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Cognitive Aging in Parents of Children with Disabilities

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Abstract

Objective: This study examines the cognitive functioning of parents of children with disabilities, specifically, whether there is an evidence of accelerated cognitive aging among these parents. In addition, the study investigates the moderating influences of two variables: parents' gender and stress from negative parenting experience.

Method: The analyses utilize data from the National Survey of Midlife in the United States (2005). The analytic sample consisted of two groups of parents, who completed the cognitive battery, the interview, and the mail-back survey: 128 parents who had children with childhood-onset disabilities and 512 matched comparison parents who had only nondisabled children.

Results: Age differences in episodic memory were more pronounced among mothers of children with disabilities than among mothers with nondisabled children, especially among mothers with higher levels of negative parenting experience. In contrast, there were no interaction effects of parenting status, age, and negative parenting experience among fathers.

Discussion: The results show that parenting children with disabilities over a prolonged period of time jeopardizes cognitive function (especially memory) among older mothers, possibly via the mechanism of heightened parenting stress due to higher levels of negative parenting experience.

Keywords: Cognition—Disabilities—Episodic memory—Executive functioning—Parenting experience—Stress

Introduction

Although the adverse effects of parenting children with disabilities on the health and well-being of aging parents have been broadly investigated, there has been little research on the impacts of this type of caregiving on cognitive aging. Parenting children with disabilities is a life-long process that entails unique challenges and adjustments. Because relatively few persons with disabilities marry (Kessler, Walters, & Forthofer, 1998; Wolfe, Song, Mailick, & Greenberg, 2014), parents often provide ongoing support to their children with disabilities even after the child reaches adulthood. Consequently, parents face many challenges in coping with the long-term care of a child with a disability, and these challenges may affect the health and well-being of parents. Studies have shown that, on average, these parents often experience chronic stress and have an elevated risk of mental health problems compared with parents of children without such conditions (Emerson, Hatton, Llewellyn, Blacker, Graham, 2006; Olsson & Hwang, 2008; Seltzer et al., 2009). By their 50s and 60s, parents of adult children with disabilities also often experience more chronic health problems and physiological dysregulation than the parents of unaffected adult children (Barker, Greenberg, Seltzer, & Almeida, 2012; Seltzer, Floyd, Song, Greenberg, &

Hong, 2011; Yamaki, Hsieh, & Heller, 2009). This study focuses on the domain of cognitive aging, which has not been investigated in parents of adults with disabilities, but we hypothesize accelerated aging in this group.

Studies have reported that among parents of children with disabilities, mothers and fathers have different parenting experiences and consequent health and well-being throughout the life course. In general, compared to fathers, mothers are more involved in caregiving for their children with disabilities and have more responsibilities as the primary caregiver; this pattern persists even when children are grown up, mothers work full time, or fathers are retired from the labor force (Essex, Seltzer, & Krauss, 2002; Heller, Hsieh, & Rowitz, 1997; Rowbotham, Carroll, & Cuskelly, 2011). The impact of lifelong caregiving of children with disabilities on health also differs for mothers and fathers. A study using population data showed that mothers of a child with disability reported higher levels of body mass index (BMI) in midlife and poorer self-rated health in early old age compared with fathers of a child with disability (Seltzer et al., 2011). The significant gender differences in certain cognitive function (Agrigoroaei & Lachman, 2011) and the cognitive effects of stress (Sandi, 2013), as well as the differences in parenting experiences between mothers and fathers of children with disabilities, suggest that the cognitive aging of parents of children with disabilities would follow different patterns for mothers and fathers.

Researchers have consistently found a negative association between age and cognitive function, specifically episodic memory and executive functions (Agrigoroaei & Lachman, 2011; Brewster et al., 2014; Lachman, Agrigoroael, Tun, & Weaver, 2013; Alley, Suthers, & Crimmins, 2007; Salthouse, 2009). Lachman and colleagues (2013) found that younger adults outperformed older adults on some dimensions of cognitive tasks (e.g., immediate word list recall, delayed word list recall, category verbal fluency, backward number counting, backward digit span) and had higher composite scores of episodic memory and executive functioning than their older counterparts. Previous research has also shown that stress affects cognitive functioning. Chronic stress is consistently related to impaired cognitive performance, especially learning and memory (Borcel et al., 2008; Sandi, 2013). In addition, researchers found a significant gender difference in the association between longitudinal patterns of stress hormones and memory functioning among older adults: A long-term increase in stress hormone levels was a significant predictor of memory decline in older women, but not in older men (Seeman et al., 1997). This suggests that compared to parents of nondisabled children, parents of children with disabilities, especially mothers, may be at a higher risk than their age peers for experiencing lower levels of cognitive function, especially in older age due to long-term exposure to chronic stresses and also possibly due to an increased risk of mental and physical health problems.

Parental caregivers of individuals with disabilities may be at increased risk for experiencing a sharper cognitive decline with age because caregiving takes a toll on mental and physical health. Research on the association between physical and mental health and cognitive ability provides an additional rationale for why we hypothesize that parents of children with disabilities will experience a sharper cognitive decline with age. Researchers have postulated that the disease can explain a substantial portion of cognitive decline in old age because the pathology of disease and the decline of cognitive abilities share some common physiological pathways (e.g., Karlamangla et al., 2013; Kimhy et al., 2013; Spiro & Brady, 2011; Warsch & Wright, 2010). Mental health problems such as depression also have been associated with impairments in episodic memory and executive function (Austin, Mitchell, & Goodwin, 2001; Elderkin-Thompson, Moody, Knowlton, Hellemann, & Kumar, 2011), and the severity of depression has been linked to the degree of cognitive impairment (Cohen et al., 1982). The greater risk for health decline (Seltzer et al., 2011, Yamaki, Hsieh, & Heller, 2009) and the higher prevalence of depressive symptoms and anxiety in midlife and old age relative to their peers without disabled children (Barker et al., 2012; Seltzer et al., 2011) suggest that these parents might also have a higher risk of cognitive decline.

