressive symptoms and the risk of clinical depression (Bruce, Seeman, Merrill, & Blazer, 1994; Gurland, Wilder, & Berkman, 1988; Phifer & Murrell, 1986). Given that driving is an everyday task for many people, it is likely that not being able to do it relates to depressive symptoms similarly. A third explanation is that changes in driving and depressive symptoms are linked through a disease that causes both. In this case, changes in driving would not directly and independently cause worsening depressive symptoms. A final explanation is found in the literature on life events and depression. This literature has suggested that certain lifestyle and identity-transforming events, such as the death of a loved one, lead to acute as well as persistent depressive symptoms in the older people who experience them (Glass, Kasl, & Berkman, 1997; Hays et al., 1998; Turvey, Carney, Arndt, Wallace, & Herzog, 1999). Inasmuch as the transition from driver to ex-driver changes one's lifestyle and identity (Rothe, 1994), it too could be a risk factor for worsening depressive symptoms.

According to the model of selective optimization with compensation, however, changes in driving patterns need not be associated with worsening depressive symptoms. This model, developed originally by P. B. Baltes and Baltes (1990), defines selection as the process whereby older people redefine their goals in response to changes in personal and environmental resources and restrict their normal activities. To illustrate selection, M. M. Baltes and Carstensen (1996) described older people who, finding driving increasingly difficult, choose to avoid highways, drive only during daylight, and/or drive shorter distances. The model defines compensation as the process whereby older people achieve the same goals (i.e., they are not restricted as they are with selection), but through new means. Highly mobile people who turn to others for transportation when they can no longer drive, for example, are compensating, according to this model. Optimization refers to the process by which older people learn new ways of doing things and thereby regain functioning, health, well-being, and so forth. Older people who equip their automobiles with assistive devices or participate in driver reeducation programs are optimizing, according to the selective optimization with compensation framework. These three strategies theoretically enable older people to maintain their previous levels of satisfaction.

Existing research specifically inspecting the link between driving and quality of life has tended to support the expectation that driving limitations have negative consequences for older people's well-being. Cutler (1972), for example, found that older people with access to personal transportation reported greater life satisfaction than their counterparts without such means. Additionally, in a study of depression among stroke survivors, Legh-Smith, Wade, and Hewer (1986) found that depression was more common among survivors who no longer drove than it was among survivors who did. This relationship persisted for stroke survivors who had alternate means of transportation. In one of the few recent studies of changes in driving patterns and affective well-being, Marottoli and associates (1997) demonstrated that driving cessation predicted higher levels of depressive symptoms at least 1–3 years after it occurred. This study is especially suggestive because it was longitudinal, the effects of driving cessation exceeded those for most other factors included in the analysis, and it used a large community sample of older adults. None of the existing studies on consequences of changes in driving behavior, however, examined how the modification of driving without stopping it (selection) impinged on older adults' quality of life. Also, with the exception of the study by Legh-Smith and colleagues, previous research on changes in driving patterns has not looked at how the presence of other drivers (i.e., options for compensation) relate to older people's well-being.

In our study we contribute to existing research by assessing the effects of two types of changes in driving patterns on older Americans' depressive symptoms: driving cessation and reduction. We posed the following three hypotheses: Older people who stop driving will be at greater risk of worsening depressive symptoms than people who continue to drive. By contrast, people who continue to drive but reduce their driving distances will not be at greater risk of worsening depressive symptoms. Lastly, having easy access to automobile transport through a spouse who drives will lessen the risk of worsening depressive symptoms that results when older adults stop driving. To test these hypotheses, we utilized a national panel study of older adults. We examined how stopping or restricting driving in one time period contributed to changes in depressive symptoms at a later, chronologically distinct time period. We included in our analyses a comprehensive set of controls suggested by previous research as being important to driving patterns and/or mental health. This approach provided a more accurate representation of how changes in driving patterns affect depressive symptoms than has been previously available.

Methods

Participants

The participants in this study were individual participants of the Asset and Health Dynamics Among the Oldest Old (AHEAD) study—a national panel study designed to enable characterization of older adults' health transitions and their effects on financial resources, formal and informal support, health care, and so forth (Soldo, Hurd, Rodgers, & Wallace, 1997). The AHEAD study was a companion to the Health and Retirement Study (HRS) until 1998, when the studies merged and combined data collection efforts. Its target population was noninstitutionalized Americans born in 1923 or earlier (aged 70 years and older) and their spouses (also aged 70 years and older). Spouses aged less than 70 years were also interviewed if they were married to an age-eligible person, but they were not considered to be part of the target population. The first interview was conducted in 1993, a second in 1995, and a third in 1998. We used Version 2.10 of Wave 1 (1993), Version 1.0 of Wave 2 (1995), and Version 1 (early release) of Wave 3 (1998). The early release version of Wave 3 is preliminary in that it has not been cleaned. The variables we used from Wave 3 (interview status and depressive symptoms), however, are not subject to change in the cleaning process.

