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Measuring Memory Lapses and Their Impact on Daily Life: Results From Two Daily Diary Studies

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Abstract

Memory lapses (e.g., forgetting a medication) are common for most people, yet past methods of assessment relied upon retrospective reports from long recall windows. Recently, researchers have incorporated daily diary methods to capture memory lapse frequency closer to the experience in real-world environments. This study describes the utility of the *Daily Memory Lapses Checklist* using data from two 14-day diary studies (*Combined Sample* = 467; 66% women). Frequency and impact (i.e., irritation and interference) of prospective and retrospective memory lapses were assessed at both individual- and daily levels. Across studies, memory lapses occurred on more than one-third of assessment days. Retrospective lapses were reported more frequently than prospective; however, both lapses had a similar impact. The *Daily Memory Lapses Checklist* represents a flexible measure that separates the occurrence of a memory lapse from its impact on daily life: metrics that will enhance our understanding of daily experiences of cognitive functioning.

Keywords

memory lapses, everyday memory, prospective memory, retrospective memory, daily assessment, coordinated analysis

Self-report measures of memory functioning often require individuals to recall experiences with forgetting over long periods of time such as within the last year or even 5 to 10 years (see Rabin et al., 2015 for review). However, long recall periods make it difficult for people to remember specific experiences with forgetting. This can contribute to inaccurate and biased reports of real-world memory functioning and may be exacerbated in certain contexts or for individuals who have a poorer recall. Critically, ecologically valid measures are necessary to understand the frequency of memory problems as well as the impacts memory problems have on daily life. Furthermore, memory functioning in naturalistic settings, either frequency of memory lapses (experiences with forgetting that occur on a daily basis) or the most problematic lapses for daily functioning, may be more sensitive to non-normative difficulties in memory (e.g., changes due to illness or stress) among cognitively normal adults. The current article presents two daily diary studies that tested the feasibility and utility of a checklist assessing memory functioning in naturalistic settings for capturing two indices: frequency of memory lapses and the impact of daily memory lapses on irritation and interference with activities.

An overarching characteristic of the current approaches to assessing perceptions of memory is the use of measures that require retrospection across months or years either explicitly as part of the instructions or implicitly through the lack of a timeframe provided to the reporter (Broadbent et al., 1982; Gilewski et al., 1990; Rabin et al., 2015). Self-reports of memory functioning generated by these types of assessments are useful in identifying which individuals are more likely to experience declines in objective cognitive performance (Crumley et al., 2014), poorer psychological well-being (Hill et al., 2016), and difficulties with functional abilities (e.g., activities of daily living; Roehr et al., 2019). However, the predictive utility of self-reported memory functioning is inconsistent across studies (Hill et al., 2016) likely due, in part, to the fact that perceptions of memory over longer timeframes reflect some combination of broader self-schemas about one's memory and specific, recent experiences with memory (Cavanaugh et al., 1998; Hertzog & Dixon, 1994; Robinson & Clore, 2002a, 2002b).

Previous work demonstrates that when presented with longer recall periods (e.g., months or years), individuals

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tend to rely on semantic memory (e.g., their beliefs about themselves and their memory) rather than episodic memory (e.g., actual instances of forgetting; Robinson & Clore, 2002a, 2002b) Furthermore, beliefs about memory in general (i.e., memory always gets worse with age), and perceptions of one's strengths and weaknesses about memory in particular (e.g., "I'm not good at remembering names"), are strongly related to other constructs such as personality and psychological well-being (Hill et al., 2017; Koller et al., 2019), creating a report that is only partially influenced by current real-world experiences with memory. To better capture memory functioning that is separable from these various individual characteristics, assessments that focus on shorter timeframes and specific experiences with memory would provide a more accurate representation of how well an individual's memory is meeting the cognitive demands they encounter in daily life (Crumley et al., 2014; Ladouce et al., 2017). Daily diaries of specific experiences of memory problems (i.e., memory lapses) ask participants to report on memory functioning (e.g., forgetting) for the last 12 to 24 hr. These daily reports can provide a critical level of nuance to perceptions of memory functioning and decline compared with those captured by responses generated from assessments with longer timeframes. Daily reports capture experiences closer in time to a memory lapse to better approximate the nature and frequency of lapses. Previous work examining daily memory lapses has made use of diverse measures to capture these experiences, from single items (e.g., *did you forget your medication during the last 24 hours*; Neupert et al., 2011) to modified and adapted checklists. For example, the *Everyday Memory Failure Items* (Neupert et al., 2006, 2008; Whitbourne et al., 2008) uses a checklist format across a range of possible daily memory failures (e.g., did you go back to check whether you had done something you meant to do?). Importantly, daily assessment tools such as these have identified unexpected trends in memory functioning relative to objectively assessed memory performance. For example, in contrast to the typical age-associated declines in objective memory performance (Craik, 1994) even among normatively aging adults, daily assessments have found only small age differences in memory lapse frequency in naturalistic settings. However, previous assessments of daily memory functioning have focused on the frequency of memory lapses but not perceptions of the impact of the lapse on daily functioning. The current measure incorporates appraisals of the irritation and interference of memory lapses to identify the impacts of forgetting both across individuals and for different types of lapses.

The *Daily Memory Lapse Checklist* (Mogle et al., 2019) expands upon the strengths of existing daily measures of memory functioning (Neupert et al., 2006, 2008) and incorporates recommendations from work on assessment building for other types of daily experiences (e.g., daily stressors; Almeida et al., 2002). Individuals are presented with a checklist of possible items or actions that they may have forgotten on a given day. This format is intended to aid individuals in recalling specific instances of memory lapses rather than focusing on broad impressions about memory. Items were specifically sampled from lapses (e.g., *Memory Functioning Questionnaire* [Gilewski et al., 1990], *Everyday Memory Failures* [Neupert et al., 2006, 2008], and *Prospective Memory Questionnaire* [Hannon et al., 1995]) related to both prospective memory (i.e., memory for future actions) and retrospective memory (i.e., memory for past events or learned information). Prospective memory is thought to be integral to daily functioning as the cognitive ability that maintains, updates, and monitors our to-do list (Brandimonte et al., 1996). Retrospective memory functions in conjunction with prospective memory and is needed to recall previous experiences, events, or content for timely use (Unsworth et al., 2013).

