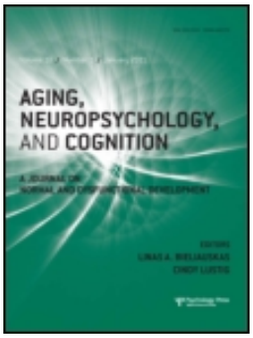

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Everyday memory errors in older adults

Lynn Ossher, Kristin E. Flegal, and Cindy Lustig

Department of Psychology, University of Michigan, Ann Arbor, MI, USA

ABSTRACT

Despite concern about cognitive decline in old age, few studies document the types and frequency of memory errors older adults make in everyday life. In the present study, 105 healthy older adults completed the Everyday Memory Questionnaire (EMQ; Sunderland, Harris, & Baddeley, 1983, *Journal of Verbal Learning and Verbal Behavior, 22*, 341), indicating what memory errors they had experienced in the last 24 hours, the Memory Self-Efficacy Questionnaire (MSEQ; West, Thorn, & Bagwell, 2003, *Psychology and Aging*, *18*, 111), and other neuropsychological and cognitive tasks. EMQ and MSEQ scores were unrelated and made separate contributions to variance on the Mini Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975, *Journal of Psychiatric Research*, *12*, 189), suggesting separate constructs. Tip-of-the-tongue errors were the most commonly reported, and the EMQ Faces/Places and New Things subscales were most strongly related to MMSE. These findings may help training programs target memory errors commonly experienced by older adults, and suggest which types of memory errors could indicate cognitive declines of clinical concern.

Keywords: Aging; Memory; Everyday memory; Memory errors; Memory self-efficacy.

Older adults' memory failures are a common theme in popular culture, for example, the infamous 'senior moment'. Both young and older adults believe that memory declines with age (Camp & Pignatiello, 1988; Hertzog, Lineweaver, & McGuire, 1999; Ryan, 1992) and such declines can be

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Address correspondence to: Cindy Lustig, Department of Psychology, University of Michigan, 530 Church Street 1, Ann Arbor, MI 48109, USA. E-mail: clustig@umich.edu

especially worrisome to older individuals concerned about the potential onset of dementia. Age differences in metamemory and older adults' complaints of reduced memory function are well-documented (e.g., Derouesné, Lacomblez, Thibault, & LePoncin, 1999; Schinka et al., 2009). However, while general memory complaints and age differences in metamemory have been well-studied, much less is known about the specific memory problems older adults face in everyday life. For example, which memory error is an older adult most likely to experience in the course of a normal day: forgetting the reason for entering a room, forgetting someone's name, or forgetting whether an intended action (such as taking a medication) was only planned or actually performed?

The present paper identifies the everyday memory errors reported by a relatively large ($n = 105$) sample of older adults and examines their relationship to memory self-efficacy, demographic variables and laboratory tasks. Identifying which errors occur most often in older adults with apparently normal cognitive function is important for focusing research on ecologically relevant problems. As we describe later, although laboratory tests have established that some types of memory ability (e.g., source memory) are especially difficult for older adults, this does not necessarily translate to the performance failures they are most likely to experience in everyday life (see the recent special issue of this journal edited by Verhaeghen, Martin, & Sędek, 2012 for an extensive discussion of this disconnect). Thus, while measures of cognitive ability taken in the lab certainly have scientific value, a more direct assessment of the errors experienced by older adults during their daily activities may be more useful for directing research to develop interventions that will have a practical impact. There may also be translational implications of investigating where correlations between everyday memory errors and laboratory or clinical measures exist: a lay individual concerned about his or her own memory or that of a spouse is more likely to describe these concerns in terms of everyday experiences rather than in scientific terms – for example, such an individual would be more likely to note an increasing difficulty in remembering the names of new acquaintances than to say that the individual has a deficit in associative memory. Establishing which types of errors relate to neuropsychological measures and indices of cognitive decline (such as the Mini Mental State Exam – MMSE; Folstein et al., 1975) may help identify areas of memory that should be carefully monitored by older adults, their families, and physicians.

Laboratory and self-report measures of everyday memory function

Age differences on most laboratory tests designed to target specific memory functions (e.g., working memory, episodic memory) are moderate to large, especially in situations that require the use of context or associations (Spencer & Raz, 1995; Verhaeghen, 2003). Despite the picture of impaired

memory that arises from these laboratory findings, most non-demented older adults are able to function well and maintain independence in everyday life. Differences in demand level between laboratory tasks and everyday life may partially explain this discrepancy. Even those tests that use ecologically relevant stimuli (e.g., face–name pairs, prescription drug labels, sentences related to recipes or food preparation; Allaire & Marsiske, 1999; West, Crook, & Barron, 1992) often use procedures better designed to test the limits of ability than the requirements of normal life. For example, outside of the lab one is not usually required to recognize 50 repeated faces from 156 presented faces, perform a 25-item recognition test for facts from a short newscast, or recall the second number used in a sentence related to food preparation. Furthermore, everyday life often provides more control over the environment, including memory cues and demands. These factors may have substantial impact on the occurrence and frequency of memory errors (Craik & Anderson, 1999; Craik & Byrd, 1982; see Bailey, Henry, Rendell, Phillips, & Kliegl, 2010 for an illustrative example). At the other end of the spectrum, neuropsychological tests designed to simulate everyday memory situations, (e.g., the Rivermead Behavioural Test; Fraser, Glass, & Leathem, 1999; Meléndez-Moral, Tomás, Blasco-Bataller, Oliver, & Navarro, 2010; Wilson, Cockburn, & Baddeley, 1989, the Instrumental Activities of Daily Living; Lawton & Brody, 1969, or Simulated Real Life Tasks; Craik et al., 2007) may be better suited to detecting clinical levels of impairment than measuring memory function in healthy, community-dwelling adults.

