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Everyday Memory Compensation: The Impact of Cognitive Reserve, Subjective Memory, and Stress

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To determine the potential importance of several unexplored covariates of everyday memory compensation, the authors examined relations between responses on the Memory Compensation Questionnaire (a self-report measure of everyday memory compensation) and cognitive reserve (education and verbal IQ), subjective memory, and life stress in 66 older adults (mean age = 70.55 years). Key results indicated that compensation occurred in people (a) whose IQ level was greater than their education level (representing cognitive reserve "discordance") but not in people whose IQ was commensurate with their education (representing cognitive reserve "concordance"); (b) who had greater perceived memory errors; and (c) who experienced heightened stress. Further, high-stress older adults compensated whether perceived memory errors were low or high, but low-stress older adults compensated only if they perceived high memory errors. Bootstrapped confidence intervals around model betas provided further support for estimate reliability. These results suggest boundary conditions for the concept of cognitive reserve, and highlight the importance of subjective memory and life stress for defining contexts in which compensation may occur.

Keywords: memory compensation, cognitive reserve, memory, stress, aging

The concept of compensation has a rich tradition in the psychological and neurorehabilitation literatures (see, e.g., Bäckman & Dixon, 1992; Dixon, Garrett, & Bäckman, 2008; Salthouse, 1991). Dixon, Garrett, and Bäckman (2008) argued that compensation refers generally to a "process of overcoming losses or deficits through one of several mechanisms" (p. 24). Although compensation may apply in a variety of contexts (e.g., following traumatic brain injury, sensory impairment, personal loss), the potential for successful memory compensation is particularly relevant for older adults, many of whom experience declines in memory performance (e.g., Balota, Dolan, & Duchek, 2000; Grady & Craik, 2000; Salthouse, 1991; Zacks, Hasher, & Li, 2000) and report that such declines are a key concern with increasing age (Glisky & Glisky, 1999).

Findings from the memory rehabilitation literature highlight the potential for loss mitigation in older adults via compensation (see Glisky & Glisky, 2008). However, until recently, research linking various concepts (including memory performance) to everyday forms of memory compensation has been hampered by the lack of available tools for operationally defining and examining compensation. In 2001, Dixon, de Frias, and Bäckman developed the Memory Compensation Questionnaire (MCQ) as a self-report tool for investigating the use of five different everyday memory compensation strategies in older adults (e.g., external aids, such as notebooks or calendars; mnemonic strategies, such as imagery or rehearsal; increased effort investment, such as concentrating harder to remember items) as well as other general aspects of compensation. To date, the MCQ is the only reliable and comprehensive tool for examining various forms of everyday memory compensation (de Frias & Dixon, 2005; Dixon & de Frias, 2004; Dixon et al., 2001). Further, results from a single previous study suggest that the five MCQ strategy scales are positively correlated, and that it is possible to extract a single factor representing everyday memory compensation strategies in healthy older adults (de Frias & Dixon, 2005).

There are several known covariates of everyday memory compensation that highlight the complexity of the compensatory process (Dixon et al., 2008). Existing work suggests links with age, objective memory, personality, health, psychosocial indicators, memory impairment, and Alzheimer's disease (de Frias & Dixon, 2005; de Frias, Dixon, & Bäckman, 2003; Dixon & de Frias, 2004, 2007; Dixon et al., 2001; Dixon, Hopp, Cohen, de Frias, & Bäckman, 2003). In the present paper, we examine three unexplored covariates that may further contribute to the conceptual

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space of everyday memory compensation: cognitive reserve, subjective memory, and stress. The concept of cognitive reserve (Stern, 2002, 2003) was postulated in part on the basis of evidence indicating that individuals with higher levels of education or IQ are less likely than others to be impaired cognitively. Higher levels of these factors may provide a "buffer" or "cognitive reserve" against possible decline, whereby some older adults can withstand greater amounts of decline before impairment becomes objectively evident (but see Tuokko, Garrett, McDowell, Silverberg, & Kristjansson, 2003). Stern (2002) argued that individuals with high cognitive reserve may exhibit less cognitive impairment over time, in part because they implement alternative strategies for completing tasks when the methods they employed previously are no longer effective. Although previous studies on the MCQ have varied in average participant education level and/or have controlled for educational attainment (e.g., Dixon & de Frias, 2004, 2007; Dixon et al., 2003), no study has directly examined the effects of education level and intelligence on everyday memory compensation. Such an examination would provide a first test of Stern's (2002) contention that higher cognitive reserve may reflect increased or differential strategy use in daily life to meet heightened age-related cognitive demands.

Subjective assessment of everyday memory is another potentially important, yet unexplored, factor in the context of everyday memory compensation. In their original framework on psychological compensation, Bäckman and Dixon (1992) argued that deliberate behavioral compensation is most likely to occur when the perception of a deficit exists (see also Dixon & Bäckman, 1999; Dixon et al., 2008). Accordingly, in the context of everyday memory compensation, one would likely report everyday memory errors prior to any deliberate attempts at restitution. However, in the absence of a perceived deficit, objective deficits may have little impact, in and of themselves, on compensatory efforts. Although objective deficits may relate to certain compensatory efforts (Dixon & de Frias, 2004, 2007), it is plausible that such deficits are neither necessary nor sufficient for spontaneous behavioral compensation to occur.

Finally, level of perceived stress may be an additional covariate of everyday memory compensation. Although perceived need and decision to compensate may result from, or interact with, a variety of psychosocial and affective factors (de Frias et al., 2003), it may be particularly important to examine level of perceived stress for two reasons. First, mounting evidence suggests that stress negatively influences various aspects of subjective and objective memory (e.g., Belanoff, Gross, Yager, & Schatzberg, 2001; Lupien & McEwen, 1997; Lupien, McEwen, Gunnar, & Heim, 2009; Neupert, Almeida, Mroczek, & Spiro, 2006; Stawski, Sliwinski, & Smyth, 2006; VonDras, Powless, Olson, Wheeler, & Snudden, 2005). Second, the general availability of psychosocial and affective resources may help determine one's adaptation to perceived losses, including compensatory responses to declines in everyday memory (de Frias et al., 2003). Accordingly, when one's ability to handle life stress is taxed, compensatory efforts may be less likely even when memory deficits are perceived. In line with this possibility, those suffering from related conditions, such as depression and anxiety, may be less likely to adopt compensatory strategies (see Dixon et al., 2001), and elevated anxiety and life stress may inhibit one's ability to problem solve effectively (Klein & Barnes, 1994). Conversely, those under greater everyday life stress may be more likely to compensate due to relatively higher levels of perceived memory impairment, compared to those who experience lower stress (e.g., Neupert et al., 2006). As noted above, perceived memory deficits may help determine an appropriate context in which to compensate; if perceived stress is indeed coupled with perceived memory ability (e.g., Neupert et al., 2006), stress may also help determine the extent of compensatory efforts.