An expansion from previous work assessing daily memory lapses (Neupert et al., 2006, 2008) is the integration of a measure of the perceived irritation and interference of the memory lapse. For their memory lapses, individuals report the extent to which the lapse irritated them or interfered with their daily activities. These questions are intended to qualify the degree of impact of the lapse on the participant's daily life (if any). Perceptions of how a memory lapse has impacted functioning may represent an important distinction among daily memory lapses. For example, forgetting a medication could cause irritation and concern about one's health, physical symptoms that disrupt daily activities, or both. In contrast, forgetting someone's name could result in irritation without interfering with an individual's routine. This format provides additional detail about the nature of the memory lapse and encourages participants to report separately about the occurrence of a memory lapse and the consequences of the lapse. These separable metrics of memory lapse frequency and the impact of the lapses on emotions and functioning that day can then be used to discriminate between types of memory lapses that occur infrequently but substantially impair well-being or functioning compared with those that occur frequently without such consequences. Distinguishing among types of lapses and their impact would provide a more fine-grained understanding of daily memory functioning and the lapses most likely to result in consequences.

Current Study

The overall goal of the present study is to examine the utility of the *Daily Memory Lapses Checklist* (Mogle et al., 2019) in two datasets that span a wide range of ages of cognitively intact adults. We examined our assessment for capturing the experience of memory lapses at two levels:

1. Individual-level tendencies in reporting memory lapses include average numbers of memory lapses and average levels of irritation and interference associated with lapses. To capture the frequency of lapses at the individual level, we computed the total number of days with memory lapses per person and the total number of individuals reporting memory lapses. To capture the impact of these lapses on individuals, we computed mean levels of irritation and interference across all lapses.
2. Details on the daily experience of memory lapses including the likelihood of different types of lapses, irritation, and interference of different types of lapses, and the most and least impactful lapses. To examine frequency at the daily level, we computed numbers of specific experiences with lapses across days. To examine the impact on daily well-being and functioning, we computed mean levels of irritation and interference for the specific lapses reported at the daily level.

The overarching goal of this research is to provide initial descriptive statistics and evidence of utility for a tool for capturing two indices of memory functioning in naturalistic settings: frequency of memory lapses and the perceived irritation and interference of memory lapses in daily life.

Research Design and Method

Participants

Samples were drawn from two studies of daily experiences of aging: the Effects of Stress on Cognitive Aging, Physiology, and Emotion (ESCAPE; Scott et al., 2015) and the Einstein Aging Study (EAS; Mogle et al., 2021; Zhaoyang et al., 2021). ESCAPE and EAS participants were recruited through systematic random sampling using Registered Voter Lists from the northeastern region of the United States and were repeatedly assessed every 12 to 18 months. The baseline 14-day daily assessments of ESCAPE (collected between May 2012 and January 2016) and EAS (collected between May 2017 and February 2020) were used in the current analyses. Participants were included if they had completed self-reported demographic information, were not classified as having mild cognitive impairment, and completed at least one daily survey containing the daily memory lapse checklist. All participants provided written consent to participate, and both the ESCAPE and the EAS studies were approved by the institutional review board at the Albert Einstein College of Medicine. The ESCAPE sample included 258 participants (age 25–65 years; $M_{years} = 46.53$, $SD = 11.02$; 65% women), and the EAS sample included 209 participants (age 70–93 years; $M_{years} = 76.85$, $SD = 4.94$; 67% women). For both ESCAPE and EAS, participants' educational attainment was categorized as: did not complete high school (1), completed high school or equivalent (i.e., GED; 2), other (i.e., Associate's Degree, Technical Degree, or some college experience without completion of degree; 3), and college degree or graduate education (4). See Table 1 for complete demographic information.

Study Design and Procedures

Data were collected as part of larger measurement burst studies using smartphone devices and recorded for 14 days. In both studies, participants completed several assessments during the course of the day (up to 5 assessments) as well as a morning survey and an evening survey. The evening survey was the only assessment that contained the memory lapse measure and is the target of the current analyses. In both EAS and ESCAPE, participants were given approximately 2 to 3 practice days to familiarize themselves with the study procedure and ask any questions before formal data collection began. These initial practice days were excluded from the analysis.

In ESCAPE, 2,953 evening surveys were completed of a total possible number of 3,612 (14 days multiplied by 258 participants), leading to average compliance of 81.76%. The average number of completed surveys was 11.45 (SD = 2.89, range 1–14). For EAS, 2,615 evening surveys were completed of a total possible number of 2,926, leading to average compliance of 89.37%. The average number of completed surveys was 12.28 (SD = 2.98, range = 1–14). There was a significant difference between ESCAPE and EAS in the number of completed surveys, $t(465) = 3.04$, $p < .01$, with participants in EAS completing approximately one additional survey on average.

Measures

Daily Memory Lapses Checklist

Frequency. Slightly different versions of the checklist were used in the two studies such that the checklist in ESCAPE contained 10 items, while the checklist in EAS contained 12 items (see Figure 1 for memory lapse items by study). In ESCAPE items reflecting retrospective memory were forgetting: *someone's name*, *where something was placed*, *a word during a conversation, something you wanted to remember*, or *"other."* Items on the prospective list included *finishing a task*, *completing an errand*, *taking medication*, or *attending a meeting or appointment*, and *why you entered a room*. The EAS study used an expanded version with three modifications to the prospective memory subscale: 2 new memory items (*bring something with you; make a phone call*) and an additional "other" category based on feedback from the study team.