Self-report measures provide an alternative method of gaining insight into older adults' everyday memory function. These measures often consist of questions about memory self-efficacy and metamemory (e.g., beliefs about memory in general and about one's own memory; use of memory strategies) rather than particular instances of everyday memory success or failure. Examples include the Memory Assessment Clinics Self-Rating Scale (MAC-S; Feher, Larrabee, Sudilovsky, & Crook, 1994; Larrabee, West, & Crook, 1991), the Metamemory in Adulthood Questionnaire (MIA; Cook & Marsiske, 2006; Dixon, Hultsch, & Hertzog, 1988; Hertzog, Dixon, & Hultsch, 1990), the Subjective Memory Complaints scale (SMC; Ginó et al., 2010), and the Memory Functioning Questionnaire (MFQ; Cook & Marsiske, 2006; Gilewski, Zelinski, & Schaie, 1990; Hertzog et al., 1990; Zelinski, Burnight, & Lane, 2001; Zelinski, Gilewski, & Anthony-Bergstone, 1990). A few measures, such as the Memory Self-Efficacy Questionnaire (MSEQ; Berry, West, & Dennehy, 1989; West et al., 2003) ask participants to indicate how confident they are in their ability to perform specific memory tasks (e.g., remember items on a shopping list). Although subjective memory complaints increase with age, these measures often show only modest or non-significant correlations with laboratory performance (Beaudoin & Desrichard, 2011; Mascherek & Zimprich, 2011). Instead, in healthy adults, subjective ratings of overall memory performance and self-efficacy generally

show stronger correlations with affective or personality factors (e.g., depression, neuroticism, stress; Benito-León, Mitchell, Vega, & Bermejo-Paraja, 2010; Jungwirth et al., 2004; Slavin et al., 2010), although they may have greater sensitivity to performance in participants at risk for cognitive decline (Cook & Marsiske, 2006).

There are a few measures that ask participants about specific memory abilities or errors (e.g., forgetting the name of someone just introduced to you), though on a broad or unspecified time scale (e.g., the MAC-S asks participants to rate their ability from *very poor* to *very good* and the frequency of occurrence from *very rare* to *very often*; the MIA uses *disagree strongly* to *agree strongly* and *never* to *always*; other measures such as the Cognitive Failures Questionnaire; Broadbent, Cooper, Fitzgerald, & Parkes, 1982, use similar Likert-type scales). Perhaps in part because of the rating scales used, most reports using these measures focus on global age-related patterns rather than which memory errors are the most frequent or most often noticed by older adults. In addition, when participants are asked such general-frequency questions, their subjective memory reports can be heavily influenced by self-schemas and stereotypes about aging rather than recollection of specific memory events; they are able to provide more specific enumerations if that is more strongly suggested by the question's format (Blair & Burton, 1987; Cook & Marsiske, 2006; Lineweaver & Hertzog, 1998).

Assessing experienced memory errors: The Everyday Memory Questionnaire

As summarized earlier, although laboratory and self-report measures of older adults' memory function are widely used, they generally do not address the question of which memory errors are experienced most often in daily life. Laboratory measures may better assess the limits of memory ability than performance in everyday settings; self-report measures often emphasize general memory beliefs and broad timescales and may be heavily influenced by stereotypes and affective and personality variables. Only a few prior studies have asked older adults to record their memory errors. For example, an early diary study by Cavanaugh, Grady, and Perlmutter (1983) categorized memory errors into eight broad materials-based categories (names, facts, appointments, etc.) and found that name-related errors occurred at an especially high rate in older adults. Zelinski et al. (1990) found that older adults' scores on the MFQ predicted MMSE scores, as well as actual memory errors that were recorded by subjects over the next two weeks. Both of these studies reported general categories of memory errors rather than the frequency of specific memory errors.

To provide a more fine-grained assessment, we used the Everyday Memory Questionnaire (EMQ; Sunderland et al., 1983). The EMQ consists of 35 questions about memory failures that occur in everyday life (e.g.,

'Forgetting something you were told yesterday or a few days ago'; 'Forgetting to keep an appointment'). It has been used to assess naturalistic memory errors in a variety of populations, including patients with brain injury, schizophrenia, Alzheimer's, or Parkinson's disease (Efklides et al., 2002; Fennig, Mottes, Ricter-Levin, Treves, & Levkovitz, 2002; Polliakoff & Smith-Spark, 2008; Pollina, Greene, Tunick, & Puckett, 1993; Sunderland, Watts, Baddeley, & Harris, 1986). Other investigators have also successfully used the EMQ or simplified versions of it with samples including older adults (Garrett, Grady, & Hasher, 2010; Koltai, Bowler, & Shore, 1996; Neupert, Almeida, Mroczek, & Spiro, 2006; Neupert, Mroczek, & Spiro, 2008). A large-sample study (Efklides et al., 2002) of healthy adults age 20–76+ years and 39 Alzheimer's patients found that the measure had good internal and test–retest reliability (all indices > 0.80). The EMQ has also been shown to be sensitive to memory training programs, even when measures of memory self-efficacy do not change (Bottiroli, Cavallini, & Vecchi, 2008; Lustig & Flegal, 2008).