Empirical evidence from previous studies also suggests that significant predictors of cognitive functioning include gender, education, psychological resources, and physical activity. Compared to those with less education, individuals with higher education performed better on both episodic memory and executive functioning, even after controlling for age and gender (Jefferson et al., 2011; Lachman et al., 2013). The association between gender and cognition followed task-specific patterns; for example, episodic memory performance was higher among women than men, whereas performance on executive functioning tasks was higher among men than women (Lachman et al., 2013). Research has also found that psychosocial resources such as social support and sense of control have beneficial effects on cognitive functioning. Social or emotional support was associated with better episodic memory and executive functioning over the life course (Agrigoroaei and Lachman, 2011; Seeman, Lusignolo, Albert, & Berkman, 2001; Seeman et al., 2011). Sense of control had protective effects for cognitive functioning in both cross-sectional and longitudinal studies; a higher level of control belief with respect to cognition was associated with better memory performance (Hutchens et al., 2013; Lachman & Agrigoroaei, 2011) and less age-related cognitive decline over a 20-year period (Caplan & Schooler, 2003). Physical activity was associated with cognitive performance; individuals who regularly participated in exercise showed better memory performance and executive functioning (Bielak, Cherbuin, Bunce, & Anstey, 2014; Kramer et al., 1999, Lachman; Neupert, Bertrand, & Jette, 2006).

In sum, previous studies have identified a wide range of factors that are tied to differences in cognitive functioning. The current study investigates whether parenting children with disabilities might be another significant influence on cognitive aging. Given empirical evidence of challenges and disadvantages of parenting children with disabilities in various dimensions (e.g., stress, mental, and physical health), we expect that parents—especially mothers—of individuals with disabilities might be at greater risk of age-related cognitive decline than their counterparts with nondisabled children. Using a sample from a nationally representative dataset, MIDUS (Midlife in the United States: A National Longitudinal Study of Health and Well-Being) (Brim, Ryff, & Kessler, 2004), the current study examined the cognitive functioning of parents of children with disabilities and investigated whether there is an evidence of accelerated cognitive aging in this group. The analysis was guided by three hypotheses: First, parents of children with disabilities will manifest lower levels of cognitive functioning in old age, compared with parents with nondisabled children. Second, mothers of children with disabilities will manifest lower cognitive functioning in old age compared with the fathers of children with disabilities. Third, chronic stress measured by negative parenting experience will be inversely related to cognitive functioning: Parents with higher levels of negative parenting experience will have poorer levels of cognitive functioning than those with lower levels of negative parenting experience.

Methods

Data and Sample

The analyses utilize data from the National Survey of MIDUS. MIDUS gathered information from a national probability sample of noninstitutionalized, English-speaking adults (Brim, Ryff, & Kessler, 2004). The first wave of data (MIDUS I) was collected in 1995–1996 from adults aged 25–74; a second wave of data was collected in 2004–2006 from the same sample (MIDUS II). The mortality-adjusted retention rate from MIDUS I to MIDUS II was 75%. In total, among the participants of the first wave, 4,032 respondents completed both a telephone interview and a self-administered set of measures in MIDUS II (Radler & Ryff, 2010). In addition, a supplementary sample of 592 African Americans from Milwaukee, WI was collected in the MIDUS II.

The sample for the present analyses was derived from two groups. The first group included parents who had children with childhood-onset disabilities (e.g., Attention Deficit Disorder [ADD]/Attention Deficit Hyperactivity Disorder [ADHD], autism, cerebral palsy, Down syndrome, epilepsy, intellectual disabilities, and learning disabilities). A total of 128 respondents who completed an interview, a mail back survey, and the cognitive battery test of MIDUS

II self-identified as having a child with conditions such as those listed earlier.

The second group consisted of parents who had completed the cognitive battery, the interview, the mailback survey, and had neither children with disabilities nor caregiving responsibilities for other family members at the time of the survey. An initial group of 1,865 respondents met these criteria. We used stratified random sampling to select a matched comparison group from these 1,865 respondents. Gender and age were used as stratification variables for two separate groups: the main sample and the African American oversample. To take full advantage of the MIDUS data and to obtain the best estimates of the effects of having a child with disabilities, we selected comparison group members at a ratio of 4:1, resulting in 512 comparison group cases. The final analytic sample consisted of 128 parents of children with disabilities (75 mothers and 53 fathers) and 512 comparison group parents (300 mothers and 212 fathers).

Measures

Cognitive functioning

Measures of cognitive functioning were collected in the MIDUS II telephone interview. The Brief Test of Adult Cognition by Telephone (BTACT) was developed for administration via telephone and consists of seven components evaluating verbal memory (immediate and delayed), verbal fluency, processing speed, inductive reasoning, and working memory span, and attention switching (Lachman et al., 2013). Studies comparing the results of the telephone test and the standard in-person test have confirmed the validity of BTACT; these studies have shown no significant effect of mode of testing on test scores and have found significant correlations between BTACT and standardized in-person tests (Lachman et al., 2013; Lachman & Tun, 2008; Tun & Lachman, 2006).

Verbal memory, immediate and delayed, was measured by word-list recall. For the assessment of *immediate memory*, participants were instructed to listen to a list of 15 words and recall as many as possible. Participants were also asked to recall the same word list at the end of the session for the assessment of *delayed memory*. *Verbal fluency* was assessed by a test of category fluency that directed participants to list as many items as possible in 1 min from the category "animals." *Working memory* was measured by a backward digit span test. Participants heard increasingly longer series of digits (ranging from two to eight digits) and were asked to repeat them in reverse order. *Processing speed* was assessed by a backward counting task. Participants were asked to count backward from 100 by ones as quickly as possible during 30 s. *Inductive reasoning* was measured by a number series completion task. Participants were given a series of numbers and were asked to respond with the number that best continued the series. A total of five number sets were provided in the task. *Attention switching*

and inhibitory control were measured by the Stop & Go Switch Task, which consists of both single-task trials (a normal condition task and a reverse condition task) and mixed-task trials. The normal-condition task required participants to say "stop" when the interviewer said "red" and "go" when the interviewer said "green." The reverse-condition task asked participants to provide the reverse response and therefore inhibit the familiar response. In mixed-task trials, the alternating condition included occasional cues for participants to switch between the two conditions, which allowed researchers to assess task-switching ability. Participants' responses were scored on both accuracy and latency and for the factor solution; latencies for the means of the switch and nonswitch trials were used (Lachman & Tun, 2008).