Irritation and Interference Due to Memory Lapses. When participants reported experiencing a memory lapse, they

Table 1. Demographic Information Divided by Dataset.

Characteristics	ESCAPE (n = 258)	EAS (n = 209)
Age (in years)[a]	46.53 (11.02)	76.83 (4.94)
Education		
Less than high school, *n* (%)	16 (6.2)	7 (3.3)
High school, *n* (%)	46 (17.8)	88 (42.1)
Other, *n* (%)[b]	83 (32.2)	18 (8.6)
College degree and beyond, *n* (%)	113 (43.8)	96 (45.9)
Gender		
Women, *n* (%)	167 (64.7)	140 (67.0)
Men, *n* (%)	91 (35.3)	69 (33.0)
Race & Ethnicity		
White, *n* (%)	22 (8.5)	110 (52.6)
Black, *n* (%)	163 (63.2)	75 (35.9)
Hispanic, *n* (%)	63 (24.4)	22 (10.5)
Other, *n* (%)	10 (3.9)	2 (1.0)
Income		
Below US$19,999, *n* (%)	51 (19.8)	16 (7.7)
Between US$20,000 and US$30,000, *n* (%)	59 (22.9)	65 (31.1)
Greater than US$30,001, *n* (%)	124 (48.1)	123 (58.9)
Did not report/know, *n* (%)	24 (9.3)	3 (1.4)

Note. ESCAPE = Effects of Stress on Cognitive Aging, Physiology, and Emotion; EAS = Einstein Aging Study.
[a]Age range in ESCAPE was 25 to 65 years. Age range in EAS was 70 to 93 years. [b] Other includes Associate's Degree, Technical Degree, or some college experience without completion of the degree.

were prompted to indicate the level of irritation (*"How much did forgetting this bother you?"*) and interference (*"How much did forgetting this disrupt your activities today?"*). ESCAPE and EAS collected these follow-up items using a 0 (*Not at all*) to 100 (*A lot*) visual analog scale (VAS).

No Memory Lapse Balancing Items. In daily diary studies, best practices suggest including balancing items to prevent underreporting of experiences due to differences in participant burden (Smyth & Stone, 2003). That is, if participants report more events, they have to answer more questions about those events and might not report events to avoid these additional questions. To account for this in the current assessment, when participants did not report experiencing a prospective memory lapse that day they indicated what tools (e.g., notes, mental rehearsal, appointment book) they used to aid in remembering. When participants did not report a retrospective memory lapse, they were asked the likelihood of forgetting anything from the retrospective memory lapse list on the following day from 0 (*Not Likely*) to 100 (*Very Likely*).

Data Analysis

Analyses were completed in a series of steps. For descriptive analyses across individuals, the prospective and retrospective memory lapses occurrence items were separately aggregated into a frequency as the total number of memory lapses within each type as well as a binary indicator of any memory lapse for each type to estimate a count of days with lapses. For the continuous VAS scales, we computed average irritation and interference separately for each lapse experience and within each lapse type. We estimated the reliability of all summary variables using techniques recommended by Hox and colleagues (2017) for repeated measures data.

To address our first research aim about individual-level differences in reporting of memory lapse frequency and impact, we examined the number of participants reporting any memory lapse of either type as well as the number of days on which participants reported both types of memory lapses across all 14 days. We also examined average ratings of irritation and interference for each memory lapse type. Differences in average ratings across types were compared using paired *t*-tests to determine whether one type was considered more problematic than the other. We also computed correlations among our memory lapse indicators and age, gender, and education to determine whether there were demographic differences in frequency or impact.

We next described specific experiences with memory lapses to address daily-level differences. We examined the number of days with any memory lapse as well as the number of days with memory lapses of either type. At this level, we also probed the specific experiences of memory lapses to determine the most frequently reported items of each type of memory lapse, and the irritation and interference of specific

Memory Lapse Type	ESCAPE (10 Items)	EAS (12 Items)
Prospective	• To do an errand/chore • To take medication on time • To finish a task • To attend a meeting/appointment • **Why you entered a room**	• To do an errand/chore • To take medication on time • To attend a meeting/appointment • Why you entered a room • **To make a phone call** • **To bring something with you** • **Other**
Retrospective	• Someone's name • Where something was placed • **A word during a conversation** • **Something you wanted toremember** • Other	• Someone's name • Where something was placed • A word during a conversation • Something you wanted toremember • Other

Figure 1. Iterations and Modifications to Daily Memory Lapse Checklist by Study
Note. Items in bold indicate changes from the previous version of the checklist (i.e., Mogle et al., 2019).

Table 2. Daily Level Descriptive Results for ESCAPE.

			Irritation 0–100	Interference 0–100
Items	N_{days}	% of Total days	*M* (*SD*)	*M* (*SD*)
Prospective memory	705		52.33 (28.80)	36.98 (27.75)
To do an errand/chore	223	7.7	57.45 (27.90)	41.49 (27.79)
To take medication on time	164	5.7	54.95 (28.14)	41.08 (28.22)
To finish a task	267	9.3	58.88 (28.57)	44.65 (28.69)
To attend a meeting/appointment	85	3.0	70.06 (27.28)	53.79 (32.02)
Why you entered a room	256	8.8	52.34 (28.97)	38.39 (27.85)
Two or more prospective complaints (range 2–5)	185	6.4	64.99 (25.90)	50.87 (27.77)
Retrospective memory	889		51.47 (29.30)	34.00 (27.74)
Someone's name	239	8.1	54.69 (30.54)	39.09 (31.55)
Where something was placed	345	11.7	55.96 (29.44)	36.48 (28.18)
A word during a conversation	240	8.2	54.20 (31.38)	37.27 (31.27)
Something you wanted to remember	173	5.9	64.32 (28.21)	46.76 (30.60)
Other	271	9.4	56.34 (27.67)	40.03 (27.60)
Two or more retrospective complaints (range 2–5)	238	8.1	65.34 (27.30)	47.25 (30.33)

Note. Total number of daily assessments = 2,953. *ESCAPE* = ESCAPE = Effects of Stress on Cognitive Aging, Physiology, and Emotion

memory lapse items. To identify the most common memory lapse type among each subscale, Wilcoxon signed-rank tests were conducted. To determine the most irritating and interfering items, we used a mixed model to compare ratings within individuals across memory lapse types while accounting for missing data. Single degree of freedom contrasts were then used to compute specific comparisons among lapse types.