Previous investigations using the EMQ with older adults have largely focused on the overall score's correlation with other psychometric variables, and have not addressed the first goal of the current study: to establish the frequency of different memory errors in daily life in healthy older adults. There is one partial precedent: Sunderland et al. (1986) used the EMQ with 60 adults age 64–75 and described eight commonly reported errors; these included tip-of-the-tongue errors and 'absent-minded' errors such as forgetting where one had put something or having to go back and check whether one had done something. They noted with some concern that the reports given by the participants did not correspond closely with those of an informant (e.g., the subject's spouse). However, this criterion might not have been as appropriate a test of reliability and validity in healthy older adults as it was for the head-injured patients who participated in an earlier study by this group (Sunderland et al., 1983), as healthy older adults are more likely to spend time away from their informant.

The present study also tested healthy older adults, but our sample differed from that of Sunderland et al. (1986) in size ($n = 105$), age range (65–92 years) and education (their subjects had a mean of 9.5 years of education; in our sample only one participant had not completed high school). The first goal of our study was to determine the frequency of different errors during a 24-hour period for these relatively healthy, high-ability older adults. Based on the previous results of Sunderland et al. (1986), we expected to find substantial differences among subscales, with verbal errors being especially common. Our second goal was to examine the relationship between everyday memory errors as reported on the EMQ and subjective memory self-efficacy as assessed by the MSEQ. Although both measures rely on self-report, we expected them to be relatively independent: the EMQ assesses which errors a

person *actually makes* in the course of their everyday life; the MSEQ asks the participant to indicate *confidence in their ability* to complete certain memory tasks, which may be more demanding than most situations the individual would likely put themselves in during their everyday routine (e.g., remember the locations of 18 objects or remember 18 items on a shopping list without writing down the list).

We also examined each measure's relationship to demographics and objective tests of ability and cognitive status. Here again, we expected the EMQ and MSEQ to have relatively independent relationships with variance in other measures. In addition, the MSEQ might be more closely related to some laboratory tests that put high demands on particular memory abilities without environmental support, as the MSEQ provides a subjective estimate of that ability and the laboratory test provides an objective one. More specific hypotheses regarding potential relations between individual EMQ or MSEQ subscales and other cognitive tests are detailed later. Indexing the most common errors made by older adults and establishing their relationship to both beliefs about memory and objective laboratory measures of cognitive function may provide insights about the real-world memory areas that interventions directed at older adults should target and the types of ecologically relevant memory problems that could be candidate indices for monitoring cognitive decline.

METHOD

Participants

A total of 106 healthy older adults were recruited from the Ann Arbor community as part of a larger cognitive training study (Flegal & Lustig, 2012; Lustig & Flegal, 2008) and were compensated for their participation. The results reported here pertain to measures obtained during the baseline session, before training occurred. Stratified sampling was used to collect approximately equal numbers of subjects in five-year age increments from 65–69 to 80+. All were native English speakers, screened for psychological or neurological conditions that could affect performance, reported no use of medications that could impact cognition, and scored above 24 on the MMSE. Inspection of the data revealed one individual with extreme outlying scores (>4 *SD* from the mean); this person was eliminated from further analyses for a final sample size of $n = 105$. See Table 1 for demographics.

Materials and procedure

We used the 35-item version of the EMQ, which evaluates the frequency with which various types of memory errors occur in daily life (Sunderland et al., 1983). Participants indicated how many times within the last 24 hours

TABLE 1. Demographic information and test performance

	Descriptive statistics		
	N	Mean	*SD*
		Demographics	
Age	105	75.3	6.8
Years of Education	105	16.6	3.4
MMSE	105	28.4	1.6
SBT	105	1.4	1.8
ERVT	105	27.9	10.7
% Female	66%		
		Questionnaires	
EMQ – Total Score	105	10.7	8.4
MSEQ – Total Score	105	63.9	19.0
		Neuropsychological Tests	
Pattern Comparison Accuracy	105	33.2	6.7
Trail Making Test – A	104	36.1	16.0
Trail Making Test – B	104	99.0	63.3
SOPT – Pattern Accuracy	105	73.6	10.1
SOPT – Word Accuracy	104	88.6	8.9
		Laboratory Memory Tasks	
Shopping List Accuracy	105	97.0	5.0
Face–Name Recall Accuracy	105	22.4	22.3

Note: Accuracy measures for neuropsychological tests and laboratory memory tasks refer to % accurate. Trail Making measures refer to RT in seconds. Trail Making and SOPT (Word) were not given to one subject due to experimenter error.

they had committed each of the memory errors. The items are organized into five conceptually derived subscales: Speech (e.g., 'Finding that a word is on the tip of your tongue'), Reading/Writing (e.g., 'Forgetting what the sentence you have just read was about and having to reread it'), Faces/Places (e.g., 'Getting lost or turning in the wrong direction on a journey or walk you have often been on'), Actions (e.g., 'Starting to do something, then forgetting what it was you wanted to do'), and New Things (e.g., 'Forgetting to keep an appointment'). See Table 2 for items in each subscale. Previous investigations using the EMQ have employed these conceptual subscales (e.g., Sunderland et al., 1983, 1986), while others have used factor analytic techniques to create data-driven subscales. We opted to use the conceptual subscales in the current investigation because the structure of the data-driven subscales may be relatively specific to the populations from whose data they were derived and because the conceptual subscales are most likely to be used by other investigators. In the current sample, EMQ total score had good internal reliability, Cronbach's alpha = 0.82; the subscales varied in their internal reliability with the highest values for the Speech subscale and the lowest for the Actions subscale (see Table 2). To compare reported memory errors to