Based on confirmatory factor analyses (Lachman, Agrigoroaei, Tun, & Weaver, 2014), Two factor scores of cognitive functioning that were computed as standardized means of the *z*-scored measures loading on the factors were utilized in the current study: episodic memory and executive functioning. Episodic memory was measured by the mean of the standardized scores for immediate verbal memory and delayed verbal memory. Executive functioning was measured by the mean of the standardized scores for verbal fluency, processing speed, inductive reasoning, working memory, and the mean of the switch and nonswitch trials from the attention switching and inhibitory control task.

Parent Status

Parent status was coded as a dichotomous variable (1 = *has a child with disabilities*; 0 = *has only nondisabled children*).

Covariates

Several variables that previous research has shown to be associated with cognitive functioning were included as controls. Because older age and lower education are associated with poorer cognitive functioning (Alley, Suthers, & Crimmins, 2007; Salthouse, 2009), age and education were controlled in all analysis. Physical health was measured by a single item asking about overall health; respondents could answer on a 5-point scale (1 = *excellent*, 5 = *poor*, reverse coded in the analysis). Based on the frequency of participation in physical activities, an ordinal measure of physical activity was created (0 = *no activity* to 4 = *frequent vigorous activity* [vigorous physical activity several times a week]). Depression was assessed by a series of questions asking about the respondent's experiences during the past 12 months; these questions were based on the screening version of the major depression section of the World Health Organization's Composite International Diagnostic Interview (Kessler, Mickelson, Walters, Zhao, & Hamilton, 2004). If a respondent had experienced a period of 2 week with a depressed mood most of the day and nearly every day, and had at least four other related symptoms

(including problems with appetite, sleeping, energy, concentration, feelings of worthlessness, or thoughts of death), the respondent was considered to have experienced depression during the past 12 months (1 = *having depression*, 0 = *otherwise*). Sense of control was measured by 12 items assessing personal mastery and perceived constraints with 7-point scales. Support from family and spouse was measured by eight items asking: (a) how much members of the respondents' family really care about him/her, (b) how much family members understand the way the respondent feels about things, (c) how much the respondent can rely on them for help if she/he has a serious problem, and (d) how much the respondent opens up to them if she/he needs to talk about worries (1 = *a lot* to 4 = *not at all*). In addition, race of the respondent (1 = *non-Hispanic White*, 0 = *others*) was controlled as in previous studies (e.g., Agrigoroaei & Lachman, 2011; Seeman et al., 2011).

Negative parenting experience was assessed by 6-items asking how much each of the following statements describes the respondent's situation: (a) I feel good about the opportunities I have been able to provide for my children (R), (b) it seems to me that family life with my children has been more negative than most people's, (c) problems with my children have caused me shame and embarrassment at times, (d) as a family, we have not had the resources to do many fun things together with the children, (e) I believe I have been able to do as much for my children as most other people (R), (f) I feel a lot of pride about what I have been able to do for my children (R) (1 = *a lot*, 2 = *some*, 3 = *a little*, 4 = *not at all*). Items marked with (R) were reverse coded so that high scores reflect more negative experience in the scale that was constructed by calculating the mean of the values of the items (α = .73).

Statistical Analyses

Multiple regression analysis was used to examine the effect of parent status on cognitive functioning and to determine whether age moderated this relationship, for mothers and fathers separately. First, we examined the effect of having a child with disabilities on parents' cognitive functioning; this step included demographic variables (age, race, and education), physical activity, physical health, experience of major depression, sense of control, social support from family and friends, parenting experience, and the key independent variable of parent status (parenting children with disabilities vs. being in the comparison group). In the second step, a variable measuring the interaction between parenting status and parents' age was added to the model. In the third step, three additional interaction variables were added. The first and second represent two-way interactions between parenting status and negative parenting experience and between age and negative parenting experience, and the third represents a three-way interaction between parenting status, negative parenting experience, and age. All continuous variables were centered to the mean.

Results

Table 1 presents descriptive statistics for the analytic sample for mothers and fathers separately. For mothers, there were no significant differences between those who had children with disabilities and mothers of unaffected children with respect to the demographic characteristics (age, education, and race). On average, the mothers were in their early 50s and had completed about 2 year of college. Over 80% of mothers were non-Hispanic White. There was a significant difference in the likelihood of experiencing depression between mothers of children with disabilities and comparison mothers. Specifically, 18.7% of the mothers of children with disabilities experienced depression during the past 12 month, compared with 7.3% of their counterparts. The mothers of children with disabilities also reported significantly poorer physical health, although the level of physical activity did not differ between the two groups. Sense of control also differed significantly between the two groups of mothers; the mothers of children with disabilities reported lower levels of sense of control than the mothers with nondisabled children. Support from family was comparable between the two mother groups, but support from friends was significant higher in mothers of children with disabilities than their counterparts. The mothers of children with disabilities reported significantly higher levels of negative parenting experience than the mothers without disabled children. The standardized *z*-scores of the cognitive variables measured via factor scores (episodic memory and executive functioning) were not significantly different between the two groups of mothers.

For fathers, there were no significant differences between the fathers of children with disabilities and the comparison group fathers for all analytic variables except parenting experience; the fathers of children with disabilities reported significantly higher levels of negative parenting experience than their peers without disabled children.