We had a twofold purpose in the present study ($N = 66$ healthy older adults). First, we examined the extent to which the five MCQ strategy scales cohere statistically using principal components analysis (PCA), given that the structure among these scales had not yet been examined beyond de Frias and Dixon (2005). Second, our primary goal was to address whether cognitive reserve, subjective everyday memory, and life stress relate to resulting everyday memory compensation components, over and above previously studied covariates such as age and objective memory performance (e.g., Dixon & de Frias, 2004, 2007). We anticipated that those with greater levels of cognitive reserve and those with poorer everyday memory would be more likely to compensate; however, given the unclear nature of a potential MCQ-stress relation, this aspect of the study was intended to be exploratory.

Method

Participants

We recruited 66 older adults (72.17% female) from the Rotman Research Institute volunteer database at Baycrest (Toronto, Ontario, Canada) and the community at large (mean age = 70.55 years, $SD = 9.26$, age range = 55–92 years). We screened participants prior to recruitment and excluded those with a history of neurological disorders or psychiatric conditions (i.e., stroke, dementia, depression, heart disease, diabetes), as well as those taking antipsychotic, antidepressant, or anxiolytic medications. The average education of the sample was 14.52 years ($SD = 3.23$), with 87.90% of participants having completed 12 or more years of formal education. The majority (86.67%) of participants rated their health as very good or good relative to a perfect state ($M = 4.15$, $SD = 0.70$, on a 5-point scale ranging from 1 (*very poor*) to 5 (*very good*), and 88.33% rated their health as very good or good relative to same-age peers ($M = 4.40$, $SD = 0.66$). We also administered the Mini-Mental State Exam (Folstein, Folstein, & McHugh, 1975) as a screening measure of global cognition, and participants demonstrated normal performance ($M = 28.28$, $SD = 1.53$). Despite the overrepresentation of women in the current sample, gender was not associated with any key variables of interest (ps $> .05$ for age, compensation, years of education, verbal IQ, objective memory, subjective everyday memory, total stressful events experienced, and average stress per event; see measure descriptions below).

Procedure

Participants who met screening criteria during a telephone interview later received a battery of tests, administered in a fixed order, over a 2.5-hr period at the Rotman Research Institute. They also completed a series of self-report questionnaires at home, following the testing session. Participants were compensated $10 per hour for their time.

Measures

Self-reported memory compensation was assessed with the strategy scales from the MCQ (Dixon et al., 2001): (a) External (i.e., use of external aids, such as notes or calendars); (b) Internal (i.e., use of mnemonic strategies, such as imagery or rehearsal); (c) Time (i.e., investing more time in performing tasks, such as asking people to speak more slowly when trying to remember information they are providing); (d) Effort (i.e., increased effort investment, such as concentrating harder); and (e) Reliance (i.e., extent one relies on others as memory aids, such as asking others to remind you to go to appointments). There were 34 items across all strategy scales, and participants responded to each item on a 5-point Likert-type scale indicating how often they employ a given strategy ranging from 0 (*not at all*) to 4 (*always*). Reported item reliabilities for the MCQ strategy scales range from .65 to .82 (Dixon & de Frias, 2004).

The North American Adult Reading Test (NAART; Blair & Spreen, 1989) was administered as a measure of verbal IQ and as a proxy measure of cognitive reserve (see Habeck et al., 2003; Stern et al., 2005). Participants were asked to read aloud a list of 61 irregularly spelled words, and one point was awarded for each correctly pronounced word. The total number of words pronounced correctly formed the measure of interest. For scoring, we recorded all participant responses on a digital recorder. Correct pronunciations were determined by *Merriam-Webster's Collegiate Dictionary* (CD edition) and its associated audio pronunciation module, which contains every correct pronunciation for each word in the dictionary. Douglas D. Garrett scored each NAART measure in the current study. The NAART is highly reliable (estimates exceed .90) in healthy and cognitively impaired samples (see Strauss, Sherman, & Spreen, 2006).

We administered four measures of objective memory: two standardized measures (the Hopkins Verbal Learning Test-Revised and the Rivermead Behavioural Memory Test) and two cognitive laboratory tasks (one measuring source memory and the other measuring verbal recall). The Hopkins Verbal Learning Test-Revised (HVLT-R; Benedict, Schretlen, Groninger, & Brandt, 1998) is a standard measure of verbal learning. Participants were read a randomly ordered list of 12 words (three words from each of four semantic categories) on three consecutive trials, and were asked to freely recall as many words from the list as possible after each trial. Using one of six alternate forms (previously found equivalent by the test's authors; Benedict et al., 1998), we examined total words recalled across Trials 1 through 3 (total possible score = 36). Test–retest reliability is adequate in both young and older samples ($r = .74$, $p < .001$; Benedict et al., 1998).

The Rivermead Behavioural Memory Test (RBMT; 2nd ed.; Wilson, Cockburn, & Baddeley, 1991) is a battery designed to tap participants' memory in everyday tasks (Wilson, 1987). Evidence supports the use of the RBMT in older adults (Wilson, Cockburn, Baddeley, & Hiorns, 1989) and for neuropsychological assessment of memory impairment (Baddeley, Harris, & Sunderland, 1987; Cockburn, 1996). Specific tests within the RBMT involve remembering names, appointments, objects, faces, and stories, and measure several forms of memory (auditory, visual, prospective, retrospective). For example, in the First and Second Name task, participants are shown a portrait of a woman, told that her name is "Catherine Taylor," and instructed to remember this face–name pair for later. Following several other RBMT tasks, participants are shown the same portrait and are asked to recall the woman's full name. For each task, up to two points were awarded, and all points were summed to create a total profile score that we analyzed in the present study (for full details on scoring criteria, see Wilson et al., 1991). The Immediate and Delayed Route and accompanying Message task were not administered, given testing room size constraints, and the Orientation task was not administered, given its close overlap with information collected on the Mini-Mental State Exam (resulting total possible profile score = 14). Reported reliabilities range from .68 to .94, depending on the index (Efklides et al., 2002).