TABLE 2. EMQ Items and percentage of subjects endorsing each item

Subscale	Cronbach's alpha	EMQ Item	Total no. reported errors	% of subjects endorsing item
Speech	.71	Forgetting the names of friends or relatives or calling them by the wrong names.	40.0	25.7
		Forgetting the names of common things or using the wrong names.	43.0	26.7
		Finding that a word is 'on the tip of your tongue'. You know what it is but can't quite find it.	**98.0**	**61.0**
		Forgetting something you were told a few minutes ago. Perhaps something your spouse or a friend has just said.	31.0	23.8
		Forgetting something you were told yesterday or a few days ago.	**53.0**	**40.0**
		Repeating something you've just said or asking the same question several times.	24.0	19.0
		Forgetting what you have just said. Maybe saying 'What was I talking about?'	36.0	28.6
		Losing track of what someone is trying to tell you. Unable to follow the thread of their conversation.	29.0	21.0
		Starting to say something, then forgetting what it was that you wanted to speak about.	39.0	32.4
		Letting yourself ramble on to speak about unimportant or irrelevant things.	35.0	22.9
		Forgetting to tell somebody something important. Perhaps forgetting to pass on a message or remind someone of something.	26.0	21.9
		Getting the details of what someone has told you mixed up and confused.	24.0	21.0
		Repeating a story/joke you've already told.	11.0	9.5
Reading/ Writing	.42	Forgetting the meanings of unusual words.	75.0	37.1
		Forgetting what the sentence you just read was about and having to reread it.	**82.0**	**55.2**
		Unable to follow the thread of a story. Lose track of what it is about.	17.0	13.3
		Forgetting how to spell words.	67.0	39.0
Faces/Places	.50	**Forgetting where you have put something. Losing things around the house.**	**58.5**	**45.7**
		Failing to recognize friends/relatives by sight.	11.0	7.6
		Failing to recognize TV characters or other famous people by sight.	35.0	21.0
		Getting lost or turning in the wrong direction on a journey/walk you have often been on.	11.0	10.5

(*Continued*)

TABLE 2. (Continued)

Subscale	Cronbach's alpha	EMQ Item	Total no. reported errors	% of subjects endorsing item
		Failing to recognize places you're told you've often been to before.	5.0	1.9
		Finding TV stories difficult to follow.	21.0	12.4
Actions	.41	Forgetting to do some routine thing which you would normally do once/twice a day.	27.0	21.0
		Discovering that you have done some routine thing twice by mistake.	2.0	1.9
		Having to go around checking whether you have done everything you meant to do.	45.0	34.3
		Forgetting what you did yesterday or getting the details of what happened mixed up and confused.	14.0	13.3
		Starting to do something, then forgetting what it was you wanted to do. Maybe saying 'What am I doing?'	46.5	34.3
		Being absent minded. Doing something which you didn't really intend to do.	11.0	9.5
New Things	.50	**Unable to remember the name of someone you met for the first time recently.**	**48.0**	**40.0**
		Failing to recognize someone you met for the first time recently.	14.0	11.4
		Getting lost on a journey or walk which you've only been on once or twice before.	9.0	8.6
		Unable to pick up a new skill such as a game or working some new gadget after you've practiced once or twice.	21.0	15.2
		Unable to cope with a change in your daily routine. Following your old routine by mistake.	8.0	7.6
		Forgetting to keep an appointment.	6.0	5.7

Top five items in terms of percent of subjects endorsing that error are marked by **bold** font.

memory self-efficacy, we also administered the four-subscale version of the MSEQ, which measures confidence in the ability to carry out daily memory activities (e.g., remembering the items on a grocery list without writing them down) at different levels of difficulty (West et al., 2003).

Participants also completed a demographics questionnaire, dementia screening (MMSE and Short Blessed Test – SBT; Katzman et al., 1983, the Extended Range Vocabulary Test – ERVT; Educational Testing Services,

1976), and a battery of neuropsychological tests to measure processing speed (Pattern Comparison; Salthouse & Babcock, 1991, Trail Making Test A; Armitage, 1945) and executive control (Trail Making Test B; word and pattern versions of the Self-Ordered Pointing Task – SOPT; Attneave & Armoult, 1956). The SOPT consisted of 16 words or patterns in a 4 × 4 grid, arranged in different orders on 16 pages, and participants were required to point to a new pattern or word on each page.

Participants also completed two typical laboratory memory tasks using ecologically valid materials: (1) a shopping list memory task with self-paced viewing of 15 words representing typical grocery items (e.g., potatoes, apples) followed by a self-paced new/old recognition test with 15 studied items and 30 new items, and (2) a face–name association task with self-paced viewing of 10 face–name pairs, followed by a self-paced recall test in which each face was used as a cue for the associated name.