Our study included only age-eligible AHEAD self-respondents. At Wave 1, there were 6,580 age-eligible White, Black, and Hispanic self-respondents who provided information about their driving status. As of Wave 2, 577 had died, 369 refused a second interview, and 395 required proxies. We excluded these respondents from the analytic sample because we did not know if their driving patterns changed after Wave 1 and/or we lacked information about their depressive symptoms at Wave 2. This yielded an analytic sample of 5,239 respondents. Only 4,102 of the 5,239 respondents, however, provided information on their depressive symptoms at both Waves 2 and 3; the others had died between Waves 2 and 3 ($n = 591$), required proxies ($n = 324$), or refused a third interview ($n = 222$).

Because the rate at which AHEAD respondents dropped from the study in Waves 1–3 was nontrivial, we took two steps to account for and limit bias arising from sample attrition. First, we explored how the Wave 1 driving behavior and depressive symptoms of decedents and nonrespondents at Wave 2 differed from the respondents still in the sample at Wave 2. We found that 46.9%, 54.0%, and 35.1% of the respondents who died between Waves 1 and 2, required

proxies at Wave 2, or refused a second interview, respectively, did not drive at Wave 1. By comparison, 26.1% of the analytic sample did not drive at Wave 1. We also found that the average number of depressive symptoms at Wave 1 for respondents who died between Waves 1 and 2, required proxies at Wave 2, or refused a second interview was 2.51, 2.18, and 1.88. The average number of depressive symptoms at Wave 1 for respondents in the analytic sample was 1.55. From these results we inferred that omitting the AHEAD respondents who died between Waves 1 and 2, required proxies at Wave 2, or refused a second interview would produce conservative estimates of the driving-depression relation. Second, because we had information about whether their driving behavior changed between Waves 1 and 2, we retained the respondents in the sample who had died, required proxies, or refused to participate in the study at Wave 3. We modeled these outcomes as *competing risks* to worsening depressive symptoms at Wave 3 so as to minimize systematic error resulting from further sample attrition.

Measures

Dependent variable.—Depressive symptoms were measured in the AHEAD study with an 8-item version of the original, 20-item Center for Epidemiologic Studies-Depression (CES-D) scale. The abbreviated CES-D scale was designed to reduce the length of survey interviews for elderly respondents while measuring the continuum of symptoms captured by the original scale (Kohout, Berkman, Evans, & Cornoni-Huntley, 1993). It has comparable reliability, validity, and dimensionality to the full version (Turvey, Wallace, & Herzog, 1999).

For these analyses we used a summary measure of respondents' answers to the abbreviated CES-D scale at Waves 2 and 3. All items were coded so as to indicate the presence of symptoms, ranging from 0 to 8; higher scores indicated worse affective functioning. We assessed change in depressive symptoms by subtracting the Wave 2 CES-D scores from the Wave 3 CES-D scores, with the change score theoretically ranging from -8 to $+8$. The average change in scores between Waves 2 and 3 was .49 (weighted mean), with 68.26% of respondents who provided information on their depressive symptoms at both waves changing by less than two symptoms ($SD = \pm 1.76$). As a result, we defined increases or decreases of at least 2 points in the CES-D score as true change. Also, after confirming that driving changes were unrelated to improvement in depressive symptoms (i.e., decrease in the CES-D score), in the final analyses we combined respondents who improved with those who did not change or changed by one symptom.

Competing risks to worsening depressive symptoms between the second and third waves were loss to follow-up and death. Loss to follow-up pertained to respondents who required proxies or refused to complete the third interview. Both were included as outcomes in our four-category dependent variable (also see the Participants section).

Driving patterns.—Each interview contained questions about respondents' driving status and modification of driving distances. Juxtaposition of respondents' answers across interviews yielded the following categories: (a) respondents who could drive at Waves 1 and 2, (b) respondents who never drove or stopped before Wave 1, and (c) respondents who stopped driving between Waves 1 and 2. This categorization is consistent with that used by Marottoli and associates (1997) in their analysis of driving and depressive symptoms among New Haven Established Populations for Epidemiologic Studies of the Elderly respondents. Among respondents who drove at Waves 1 and 2, there were the following groups: (a) respondents who drove unrestricted at Waves 1 and 2, (b) respondents who restricted their driving distances before Wave 1, and (c) respondents who restricted their driving distances between Waves 1 and 2. Few AHEAD respondents started driving between Waves 1 and 2 or increased their driving distances, so these respondents were grouped with those who drove and drove without restrictions at Waves 1 and 2.

Social-demographic controls.—The analyses controlled for several background characteristics: respondents' age, gender, race, educational attainment, and whether they lived in an urban area.