Source memory was tested using a task similar to that employed in a previous study (Cabeza, Anderson, Locantore, & McIntosh, 2002). During the encoding phase, participants were administered one of eight possible lists of 24 single words; 12 were presented through headphones, and the other 12 were presented on a 14.1-in. laptop computer screen. Each list was followed by a distractor counting task (participants are asked to count "backwards from 150 by sixes") and a test phase. At test, participants were shown all 24 studied words separately on the computer screen and were then asked to indicate whether they had heard or read each word during the study phase (by pressing one of two buttons on a response board). All lists were matched for both concreteness and Kucera–Francis word frequency (Kucera & Francis, 1967). The order of words at the encoding phase was randomized under the condition that no more than three words within a particular modality were presented consecutively. Further, for each list of words, the presentation modality was counterbalanced such that each word from each list was presented equally in both modalities across participants. The total proportion correct formed the measure of interest.

As another measure of free recall, we employed a task designed to test the ability to remember important information and disregard less important information (see Castel, Benjamin, Craik, & Watkins, 2002). Participants were given two separate lists of 16 words (on a 14.1-in. laptop screen), statistically matched for concreteness and Kucera–Francis word frequency (Kucera & Francis, 1967), counterbalanced for list order, and randomized for word order within lists. Within a list, each word was paired with an arbitrary value ranging from 1 to 16. Each list was followed by a distractor counting task (participants were asked to count "backwards from 150 by sixes"); participants were then asked to freely recall as many words as they could remember from the list just seen. Prior to the task, participants were instructed to remember those words that would maximize the "point value" of their memory during a subsequent free-recall phase, the implication being that a greater premium was placed on higher valued words. Although this task produces several different indices of both memory recall and one's ability to control what items are committed to memory, our primary measure of interest was total words recalled across both lists, as this measure was conceptually similar to our other measures of objective memory in the current study (total possible score = 32).

In the interests of regression model parsimony, we then ran a PCA to capture the presence of any higher order objective memory components across the four measures (HVLT-R, RBMT, source memory, free recall). A single component resulted with an eigenvalue greater than 1.00 (eigenvalue = 2.19, accounting for 54.61% of the variance across all variables), and each of the four memory measures loaded well (HVLT-R = 0.81; RBMT = 0.74; source memory = 0.66; free recall = 0.75). Thus, a "global objective memory" component served as a single comprehensive measure in subsequent analyses.

We used the revised (28-item) version of the Everyday Memory Questionnaire (EMQ; Sunderland, Harris, & Baddeley, 1984) to measure the self-reported frequency of everyday memory failures across several functional domains (e.g., finding a television story difficult to follow, asking the same question twice). The EMQ has been employed in several previous studies of older adults (e.g., Efklides et al., 2002; Koltai, Bowler, & Shore, 1996; Neupert et al., 2006), and unlike many other memory complaint scales (see Hertzog, Park, Morrell, & Martin, 2000; Pearman & Storandt, 2004), it correlates with several different objective memory measures (e.g., Efklides et al., 2002; Koltai et al., 1996; Neupert et al., 2006). On the questionnaire, participants were asked to rate the frequency of memory failures on a scale of 1 (*not at all in the last 6 months*) to 9 (*more than once a day*). The variable of interest was a total score across all items (total possible score = 252). Reported reliabilities range from .85 to .90 (Cornish, 2000; Efklides et al., 2002).

To measure the influence of subjective everyday life stress, we employed the Elder's Life Stress Inventory (ELSI; Aldwin, 1990), which comprises 31 items referring to stressful events experienced in the last year. For those events experienced, participants were asked to rate their level of stress surrounding each event on a scale of 1 (*not at all stressful*) to 5 (*extremely stressful*). The total number of events experienced and the average stress rating across events were each analyzed in the current study. The ELSI has been used successfully in previous studies linking stress to memory failure in older adults (e.g., Neupert et al., 2006; VonDras et al., 2005), and it demonstrates adequate reliability (e.g., coefficient $\alpha = .70$; VonDras et al., 2005).

Across all measures, we found only limited missing data; a total of 2.6% of cells was missing randomly across MCQ, age, education, NAART, HVLT-R, RBMT, source memory, free recall, EMQ, and ELSI. To preserve maximum power in our analyses, we imputed within-variable mean data for missing cells.[1] Descriptive data for all model variables can be found in Table 1. Bivariate correlations between all model variables can be found in Table 2.

Analytic Strategy

First, we calculated mean MCQ scale values to place the present data in context with existing MCQ studies. Second, we ran PCA to examine whether the five strategy scales of the MCQ would converge to create one or more memory compensation components. Standardized component scores formed the variable(s) of interest. Bootstrapping was performed on the eigenvalues of resulting components and on resulting component loadings to provide reliability estimates. This was done using 1,000 bootstrap samples and random resampling of participants (with replacement). We adopted a threshold of 95% for calculation of confidence intervals (CIs) using the percentile method (Efron & Tibshirani, 1986, 1993; Mooney & Duval, 1993). Finally, the MCQ factors were then regressed onto the cognitive reserve proxies (education and NAART), subjective memory (EMQ), stress (ELSI), age, and the objective memory component. Bootstrapped CIs for unstandardized betas were calculated using the same criteria employed for the PCA analysis. All model variables were in standard normal form. SPSS 15.0 was employed for all analyses.

Results

Descriptive Data on MCQ Scales

Mean reported usage of MCQ strategies was consistent with levels reported by previous researchers (Dixon et al., 2001); the use of External strategies was most common, followed by Effort, Internal, Time, and Reliance (see Table 1).

PCA of MCQ

Average scores for each of the five MCQ strategy scales were submitted to PCA. All scales loaded substantially on a single component only (eigenvalue = 2.91; see Table 3), accounting for 58.26% of the variance among the scales. Zero-order factor loadings (i.e., structure coefficients) were all positive and ranged from 0.52 to 0.88. All other extracted components offered little variance explained (e.g., for the second component, eigenvalue = 0.83). Thus, confirmation of a single component among the five MCQ scales provided support for an overarching "memory compensation strategy" component, negating the need for component rotation. Eigenvalue bootstrapping on this single component revealed that the original sample estimate was highly reliable, with a narrow bootstrapped 95% CI [2.49, 3.30]. Visual inspection of a normal quantile–quantile (Q-Q) plot of bootstrapped eigenvalues against expected normal values revealed distribution normality with only very slight departures from normality at the tails. Scaling of component scores (used in the multiple regression analyses below) was such that higher values indicated greater levels of compensation. Component loadings and bootstrapped CIs are included in Table 3.