This battery of neuropsychological and laboratory tasks was designed as a set of transfer measures to index training success in a variant of the widely used repetition lag training procedure originally developed by Jennings and Jacoby (2003). For the present study, we hypothesized that the EMQ and MSEQ would correlate specifically with those measures related to memory, and not those related to executive function or processing speed. We also examined relationships between specific ability measures and subscales of the EMQ and MSEQ. We expected that the subscales would only be associated with performance in laboratory or neuropsychological tasks that tapped the same conceptual domain. For example, vocabulary ability was expected to be related to memory errors and self-efficacy in the verbal domain but not to other subscales.

RESULTS

Frequency and type of memory errors

The distribution of reported errors was inspected, and values beyond five errors reported in the previous 24 hours for a single item fell into the tail of the distribution, causing skewness. To prevent extreme scores from overly influencing the analyses, responses greater than or equal to five reported failures on a given item were thus assigned a value of 5. This affected 7 out of 3675 responses (<0.2%).

The mean number of memory errors reported on the EMQ was 10.7 (SD = 8.4), and these errors were largely verbal. Reported errors were highest for the Speech (M = 4.7, SD = 4.0) and Reading/Writing subscales (M = 2.3, SD = 2.4), followed by the Faces/Places (M = 1.4, SD = 1.8), Actions (M = 1.4, SD = 1.6), and New Things subscales (M = 1.0, SD = 1.4). Because the number of questions assigned to each subscale varies,

we converted the subscale scores to proportional scores for further analyses; by this metric errors were also largely verbal but there were higher proportional errors on the Reading/Writing subscale ($M = 0.57$, $SD = 0.60$) than on the Speech subscale ($M = 0.36$, $SD = 0.31$). Proportional scores on the other subscales were lower and similar to each other (Faces/Places $M = 0.22$, $SD = 0.30$; Actions $M = 0.23$, $SD = 0.26$; New Things $M = 0.17$, $SD = 0.24$). A repeated-measures ANOVA with Greenhouse–Geisser corrected degrees of freedom showed that the differences between the subscales were statistically significant $F(2.19, 227.25) = 31.91$, $p < .0001$. Planned contrasts between the subscales confirmed that Reading/Writing errors were proportionally higher than Speech errors, and that both types of verbal errors were reported at a higher rate than all other error types, all $p < .0001$. The other subscales were also all significantly different from each other, all $p < .05$, with the exception of Faces/Places and Actions, which were nearly identical, $p > .80$.

These patterns are preserved if non-zero endorsements of each item (i.e., a binary classification of whether the participant reported making that error or not) are used as the dependent variable rather than the number of reported occurrences for each item. Overall, the mean number of items endorsed by participants was 8.0 ($SD = 5.4$). The Speech subscale had the highest mean number of endorsed items (3.5, $SD = 2.5$), followed by Reading/Writing (1.5, $SD = 1.1$), Faces/Places (1.0, $SD = 1.1$), Actions (1.1, $SD = 1.2$), and New Things (0.9, $SD = 1.1$). As before, when adjusted for the number of questions in each subscale, Reading/Writing errors ($M = 0.36$, $SD = 0.28$) were proportionally higher than Speech errors ($M = 0.27$, $SD = 0.20$) and both types of verbal errors were reported at higher rates than were errors on the other subscales (Faces/Places $M = 0.17$, $SD = 0.19$; Actions $M = 0.19$, $SD = 0.20$; New Things $M = 0.15$, $SD = 0.18$). These patterns suggest predominantly verbal errors even in this high-ability sample. There were no differences between males and females using either the full or binary scales, both $p > .20$, despite previous reports of subtle gender effects in memory complaints (e.g., Crook & Larrabee, 1990).

The errors that most participants reported making at least once were 'Finding that a word is 'on the tip of your tongue'. You know what it is but can't quite find it' (reported by 61% of subjects; Speech subscale), 'Forgetting what the sentence you have just read was about and having to re-read it' (55%; Reading), 'Forgetting where you have put something. Losing things around the house' (46%; Faces/Places), 'Unable to remember the name of someone you met for the first time recently' (40%; New Things), 'Forgetting something you were told yesterday or a few days ago' (40%; Speech), and 'Forgetting how to spell words' (39%; Reading/Writing). These items sample from multiple subscales, indicating that although verbal memory errors are the most commonly reported type of error overall, errors involving faces, places and learning new things are also prominent experiences of memory failure for

older adults. Table 2 provides a full listing. The least frequently endorsed items involved familiar contexts, 'Discovering that you have done some routine thing twice by mistake' (Actions subscale), and 'Failing to recognise places you are told you've often been to before' (Faces/Places subscale), both of which were only reported by two subjects.

Although our results did not exactly replicate those of Sunderland et al. (1986) on an item-by-item basis, there were remarkable similarities between them. The correlation between the rank-ordering of the most commonly endorsed items in their study (Table 1 of Sunderland et al., 1986) and the percentage of participants who endorsed those items in the current study was quite strong, $r = .90$. Most notably, 'tip-of-the-tongue errors', the most frequently reported errors in the current sample, were also the errors most commonly reported by participants and their relatives in the Sunderland et al. study, and were the errors most often endorsed on a checklist tracking frequency of occurrence in the following week. The next most frequently endorsed errors in the Sunderland et al. self-report data were 'Forgetting where you have put something' (third most common in our sample; endorsed by 46% of our sample), 'Having to go back to check whether you have done something' (ninth most common in our sample; 34%), and 'Forgetting something you were told yesterday' (fifth most common in our sample; 40%). One noticeable difference between the two studies was that the current sample showed a higher preponderance of errors related to reading and writing. This might be related to their higher education levels and thus potentially higher likelihood of being involved in activities that provide the opportunity for such errors. Overall, however, the two studies provide a fairly consistent indication of which memory errors are the most noticed or easily identified as occurring for older adults, and suggest that tip-of-the-tongue errors are especially common.