Table 2 presents the results of the regression analysis examining the effect of parent status on cognitive outcomes and the moderating influence of mothers' age and the level of negative parenting experience. As shown in Model 1, mothers who were younger, White, and more educated, and who had more support from friends performed significantly better on episodic memory and executive functioning assessments. Mothers who reported higher levels of sense of control showed better performance in episodic memory and mothers who engaged in more vigorous physical activities performed better in executive functioning tasks than their counterparts.

As hypothesized, the interaction between parenting status and age had a significant effect on episodic memory (see Table 2, Model 2 and Figure 1; $t = -1.975$, $p < .05$). Specifically, age differences in episodic memory were more pronounced in the mothers of children with disabilities than in comparison mothers without disabled children. Whereas at a younger age, parenting a child with a disability was associated with better performance in the episodic memory task, by age 60 the pattern had reversed.

Further, Model 3 in Table 2 and Figure 2 shows that the three-way interaction of parenting status by age by negative parenting experience had a significant effect on mothers' episodic memory ($t = -1.966$, $p < .05$). Age differences in episodic memory were pronounced among mothers of children with disabilities who had higher levels of negative parenting experience, while no substantial age difference in episodic memory was found among mothers of children with disabilities who had lower levels of negative parenting experience. Thus, chronic exposure to negative parenting

Table 1. Descriptive Statistics of the Analytic Sample

	Mothers (N = 375)			Fathers (N = 265)		
	Mothers of children with disabilities (N = 75)	Mothers of unaffected children (N = 300)	Group differences	Fathers of children with disabilities (N = 53)	Fathers of unaffected children (N = 212)	Group differences
Age	52.12 (11.78)	52.58 (10.91)	ns	54.72 (13.71)	54.24 (12.73)	ns
Education (years)	14.25 (2.71)	14.43 (2.43)	ns	13.81 (3.14)	14.65 (2.85)	+
% Non-Hispanic White	85.3	84.3	ns	88.7	88.7	ns
% Depression	18.7	7.3	**	5.7	4.3	ns
Physical health	3.29 (1.14)	3.63 (1.01)	*	3.32 (1.24)	2.57 (0.99)	ns
Physical activity	2.85 (0.59)	2.80 (0.64)	ns	2.75 (0.73)	2.84 (0.57)	ns
Sense of control	5.21 (1.15)	5.49 (1.01)	*	5.54 (0.84)	5.55 (1.07)	ns
Support from family	5.81 (2.30)	5.92 (2.21)	ns	6.55 (1.55)	6.54 (1.82)	ns
Support from friends	3.18 (0.78)	3.38 (0.65)	*	3.00 (0.69)	3.15 (0.68)	ns
Negative parenting experience	1.78 (0.59)	1.50 (0.49)	***	1.74 (0.52)	1.54 (0.51)	**
Episodic memory	.32 (1.0)	.36 (0.9)	ns	−.30 (0.9)	-.13 (0.9)	ns
Executive functioning	.11 (0.9)	.18 (0.9)	ns	.32 (0.9)	.22 (1.0)	ns

Note: ns = nonsignificant. *$p < .05$, **$p < .01$, ***$p < .001$.

Table 2. Regression Models for the Associations Between Parenting Status, Stresses, and Mothers' Cognitive Functioning

	Episodic memory						Executive functioning					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.
Age	−.274***	.055	−.218***	.062	−.206***	.062	−.367***	.047	−.362***	.053	−.368***	.054
Race (1 = White)	.403**	.142	.400**	.141	.404**	.141	.604***	.121	.604***	.121	.612***	.121
Education (years)	.112*	.055	.111*	.055	.111*	.055	.281***	.047	.281***	.047	.283***	.047
Physical health	.049	.055	.047	.055	.045	.055	.063	.047	.063	.047	.058	.047
Physical activity	.052	.048	.052	.048	.048	.048	.079*	.041	.079*	.041	.081*	.041
Depression (1/0)	.314+	.171	.285+	.171	.273	.170	−.026	.146	−.028	.147	−.042	.147
Sense of control	.118*	.055	.123*	.055	.116*	.055	−.009	.047	−.008	.047	−.011	.047
Family support	.061	.049	.053	.049	.050	.049	.015	.042	.014	.042	.013	.042
Friends support	.105*	.053	.103*	.053	.105*	.053	.110*	.045	.110*	.045	.116*	.045
Parenting stress	.125*	.055	.125*	.055	.075	.062	.015	.047	.015	.047	−.010	.053
DD parents (1/0)	−.068	.121	−.090	.121	−.102	.125	−.026	.104	−.028	.104	−.029	.108
DD × Age			−.243*	.123	−.170	.136			−.024	.106	.059	.117
DD × Negative parenting experience					.141	.112					.067	.096
Age × Negative parenting experience					.073	.068					−.045	.059
DD × Age × Negative parenting experience					−.249*	.126					−.108	.109
Constant/R^2/Adjusted R^2	−.157/.172/.146		−.148/.181/.153		−.162/.195/.161		−.575/.356/.336		−.575/.356/.334		−.582/.364/.337	

Note: DD = Developmental disability. $^+p < .10$, $^*p < .05$, $^{**}p < .01$, $^{***}p < .001$.

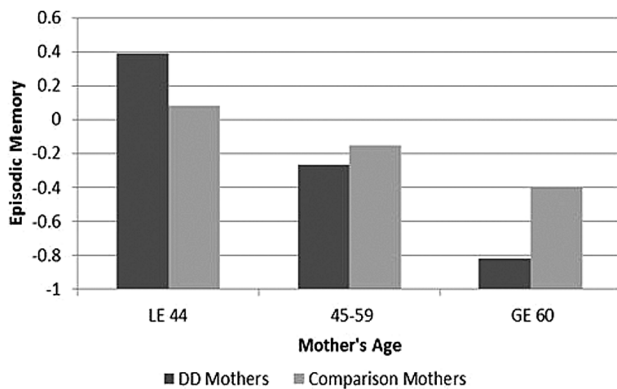**Figure 1.** Predicted episodic memory score by mother's age of children with disabilities and comparison group mothers.