The variance in bootstrapped component loadings should also be noted. The CIs of most loadings were narrow (particularly for the Internal, Time, and Effort scales), but the CI width for the Reliance scale was wider (although it did not approach zero). Reliance also held the lowest loading value on the MCQ factor; in combination with its wider bootstrapped CI, this may indicate a less reliable loading pattern than those for the other four strategy scales. Q-Q plots revealed loading distribution normality.

Multiple Regression Analyses

In preliminary model runs predicting MCQ from age, education, NAART, EMQ, objective memory, ELSI total events, and ELSI average stress, we first noticed that fewer years of education and greater NAART predicted greater MCQ (both ps $< .05$), despite a positive correlation between education and NAART at the bivariate level ($r = .55$, $p < .01$). To probe this surprising effect further

[1] Mean-based imputation, by definition, does not shift mean values for any measure, and shifts measure variance toward zero (thus underestimating true within-measure variance as a result). We had only single measures of each measure of interest that were at best moderately correlated, and this precluded the highly accurate imputation of missing cells using prediction-based methods, such as multiple or regression-based imputation (Rubin, 1987).

Table 1
Descriptive Statistics for Model Variables

Variable	*M*	*SD*	Minimum	Maximum
MCQ scales				
External	4.21	0.58	2.50	5.43
Internal	3.19	0.68	1.70	4.40
Time	2.87	0.71	1.60	4.80
Reliance	2.01	0.83	1.00	4.00
Effort	3.56	0.72	2.17	4.83
Predictors				
Age	70.55	9.26	55.00	92.00
Years of education	14.52	3.23	6.00	22.00
NAART (total score)	39.46	9.49	18.00	58.00
HVLT (total words recalled)	23.97	5.89	8.00	34.00
Source memory (percentage correct)	0.71	0.13	0.29	1.00
Free recall (total words recalled)	6.00	3.37	0.00	15.00
RBMT (total profile score)	11.41	2.28	5.00	14.00
EMQ (total score)	53.38	15.78	28.00	97.00
ELSI (total events)	3.62	2.17	0.00	10.00
ELSI (average level of stress per event)	2.37	1.10	0.00	5.00

Note. MCQ = Memory Compensation Questionnaire; NAART = North American Adult Reading Test; HVLT-R = Hopkins Verbal Learning Test-Revised; RBMT = Rivermead Behavioural Memory Test; EMQ = Everyday Memory Questionnaire; ELSI = Elder's Life Stress Inventory. MCQ scale means reflect average score on a 5-point Likert-type scale ranging from 0 (*not at all*) to 4 (*always*).

in the context of MCQ, we calculated a "concordant" reserve variable that captured common variance between education and NAART (by summing the two variables) and a "discordant" and orthogonal reserve variable that captured differential variance between them (by subtracting the two variables). It is well documented that the simple addition and subtraction of two variables produces orthogonal dimensions representing what is similar and what is different between those variables (e.g., Kriegeskorte, Simmons, Bellgowan, & Baker, 2009); we used this approach to examine how our two reserve proxies were differentially operating on MCQ in our preliminary model runs. For the discordant variable, positive values indicated that NAART outpaced (i.e., was greater than) education; negative discordant values indicated that education outpaced NAART. We then submitted the concordant and discordant variables to our original model in place of education and NAART. The discordant variable was highly and positively related to MCQ ($p = .02$); the concordant variable, which captures common variance between these typical cognitive reserve proxies, was not predictive ($p = .64$). For parsimony in all subsequent models, we elected to include the discordant variable and to exclude the concordant, education, and NAART variables.

Final models with MCQ as the outcome of interest revealed that all main effects involving age ($p = .85$), objective memory ($p = .99$), and ELSI average stress ($p = .43$) were nonsignificant (as were all interactions); we thus dropped these predictors from a concluding model run to preserve degrees of freedom and reduce model complexity. In this model, the discordant vector, EMQ, and ELSI total stressful events positively related to MCQ (see Table 4), which all accounted for substantial variance (adjusted model $R^2 = .26$). The discordant vector relation suggested that compensation was significantly greater for participants whose NAART scores outpaced their level of education than for those whose education outpaced their NAART score (see Figure 1). A two-way interaction between EMQ and ELSI total stressful events was also present, and we probed this interaction of continuous variables using typical methods (i.e., slopes were calculated using values of 1 *SD* above and below the mean; Aiken & West, 1991; Cohen & Cohen, 1983). Those who reported low stress and low everyday memory errors were highly unlikely to compensate; however, those who reported high memory errors in the low-stress group were much more likely to expend compensatory effort (see Figure 2). Conversely, those under high stress compensated whether they reported high or low memory errors. No other interactions were present. Bootstrapped confidence intervals around unstandardized betas revealed reliability for all main effects and the interaction (i.e., no beta crossed a zero threshold; see Table 4). Q-Q plots revealed beta distribution normality for each measure.

Discussion

In the current study, our initial goal was to examine the structure of the MCQ in a novel older adult sample outside of data used to create and explore the scale (e.g., de Frias & Dixon, 2005; Dixon et al., 2001). Results revealed that mean reported levels for each of the five employed MCQ strategy scales were commensurate with previously published results (Dixon et al., 2001). PCA results demonstrated that all five scales loaded reliably on a single component only; this indicated the presence of an overarching construct of "everyday memory compensation strategies" and coherence between scales in contributing to this construct. Although there is variance in each scale not captured by this single component, we did not find reliable separate components. This result converged with de Frias and Dixon's (2005) report of the presence of a single component (along with separate components) among the five scales. Despite our modest sample size, we found narrow and reliable bootstrapped loading CIs for all scales across 1,000 resamples of our data, although the Reliance CI was somewhat wider.