Memory self-efficacy

MSEQ subscale scores were calculated by averaging the confidence ratings for all levels of difficulty of each task. Total MSEQ scores were calculated by averaging the levels of confidence (from 0 to 100%) on each of the four subscales for each participant. Mean total self-efficacy strength was 63.9% ($SD = 19.0$). On the subscales, confidence for remembering where one had placed household items was 77.0% ($SD = 22.3$), remembering the details of a story was 67.0% ($SD = 24.6$), remembering names of people you had recently been introduced to was 56.1% ($SD = 23.2$), for remembering items on a shopping list was 54.9% ($SD = 23.2$). A repeated measures ANOVA was significant, with contrasts indicating that confidence on each subscale differed from one another (all $F > 22$, all $p < .0001$), except the Names and Shopping subscales ($F < 1$, $p > .4$).

Correlations

To reduce the problem of alpha inflation caused by the large number of possible correlation pairs, we restrict our discussion of the correlations between the EMQ, MSEQ, and other measures to the full questionnaires and subscales of theoretical interest.

Total EMQ score was not correlated with either age or years of education (both $r < .11$), nor were any of its subscales (all $r < .15$). Total MSEQ score was correlated with age ($r = –0.21$, $p < .05$) and marginally with education ($r = .17$, $p < .08$); the magnitude of correlations did not significantly differ across subscales. Given the large age range of our sample (65–92 years) the lack of an age-EMQ correlation was surprising. It is unlikely that our sample simply consisted of extremely high functioning older adults who are not experiencing a decline in cognitive function with age, as age did correlate with most laboratory and neuropsychological tests (e.g., Face–Name Recall $r = –.28$, $p < .005$; Pattern Comparison $r = –.29$, $p < .005$). Instead, as suggested earlier, the greater availability of environmental support in everyday life (e.g., lists, calendars) may help older individuals perform better in real-world settings than in the laboratory, where they are deprived of such aids. Notably, on the MSEQ, which asked participants how they would perform without such aids, there was a significant correlation with age. These patterns suggest that although memory beliefs conform to general expectations about aging, education, and performance, actually experienced memory errors do not.

We next examined whether the EMQ and MSEQ reflected general ability or might be more specifically related to different types of memory processing. Contrary to the idea that the EMQ or MSEQ reflect general ability, neither measure correlated with speed or executive processing, all $p > .23$. In contrast, both correlated with scores on the MMSE, commonly used to screen for Alzheimer's disease and other dementias (EMQ $r = -.24$, $p = .01$; MSEQ $r = .23$, $p = .01$). The MMSE's relationship to the EMQ was primarily driven by correlations with the Faces/Places and New Things subscales ($r = –.28$ and $–.26$, respectively, both $p < .01$). This pattern is notable given that new learning and associative memory (necessary to make face–name associations) are especially vulnerable in Alzheimer's disease. The MMSE–MSEQ relation was less specific, with approximately equivalent correlations ($r = .20$ to $.25$) for all subscales except the Shopping subscale ($r = .09$, $p > .4$). High verbal ability may also provide some protection against verbal memory errors; ERVT score selectively correlated with fewer errors on the Reading/Writing subscale of the EMQ ($r = –.28$, $p < .005$), and higher confidence on the Story subscale of the MSEQ ($r = .24$, $p < .05$); ERVT correlations with all other EMQ or MSEQ subscales were $r < .11$.

In addition to these standardized measures, we also examined how EMQ and MSEQ scores related to specific laboratory tests. We were surprised to see that shopping-list recall did not correlate with either the EMQ or MSEQ total scores (both $r < .05$). A large proportion of individuals performed at or near ceiling on the shopping-list task, possibly restricting the range of scores and thus the ability to find correlations, though this explanation is somewhat discounted by significant correlations between shopping-list accuracy and other measures (e.g., face–name recall $r = .25$, $p < .01$; ERVT $r = .33$, $p < .001$). Face–name recall significantly correlated with total scores on the EMQ ($r = -.21$, $p < .05$) and the MSEQ ($r = .23$, $p < .05$) and their conceptually relevant subscales (EMQ Faces/Places $r = -.19$, $p = .05$; MSEQ Names $r = .20$, $p < .05$). However, it did not show the same subscale selectivity as the ERVT. The EMQ and MSEQ total scores did not correlate with each other ($r = -.11$, $p = .27$). Their conceptually related subscales were also uncorrelated ($p > .12$ for both the EMQ Faces/Places and MSEQ Names; EMQ Read/Write and MSEQ Story correlation tests).

These results suggest that the EMQ and the MSEQ were both modestly but significantly correlated with cognitive status and subscale-related performance measures, but independent of each other. We next used regression analyses to more formally test this hypothesis and obtain estimates of the unique variance shared between each questionnaire measure (EMQ, MSEQ) and performance measures (MMSE, face–name recall).