Controls for health and functioning at Wave 1.—The analyses also controlled for respondents' debilitating and life-threatening health conditions, physical limitations, and cognitive functioning at Wave 1. The indicator for debilitating health conditions measured the presence of high blood pressure, arthritis, incontinence, vision problems, and hearing problems (Fonda & Herzog, 2001; House, Lepkowski, & Williams, 2000). The indicator of life-threatening health conditions measured whether respondents had cancer, stroke, lung disease, cardiac disease, and diabetes (Fonda & Herzog, 2001; House et al., 2000; Musick, Herzog, & House, 1999). The measure for physical limitations summed the number of strength and mobility tasks (i.e., walk several blocks, climb a flight of stairs, lift/carry over 10 lb, pull/push large objects, pick up a dime) with which respondents had difficulty (Wallace & Herzog, 1995). We measured cognitive functioning using a continuous indicator of respondents' total number of correct answers to tests assessing their orientation to the current date (e.g., day, month), ability to count backward from 20, word/name recognition, ability to subtract by 7 starting from 100 (Serial 7s), and ability to recall 10 common nouns immediately and then later in the interview (memory; Herzog & Wallace, 1997).

Controls for changes in health and functioning.—The analyses also added measures that might account for the relationship between changes in driving patterns and depressive symptoms. One measure indicated whether respondents reported having a new debilitating health condition at Wave 2; one indicated whether they had a new life-threatening health condition; another indicated if their physical limitations worsened; and the last indicated whether respondents' cognitive scores declined by at least 4 points.

Spouse's driving status.—The study incorporated measures of whether the respondents had a spouse who drove at

Wave 2, had a spouse who did not drive, had a spouse who did not say whether they drove because they did not complete the interview, or were unmarried. Other drivers may also have been available to respondents, but the AHEAD data do not provide clear information about this.

Statistical Analysis

The analyses involved estimation of three multinomial logistic regression models. The first compared the relationships of driving, never having driven or stopped before Wave 1, and driving cessation between Waves 1 and 2 to worsening depressive symptoms and its competing risks at Wave 3. The comparison group for the Wave 3 outcomes consisted of respondents whose depressive symptoms did not change or improved at Wave 3. The model adjusted for respondents' social-demographics, baseline health, changes in health that occurred between Waves 1 and 2, and spouse's driving characteristics at Wave 2. We added a measure of respondents' preexisting symptoms to both models to adjust for the fact that respondents with few symptoms had more opportunity to worsen than those with many symptoms. The second model focused on drivers only and contrasted the effects of driving unrestricted, restricting driving distances between Waves 1 and 2, and restricting driving distances before Wave 1. It used the same set of controls as the first model. The third model added multiplicative interaction terms (e.g., Stopped Driving × Married and Spouse Drove, Never Drove or Stopped Before Wave 1 × Married and Spouse Drove) to the first model to test whether respondents who stopped driving but had alternative transportation through a spouse were protected against the negative affective consequences of driving cessation. All of the models used the survey estimation program in STATA 7 to adjust for the unequal probabilities of selection to participate in the AHEAD study and nonresponse.

Results

The characteristics of the study sample are shown in Table 1. Among all respondents, more than half were women and most were between 70 and 74 years of age at Wave 1. About 36.7% of all respondents had less than a high school education, 32.5% had exactly 12 years of education, and 30.8% had a least some college education. About equal proportions of the respondents were unmarried as married at Wave 2. With respect to driving patterns, 71.3% of all respondents drove at Wave 2, 22.5% reported that they never drove or stopped before Wave 1, and 6.3% stopped driving between Waves 1 and 2. Among the subsample of respondents who continued to drive (column 4), about half restricted their driving distances between Waves 1 and 2 or some time before Wave 1. This subsample of continuing drivers was younger, more educated, and slightly healthier than the full sample.

Our first research question was concerned with whether older people were at greater risk for worsened depressive symptoms if they stopped driving. Our analyses showed that the AHEAD respondents were at greater risk (Table 2); the relative risk of having experienced worsened depressive symptoms at Wave 3 was 1.44 times greater (adjusted predicted probability = 34.1%) for respondents who stopped driving between Waves 1 and 2 than for respondents who still drove at Wave 2. Although the relationship of changes in driving patterns to competing risks (died, lost to follow-up) was not the focus of this study, it is noteworthy that respondents who stopped driving were considerably more likely to experience these outcomes. The effects of never having been a driver or driving cessation before the

Table 1. Ranges, Means, and Percentages of Study Variables, Using the Weighted Sample of Self-Respondents Aged 70 and Older in 1993

		M or %	
Variable	Range	All Respondents (N = 5,239)	Drivers Only[a] (n = 3,543)
Driving cessation			
Stopped driving between Waves 1 and 2	0–1	6.29	NA
Never drove or stopped before Wave 1	0–1	22.46	NA
Drove[b]	0–1	71.25	NA
Driving reduction			
Restricted driving distances between Waves 1 and 2	0–1	NA	15.94
Restricted driving distances before Wave 1	0–1	NA	33.36
Drove unrestricted	0–1	NA	50.70
Social-demographic controls			
Aged 70–74 years	0–1	42.78	49.75
Aged 75–79 years	0–1	29.47	29.84
Aged 80–84 years	0–1	18.22	15.55
Aged 85+ years	0–1	9.52	4.86
Female	0–1	61.58	52.37
White	0–1	89.99	93.36
Black	0–1	6.97	4.79
Hispanic	0–1	3.04	1.85
<12 years education	0–1	36.68	28.97
Exactly 12 years education	0–1	32.48	34.62
>12 years education	0–1	30.84	36.41
Lives in an urban area	0–1	71.60	70.53
Controls for health and functioning at Wave 1			
No. of debilitating health conditions	0–5	1.02	0.89
No. of life-threatening health conditions	0–5	0.74	0.69
Cognitive functioning	0–35	20.67	21.78
No. of physical limitations	0–5	1.15	0.81
Controls for changes in health and functioning			
New debilitating health condition	0–1	40.13	38.35
New life-threatening health condition	0–1	13.99	13.02
Cognitive decline	0–1	16.10	14.14
New physical limitation	0–1	14.55	11.27
Spouse's driving status at Wave 2			
Unmarried	0–1	49.85	42.13
Married, unknown if spouse drove	0–1	1.46	1.56
Married, spouse did not drive	0–1	10.39	10.90
Married, spouse drove	0–1	38.30	45.40
Depressive symptoms at Wave 2	0–8	1.44	1.14