Table 2
Bivariate Correlation Matrix Between All Model Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. MCQ factor	—																		
2. MCQ External	.67***	—																	
3. MCQ Internal	.82***	.37**	—																
4. MCQ Time	.88***	.56***	.63***	—															
5. MCQ Reliance	.52***	.23	.24	.39**	—														
6. MCQ Effort	.87***	.44***	.74***	.67***	.34**	—													
7. Age	.08	.17	.11	.01	−.04	.04	—												
8. Education	−.20	−.25*	−.15	−.15	−.22	−.05	−.40**	—											
9. NAART	.11	.14	.13	.00	−.13	.22	−.06	.55***	—										
10. Cognitive reserve discordance	.33**	.43***	.30*	.17	.10	.29*	.36**	−.47***	.47***	—									
11. Cognitive reserve concordance	−.05	−.07	−.02	−.08	−.20	.10	−.26*	.88***	.88***	.00	—								
12. Objective memory factor	−.11	−.05	−.09	−.08	−.27*	−.01	−.51***	.44***	.44***	.00	.50***	—							
13. HVLT-R	−.05	.00	.02	−.04	−.27*	.01	−.34**	.41**	.37**	−.05	.44***	.82***	—						
14. Source memory	−.13	−.17	−.13	−.10	−.16	.01	−.35**	.23	.17	−.06	.23	.64***	.36**	—					
15. Free recall	−.05	.07	−.10	.04	−.14	−.07	−.49***	.34**	.30*	−.05	.36**	.76***	.56***	.28*	—				
16. RBMT	−.12	−.07	−.07	−.15	−.24	.01	−.34**	.31*	.45***	.15	.43***	.76***	.46***	.38**	.40**	—			
17. EMQ	.32**	.09	.26*	.20	.44***	.31*	−.06	−.07	−.06	.02	−.07	−.12	−.14	−.13	−.07	−.04	—		
18. ELSI (total events)	.36**	.16	.23	.38**	.42**	.21	−.12	−.09	.08	.18	−.01	−.14	−.04	−.14	−.10	−.16	.41**	—	
19. ELSI (average stress per event)	.27*	−.09	.36**	.31*	.14	.25*	−.14	−.23	−.27*	−.04	−.28*	−.08	−.02	−.07	−.08	−.09	.23	.20	—

Note. MCQ = Memory Compensation Questionnaire; NAART = North American Adult Reading Test; HVLT-R = Hopkins Verbal Learning Test-Revised; RBMT = Rivermead Behavioural Memory Test; EMQ = Everyday Memory Questionnaire; ELSI = Elder's Life Stress Inventory.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 3
Principal Components Analysis on the Five MCQ Strategy Scales

Latent variable	Predictor	Eigenvalue	% of variance	Component loadings
MCQ	Component	2.91 (bootstrapped CI [2.49, 3.30])	58.26	
	External			0.67 (bootstrapped CI [0.53, 0.79])
	Internal			0.82 (bootstrapped CI [0.74, 0.88])
	Time			0.88 (bootstrapped CI [0.81, 0.92])
	Reliance			0.52 (bootstrapped CI [0.19, 0.71])
	Effort			0.87 (bootstrapped CI [0.80, 0.92])

Note. MCQ = Memory Compensation Questionnaire. CI = confidence interval. All CIs are 95%.

Our primary goal was to investigate the relations among memory compensation and cognitive reserve, subjective everyday memory, and stress, over and above age and objective memory. We wanted to provide a first test of Stern's (2002) contention that those with higher levels of reserve (as measured by education and NAART) may be more likely to implement alternative strategies to meet increased cognitive demands with age. Surprisingly, we found that no relations with MCQ emerged for participants whose education and NAART were positively related (see right side of Figure 1); increased compensation emerged only for those whose education (negative) and NAART (positive) were oppositely loaded on a "discordant" variable (see left side of Figure 1). This suggested that compensation was significantly likely for those whose NAART outpaced their education (i.e., those older adults whose verbal IQ was higher than their education level would indicate). MCQ values were lower for those whose education level outpaced their NAART. Indeed, this effect was reliable and had the narrowest 95% bootstrapped CI of all predictors in our final MCQ regression model (see Table 4).

One possible explanation for this effect is that education largely reflects socioeconomic status (SES), as educational attainment is often a by-product of familial income and accessibility to resources (Hollingshead & Redlich, 1958; Seifer, 2001). Conversely, although relations may exist between intelligence and SES, intelligence is not typically considered in SES calculations. Likely, this is because (a) high intelligence can persist in absence of high SES (i.e., the relation between them is only between $r = .30$ and 0.40; see Seifer, 2001) and (b) intelligence does not determine social position, either statistically or conceptually, to a greater extent than do typical SES proxies (e.g., education, occupational attainment, income, neighborhood of residence). In fact, given that education is actually part of linearly combined SES measures (e.g. the Hollingshead Index; Hollingshead & Redlich, 1958), the statistical relation between education and SES is necessarily somewhat redundant, compared to the low-to-moderate relations typically found between IQ and SES. Whatever is common between education and intelligence could reflect a mutual SES link as well as reserve, but in the present study, those commonalities (i.e., "Concordance" in Figure 1) showed no relation with MCQ. However, discordance reflects how intelligence differs from education, and this is where relations with MCQ emerged. Perhaps, then, older adults who compensate are intellectually capable of devising and/or employing compensatory strategies in the face of the negative impacts of lower SES. Future studies should examine this possibility directly. In any event, consideration of both education and NAART is required to capture true relations with MCQ. Although we cannot rule out the possibility that cognitive reserve plays a role in the current results, it remains clear that the way in which reserve proxies are typically conceived (i.e., that education and NAART would capture similar phenomena; e.g., Stern, 2002; Stern et al., 2005) does not apply to this sample. Because relations between education and intelligence in older adults are often only moderate (e.g., $r = .55$, $p < .01$, in the current sample; $r = .53$, McDowell, Xi, Lindsay, & Tierney, 2007), there is some 70%–75% of the variance in these predictors that is not shared between them; we appear to be capturing some of these important differences in the context of MCQ.

We also sought to explore the link between subjective assessments of everyday memory and everyday memory compensation. The EMQ (a measure of everyday memory errors and memory deficit perception) had not been examined previously in relation to the MCQ. We found that greater everyday memory errors related to increased memory compensation, supporting Bäckman and Dixon's (1992) argument that deliberate behavioral compensation must originate in a deficit and is most likely to occur when the perception of a deficit exists. Although objective memory deficits

Table 4
Multiple Regression Model

Dependent variable	Predictor	*B*	*SE*	*t*	*p*	Partial η^2
MCQ	Education/NAART discordant vector	0.31 (bootstrapped CI [0.12, 0.51])	0.11	2.88	.005	.12
	EMQ	0.22 (bootstrapped CI [0.00, 0.44])	0.11	2.00	.049	.06
	ELSI (total events)	0.33 (bootstrapped CI [0.09, 0.53])	0.11	2.94	.005	.12
	EMQ × ELSI (total events)	−0.32 (bootstrapped CI [−0.56, −0.05])	0.14	−2.32	.024	.08

Note. MCQ = Memory Compensation Questionnaire; NAART = North American Adult Reading Test; CI = confidence interval; EMQ = Everyday Memory Questionnaire; ELSI = Elder's Life Stress Inventory. Model $R^2 = .30$, adjusted model $R^2 = .26$. All variables were standardized prior to analysis. We found no evidence for multicollinearity among the predictors in the model; all variance inflation factor values were less than 1.13. All CIs are 95%.