Figure 2. Predicted episodic memory score at higher and lower levels of negative parenting experience.

experience predicted cognitive aging for mothers of children with disabilities.

Table 3 presents the results of the regression analysis examining the effect of parent status on cognitive outcomes and the moderating influence of fathers' age and the level of negative parenting experience. Fathers who were younger, more highly educated, those who reported higher levels of support from friends had higher scores on episodic memory and executive functioning tasks than their counterparts. In addition, fathers who reported vigorous physical activity and had not experienced major depression had higher scores on episodic memory than their counterpart. Fathers who were White and who had better physical health had better performance in executive functioning than their counterparts. Contrary to the hypothesis, there were no
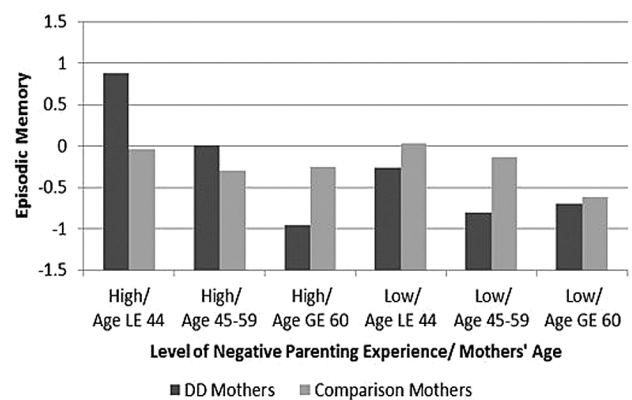
interaction effects of parenting status, age, and the level of negative parenting experience.

Discussion

The present study examined the effects of having a child with disabilities on the cognitive functioning of parents as measured by episodic memory and executive functioning, as well as the moderating influence of parents' age and level of stress from negative parenting experience.

Age differences in episodic memory were more pronounced among mothers of children with disabilities than among mothers with nondisabled children. The results for mothers support our hypothesis, which postulated that

Table 3. Regression Models for the Associations Between Parenting Status, Stresses, and Fathers' Cognitive Functioning

	Episodic memory						Executive functioning					
	Model 1		Model 2		Model 3		Model 1		Model 2		Model 3	
	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.	b	s.e.
Age	−.294***	.055	−.269***	.061	−.259***	.062	−.393***	.053	−.388***	.060	−.383***	.061
Race (1 = White)	.341+	.184	.356+	.185	.338+	.187	.393*	.180	.396*	.181	.407*	.183
Education (years)	.215***	.052	.217***	.052	.217***	.052	.301***	.051	.301***	.051	.301***	.051
Physical health	.030	.063	.038	.063	.051	.065	.144*	.061	.146*	.062	.158*	.064
Physical activity	.140*	.062	.135*	.062	.133*	.062	.096	.060	.095	.060	.093	.061
Depression (1/0)	−.592*	.269	−.586*	.269	−.562*	.272	−.477+	.262	−.476+	.263	−.461+	.265
Sense of control	.013	.063	.017	.063	.020	.064	−.036	.061	−.036	.061	−.025	.062
Family support	−.018	.074	−.019	.074	−.005	.076	−.093	.072	−.093	.072	−.095	.074
Friends support	.125*	.059	.124	.059	.120*	.059	.122*	.057	.122*	.057	.119*	.058
Parenting stress	.062	.062	.063	.062	.061	.069	.019	.060	.019	.060	.024	.068
DD parents (1/0)	−.106	.135	−.097	.135	−.090	.140	.200	.131	.202	.132	.206	.136
DD × Age			−.116	.124	−.117	.126			−.021	.117	−.005	.118
DD × Negativei parenting experience					.005	.140					−.025	.136
Age × Negative parenting experience					.060	.056					.003	.055
DD × Age × Negative parenting experience					−.107	.142					−.175	.136
Constant/R^2/Adjusted R^2	−.493/.258/.224		−.509/.261/.224		−.504/.264/.218		−.209/.382/.354		−.212/.382/.351		−.224/.387/.349	

+p < .10, *p < .05, **p < .01, ***p < .001.

individuals parenting a child with disabilities might be at an increased risk of cognitive aging due to higher levels of exposure to stress. These mothers often face more chronically stressful situations due to their children's disabilities and need for care and support, and chronic stress has been found in past research to lead to memory decline (Sandi, 2013), especially among older women, as a result of both mental health problems and physical health problems (via physiological dysregulation or deterioration).

The significant three-way interaction of age by parenting status by negative parenting experience among mothers strengthens this interpretation, although the effect is small in size. Figure 2 illustrates the predicted levels of episodic memory across levels of negative parenting experience and age groups for mothers of children with disabilities and comparison mothers. The figure shows that the age difference in episodic memory among mothers of children with disabilities is pronounced at higher levels of negative parenting experience (i.e., above the mean) but not at lower levels of negative parenting experience (i.e., below the mean). Mothers of children with disabilities reported significantly higher levels of negative parenting experience than mothers with nondisabled children, and thus the majority of mothers of children with disabilities (76% of mothers of children with disabilities compared with 46% of comparison group mothers) were in the higher level of negative parenting experience category. These results support our hypothesis and confirm the overall interpretation that parenting children with disabilities over a prolonged period of time takes a toll and jeopardizes cognitive function (especially memory) among older mothers, possibly

via the mechanism of heightened parenting stress due to higher levels of negative parenting experience. Thus, the results of the present study are also congruent with the empirical evidence showing that the chronic stress leads to memory decline among older women (e.g., Almela et al., 2011; Seeman et al., 1997; Wolf, Kudielka, Hellhammer, Hellhammer, & Kirschbaum, 1998).