Note: NA = Not applicable for the purposes of certain analyses.
[a]Excludes the 63 people who started driving after Wave 1.
[b]Includes the 63 people who started driving after Wave 1.

Table 2. Risk Ratios for Multinomial Logit Model of Worsening Depressive Symptoms and Its Competing Risks, Using the Weighted Sample of 5,239 Self-Respondents Aged 70 and Older in 1993

Variable	Depressive Symptoms Worsened (n = 943)	Lost to Follow-Up (n = 541)	Died (n = 591)
Driving cessation			
Stopped driving between Waves 1 and 2	1.437*	1.605*	2.434***
Never drove or stopped before Wave 1	0.932	1.327*	1.430**
Drove	(reference)	(reference)	(reference)
Social-demographic controls			
Aged 70–74	(reference)	(reference)	(reference)
Aged 75–79	1.158	1.195	1.273
Aged 80–84	1.256	1.445*	1.797***
Aged 85+	1.180	1.364	2.823***
Female	1.180	1.003	0.465***
White	(reference)	(reference)	(reference)
Black	1.367*	0.729*	0.671*
Hispanic	1.802***	0.823	0.479*
<12 years education	1.217	1.456*	1.045
Exactly 12 years education	1.199	1.348*	1.188
>12 years education	(reference)	(reference)	(reference)
Lives in urban area	1.360**	1.254	1.592***
Controls for health and functioning at Wave 1			
No. of debilitating health conditions	1.222***	1.045	1.041
No. of life-threatening health conditions	1.023	0.997	1.367***
Cognitive functioning	0.978*	0.890***	0.926***
No. of physical limitations	1.084*	1.026	1.228***
Controls for changes in health and functioning			
New debilitating health condition	1.295**	1.049	1.096
New life-threatening health condition	1.075	1.028	1.649***
Cognitive decline	1.260	2.750***	2.042***
New physical limitation	1.105	0.967	1.724***
Spouse's driving status			
Unmarried	(reference)	(reference)	(reference)
Married, unknown if spouse drove	1.272	2.856**	1.644
Married, spouse did not drive	1.679***	1.165	0.936
Married, spouse drove	1.193	1.097	0.873
Depressive symptoms at Wave 2	0.733***	0.934*	1.007

Note: The comparison group for the model is respondents whose symptoms did not worsen (n = 3,164).
*$p < .05$; **$p < .01$; ***$p < .001$.

AHEAD study began were not significantly related to worsening depressive symptoms, but they were significantly related to its competing risks.

Among drivers, longer term restrictions to one's driving distance also increased the risk of worsening depressive symptoms (Table 3). That is, the net relative risk of having worsened symptoms at Wave 3 was 1.27 times greater (adjusted predicted probability = 22.7%) for respondents who restricted their driving distances before Wave 1 than for respondents without such restrictions. This effect appears to be smaller than the effect found for driving cessation in the first model (this difference cannot be tested empirically, however). The relative risk of having worsened depressive symptoms was not statistically greater for respondents who restricted their driving distances between Waves 1 and 2. Both longer term and relatively recent restrictions to driving distances were premonitory of loss to follow-up and death.

Are the effects of driving cessation on worsening depressive symptoms offset by having access to transportation through a spouse? Examination of the predicted probabilities calculated from estimates of the first multinomial logit model and then of interaction terms added to the model suggested that they were not. From the predicted probabilities, AHEAD respondents who stopped driving between Waves 1 and 2 had a lower probability (about 8%) of worsening depressive symptoms at Wave 3 if they had a spouse who drove than if they had a spouse who did not (Figure 1). This finding hints at a protective effect. At the same time, the predicted probability of worsening depressive symptoms for unmarried respondents who stopped driving was about 4% lower than it was for married counterparts who had a spouse who drove, countering the suggestion of a protective effect. Moreover, the same general patterns among the predicted probabilities were observed for each driving/nondriving group, suggesting that an additive effect was operating rather than an interactive effect. The multinomial logit model examining the interactions between changes in driving patterns and spousal driving characteristics (not shown) indicated that indeed the interaction terms were not statistically significant.

Discussion

In this study we investigated whether two changes in driving patterns—driving cessation and reduction—contributed to worsening depressive symptoms among respondents of a nationally representative panel study of older people.