Finally, to provide details on our balancing items, we computed individual-level and daily-level descriptive statistics for the items presented on days when participants did not report a memory lapse. For prospective memory lapses, this was the frequency of the use of different types of memory aids. For retrospective memory lapses, this was a rating indicating the likelihood of forgetting items from that checklist the next day.

Results

ESCAPE Sample

Overall frequencies of memory lapses are reported in Table 2 along with means and standard deviations for impact ratings. Frequencies and ratings for each age decade appear in Table 3.

Reliability. Reliability for frequency of lapses was .77 for prospective memory and .73 for retrospective memory. Reliability for ratings of irritation was .90 for prospective memory lapses and .92 for retrospective memory lapses. Reliability for ratings of interference was .91 for both types of lapses. Reliability was .80 for the memory aids item and .89 for ratings of likelihood of forgetting something the next day.

Table 3. Average Memory Lapses and Daily Impacts Divided by Decade in ESCAPE.

Variables of Interest, *M* (*SD*)	25–29 Years (*n* = 21)	30–39 Years (*n* = 57)	40–49 Years (*n* = 60)	50–59 Years (*n* = 84)	60–65 Years (*n* = 35)
Prospective memory lapses	.12 (.24)	.37 (.59)	.37 (.58)	.30 (.40)	.48 (.68)
Prospective irritation	48.39 (20.21)	57.69 (26.22)	47.04 (25.50)	49.57 (23.23)	38.45 (20.00)
Prospective interference	24.38 (25.91)	38.31 (27.22)	36.27 (21.96)	30.77 (22.75)	23.47 (16.82)
Retrospective memory lapses	.15 (.24)	.42 (.66)	.46 (.69)	.40 (.50)	.64 (.71)
Retrospective irritation	35.69 (19.82)	53.24 (24.70)	50.32 (22.28)	46.50 (25.77)	47.21 (21.04)
Retrospective interference	18.41 (17.87)	33.44 (26.10)	35.15 (18.91)	28.58 (22.93)	27.08 (15.79)

Note. Prospective Memory Lapses ranged from 0 to 5, Retrospective Memory Lapses ranged from 0 to 5. For both RM and PM lapses, irritation and interference were scored from 0 to 100. ESCAPE = Effects of Stress on Cognitive Aging, Physiology, and Emotion; RM = retrospective memory; PM = prospective memory.

Table 4. Between-Person Correlations in ESCAPE and EAS.

Variables	1	2	3	4	5	6	7	8	9
1. Age (Years)		.014	.090	.089	−.195*	−.159*	.153*	−.056	−.067
2. Gender (0 = Women, 1 = Men)	−.126		−.051	−.198**	.025	.019	−.169**	.076	.028
3. Education [a]	−.079	−.032		.056	−.173*	−.145	.078	−.134	−.096
4. Prospective memory lapses	−.061	−.002	.077		.268***	.398***	.777***	.247**	.417***
5. Prospective irritation	−.036	−.030	.006	.237**		.652***	.196*	.710***	.560***
6. Prospective interference	−.049	.011	−.069	.287***	.694***		.325***	.609***	.798***
7. Retrospective memory lapses	.000	.078	.033	.749***	.180*	.266**		.199**	.331***
8. Retrospective irritation	−.010	−.071	−.089	.229**	.779***	.566***	.224**		.651***
9. Retrospective interference	.045	−.044	−.096	.340***	.644***	.834***	.354***	.696***	

Note. Correlations are Spearman's rho. EAS is presented below the diagonal and ESCAPE is present above the diagonal. ESCAPE = Effects of Stress on Cognitive Aging, Physiology, and Emotion; EAS = Einstein Aging Study.
[a]Education was coded as 1 (< High School), 2 (Completed High School), 3 (Other), and 4 (College and Beyond).
*< .05. ** < .01. *** < .001.

Individual-Level Descriptions of Memory Lapses. Among prospective memory lapses, on average, participants reported approximately 4 lapses across the 14 days ($M = 3.94$, $SD = 6.46$) with a range of 0 to 46 lapses reported in total. Of the 258 participants, $n = 82$ participants (31.8%) never reported experiencing a prospective memory lapse, while $n = 7$ participants (2.7%) reported experiencing a prospective memory lapse every day. We also examined correlations with age, gender, and education (significant correlations are highlighted in the text and all correlations are available in Table 4; ESCAPE above the diagonal) to determine whether there were any demographic differences in frequency. Women were more likely to report prospective memory lapses compared with men ($r = -.198$).

In ESCAPE, retrospective memory lapses were more frequently reported compared with prospective memory lapses ($Z = 4.71$, $p < .001$); participants reported approximately 5 lapses across the 14 days on average ($M = 4.95$, $SD = 7.42$; range = 0–46). More than a quarter of participants ($n = 74$; 28.7%) never reported a retrospective memory lapse, while $n = 15$ participants (5.8%) reported a retrospective memory lapse every day. Frequency of retrospective lapses was positively correlated with age ($r = .153$), and women were more likely to report lapses compared with men ($r = –.169$).

A subset of participants never reported experiencing memory lapses of either type throughout the 14 days ($n = 53$; 20.5%), and $n = 6$ participants (2.3%) always reported experiencing co-occurring retrospective and prospective lapse types on each assessment. Total counts of the two types of memory lapses were highly correlated (Spearman's $\rho = .78$, $p < .001$).