However, the data also suggest that at younger ages following a relatively short period of providing care to children with disabilities, higher level of negative parenting experience is associated with better memory. During the early years of parenting a child with disabilities, parents face new cognitive challenges, such as learning about regulations pertinent to benefits their child might be eligible to receive, participating with school personnel in creating Individualized Educational Plans that are mandated by Federal law, managing interactions with agencies, and advocating on their child's behalf. These activities with higher level of cognitive engagement, although stressful, could lead to a short-term cognitive benefit, as suggested by past research (e.g., Cahill, Gorski, & Le, 2003). However, over time, the exposure to negative parenting may take a toll on cognitive functioning and lead to a steeper age-related decline in memory functioning partly due to long-term effects of stress on health and well-being. This result is in line with Agrigoroaei and Lachman's (2011) finding that frequent engagement in cognitive activities was associated with better episodic memory and executive functions in general population.

Notably, the current results also showed significantly higher levels of depression and poorer self-rated health

among these mothers of children with disabilities than among comparison mothers. The findings are consistent with the studies that have revealed the links between health problems and substantial portion of cognitive decline in old age. For example, proponents of the "vascular hypothesis" posit that vascular disease as well as vascular risk factors (e.g., high blood pressure, elevated glucose and cholesterol, alcohol consumption and smoking, and obesity) influences not only the heart but also the brain and thus cognitive functioning (Spiro & Brady, 2011). This hypothesis has been supported empirically at the clinical level including dementia patients and also cognitive decline related to normal aging (e.g., Karlamangla et al., 2013; Kimhy et al., 2013; Spiro & Brady, 2011; Warsch & Wright, 2010). Future studies examining the extent to which specific health problems or risk factors (e.g., blood pressure, cholesterol, BMI) predict cognitive decline among parents of children with disabilities would provide a more nuanced understanding and have practical implications for interventions among these parents. Another mechanism through which the chronic stress associated with parenting children with disabilities impinges on the cognition of these parents concerns hypothalamic-pituitary-adrenal (HPA) axis malfunctioning such as the glucocorticoid dysregulation that has been reported in parents of children with disabilities (e.g., Seltzer et al., 2010). HPA axis dysregulation (both hypercortisolism and hypocortisolism) have been found to affect cognitive impairment in the general population. Future studies investigating the particular effects of these two conditions on cognitive declines in these parent groups would also enhance the understanding of the underlying mechanisms.

The results also showed that certain psychosocial resources had protective effects for cognitive functioning: Support from friends was significantly associated with better episodic memory and executive functioning for both mothers and fathers, and a higher level of sense of control was a predictor of better episodic memory performance among mothers, a result consistent with previous studies (e.g., Agrigoroaei & Lachman, 2011). Future research efforts investigating additional factors that protect against cognitive decline among parents of children with disabilities would further enhance the scholarly understanding of these parents' long-term cognitive trajectories and contribute to the establishment of effective interventions.

Notably, in the current analysis, having children with disabilities was associated with the cognitive functioning of older mothers, but not fathers. This gender difference is somewhat consistent with previous studies showing that women are generally more susceptible than men to the detrimental effects of stress on cognition (e.g., Sandi, 2013). In addition, given the empirical evidence showing a lifelong pattern that mothers of children with disabilities are more involved in childcare and housework than their spouses (Essex, Seltzer, & Krauss, 2002; Heller, Hsieh, & Rowitz, 1997; Rowbotham, Carroll, & Cuskelly, 2011), it is likely that these mothers are more exposed to chronic stress and consequently at higher risks of cognitive decline compared with fathers of children with disabilities over the life course.

Some limitations of this study should be acknowledged. Due to the use of secondary data from the MIDUS, we did not have more detailed measures on children's characteristics, such as extent of behavior problems, although empirical evidence has shown that the severity of the child's behavior problems affects parents' stress-sensitive biomarkers (e.g., cortisol) and health (e.g., Seltzer et al., 2010). The cross-sectional research design that reported age-related differences warrants replication with longitudinal data that would directly reveal age-related change, and thus rule out possible alternative explanations such as cohort effects. With inherited conditions (e.g., fragile × syndrome), genetic aspects of the disorder may also have an impact on how changes in parents' cognition interact with parenting stress (Seltzer et al., 2012). Future studies focusing on children's specific symptoms would clarify this issue. In addition, why there were effects on episodic memory but not executive functioning warrants exploration in future research.

The present study also had a number of unique strengths, including the well-controlled statistical models, and the nationally representative data which increases generalizability of the findings. Additionally, the current sample of parents of children with disabilities did not volunteer for a study of caregiving effects, as is the case with most research on such parents, and thus the results are less vulnerable to self-selection bias.

In conclusion, this study suggests that long-term parenting of children with disabilities may place older mothers at risk for accelerated cognitive aging as well as increased health problems, especially at higher levels of parenting stress. Given the substantial cumulative prevalence of these types of disabilities in the U.S. population, the increased lifespan of both individuals with disabilities and their primary caregivers, and the very large cost to society of disability and the opportunity costs to their parents, interventions to reduce parental distress would have important implications for public health.

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References

Agrigoroaei, S., & Lachman, M. E. (2011). Cognitive functioning in midlife and old age: Combined effects of psychosocial and behavioral factors. *The Journal of Gerontology, Series B: Psychological Sciences and Social Sciences*, 66(Suppl. 1), 130–140. doi:10.1093/geronb/gbr017

Alley, D., Suthers, K., & Crimmins, E. (2007). Education and cognitive decline in older Americans: Results from the AHEAD sample. *Research on Aging*, 29, 73–94. doi:10.1177/0164027506294245

Almela, M., Hidalgo, V., Villada, C., Espin. L., Gomez-Amor, J., & Salvador, A. (2011). The impact of cortisol reactivity to acute stress on memory: Sex differences in middle-aged people. *Stress*, 14, 117–127. doi:10.3109/10253890.2010.514671

Austin, M. P., Mitchell, P., & Goodwin, G. M. (2001). Cognitive deficits in depression. *British Journal of Psychiatry*, 178, 200–206.