Table 3. Risk Ratios for Multinomial Logit Model of Worsening Depressive Symptoms and Its Competing Risks, Using the Weighted Sample of 3,543 Self-Respondents Who Were Aged 70 and Older in 1993 and Were Drivers 1993–1995

Variable	Depressive Symptoms Worsened (n = 652)	Lost to Follow-Up (n = 286)	Died (n = 297)
Driving patterns			
Restricted driving distances	1.333	2.153***	1.510*
Restricted driving distances before Wave 1	1.271*	1.606**	1.480*
Drove unrestricted	(reference)	(reference)	(reference)
Social-demographic controls			
Aged 70–74	(reference)	(reference)	(reference)
Aged 75–79	1.279*	1.241	1.274
Aged 80–84	1.229	1.568*	2.120***
Aged 85+	1.392	1.403	2.319***
Female	1.142	0.913	0.430***
White	(reference)	(reference)	(reference)
Black	1.503*	0.641	0.730
Hispanic	1.210	0.707	0.525
<12 years education	1.078	1.352	1.089
Exactly 12 years education	1.157	1.145	1.185
>12 years education	(reference)	(reference)	(reference)
Lives in urban area	1.358**	1.130	1.779***
Controls for health and functioning at Wave 1			
No. of debilitating health conditions	1.127	1.084	0.999
No. of life-threatening health conditions	1.015	0.928	1.371***
Cognitive functioning	0.986	0.908***	0.947**
No. of physical limitations	1.097*	1.005	1.142*
Controls for changes in health and functioning			
New debilitating health condition	1.273*	1.289	0.928
New life-threatening health condition	1.143	0.833	1.752***
Cognitive decline	1.342*	2.061***	1.569*
New mobility impairment	1.037	1.175	1.635**
Spouse's driving status			
Unmarried	(reference)	(reference)	(reference)
Married, unknown if spouse drove	1.644	5.033***	1.366
Married, spouse did not drive	1.673**	1.344	0.689
Married, spouse drove	1.196	1.262	0.783
Depressive symptoms at Wave 2	0.760***	0.886**	1.060

Note: The comparison group for the model is people whose symptoms did not worsen (n = 2,308).
*$p < .05$; **$p < .01$; ***$p < .001$.

Worsening depressive symptoms were measured as an increase (two or more) over time in the number of depressive symptoms respondents reported. We controlled for alternative explanations for worsening depressive symptoms and for factors that might mitigate the effects of driving changes. Further, although the effects of driving changes on depressive symptoms probably are strongest when the change first occurs and attenuate over time as people adapt, we focused on the persistent rather than acute effects; that is, we analyzed the effects of driving changes that occurred in one time period on changes in symptoms that occurred during a chronologically distinct period 3–5 years later. We used this approach to ensure that the change in driving patterns preceded change in depressive symptoms, thereby strengthening our causal inferences.

Several particularities of this study warrant mention before we discuss our findings. First, we had pragmatic and substantive grounds for focusing on increases of two or more depressive symptoms. Pragmatically, the relatively high frequency of one-symptom changes (32.9% of respondents) suggested that one-symptom increases could be due disproportionately to measurement error and confound the results. Moreover, limiting increases to those of three or more depressive symptoms probably would have precluded understanding the subtler effects of driving changes. From a substantive standpoint, previous research has shown that four or more symptoms on the abbreviated CES-D scale in the AHEAD study is roughly equivalent to the 16-plus cutoff on the full CES-D scale used to differentiate depressed people from nondepressed people (Turvey, Wallace, & Herzog, 1999). Hence, an increase of two symptoms on the abbreviated scale would indicate at least a subsyndromal depressive episode, which is known to affect daily physical functioning in a manner similar to clinical depression (Rollman & Reynolds, 1999; Whooley & Browner, 1998; Wulsin, Vaillant, & Wells, 1999).

Second, we do not know what precipitated the changes in driving patterns among the AHEAD respondents. Family intervention, advice from a physician, a crash, state intervention, the costs of operating a vehicle, and a decision by the older driver could each lead to changes in driving patterns, but with very different implications for how the drivers interpret these changes and, ultimately, for their affective well-being. For example, events that convey to older drivers that they lack control over their lives could deleteriously affect their self-concept (M. M. Baltes & Skinner, 1983). But driv-