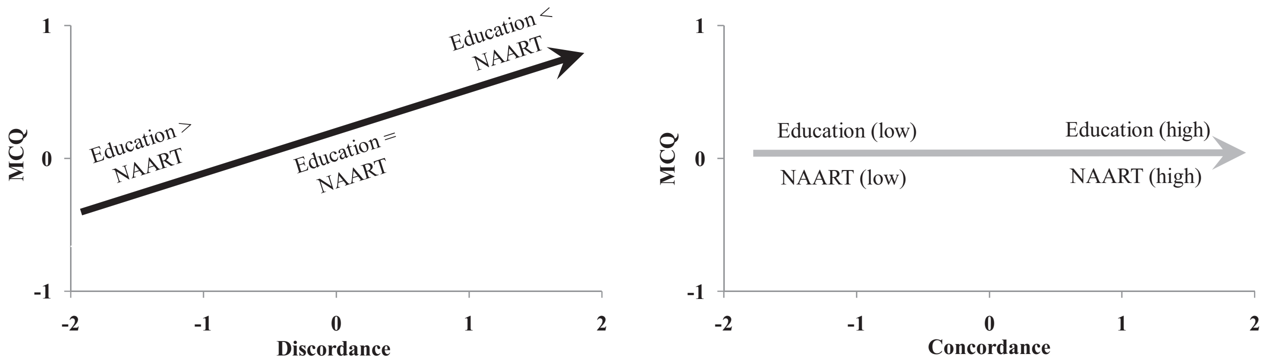

Figure 1. Cognitive reserve discordance and concordance vector scores plotted against MCQ component scores. The discordance effect was derived from our final model run, in which MCQ was predicted from discordance, everyday memory (EMQ), and total stressful events (ELSI total events; see Results). The lack of concordance effect shown here resulted from a preliminary model run in which MCQ was predicted from age, discordance, concordance, objective memory, EMQ, ELSI total events, and ELSI average stress (see Results). Although the discordance slope here is derived from a simpler model than that used to test the concordance effect, the discordance effect was similar and significant in the preliminary model used to test the concordance effect. MCQ = Memory Compensation Questionnaire; NAART = North American Adult Reading Test; EMQ = Everyday Memory Questionnaire; ELSI = Elder's Life Stress Inventory.

may also help determine certain compensatory efforts over time (see Dixon & de Frias, 2004, 2007), such deficits may not be required for spontaneous behavioral compensation to occur (as we found in the current study). There are several possible reasons why memory compensation may exist in the absence of objective memory impairment. For example, this could result from anticipatory (rather than immediately necessary) efforts to offset impending decline in cognitive function with age, or from a cross-sectional mismatch between metamemory measures and objective performance (see Dixon & de Frias, 2004; Pearman & Storandt, 2004). Regardless, our finding that those who report greater everyday memory errors also compensate more so suggests that the compensatory responses of older adults are in line with their perceptions of their own memory performance, even if their perceptions of performance are somewhat inaccurate. In short, older adults appear to be resilient in the face of perceived memory difficulties in everyday situations.

We also considered the relation between everyday life stress and compensation. Research on the negative influence of stress on various aspects of cognition is widely available (e.g., Belanoff et al., 2001; Lupien & McEwen, 1997; Lupien et al., 2009; Neupert et al., 2006; Stawski et al., 2006; VonDras et al., 2005), but to our knowledge, this is the first study to examine the influence of stress on everyday memory compensation. Results indicated that a greater number of stressful events predicted higher MCQ component scores, and we found a reliable two-way interaction that helped qualify the main effects of total stressful events and everyday memory errors (see Figure 2). Those under low life stress compensated far less in the presence of low everyday memory errors. In the face of high memory errors, however, low-stress

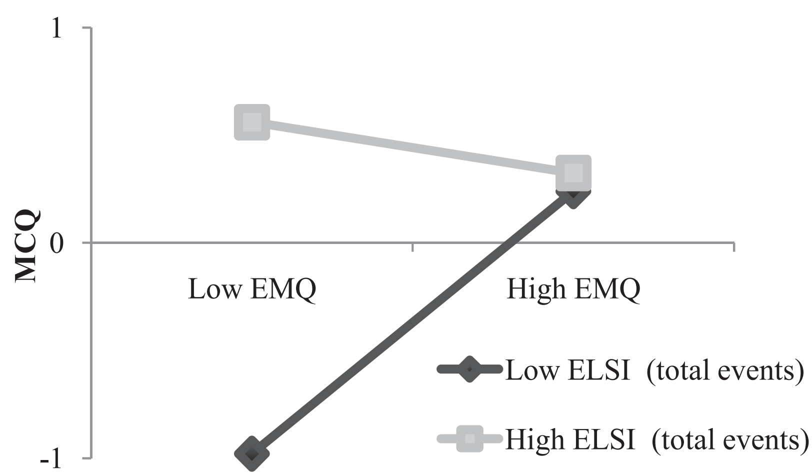

Figure 2. EMQ × ELSI (total events) interaction on MCQ. MCQ = Memory Compensation Questionnaire; EMQ = Everyday Memory Questionnaire; ELSI = Elder's Life Stress Inventory.

older adults exhibited dramatically higher levels of compensation representative of resilience. However, those under high life stress compensated despite memory errors. This finding may indicate a relative lack of resilience by those under high stress who also exhibit greater memory errors, and it provides support for notions that those in this group may be less likely to boost their compensatory efforts or to problem solve when necessary (see Dixon et al., 2001; Klein & Barnes, 1994). Lack of resilience in this group may result from an additive effect between life stress and high memory errors. High-stress older adults may become overwhelmed in the presence of high memory errors, and compensatory responses may suffer as a result. Alternatively, perhaps those in this group feel that increased compensatory strategy employment would provide little additional help for their level of memory, because their level of compensation is already relatively high; this could thus represent a "compensatory ceiling." Future research could explore these possibilities. In any event, this interaction provides novel evidence regarding the links between stress, everyday memory, and compensatory strategy use, and helps illuminate contexts in which varying degrees of life stress associate with everyday memory compensation.