Barker, E.T., Greenberg, J.S., Seltzer, M.M., & Almeida, D.M. (2012). Daily stress and cortisol patterns in parents of adult children with a serious mental illness. *Health Psychology*, 31, 130–134. doi:10.1037/a0025325

Bielak, A. A. M., Cherbuin, N., Bunce, D., & Anstey, K. J. (2014). Preserved differentiation between physical activity and cognitive performance across young, middle, and older adulthood over 8 years. *The Journal of Gerontology, Series B: Psychological Sciences and Social Sciences*. 69, 523–532. doi:10.1093/geronb/gbu016

Borcel, E., Perez-Alvarez, L., Herrero, A. I., Brionne, T., Varea, E., Berezin, V., Bock, E., ... Venero, C. (2008). Chronic stress in adulthood followed by intermittent stress impairs spatial memory and the survival of newborn hippocampal cells in aging animals: Prevention by FGL, a peptide mimetic of neural cell adhesion molecule. *Behavioral Pharmacology*, 19, 41–49.

Brewster, P. W. H., Melrose, R. J., Marquine, M. J., Johnson, J. K., Napoles, A., MacKay-Brandt, A. ... Mungas, D. (2014). Life experience and demographic influences on cognitive function in older adults. *Neuropsychology*, 28, 846–858.

Brim, O. G., Ryff, C. D., & Kessler, R. C. (2004). The MIDUS National Survey: An overview. In Brim OG, Ryff CD, Kessler RC (Eds.), *How healthy are we? A national study of well-being at midlife* (pp. 1–16). Chicago: University of Chicago Press.

Cahill, L., Gorski, L., & Le, K. (2003). Enhanced human memory consolidation with post-learning stress: Interaction with the degree of arousal at encoding. *Learning and Memory*, 10, 270–274. doi:10.1101/lm.62403

Caplan, L. J., & Schooler, C. (2003). The role of fatalism, self-confidence, and intellectual resources in the disablement process in older adults. *Psychology and Aging*, 18, 551–561.

Cohen, R. M., Weingartner, H., Smallberg, S. A., Pickar, D., & Murphy, D. L. (1982). Effort and cognition in depression. *Archives of General Psychiatry*, 39, 593–597.

Elderkin-Thompson, V., Moody, T., Knowlton, B., Hellemann, G., & Kumar, A. (2011). Explicit and implicit memory in late-life depression. *American Journal of Geriatric Psychiatry*, 19, 364–373. doi:10.1097/JGP.0b013e3181e89a5b

Emerson E, Hatton C, Llewellyn G, Blacker J, & Graham H. (2006). Socio-economic position, household composition, health status and indicators of the well-being of mothers of children with and without intellectual disabilities. *Journal of Intellectual Disability Research*, 50, 862–873. doi:10.1111/j.1365-2788.2006.00900.x

Essex, E. L., Seltzer, M. M., & Krauss, M. W. (2002). Fathers as caregivers for adult children with mental retardation. In B. J. Kramer & E. H. Thompson (Eds.), *Men as caregiver: Theory, research, and service implications* (pp. 250–268). New York: Springer.

Heller, T., Hsieh, K., & Rowitz, L. (1997). Maternal and paternal caregiving of persons with mental retardation across the lifespan. *Family Relations*, 46, 407–415.

Hutchens, R. L., Kinsella, G. J., Ong, B., Pike, K. E., Clare, L., Ames, D., ... Parsons, S. (2013). Relationship between control beliefs, strategy use, and memory performance in amnestic mild cognitive impairment and healthy aging. *The Journal of Gerontology, Series B: Psychological Sciences and Social Sciences*, 68, 862–871. doi:10.1093/geronb/gbt016

Jefferson, A. L., Gibbons, L. E., Rentz, D. M., Carvalho, J. O., Manly, J., Bennett, D. A., Jones, R. N. (2011). A life course model of cognitive activities, socioeconomic status, education, reading ability, and cognition. *Journal of American Geriatric Society*, 59, 1403–1411. doi:10.1111/j.1532-5415.2011.03499.x

Karlamangla, A. S., Miller-Martinez, D., Lachman, M. E., Tun, P. A., Koretz, B. K., & Seeman, T. E. (2013). Biological correlates of adult cognition: Midlife in the United States (MIDUS). *Neurobiology and Aging*. 35, 387–394. doi:10.1016/j.neurobiolaging.2013.07.028

Kessler, R. C., Walters, E. E., & Forthofer, M. S. (1998). The social consequences of psychiatric disorders, III: Probability of marital stability. *The American Journal of Psychiatry*, 155, 1092–1096.

Kessler, R. C., Mickelson, K. D., Walters, E. E., Zhao, S., & Hamilton, L. (2004). Age and depression in the MIDUS survey. In O.G. Brim, C.D. Ryff, & R.C. Kessler (Eds.), *How healthy are we?* (pp. 252–272). Chicago: The University of Chicago Press.

Kimhy, D., Crowley, O. V., McKinley, P. S., Burg, M. M., Lachman, M. E., Tun, P. A., ... Solan, R. P. (2013). The association of cardiac vagal control and executive functioning—Findings from the MIDUS study. *Journal of Psychiatric Research*, 47, 628–635. doi:10.1016/j.jpsychires.2013.01.018

Kramer, A. F., Hahn, S., Cohen, N. J., Banich, M. T., McAuley, E., Harrison, C. R., Colcombe, A. (1999). Ageing, fitness and neurocognitive function. *Nature*, 400, 418–419. doi:10.1038/22682

Lachman, M. E., & Agrigoroaei, S. (2011). Low perceived control as a risk factor for episodic memory: The mediational role of anxiety and task interference. *Memory and Cognition*, 40, 287–296. doi:10.3758/s13421-011-0140-x

Lachman, M. E., Agrigoroael, S., Tun, P. A., & Weaver, S. L. (2013). Monitoring cognitive functioning: Psychometric properties of the brief test of adult cognition by telephone. *Assessment*, 21, 404–417. doi:10.1177/1073191113508807

Lachman, M. E., Neupert, S. D., Bertrand, R., & Jette, A. M. (2006). The effects of strength training on memory in older adults. *Journal of Aging and Physical Activity*, 14, 59–73.