Multiple regressions

The first set of models used MMSE as the outcome variable. Age, years of education, and ERVT score were entered in a single step that accounted for 10.8% of the variance in MMSE scores, $F(3, 101) = 4.09$, $p < .01$. Adding the EMQ total score as the second step added an additional 3.9%, $b^* = -0.20$, $t = 2.14$, $p < .04$. Similar results were found for the MSEQ total score when it was added as the second step instead, $\Delta R^2 = .032$, $b^* = 0.18$, $t = 1.92$, $p = .06$. Including both EMQ and MSEQ scores did little to change either's relation to MMSE (EMQ $b^* = -0.19$, MSEQ $b^* = 0.17$) regardless of the order in which they were entered. The final model with all predictors accounted for 17.4% of the variance in MMSE, $F(5, 99) = 4.17$, $p < .01$. These results are consistent with the idea that both memory errors and memory self-efficacy are related to cognitive status, but those relations are independent of each other and of general demographic or ability measures.

The same algorithm was followed when face–name recall was used as the outcome variable. The first step accounted for 9.4% of variance, $F(3, 101) = 3.51$, $p < .02$. Adding either EMQ or MSEQ as the second step resulted in a marginal increase in variance (EMQ 2.9%; $b^* = -0.17$, $t = -1.83$, $p = .07$; MSEQ 2.8%, $b^* = 0.17$, $t = 1.79$, $p = .08$). Again, including both questionnaires in the model had little effect on the predictive power of either

one regardless of the order of entry (EMQ $b^* = -0.16$, MSEQ $b^* = 0.16$). The final model accounted for 14.7% of the variance in face–name recall, $F(5, 99) = 3.42$, $p = .007$.

DISCUSSION

Although the idea that older adults often experience memory problems is well-accepted both in the scientific literature and popular discourse, there has been surprisingly little examination of how often such errors occur in everyday life or whether such errors have any relationship to laboratory task performance or feelings about one's own memory competence. We found that even in this sample of healthy, high-functioning older adults, minor everyday memory errors were reported with some frequency, and were most often in the verbal domain. The preponderance of verbal errors found here is consistent with the results reported by Sunderland et al. (1983) using a younger (16–65 years; mean age 35 years) sample of healthy and brain-damaged adults, as well as the general trends in their report using a sample of older adults (Sunderland et al., 1986). Errors related to reading and writing were especially prominent in the current sample, perhaps because it consisted of highly educated individuals likely to participate in activities that would expose them to the opportunity for such errors. Particularly striking is the preponderance of tip-of-the-tongue errors in all of these samples. Taken together, these results suggest first that the EMQ produces consistent results across different samples and second that tip-of-the-tongue errors are especially noticeable for all adult age groups, making them a potentially important target for training and remediation.

Notably, a search through the literature found only one training program targeted at reducing tip-of-the-tongue errors (Milders, Deelman, & Berg, 1998), suggesting that this is a neglected area in cognitive training research. In contrast, while many training programs aim to improve older adults' executive function (see Lustig, Shah, Seidler, & Reuter-Lorenz, 2009, for a review), we found that neither executive function nor processing speed correlated with reported memory errors. Training studies are often plagued by difficulties in showing reliable transfer and an impact of training on everyday life; a refocus to target training efforts on the problems older adults experience in everyday life rather than those that they exhibit in the laboratory might help to ameliorate this problem. In addition, comparing training programs targeting different cognitive processes (inhibition, lexical-phonological association) could help resolve debates as to the primary causes of such errors (Brown, 1991; Burke, McKay, Worthley, & Wade 1991).

Generally speaking, correlations between the laboratory measures and either the EMQ or MSEQ and their respective subscales were small and selective, replicating previous findings. Those correlations that did occur were

logically consistent; for example, high verbal ability measured by the ERVT appeared to provide some protection against errors on the Reading/Writing scale. An interesting pattern occurred for the EMQ Faces/Places subscale, which was correlated both with MMSE score and the laboratory measure of face–name recall; MMSE and face–name recall were also correlated ($r = .35$, $p < .0005$). The correlations between the Faces/Places subscale and laboratory face–name recall may occur because this is a case where laboratory conditions approximate daily life: even in the real world, names and their associations with particular people are rather arbitrary memoranda, and the demands to recall them often occur in non-supportive conditions. The correlations with MMSE suggest that memory for faces and names may be especially sensitive to potential cognitive decline even in this healthy, highly educated sample and could be an area of real-world memory that should be monitored in those at risk for cognitive impairment.

Although both the EMQ and MSEQ are self-report measures, they were not correlated with each other at either the total score or subscale level and multiple regression analyses showed that their contributions to variance in other tests were independent. This independence suggests a practically and theoretically important distinction between memory experience as measured by the EMQ and other methods that ask participants to record the errors that occur, and memory self-efficacy as measured by questionnaires such as MSEQ, MAC-S, MIA, and SMQ.

Several factors may contribute to the independence of these measures. As noted earlier, the MSEQ and other measures of self-efficacy focus on participants' beliefs about their memory abilities, often in unsupported situations, whereas the EMQ asks participants about the errors they actually experience. Self-efficacy ratings may be heavily influenced by general schemas about the self and general stereotypes about aging (Blair & Burton, 1987; Cook & Marsiske, 2006; Lineweaver & Hertzog, 1998). Interestingly, these stereotypes may also have a large impact on older adults' performance on standard laboratory tests (e.g., Hess, Auman, Colcombe, & Rahhal, 2003; Rahhal, Hasher, & Colcombe, 2001) and could serve as a source of common variance between laboratory test performance and measures of self-efficacy.