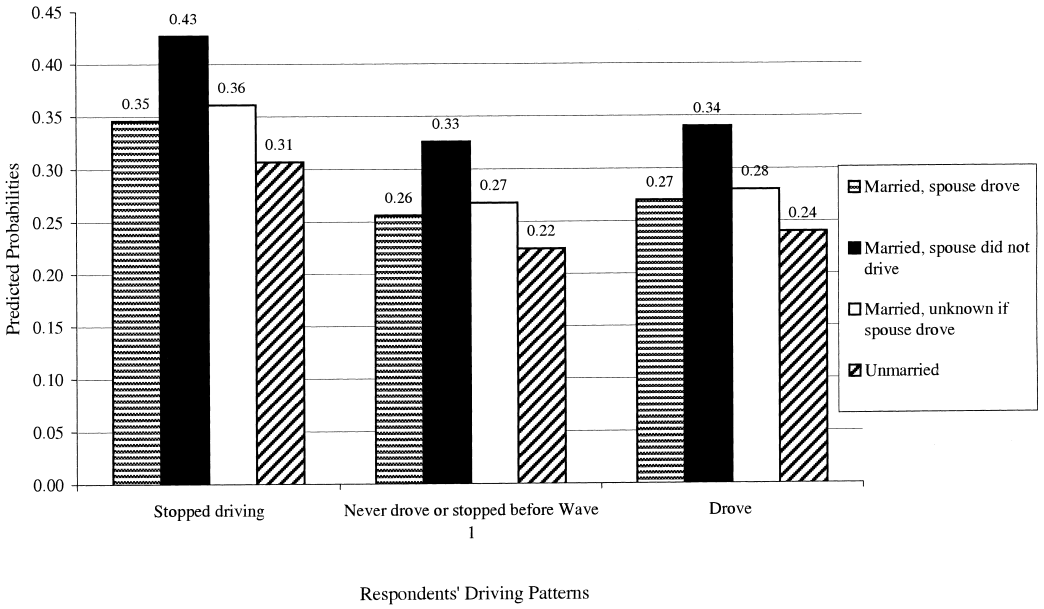

Figure 1. Predicted probabilities for worsening depressive symptoms by respondents' driving status and their spouses' driving status, calculated from coefficients obtained in the first multinomial logit model.

ers who select for themselves whether to drive and under what circumstances might retain their feelings of self-efficacy and affective well-being (P. B. Baltes & Baltes, 1990; M. M. Baltes & Carstensen, 1996). Information about what precipitated changes in driving could be useful for refining the general hypotheses regarding the relationship between changes in driving and depressive symptoms.

Third, aside from information about whether respondents lived in an urban area and had a spouse who drove, we did not have information about the ecological aspects of the respondents' settings. We did not know who had easy access to public transportation or whether other household members could drive respondents. This study, therefore, indicates how changes in driving related to changes in depressive symptoms for AHEAD respondents living in average settings. Examination of how environment mediates the relationship between driving limitations and well-being could be an area of further study.

Consistent with previous research (Carp, 1971; Cutler, 1972, 1974; Legh-Smith, et al., 1986; Marottoli et al., 1997) and our hypothesis, in this study we find that respondents who stop driving are more likely to later report worsening depressive symptoms. Driving cessation also predicts death and loss to follow-up, which, although not the focus of this study, is interesting because it suggests that driving cessation could be a sentinel event for these outcomes. The findings lead us to speculate that driving cessation signifies—in ways that are especially tangible—the attainment of old age and its stigma of dependency and/or the constriction of access to necessary and recreational activities. Empirical tests of our speculations may be an area for further study.

Our findings for driving modification, or selection, are mixed with respect to the model of selective optimization with compensation and our hypotheses. According to the model of selective optimization with compensation, selection through an act such as driving modification is a strategy older people use to continue the basic themes in their lives and thereby maintain satisfaction (P. B. Baltes & Baltes, 1990). Yet we find that respondents who restricted their driving distances before the study began (i.e., for at least 2 years) are at greater risk of worsening depressive symptoms. This result might mean that respondents who have restricted their driving behavior for a while view driving cessation as an increasing possibility, which is an event that many drivers dread (Burkhardt, et al., 1996; Carp, 1971). We also find, however, that respondents who restricted their driving distances relatively recently (i.e., between Waves 1 and 2) are not at greater risk of worsening depressive symptoms and respondents who restricted their driving before the study began do not experience an equally large increase in depressive symptoms as those who stopped driving altogether. These findings support the idea that modification of driving, at least for shorter durations, is one way that older people can achieve their transportation goals and maintain affective well-being.

Lastly, we find that the effects of driving cessation on worsening depressive symptoms are not mitigated by the presence of a spouse who drives. This finding is contrary to what we expected given the model of selective optimization with compensation. Our finding suggests that driving cessation per se—not just access to transportation—might be the more crucial risk factor for many older people and raises questions about how effective transportation programs are likely to be for older people's affective well-being. It is possible such programs will not be especially effective, assuming it is true that older adults prefer to receive assistance from people with whom they have the closest relationships, followed by people with whom they have the next closest

relationships, and so on, with professionals being the least desirable sources of assistance (Cantor, 1979; Shanas, 1979). This remains an open question.

In light of these results, we propose that initiatives to address the driving concerns of older people should promote strategies to prevent driving cessation. Such strategies might include the development of driver self-evaluation workbooks to encourage safe behavior (Eby, Shope, Molnar, Vivoda, & Fordyce, 2000), advanced traveler information systems that relay timely information (e.g., navigation instructions) to older drivers while they are driving (Eby & Kostyniuk, 1998), and driving simulators that reeducate older drivers and enable them to practice driving in a safe setting (Ward, 1996). Even educating older people about how they can effectively modify their driving (e.g., limiting driving distances) is a possible strategy for preventing (or at least delaying) driving cessation, although the protective effects of driving modifications may be short term. If driving cessation remains the only choice for some people, transportation programs for older people should include efforts to prepare them for the life transition from driver to ex-driver. This transition could be couched in terms of new opportunities (e.g., to save money by no longer maintaining a car) rather than as exclusively a loss. Finally, family members and care providers should know that changes in driving patterns may put the older driver at risk of worsening depressive symptoms and take steps to ensure that the older person has access to various mental health therapies.