Lachman, M. E., & Tun, P. A. (2008). Cognitive testing in large-scale surveys: Assessment by telephone. In S. Hofer & D. Alwin (Eds.). *Handbook on cognitive aging: Interdisciplinary perspectives* (pp. 506–522). Thousand Oaks, CA: Sage Publication.

Lachman, M. E., Agrigoroaei, S., Tun, P. A., & Weaver, S. L. (2014). Monitoring cognitive functioning: Psychometric properties of the brief test of adult cognition by telephone. *Assessment*, 21, 404–417. doi:10.1177/1073191113508807

Olsson M. B., & Hwang C. P. (2008). Socioeconomic and psychological variables as risk and protective factors for parental well-being in families of children with intellectual disabilities. *Journal of Intellectual Disability Research*, 52, 1102–1113. doi:10.1111/j.1365-2788.2008.01081.x

Radler, B. T., & Ryff, C. D. (2010). Who participates? Accounting for longitudinal retention in the MIDUS National Study of Health

and Well-Being. *Journal of Aging and Health*, 22, 307–331. doi:10.1177/0898264309358617

Rowbotham, M., Carroll, A., & Cuskelly, M. (2011). Mothers' and fathers' roles in caring for an adult child with an intellectual disability. *International Journal of Disability Development and Education*, 58, 223–240.

Salthouse, T.A. (2009). When does age-related cognitive decline begin? *Neurobiology of Aging*, 30, 507–514. doi:10.1016/j.neurobiolaging.2008.09.023

Sandi, C. (2013). Stress and cognition. *WIREs Cognitive Science*, 4, 245–261. doi:10.1002/wcs.1222.

Seeman, T. E., Lusignolo, T. M., Albert, M., & Berkman, L. (2001). Social relationships, social support, and patterns of cognitive aging in healthy, high-functioning older adults: MacArthur Studies of Successful Aging. *Health Psychology*, 20, 243–255.

Seeman, T. E., McEwen, B. S., Albert, M. S., & Rowe, J. W. (1997). Increase in urinary cortisol excretion and memory declines: MacArthur studies of successful aging. *Journal of Clinical Endocrinology & Metabolism*, 82, 2458–2465.

Seeman, T. E., Miller-Martinez, D. M., Stein Merkin, S., Lachman, M. E., Tun, P. A., & Karlamangla, A. S. (2011). Histories of social engagement and adult cognition: Midlife in the US study. *Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 66(Suppl. 1), 141–152. doi:10.1093/geronb/gbq091

Seltzer, M. M., Almeida, D. M., Greenberg, J. S., Savla, J., Stawski, R. S., Hong, J., & Taylor, J. L. (2009). Psychosocial and biological markers of daily lives of midlife parents of children with disabilities. *Journal of Health and Social Behavior*, 50, 1–15.

Seltzer, M. M., Barker, E. T., Greenberg, J. S., Hong, J., Coe, C., & Almeida, D. (2012). Differential sensitivity to life stress in FMR1 premutation carrier mothers of children with fragile X syndrome. *Health Psychology*, 31, 612–622. doi:10.1037/a0026528

Seltzer, M. M., Floyd, F. J., Song, J., Greenberg, J. S., & Hong, J. (2011). Midlife and aging parents of adults with intellectual and developmental disabilities: Impacts of lifelong parenting. *The American Journal on Intellectual and Developmental Disabilities*, 116, 479–499. doi:10.1352/1944-7558-116.6.479

Seltzer, M. M., Greenberg, J. S., Hong, J., Smith, L. E., Almeida, D. M., Coe, C., & Stawski, R. S. (2010). Maternal cortisol levels and behavior problems in adolescents and adults with ASD. *Journal of Autism and Developmental Disorders*, 40, 457–469. doi:10.1007/s10803-009-0887-0

Spiro, A., & Brady, C. B. (2011). Integrating health into cognitive aging: Toward a preventive cognitive neuroscience of aging. *Journal of Gerontology, Series B: Psychological Sciences and Social Sciences*, 66(Suppl. 1), 17–25. doi:10.1093/geronb/gbr018

Tun, P. A., & Lachman, M. E. (2006). Telephone assessment of cognitive function in adulthood: The brief test of adult cognition by telephone (BTACT). *Age & Ageing*, 35, 629–932. doi:10.1093/ageing/afl095

Warsch, J. R. L., & Wright, C. B. (2010). The aging mind: Vascular health in normal cognitive aging. *Journal of the American Geriatric Society*, 58(Suppl. 2), S319–S324. doi:10.1111/j.1532-5415.2010.02983.x

Wolf, O. T., Kudielka, B. M., Hellhammer, D. H., Hellhammer, J., & Kirschbaum, C. (1998). Opposing effects of DHEA replacement in elderly subjects on declarative memory and attention after exposure to a laboratory stressor. *Psychoneuroendocrinology*, 23, 617–629.

Wolfe, B., Song, J., Mailick, M. M., & Greenberg, J. S. (2014). Ripple effects of developmental disabilities and mental illness on non-disabled adult siblings. *Journal of Social Science and Medicine*, 108, 1–9. doi:10.1016/j.socscimed.2014.01.021

Yamaki, K., Hsieh, K., & Heller, T., (2009). Health profile of aging family caregivers supporting adults with intellectual and developmental disabilities at home. *Intellectual and Developmental Disabilities*, 47, 425–435. doi:10.1352/1934-9556-47.6.425