There are a number of limitations to the current study. First, our sample size was relatively small ($N = 66$). Previous research on the MCQ employed samples from $N = 106$ (Dixon et al., 2003) to $N = 854$ (Dixon et al., 2001). Thus, some predictive effects found in previous studies (e.g., objective episodic memory performance; Dixon & de Frias, 2004, 2007) may not have been observed here due to modest power. However, our inclusion of bootstrap resampling does offer reliability information for all effects we tested. Another potential limitation is that the age of our sample ($M = 70.55$ years) may not have captured the extent of everyday memory compensation in late life. Given that memory problems increase significantly with age (e.g., Balota et al., 2000; Grady & Craik, 2000; Zacks et al., 2000), future studies should selectively recruit a greater proportion of adults in the old-old age range (e.g., 85+ years) than we had available in the current study. This would help ensure that everyday memory compensation is examined at a point in the life span at which memory impairment is most likely to occur.

Conclusion

With the increasing age of the adult population and projected increases in dementia prevalence (Ferri et al., 2005; United Nations, 1995), heightened interest in the complexities, probability, and efficacy of everyday memory compensation strategies is warranted. We examined several measures and concepts not previously linked to everyday memory compensation and found that greater discordance between education and IQ, more perceived memory errors, and greater life stress predicted greater everyday memory compensation. We found also that high-stress older adults compensated whether perceived memory errors were low or high but low-stress older adults compensated only if they perceived high memory errors. We argue that these covariates and effects are important for understanding the complexities of compensation, are robust, and provide a contextual basis for future research.

References

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions.* Thousand Oaks, CA: Sage.

Aldwin, C. M. (1990). The Elders Life Stress Inventory: Egocentric and nonegocentric stress. In M. A. P. Stephens, J. H. Crowther, S. E. Hobfoll, & D. L. Tennenbaum (Eds.), *Stress and coping in later-life families* (pp. 49–69). Washington, DC: Hemisphere.

Bäckman, L., & Dixon, R. A. (1992). Psychological compensation: A theoretical framework. *Psychological Bulletin, 112,* 259–283.

Baddeley, A., Harris, J., & Sunderland, A. (1987). Closed head injury and memory. In H. S. Levin, J. Grafman, & H. M. Eisenberg (Eds.), *Neurobehavioral recovery from head injury* (pp. 295–317). New York, NY: Oxford University Press.

Balota, D. A., Dolan, P. O., & Duchek, J. M. (2000). Memory changes in healthy older adults. In E. Tulving & F. I. M. Craik (Eds.), *The Oxford handbook of memory* (pp. 395–409). New York, NY: Oxford University Press.

Belanoff, J. K., Gross, K., Yager, A., & Schatzberg, A. F. (2001). Corticosteroids and cognition. *Journal of Psychiatric Research, 35,* 127–145.

Benedict, R. H. B., Schretlen, D., Groninger, L., & Brandt, J. (1998). Hopkins Verbal Learning Test-Revised: Normative data and analysis of interform and test–retest reliability. *Clinical Neuropsychologist, 12,* 43–55.

Blair, J. R., & Spreen, O. (1989). Predicting premorbid IQ: A revision of the National Adult Reading Test. *Clinical Neuropsychologist, 3,* 129–136.

Cabeza, R., Anderson, N. D., Locantore, J. K., & McIntosh, A. R. (2002). Aging gracefully: Compensatory brain activity in high-performing older adults. *NeuroImage, 17,* 1394–1402.

Castel, A. D., Benjamin, A. S., Craik, F. I. M., & Watkins, M. J. (2002). The effects of aging on selectivity and control in short-term recall. *Memory & Cognition, 30,* 1078–1085.

Cockburn, J. (1996). The pragmatic and ecological perspective: Evaluation of memory disorders. *European Review of Applied Psychology, 46,* 201–205.

Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences.* Oxford, England: Erlbaum.

Cornish, I. M. (2000). Factor structure of the Everyday Memory Questionnaire. *British Journal of Psychology, 91,* 427–438.

de Frias, C. M., & Dixon, R. A. (2005). Confirmatory factor structure and measurement invariance of the Memory Compensation Questionnaire. *Psychological Assessment, 17,* 168–178.

de Frias, C. M., Dixon, R. A., & Bäckman, L. (2003). Use of memory compensation strategies is related to psychosocial and health indicators. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 58,* 12–22.

Dixon, R. A., & Bäckman, L. (1999). Principles of compensation in cognitive neurorehabilitation. In D. T. Stuss, G. Winocur, & I. H. Robertson (Eds.), *Cognitive neurorehabilitation* (pp. 59–72). Cambridge, England: Cambridge University Press.

Dixon, R. A., & de Frias, C. M. (2004). The Victoria Longitudinal Study: From characterizing cognitive aging to illustrating changes in memory compensation. *Aging, Neuropsychology, and Cognition, 11,* 346–376.

Dixon, R. A., & de Frias, C. M. (2007). Mild memory deficits differentially affect 6-year changes in compensatory strategy use. *Psychology and Aging, 22,* 632–638.

Dixon, R. A., de Frias, C. M., & Bäckman, L. (2001). Characteristics of self-reported memory compensation in older adults. *Journal of Clinical and Experimental Neuropsychology, 23,* 630–661.

Dixon, R. A., Garrett, D. D., & Bäckman, L. (2008). Principles of compensation in cognitive neuroscience and neurorehabilitation. In D. T. Stuss, G. Winocur, & I. H. Robertson (Eds.), *Cognitive neurorehabilitation: Evidence and application* (2nd ed., pp. 22–38). Cambridge, England: Cambridge University Press.

Dixon, R. A., Hopp, G. A., Cohen, A.-L., de Frias, C. M., & Bäckman, L. (2003). Self-reported memory compensation: Similar patterns in Alzheimer's disease and very old adult samples. *Journal of Clinical and Experimental Neuropsychology, 25,* 382–390.

Efklides, A., Yiultsi, E., Kangellidou, T., Kounti, F., Dina, F., & Tsolaki, M. (2002). Wechsler Memory Scale, Rivermead Behavioural Memory Test, and Everyday Memory Questionnaire in healthy adults and Alzheimer's patients. *European Journal of Psychological Assessment, 18,* 63–77.

Efron, B., & Tibshirani, R. J. (1986). Bootstrap methods for standard errors, confidence intervals, and other measures of statistical accuracy. *Statistical Science, 1,* 54–77.

Efron, B., & Tibshirani, R. J. (1993). *An introduction to the bootstrap*. New York, NY: Chapman & Hall.

Ferri, C. P., Prince, M., Brayne, C., Brodaty, H., Fratiglioni, L., Ganguli, M., . . . Alzheimer's Disease International. (2005). Global prevalence of dementia: A Delphi consensus study. *Lancet, 366,* 2112–2117.