On average, prospective memory lapses were rated as 49.61 (out of 100; $SD = 23.75$) on irritation and 33.72 (out of 100; $SD = 23.52$) on interference; retrospective memory lapses were rated 49.08 ($SD = 23.85$) on irritation and 31.98 ($SD = 21.57$) on interference. No differences between impact ratings for lapse types were found in irritation, $t(153) = .37$, $p = .71$, or interference, $t(153) = 1.44$, $p = .15$. Because ESCAPE contained participants with a broad age range (i.e., ages 25–65 years), we also described our variables of interest by decade (see Table 3). Correlations with age indicated that as age increased, ratings of irritation and interference decreased but only for prospective memory lapses (rs = −.195 and −.159, respectively). Similarly, higher levels of education were

Table 5. Memory Lapse Balancing Items in ESCAPE and EAS.

Balancing items when no lapses reported	ESCAPE		EAS	
Reminder type—prospective lapses	N_{days} [a]	Frequency of use (%)	N_{days} [b]	Frequency of use (%)
List	200	8.9	328	14.6
Notes	188	8.4	198	8.8
Appointment book	142	6.3	407	18.1
Someone else	50	2.2	31	1.4
Rehearse	245	10.9	—	—
Familiar places	—	—	189	8.4
Smartphone alarm	—	—	111	4.9
Routine	—	—	224	9.9
Retrace steps	—	—	35	1.6
None	1,700	75.6	934	41.4
Two or more reminders	186	8.3	382	16.9
Likelihood of forgetting—Retrospective lapses	N_{days}	*M* (Day*SD*; Individual*SD*)	N_{days}	*M* (Day*SD*; Individual*SD*)
Likelihood of forgetting tomorrow (0–100)	2,056	24.85 (23.28; 17.72)	1,521	19.27 (20.36; 19.77)

Note. ESCAPE = Effects of Stress on Cognitive Aging, Physiology, and Emotion; EAS = Einstein Aging Study.
[a]Maximum number of responses for prospective lapse reminders in ESCAPE = 2,250. [b] Maximum number of responses for prospective lapse reminders in EAS = 2,254. For both prospective and retrospective items: questions were only asked if participants reported experiencing no memory lapses during the day.

associated with lower ratings of irritation for prospective memory lapses ($r = -.173$).

Daily-Level Descriptions of Memory Lapses. At the daily level, memory lapses were reported on 36.5% of assessments. A Wilcoxon signed-rank test found a significant difference in daily frequency between memory lapse types ($Z = 7.797$, $p < .001$): Prospective memory lapses occurred on 23.9% of days ($N_{days} = 705$) and retrospective memory lapses occurred on 30.1% ($N_{days} = 889$). On approximately 17.4% of days, participants reported experiencing both types of lapses ($N_{days} = 515$). The most common retrospective memory lapse was forgetting *where something was placed* (11.7%; Zs = 3.00 to 8.76, all ps $< .003$), and the most common prospective memory lapse was forgetting *to complete a task* (9.3%; Zs = 2.54 to 10.73, all ps $\leq .01$); however, this was not significantly different from forgetting why you entered a room (8.8%; $Z = .71$, $p = .48$).

Examining specific experiences of prospective memory lapses, forgetting *to attend a meeting or appointment* was rated as the most irritating ($M = 70.06$, $SD = 27.28$) and interfering ($M = 53.79$, $SD = 32.02$), although these differences were not significant (ps $> .09$). For retrospective memory lapses, forgetting *something you wanted to remember* was rated highest on irritation ($M = 64.32$, $SD = 28.21$) and interference ($M = 46.76$, $SD = 30.60$); both differences were significant (ps $\leq .001$). Although these specific items were the most impactful, they were also the least frequent in each type, representing 3% and 5.9% of lapses, respectively. In contrast, *why you entered a room* was the prospective memory lapse rated lowest on measures of impact ($M_{irritation} = 52.34$, $SD = 28.97$, $p = .02$; $M_{interference} = 38.39$, $SD = 27.85$, $p = .08$) and *a word during conversation* was rated lowest for retrospective memory ($M_{irritation} = 54.20$, $SD = 31.38$, $p = .78$; $M_{interference} = 37.27$, $SD = 31.27$, $p = .64$).

Memory Aids and Expectations. On days when participants did not report experiencing a prospective memory lapse, most said that they did not use a memory aid to assist in remembering ($N_{days} = 1,700$; 75.6%). The most common tools were to *mentally rehearse* (10.9%) or to *make a list* (8.9%; see Table 5). The least common tool to reduce the likelihood of forgetting a prospective lapse was *someone else* (2.2%). Regarding retrospective lapses, on average participants felt that the likelihood of forgetting something the following day was low ($M_{likelihood} = 24.85$); however, this demonstrated wide variability ($SD = 23.28$).

Given that individuals who report the fewest lapses will provide the most data on the memory aid and likelihood of forgetting items, we also compared individuals in the lowest and highest quartiles to determine whether patterns of reporting might be biased due to the dependence of these items (see Supplementary Table 1).[1] Endorsement of memory aids was similar across the quartiles except in "None." Participants in the lowest quartile were more likely to endorse that option (72% v. 17%). For the likelihood of forgetting rating, participants in the lowest quartile reported a lower likelihood of forgetting something the next day ($M = 26.14$ v. $M = 37.94$).

EAS Sample

Overall frequencies of memory lapses are presented in Table 6 along with descriptive information for impact rat-

Table 6. Daily Level Descriptive Results for EAS.