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References

Baltes, M. M., & Carstensen, L. L. (1996). The process of successful ageing. *Ageing and Society, 16*, 397–422.

Baltes, M. M., & Skinner, E. A. (1983). Cognitive performance deficits and hospitalization: Learned helplessness, instrumental passivity, or what? Comment on Raps, Peterson, Jonas, and Seligman. *Journal of Personality and Social Psychology, 45*, 1013–1016.

Baltes, P. B., & Baltes, M. M. (1990). Psychological perspectives on successful aging: The model of selective optimization with compensation. In P. B. Baltes & M. M. Baltes (Eds.), *Successful aging: Perspectives from the behavioral sciences* (pp. 1–34). New York: Cambridge University Press.

Bruce, M. L., Seeman, T. E., Merrill, S. S., & Blazer, D. G. (1994). The impact of depressive symptomatology on physical disability: MacArthur Studies of Successful Aging. *American Journal of Public Health, 84*, 1796–1799.

Burkhardt, J., Berger, A. M., & McGavock, A. T. (1996, October). *The mobility consequences of the reduction or cessation of driving by older women.* Paper presented at the Women's Travel Issues Second National Conference, Baltimore, MD.

Campbell, M. K., Bush, T. L., & Hale, W. E. (1993). Medical conditions associated with driving cessation in community-dwelling, ambulatory elders. *Journal of Gerontology: Social Sciences, 48*, S230–S234.

Cantor, M. H. (1979). Neighbors and friends: An overlooked resource in the informal support system. *Research on Aging, 1*, 434–463.

Carp, F. M. (1971). On becoming an exdriver: Prospect and retrospect. *The Gerontologist, 11*, 101–103.

Cox, D. J., Quillian, W. C., Thorndike, F. P., Kovatchev, B. P., & Hanna, G. (1998). Evaluating driving performance of outpatients with Alzheimer disease. *The Journal of the American Board of Family Practice, 11*, 264–271.

Cutler, S. J. (1972). The availability of personal transportation, residential location, and life satisfaction among the aged. *Journal of Gerontology, 27*, 383–389.

Cutler, S. J. (1974). The effects of transportation and distance on voluntary association participation among the aged. *International Journal of Aging and Human Development, 5*, 81–93.

Cutler, S. J. (1975). Transportation and changes in life satisfaction. *The Gerontologist, 15*, 155–159.

Eby, D. W., & Kostyniuk, L. P. (1998). Maintaining older driver mobility and well-being with traveler information systems. *Transportation Quarterly, 52*, 45–53.

Eby, D. W., Shope, J. T., Molnar, L. J., Vivoda, J. M., & Fordyce, T. A. (2000). *Improvement of older driver safety through self evaluation: The development of a self-evaluation instrument* (Tech. Rep. No. 2000-04). Ann Arbor: University of Michigan, Transportation Research Institute.

Fonda, S. J., & Herzog, A. R. (2001). Patterns and risk factors of change in somatic and mood symptoms among older adults. *Annals of Epidemiology, 11*, 361–368.

Forrest, K. Y., Bunker, C. H., Songer, T. J., Coben, J. H., & Cauley, J. A. (1997). Driving patterns and medical conditions in older women. *Journal of the American Geriatrics Society, 45*, 1214–1218.

Freund, K., & McKnight, A. J. (1997). *Independent transportation network: Alternative transportation for the elderly.* Portland: Southern Maine Area Agency on Aging. (NTIS No. PB 97-171540)

Glass, T. A., Kasl, S. V., & Berkman, L. F. (1997). Stressful life events and depressive symptoms among the elderly: Evidence from a prospective community study. *Journal of Aging and Health, 9*, 70–89.

Gurland, B. J., Wilder, D. E., & Berkman, C. (1988). Depression and disability in the elderly: Reciprocal relations and changes with age. *International Journal of Geriatric Psychiatry, 3*, 163–179.

Hays, J. C., Landerman, L. R., George, L. K., Flint, E. P., Koenig, H. G., Land, K. C., & Blazer, D. G. (1998). Social correlates of the dimensions of depression in the elderly. *Journal of Gerontology: Social Sciences, 53B*, S31–S39.

Herzog, A. R., & Wallace, R. B. (1997). Measures of cognitive functioning in the AHEAD study. *Journals of Gerontology: Psychological Sciences and Social Sciences, 52B* (Special Issue), 37–48.

House, J. S., Lepkowski, J. M., & Williams, D. R. (2000). Excess mortality among urban residents: How much, for whom, and why? *American Journal of Public Health, 90*, 1898–1904.