Folstein, M. F., Folstein, S. E., & McHugh, P. R. (1975). Mini-Mental State, a practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research, 12,* 189–198.

Glisky, E. L., & Glisky, M. L. (1999). Memory rehabilitation in the elderly. In D. T. Stuss, G. Winocur, & I. H. Robertson (Eds.), *Cognitive neurorehabilitation* (pp. 347–361). Cambridge, England: Cambridge University Press.

Glisky, E. L., & Glisky, M. L. (2008). Memory rehabilitation in older adults. In D. T. Stuss, G. Winocur, & I. H. Robertson (Eds.), *Cognitive neurorehabilitation: Evidence and application* (2nd ed., pp. 541–562). Cambridge, England: Cambridge University Press.

Grady, C. L., & Craik, F. I. M. (2000). Changes in memory processing with age. *Current Opinion in Neurobiology, 10,* 224–231.

Habeck, C., Hilton, H. J., Zarahn, E., Flynn, J., Moeller, J., & Stern, Y. (2003). Relation of cognitive reserve and task performance to expression of regional covariance networks in an event-related fMRI study of nonverbal memory. *NeuroImage, 20,* 1723–1733.

Hertzog, C., Park, D. C., Morrell, R. W., & Martin, M. (2000). Ask and ye shall receive: Behavioural specificity in the accuracy of subjective memory complaints. *Applied Cognitive Psychology, 14,* 257–275.

Hollingshead, A. B., & Redlich, F. C. (1958). *Social class and mental illness.* New York, NY: Wiley.

Klein, K., & Barnes, D. (1994). The relationship of life stress to problem solving: Task complexity and individual differences. *Social Cognition, 12,* 187–204.

Koltai, D. C., Bowler, R. M., & Shore, M. D. (1996). The Rivermead Behavioural Memory Test and Wechsler Memory Scale—Revised: Relationship to everyday memory impairment. *Assessment, 3,* 443–448.

Kriegeskorte, N., Simmons, W. K., Bellgowan, P. S. F., & Baker, C. I. (2009). Circular analysis in systems neuroscience: The dangers of double dipping. *Nature Neuroscience, 12,* 535–540.

Kucera, H., & Francis, W. N. (1967). *Computational analysis of present-day American English.* Providence, RI: Brown University Press.

Lupien, S. J., & McEwen, B. S. (1997). The acute effects of corticosteroids on cognition: Integration of animal and human model studies. *Brain Research Reviews, 24,* 1–27.

Lupien, S. J., McEwen, B. S., Gunnar, M. R., & Heim, C. (2009). Effects of stress throughout the lifespan on the brain, behaviour and cognition. *Nature Reviews Neuroscience, 10,* 434–445.

McDowell, I., Xi, G., Lindsay, J., & Tierney, M. (2007). Mapping the connections between education and dementia. *Journal of Clinical and Experimental Neuropsychology, 29,* 127–141.

Mooney, C. Z., & Duval, R. D. (1993). *Bootstrapping: A nonparametric approach to statistical inference.* Newbury Park, CA: Sage.

Neupert, S. D., Almeida, D. M., Mroczek, D. K., & Spiro, A., III (2006). Daily stressors and memory failures in a naturalistic setting: Findings from the VA Normative Aging Study. *Psychology and Aging, 21,* 424–429.

Pearman, A., & Storandt, M. (2004). Predictors of subjective memory in older adults. *Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 59,* 4–6.

Rubin, D. B. (1987). *Multiple imputation for nonresponse in surveys.* New York, NY: Wiley.

Salthouse, T. A. (1991). *Theoretical perspectives on cognitive aging.* Hillsdale, NJ: Erlbaum.

Seifer, R. (2001). Socioeconomic status, multiple risks, and development of intelligence. In R. J. Sternberg & E. L. Grigorenko (Eds.), *Environmental effects on cognitive abilities* (pp. 59–82). Mahwah, NJ: Erlbaum.

Stawski, R. S., Sliwinski, M. J., & Smyth, J. M. (2006). Stress-related cognitive interference predicts cognitive function in old age. *Psychology and Aging, 21,* 535–544.

Stern, Y. (2002). What is cognitive reserve? Theory and research application of the reserve concept. *Journal of the International Neuropsychological Society, 8,* 448–460.

Stern, Y. (2003). The concept of cognitive reserve: A catalyst for research. *Journal of Clinical and Experimental Neuropsychology, 25,* 589–593.

Stern, Y., Habeck, C., Moeller, J., Scarmeas, N., Anderson, K. E., Hilton, H. J., . . . van Heertum, R. (2005). Brain networks associated with cognitive reserve in healthy young and old adults. *Cerebral Cortex, 15,* 394–402.

Strauss, E., Sherman, E. M. S., & Spreen, O. (2006). *A compendium of neuropsychological tests: Administration, norms, and commentary* (3rd ed.). Oxford, England: Oxford University Press.

Sunderland, A., Harris, J. E., & Baddeley, A. D. (1984). Assessing everyday memory after severe head injury. In J. E. Harris & P. E. Morris (Eds.), *Everyday memory, actions, and absent-mindedness* (pp. 193–212). London, England: Academic Press.

Tuokko, H., Garrett, D. D., McDowell, I., Silverberg, N., & Kristjansson, B. (2003). Cognitive decline in high-functioning older adults: Reserve or ascertainment bias? *Aging & Mental Health, 7,* 259–270.

United Nations. (1995). *World population prospects: The 1994 revision.* New York, NY: Author.

VonDras, D. D., Powless, M. R., Olson, A. K., Wheeler, D., & Snudden, A. L. (2005). Differential effects of everyday stress on the episodic memory test performances of young, mid-life, and older adults. *Aging & Mental Health, 9,* 60–70.

Wilson, B. A. (1987). *Rehabilitation of memory.* New York, NY: Guilford Press.

Wilson, B. A., Cockburn, J., & Baddeley, A. D. (1991). *The Rivermead Behavioural Memory Test manual* (2nd ed.). Suffolk, England: Thames Valley Test Company.

Wilson, B., Cockburn, J., Baddeley, A. D., & Hiorns, R. (1989). The development and validation of a test battery for detecting and monitoring everyday memory problems. *Journal of Clinical and Experimental Neuropsychology, 11,* 855–870.

Zacks, R. T., Hasher, L., & Li, K. Z. H. (2000). Human memory. In F. I. M. Craik & T. A. Salthouse (Eds.), *The handbook of aging and cognition* (2nd ed., pp. 293–357). Mahwah, NJ: Erlbaum.

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