Items	N_{days}	% of Total days	Irritation 0–100	Interference 0–100
			M (*SD*)	*M* (*SD*)
Prospective memory	809		33.61 (26.68)	19.86 (20.42)
To do an errand/chore	83	3.2	37.96 (25.00)	26.31 (22.54)
To take medication on time	163	6.4	38.13 (28.53)	21.55 (19.54)
To attend a meeting/appointment	18	0.7	49.89 (31.33)	32.67 (30.11)
To make a phone call	185	7.1	35.10 (28.56)	19.98 (19.41)
Why you entered a room	199	7.8	25.59 (24.81)	12.42 (15.67)
To bring something with you	222	8.5	35.87 (26.29)	21.97 (20.23)
Do something else	243	9.5	38.47 (27.72)	23.21 (22.76)
Two or more prospective complaints (range 2–3)	244	9.3	38.17 (28.73)	21.97 (20.90)
Retrospective memory	1,034		33.85 (26.79)	20.22 (21.12)
Someone's name	339	13.3	30.61 (27.18)	17.46 (19.60)
Where something was placed	326	12.5	34.79 (26.91)	21.29 (21.60)
A word during a conversation	268	10.2	35.58 (27.78)	19.72 (20.17)
Something you wanted to remember	164	6.4	42.54 (27.01)	27.58 (22.62)
Other	269	10.5	37.09 (27.09)	24.02 (22.94)
Two or more retrospective complaints (range 2–4)	275	10.5	38.84 (28.93)	23.36 (21.46)

Note. Total number of daily assessments = 2,615. EAS = Einstein Aging Study.

Table 7. Average Memory Lapses and Daily Impacts Divided by Decade in EAS.

Variables of interest, *M* (*SD*)	70–79 Years (*n* = 155)	80–89 Years (*n* = 52)	90–93 Years (*n* = 2)
Prospective memory lapses	.47 (.57)	.38 (.50)	0
Prospective irritation	33.19 (22.81)	28.52 (20.99)	0
Prospective interference	19.66 (18.11)	15.86 (14.95)	0
Retrospective memory lapses	.56 (.56)	.52 (.49)	.18 (.11)
Retrospective irritation	33.09 (22.37)	32.25 (21.11)	0
Retrospective interference	18.87 (18.28)	18.78 (16.00)	2.00 (1.41)

Note. Prospective Memory Lapses ranged from 0 to 3, Retrospective Memory Lapses ranged from 0 to 4. For both RM and PM lapses, daily impact (i.e., irritation and interference) were scored from 0 to 100. EAS = Einstein Aging Study.

ings. Frequencies and ratings for each age decade are presented in Table 7.

Reliability. Reliability for frequency of memory lapses was .70 for prospective memory lapses and .62 for retrospective memory lapses. Reliability for ratings of irritation was .91 for both types of lapses while the reliability for interference ratings was .91 and .92, for prospective and retrospective memory lapses, respectively. Reliability was .74 for the reports of aid use and .96 for the ratings of likelihood.

Individual-Level Descriptions of Memory Lapses. On average, participants reported a total of approximately 5 prospective memory lapses (M = 5.35, *SD* = 6.75) with a range of 0 to 35. Across all 209 participants, $n = 50$ (23.9%) never reported experiencing a memory lapse over the 14 days, while $n = 8$ participants (3.8%) reported experiencing one prospective memory lapse every day.

Like ESCAPE, retrospective memory lapses were more frequently reported compared with prospective memory lapses in EAS ($Z = 4.03$, $p < .001$). On average, participants reported a total of approximately 6 retrospective memory lapses across the 14 days (M = 6.57, *SD* = 6.88; range 0–33). Some participants ($n = 35$; 16.7%) never reported a lapse, while $n = 12$ participants (5.7%) reported one retrospective memory lapse every day.

A subset of participants never reported experiencing memory lapses of either type throughout the 14 days ($n = 27$; 12.9%), while only $n = 5$ participants reported experiencing both types of lapses at every prompt (2.4%). Total numbers of memory lapses were highly correlated across types (Spearman's $\rho = .75$, $p < .001$).

On average, prospective memory lapses were rated as 32.75 (*SD* = 22.25) on irritation and 18.92 (*SD* = 17.48) on interference; retrospective memory lapses were rated 34.12 (*SD* = 22.66) on irritation and 20.35 (*SD* = 17.75)

on interference. No differences between lapse types at the individual-level were found in irritation, t (151) = 1.14, p = .26, or interference, t (151) = 1.66, p = .10. We described trends in memory lapses or ratings of daily impact by decade in EAS (see Table 7); all correlations with age, gender, and education were non-significant (ps > .05).

Daily-Level Descriptions of Memory Lapses. Participants reported memory lapses on 47.9% of assessments. A Wilcoxon signed-rank test found a significant difference in daily frequency between memory lapse types (Z = 8.757, p < .001): Prospective memory lapses occurred on 31.7% of assessments (N_{days} = 809) and retrospective memory lapses occurred on 39.5% (N_{days} = 1,034). In approximately 22.5% of surveys, participants reported experiencing both retrospective and prospective memory lapses on the same prompt (N_{days} = 588), suggesting that it was not uncommon to experience multiple types of forgetting during the same 24-hr period. Within each memory lapse subscale, the frequency of specific lapse types was unequally distributed as determined by an omnibus Friedman test, prospective lapses: $\chi^2(4)$ = 275.111, p < .001; retrospective lapses: $\chi^2(4)$ = 81.602, p < .001. To identify the most common memory lapse type among each subscale, post hoc Wilcoxon signed-rank tests were conducted. The most common retrospective lapses were forgetting *someone's name* (13.3%; Zs = 2.99 to 8.33, ps < .003) and *where something was placed* (12.5%), which were not significantly different from each other (Z = .55, p = .59). Among prospective lapses, the most common lapse, aside from the "other" category, was forgetting to bring something with them (8.5% of occasions; Zs = 1.96 to 13.17, ps < .05); however, this was not significantly different from forgetting why they *entered a room* (7.8%; Z = 1.207, p = .28).