Kington, R., Reuben, D., Rogowski, J., & Lillard, L. (1994). Sociodemographic and health factors in driving patterns after 50 years of age. *American Journal of Public Health, 84*, 1327–1329.

Kohout, F. J., Berkman, L. F., Evans, D. A., & Cornoni-Huntley, J. (1993). Two shorter forms of the CES-D depression symptoms index. *Journal of Aging and Health, 5*, 179–193.

Lebowitz, B. D., Pearson, J. L., Schneider, L. S., Reynolds, C. F., III, Alexopoulos, G. S., Bruce, M. L., Conwell, Y., Katz, I. R., Meyers, B. S., Morrison, M. F., Mossey, J., Niederehe, G., & Parmelee, P. (1997). Diagnosis and treatment of depression in late life: Consensus statement update. *Journal of the American Medical Association, 278*, 1186–1190.

Legh-Smith, J., Wade, D. T., & Hewer, R. L. (1986). Driving after a stroke. *Journal of the Royal Society of Medicine, 79*, 200–203.

Marottoli, R. A., Mendes de Leon, C. F., Glass, T. A., Williams, C. S., Cooney, L. M., & Berkman, L. F. (2000). Consequences of driving cessation: Decreased out-of-home activity levels. *Journal of Gerontology: Social Sciences, 55B*, S334–S340.

Marottoli, R. A., Mendes de Leon, C. F., Glass, T. A., Williams, C. S., Cooney, L. M., Berkman, L. F., & Tinetti, M. E. (1997). Driving cessation and increased depressive symptoms: Prospective evidence from the New Haven EPESE. *Journal of the American Geriatrics Society, 45*, 202–206.

Marottoli, R. A., Ostfeld, A. M., Merrill, S. S., Perlman, G. D., Foley, D. J., & Cooney, L. M. (1993). Driving cessation and changes in mileage driven among elderly individuals. *Journal of Gerontology: Social Sciences, 48*, S255–S260.

Musick, M. A., Herzog, A. R., & House, J. S. (1999). Volunteering and mortality among older adults: Findings from a national sample. *Journal of Gerontology: Social Sciences, 54B*, S173–S180.

Odenheimer, G. L., Beaudet, M., Jette, A. M., Albert, M. S., Grande, L., & Minaker, K. L. (1994). Performance-based driving evaluation of the elderly driver: Safety, reliability and validity. *Journal of Gerontology: Medical Sciences, 49*, M153–M159.

Owsley, C., Ball, K., McGwin, G., Sloane, M. E., Roenker, D. L., White, M. F., Overley, E., & Todd, O. D. (1998). Visual processing impairment and risk of motor vehicle crash among older adults. *Journal of the American Medical Association, 279*, 1083–1088.

Phifer, J. F., & Murrell, S. A. (1986). Etiologic factors in the onset of depressive symptoms in older adults. *Journal of Abnormal Psychology, 95*, 282–291.

Rollman, B. L., & Reynolds, C. F., III. (1999). Minor and subsyndromal depression: Functional disability worth treating. *Journal of the American Geriatrics Society, 47*, 757–758.

Rothe, J. P. (1994). *Beyond traffic safety.* New Brunswick, NJ: Transaction.

Shanas, E. (1979). The family as support system in old age. *The Gerontologist, 19*, 169–174.

Soldo, B. J., Hurd, M. D., Rodgers, W. L., & Wallace, R. B. (1997). Asset and Health Dynamics Among the Oldest Old: An overview of the AHEAD study. *Journals of Gerontology: Psychological Sciences and Social Sciences, 52B*(Special Issue), 1–20.

Turvey, C. L., Carney, C., Arndt, S., Wallace, R. B., & Herzog, R. (1999). Conjugal loss and syndromal depression in a sample of elders aged 70 years or older. *American Journal of Psychiatry, 156*, 1596–1601.

Turvey, C. L., Wallace, R. B., & Herzog, A. R. (1999). A revised CES-D measure of depressive symptoms and a *DSM*-based measure of major depressive episodes in the elderly. *International Psychogeriatrics, 11*, 139–148.

U.S. Bureau of the Census. (1993). *Population projections of the United States, by age, sex, race, and Hispanic origin: 1993 to 2050* (Current Population Reports No. P25-1104). Washington, DC: U.S. Government Printing Office.

U.S. Department of Transportation. (1997). *Improving transportation for a maturing society.* (DOT Publ. No. P10-97-01). Washington, DC: Author.

Wallace, R. B., & Herzog, A. R. (1995). Overview of the health measures in the Health and Retirement Study. *Journal of Human Resources, 30*(Suppl.), S84–S107.

Ward, M. (1996). Driving simulators for the elderly. *Technology Review, 99*, 19–20.

Whooley, M. A., & Browner, W. S. (1998). Association between depressive symptoms and mortality in older women: Study of Osteoporotic Fractures Research Group. *Archives of Internal Medicine, 158*, 2129–2135.

Wulsin, L. R., Vaillant, G. E., & Wells, V. E. (1999). A systematic review of the mortality of depression. *Psychosomatic Medicine, 61*, 6–17.

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