In contrast, both the type and frequency of memory errors that older adults actually experience may be more heavily influenced by the situations in which they put themselves and the environmental cues and supports they are able to make use of. As noted by Hess and Pullen (1996), although older adults endorse lower memory self-efficacy ratings and often perform poorly on laboratory memory tests, healthy non-demented older adults rarely complain that their memory difficulties interfere with their abilities to live independently and carry on the activities of everyday life. This may be due in part to an increased use of memory aids (e.g., Bouazzaoui et al., 2010; Lovelace & Twohig, 1990). Prospective memory is an especially salient

illustration of the importance of such memory aids: older adults often perform better than young adults in 'real-world' prospective memory tasks, where they can make use of such aids, but consistently worse than young adults in laboratory tasks that do not allow such aids (Henry, MacLeod, Phillips, & Crawford, 2004; Uttl, 2010). Spatial memory provides an example of how older adults' experience may buffer their memory performance: age differences in memory are much reduced and sometimes eliminated if the test involves a familiar spatial context (Gilbert & Rogers, 1999; Kirasic, 1991); notably, the same differential benefit to older adults does not occur if the materials are ecologically valid (Arbuckle, Cooney, Milne, & Melchior, 1994; Cherry & Park, 1993; Head & Isom, 2010; Zelinski & Light, 1988) but not familiar to the individual. In addition, normal daily life activities are typically not as resource-demanding as laboratory tasks, which are often designed to examine the limits of performance. As discussed in the introduction, this discrepancy in demand level may explain why previous investigations often find small or nonexistent correlations between laboratory tasks and real-world memory.

The present study has several limitations that should be kept in mind when considering the potential implications and generalization of its results. First, both the EMQ and MSEQ are self-report measures and ask about specific types of memory situations. Thus, the EMQ would conservatively be described as a measure of which errors participants notice and remember (rather than necessarily all those they make), and the MSEQ as a measure of people's beliefs rather than their actual capabilities; both may miss important areas of memory performance not included in their questions. New camera technologies that allow nonintrusive recording of everyday activities (e.g., St. Jacques, Conway, Lowder, & Cabeza, 2011) could provide richer data for future studies. In addition, it should be kept in mind that the errors that occur most frequently do not necessary reflect the areas of cognition most vulnerable to decline; whether the participant was in a situation providing an opportunity to make the error would also play a role. For example, the high volume of reading/writing errors in the current study may have been a by-product of our highly educated sample's tendency to engage in reading, writing, or other verbal activities rather than activities such as watching television. This would provide relatively more opportunities for those kinds of errors. On the other end of the spectrum, low rates of errors related to remembering new places and new routes or to learning new skills may be partially due to most participants not being exposed to situations where such new learning was required. The low error rates on some subscales may have contributed to their relatively low internal reliability, thus making it difficult to detect correlations between the subscales and other measures. A large-scale study that followed participants for a longer period of time, for example, through a weekly or monthly routine, could provide a more comprehensive

picture and may also allow for the empirical derivation of subscales with better psychometric properties.

Our sample is largely healthy and well-educated and likely not representative of those older adults whose memory problems are disruptive to everyday life. However, they are representative of the older adults who generally participate in research studies on cognitive training and who are likely to have the time and resources to invest in commercial or community-based programs. Likewise, the lack of a young adult comparison group is a limitation of the study, but young adults are much less likely to enroll in memory-training programs or to discuss memory concerns with their physicians. Notably, despite testing a wide age range (65–92 years, stratified in five-year subsets), we did not observe an increase in EMQ score with increased age. It is possible that the high status of our participants masked a relationship between chronological age and everyday memory errors. However, age was related to declines on laboratory tests and memory self-efficacy, making this 'super seniors' explanation less likely. Instead, aging individuals may use a combination of compensatory strategies, environmental supports, and careful choices about the situations in which they place themselves to reduce the likelihood that they will make memory errors (cf., Baltes, 1997). Interestingly, Garrett et al. (2010) recently found evidence suggesting that older individuals' exposure to stress in everyday life influenced the degree to which they engaged compensatory strategies to reduce everyday memory errors. The interactions between cognition, meta-cognition, and environmental factors in determining older adults' everyday performance and ability to maintain independent function are undeniably complex. However, as older adults make up a rising proportion of the population, from a public health standpoint the need for translational studies of these interactions is just as undeniable.

In summary, the present paper characterizes the everyday memory errors most frequently reported in a sample of healthy, high-functioning older adults typical of those who often participate in cognitive-aging studies. We hope that this information will be useful in the design and assessment of cognitive training programs and that it will stimulate further research about the potential utility of self-reported daily life memory errors in monitoring at-risk older adults for cognitive decline or memory impairment. Notably, although both the EMQ and MSEQ were related to cognitive status and a laboratory task using ecologically valid materials (face–name recall), their contributions were independent. The EMQ and similar inventories may be useful for determining which memory errors training programs should target, whereas the MSEQ and other measures of self-efficacy may help predict individuals' engagement in such programs and the degree to which they are likely to generalize skills trained in the lab to everyday life (Miller & West, 2010; West, Bagwell, & Dark-Freudeman, 2008). The ways in which age, real and self-perceived

ability, and life stress influence the type and frequency of errors and the use of compensatory strategies to avoid those errors remain important areas for future research to improve the quality of life for older adults.

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