Examining specific experiences of prospective memory lapses, forgetting *to attend a meeting or appointment* was rated as both the most irritating (M = 49.89, SD = 31.33, p = .28) and the most interfering (M = 32.67, SD = 30.11, p = .21). For retrospective memory lapses, forgetting *something you wanted to remember* was rated highest on irritation (M = 42.54, SD = 27.01, p = .06) and interference (M = 27.58, SD = 22.62, p = .34). In contrast, *why you entered a room* was the prospective memory lapse rated lowest on measures of irritation and interference ($M_{irritation}$ = 25.59, SD = 24.81, p = .33; $M_{interference}$ = 12.42, SD = 15.67, p = .36) and *forgetting someone's name* was rated lowest for retrospective memory ($M_{irritation}$ = 30.61, SD = 27.18, p = .003; $M_{interference}$ = 17.46, SD = 19.60, p = .04).

Memory Aids and Expectations. On days when participants did not report experiencing a prospective memory lapse over one-third of participants reported not using a memory aid (N_{days} = 934; 41.4%). The most common memory aids were an *appointment book* (18.1%) or to combine memory aids and use two or more (i.e., *smartphone alarm* and *list*; 16.9%). The least common memory aid was *someone else* (1.4%). On days when participants did not report a retrospective memory lapse, participants rated the likelihood of forgetting something the following day was low ($M_{likelihood}$ = 19.27, SD = 20.36).

We also compared individuals in the lowest and highest quartiles on the frequency of memory aid endorsement and the likelihood of forgetting the next day (see Supplementary Table 2). Participants in the lowest quartile were more likely to select "None" or two memory aids relative to participants in the highest quartile (None: 37% vs. 6%; Two or more: 25% vs. 7%). Participants in the lowest quartile also rated their likelihood of forgetting the next day lower than participants in the highest quartile (M = 15.3 vs. M = 40.29).

Discussion

The current study examined the utility of a measure of memory lapses for the assessment of naturalistic memory functioning. We also provided examples of the types of information generated across two datasets that included adults without objective cognitive impairment. Using a checklist format, we examined the likelihood of memory lapses across individuals as well as across days. As an extension of previous work, we investigated the self-ratings of the impact of daily memory lapses in terms of the irritation attributed to a lapse as well as the extent to which lapses were perceived as interfering with daily activities.

Most individuals reported at least one memory lapse across the 14-day period although a subset of individuals (20.5% and 12.9% in ESCAPE and EAS samples, respectively) reported no lapses. The lack of reports may reflect a key issue in reports of memory functioning more generally: lack of awareness of a memory lapse (Cavanaugh et al., 1998; Rabbitt & Abson, 1990). Some memory lapses go unnoticed until individuals are reminded about a particular activity or until they need the item that has been misplaced (Cavanaugh et al., 1998). Awareness of forgetting is typically associated with substantial cognitive deficits such as those in mild cognitive impairment or Alzheimer's disease (Silva et al., 2016) yet can impact cognitively intact individuals (such as those in the current study) to some extent, given the high number of daily cognitive demands people tend to face (Festini et al., 2016). Although the *Daily Memory Lapses Checklist* is designed to aid in identifying possible lapses, underreporting remains a potential concern for understanding the frequency of memory lapses in daily life. Although reporting just over the past 8 to 12 hr as waking likely improves the recollection of experiences that occurred that day, lapses earlier in the day may not rise to the level of importance for recollecting and reporting by the end of the day.

For the daily reports of lapses, retrospective memory lapses were reported on more days relative to prospective memory lapses in both datasets. This is consistent with previous work examining daily memory lapses (Mogle et al., 2019; Scott et al., 2020). The previous theorizing on prospective memory has proposed that these types of demands (i.e., remembering to do something in the future) would be more common in daily life (McDaniel & Einstein, 2007). A likely reason for the disconnect between the presumed frequency of the demand and reported prospective lapses is akin to the awareness issue noted earlier at the individual level. Even at the daily level, individuals may not realize they have forgotten to do something until they receive a reminder of the missed task later. For example, receiving a bill for a missed doctor's appointment might be the first reminder someone has of the appointment (and therefore the lapse). On a daily basis, retrospective memory lapses may stand out in that needed information or items are not readily accessible and are immediately obvious as forgotten. This likely also affects the appraisals of lapses in daily life. Lapses that are not noticed and reported immediately may have greater impacts when they finally are detected. Future work could examine the timing of the lapse relative to the report to better understand how when the lapse occurred differs from when the lapse was noticed by the individual.

Importantly, a key feature of the daily memory lapses measure described in the current article is the potential to create separate indices of the frequency of memory lapses and the impact these lapses have on an individual's daily emotions and functioning. As evidence for the ability of individuals to discriminate between frequency and impact, we identified forgetting *a meeting* and forgetting *something you wanted to remember* as least common types of prospective and retrospective memory lapses, respectively, across both datasets. However, despite being least likely to occur, these types of events were rated as among the most impactful, suggesting that when a lapse of this type happened it led to worse outcomes for the individual. Using a traditional measure of self-reported memory functioning, individuals may only report the frequency of these events, which would indicate a lower likelihood of memory lapses (Gilewski et al., 1990; Hannon et al., 1995) and imply lower importance of these types of experiences. Our results provide initial evidence for the timing of emotional (i.e., irritation) and functional (i.e., interference) impacts of memory lapses. Although previous work has established that individual differences in depressive and anxiety symptoms correlate with poorer memory functioning (Hill et al., 2016), the direction and timing of that relationship remain unclear. The current study begins to establish the impacts of specific difficulties with memory functioning when those difficulties occurred. The addition of the ratings of impact allows better triangulation of the appraisal of memory lapse events as problematic for daily functioning. The impact of lapses can be quantified at the individual level (i.e., people who experience greater irritation or disruption relative to others) as well as at the daily level (i.e., on days when an individual experiences greater irritation or disruption relative to days without) to provide indicators of how often impactful lapses occur as well as whether these impacts predict other experiences (e.g., daily stressors; Almeida, 2005). An important caveat is the dependence of impact and frequency. Memory lapses that are too minor to have any impact (emotional or functional) may go completely unnoticed and unreported, resulting in the underrepresentation of these types of lapses in daily reports. Additional work is needed to understand how well individuals are able to separate identification of memory lapses (i.e., how often they occur) from their impact.

Future studies using this checklist might consider modifications to address some issues noted. First, despite the high compliance in our datasets (>81%), participants were not prompted to complete the assessment at the end of each day, and missed surveys might reflect another form of memory lapse. Future work using this measure would benefit from including a prompt to ensure participants complete the survey at the expected time and reduce the cognitive burden of remembering to complete the survey in addition to remembering their other experiences from earlier in the day. Second, approximately 10% of lapses were indicated as "other" or "something else." This suggests that individuals are experiencing and recalling experiences with memory lapses that are not adequately captured by the current measure. Qualitative work would aid in the identification of these missing experiences so that we can better differentiate among the reported lapses (Arigo et al., 2021; Hill et al., 2019). Finally, the current items cannot capture changes in memory functioning from earlier points in time or within days. The memory lapses assessed in the current 2-week period represent a snapshot of memory functioning for an individual within their given context. Participants could complete another round of daily diaries to determine whether there is an increase in the frequency of memory lapses or in the irritation and interference of lapses over time but whether this measure will be sensitive to those changes remains unclear. Similarly, this type of checklist could be incorporated into more intensive protocols (e.g., ecological momentary assessments) to examine trends in forgetting throughout the day. Previous work suggests forgetting is more likely to occur during transition periods (e.g., going from home to work) which could be interrogated with an intensive design. In addition, including more assessments would likely capture more lapses closer in time to their occurrence for more accurate recollection and reporting.

Strengths and Limitations

The current study presents an innovative measure of daily memory lapses administered to two different samples of adults from across the lifespan. However, there are important

limitations to consider in interpreting these data. First, both samples were recruited from the same general area (Bronx, NY). While these samples are more diverse than is typically found in work examining naturalistic memory functioning, they do not represent the full range of experiences that might be important for understanding memory lapses. The ESCAPE study did include at least 60% Black participants improving on the representation in previous work; however, additional work is needed to examine the current measure in other, larger, and diverse samples to better understand the normative frequency and impact of memory lapses. As noted earlier, the current measure was embedded in a larger study on aging that did not include a prompt for the end-of-day survey. This is important as those with poorer memory functioning may be more likely to forget to complete the end-of-day survey leading to underreporting of lapses, particularly given that the survey with this item was unprompted. Another limitation is the identified bias in the reporting of memory aids and the likelihood of forgetting the next day. Individuals reporting fewer lapses were also more likely to report using no memory aids and a lower likelihood of forgetting the next day. These could represent response biases: Individuals who feel their memory is "good" are less likely to endorse lapses or use of memory aids and forget in the future. Future work could separate these items from the lapses checklist to examine this trend more rigorously. Finally, the checklist format of the measure means that more traditional psychometrics (e.g., Cronbach's α) are not recommended. Instead, we provide modified measures of reliability as appropriate for repeated measures assessments that include binary outcomes (Hox et al., 2017).

Despite these limitations, there are several strengths to our study assessing naturalistic memory functioning using daily memory lapses. The results were strikingly similar across two samples of adults from across the lifespan. This suggests that memory lapses are a daily experience that is common and that these lapses have a noticeable, measurable impact on everyday functioning. To that end, checklists like these would be a useful addition to projects using daily diaries to understand daily hassles or daily functioning. Memory lapses appear to be one among many experiences that can have an immediate impact on emotional states (Mogle et al., 2019), and the current data suggest they are perceived to disrupt activities as well. The assessment is also brief (~1 min) making it easy to integrate into other protocols for understanding daily experiences. Another strength is the separation of the frequency of a memory lapse from irritation and interference attributed to the lapse. Allowing participants to make a distinction between how often memory lapses occur and impact may encourage reporting: Participants are able to acknowledge they experienced a lapse while being able to indicate that the lapse did not significantly interfere with their daily life. This may reduce the stigma of reporting experiences in which memory has failed that could be interpreted as threatening for some individuals.

Conclusion

Examination of the daily experience of memory functioning is still being refined, as researchers progress from reliance on retrospective measures to daily assessments. The current study presents a key extension of this work by examining a memory lapse measure in two daily diary studies that quantify the frequency of prospective and retrospective memory lapses. This measure also extends previous work to assess the impact of these experiences to identify the types of memory lapses with the greatest emotional (i.e., irritation) and functional (i.e., interference) outcomes. Establishing the types of lapses that are associated with poorer everyday outcomes also provides a preliminary step toward classifying which individuals may be prime targets for memory interventions and importantly, at what times. Given the ubiquity of cognitive demands in daily life, and the breadth of conditions that impact memory functioning, there is a need for brief and temporally sensitive measures of capturing these constructs in naturalistic settings. We were able to establish the utility of this measure for capturing a range of memory lapses and their impacts in two different samples, providing foundational evidence for the *Daily Memory Lapses Checklist* as a tool for use in daily diary studies.

Authors' Note

The EAS and ESCAPE datasets are available from the Albert Einstein College of Medicine (https://www.einstein.yu.edu/departments/neurology/clinical-research-program/eas/data-sharing.aspx and http://www.einstein.yu.edu/departments/neurology/clinical-research-program/escape/data-sharing.aspx, respectively). Data are available under reasonable request with permission of the Principal Investigators of EAS and ESCAPE, as well as their affiliated organizations.

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Supplemental Material

Supplemental material for this article is available online.

Note

1. We thank a reviewer for pointing out this potential bias and suggesting this comparison.

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