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Experimental Aging Research

An International Journal Devoted to the Scientific Study of the Aging Process

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/uear20

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To cite this article: Jared F. Benge, Alyssa Aguirre, Michael K. Scullin, Andrew Kiselica, Robin C. Hilsabeck, David Paydarfar, Edison Thomaz & Michael Douglas (2023): Digital Methods for Performing Daily Tasks Among Older Adults: An Initial Report of Frequency of Use and Perceived Utility, Experimental Aging Research, DOI: 10.1080/0361073X.2023.2172950

To link to this article: https://doi.org/10.1080/0361073X.2023.2172950

Published online: 05 Feb 2023.

EXPERIMENTAL AGING RESEARCH
https://doi.org/10.1080/0361073X.2023.2172950

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RESEARCH ARTICLE

Digital Methods for Performing Daily Tasks Among Older Adults: An Initial Report of Frequency of Use and Perceived Utility

Jared F. Benge[a,b], Alyssa Aguirre[a,b], Michael K. Scullin[c], Andrew Kiselica[d], Robin C. Hilsabeck[a,b], David Paydarfar[a,b], Edison Thomaz[e], and Michael Douglas[f]

[a]Department of Neurology, University of Texas at Austin, Austin, TX, USA; [b]Mulva Clinic for the Neurosciences, University of Texas at Austin, Austin, TX, USA; [c]Department of Psychology and Neurosciences, Baylor University, Waco, TX, USA; [d]Department of Health Psychology, University of Missouri, Columbia, MO, USA; [e]Department of Electrical and Computer Engineering, University of Texas at Austin, Austin, TX, USA; [f]Georgetown Neuroscience Foundation, Georgetown, TX, USA

ABSTRACT

Objective: Digital technologies permit new ways of performing instrumental activities of daily living (iADLs) for older adults, but these approaches are not usually considered in existing iADL measures. The current study investigated how a sample of older adults report using digital versus analog approaches for iADLs.

Method: 248 older adults completed the Digital and Analog Daily Activities Survey, a newly developed measure of how an individual performs financial, navigation, medication, and other iADLs.

Results: The majority of participants reported regularly using digital methods for some iADLs, such as paying bills (67.7%) and using GPS (67.7%). Low digital adopters were older than high adopters ($F(2, 245) = 12.24$, $p < .001$), but otherwise the groups did not differ in terms of gender, years of education, or history of neurological disorders. Participants who used digital methods relatively more than analog methods reported greater levels of satisfaction with their approach and fewer daily errors.

Conclusions: Many older adults have adopted digital technologies for supporting daily tasks, which suggests limitations to the validity of current iADL assessments. By capitalizing on existing habits and enriching environments with new technologies, there are opportunities to promote technological reserve in older adults in a manner that sustains daily functioning.

ARTICLE HISTORY
Received 21 July 2022
Accepted 22 January 2023

Introduction

The last 60 years have witnessed unprecedented changes in digital technologies, marked initially with the advent of personal computers, followed by consumer-focused high-speed internet, and more recently the smartphone revolution (Figure 1). These technologies have dramatically altered how individuals can approach day-to-day activities, such as making payments, navigating, and managing personal tasks. Within neuropsychology, the digital revolution has largely been met with a focus on developing computerized cognitive assessments (Bauer et al., 2012; Sternin, Burns, & Owen, 2019; Wild, Howieson, Webbe, Seelye, &

CONTACT Jared F. Benge jared.benge@utexas.edu Health Discovery Building,1601 Trinity St. Building B, Austin, TX 78712

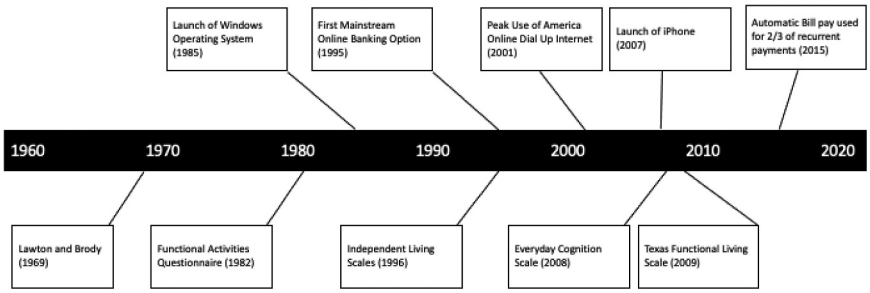

Figure 1. Timeline of development of activities of daily living instruments relative to digital technology advancements.

Kaye, 2008) and capturing digital biomarkers of cognitive decline (Kourtis, Regele, Wright, & Jones, 2019). With notable exceptions, the impact of technological advances on *how* older adults perform daily tasks has garnered relatively less research focus (Czaja, Kallestrup, & Harvey, 2020; Malinowsky et al., 2017; Malinowsky, Almkvist, Kottorp, & Nygård, 2010; Rogers, Mitzner, & Bixter, 2020). This may be a barrier for those who perform research and clinical practice in older adults with known or suspected neurodegenerative disease as valid assessments of instrumental activities of daily living (iADL) are critical for making diagnostic distinctions (Albert et al., 2011). Further, capturing patient-centered outcomes such as perceived independent functioning (Jennings et al., 2017) and demonstrating real-world impact of treatments on day-to-day functioning are valued and necessary for regulatory agency approval of therapeutics (Health and Human Services Food and Drug Administration, 2018). Dated or invalid instruments would hinder these goals.

The distinction between approaches to daily tasks commonly queried in existing iADL assessments and technological approaches can be illustrated by considering both the timeline of instrument development and the content of core measures used in the assessment in neurodegenerative disease research and clinical care. In Figure 1, the dates of publication for several iADL measures still commonly used in neurodegenerative research and clinical practice are contrasted with major technological milestones. As can be readily observed, some measures such as the Lawton and Brody (Lawton & Brody, 1969) and Pfeffer Functional Activity Questionnaire (FAQ; (Pfeffer, Kurosaki, Harrah, Chance, & Filos, 1982) scales were developed four to five decades ago, preceding the development of modern smartphone technologies and internet use. While older adults have traditionally lagged beyond other portions of the population with digital adoption, a subset of older adults are crossing the digital divide as indicated by a relatively high and increasing adoption of digital technologies amongst some older adults (Research Center, 2021).

As a corollary, Table 1 contrasts selected item content from iADL measures and modern approaches. The distinctions are perhaps most obvious for financial management. Many existing iADL measures focus on methods of performing financial tasks by assessing writing paper checks, paying bills via mailed in paper forms, or counting paper and coin currency. Our clinical experience is that many older adults and family informants report that most bills are on auto-pay and most purchases are handled via credit card. In a similar vein, map reading is another queried area in common iADL measures. However, this skill may be infrequently utilized if individuals regularly use global positioning system (GPS)

Table 1. Contrasts between commonly assessed methods vs. digital methods for performing daily tasks.

Daily Task	Commonly Assessed Method	Potential Digital Method
Financial Management	Counting currency	Credit card management
	Check writing	Automatic payments
	Reading a paper bill	Accessing online statements
Navigation	Reading a paper map	Utilizing a GPS system
Communication	Looking up a number in phonebook	Finding a number online
	Making a phone call	Sending a text message
Shopping	Store-based	Online retailer
Cooking	Using a stove	Using a microwave
Media Consumption	Newspaper	Website or social media
Managing appointments and to-dos	Written lists	App based system
	Written calendar	Digital calendars

technologies (Benge, Artz, & Kiselica, 2020). Thus, iADL measures may need modification to match the evolving technological landscape in use by some individuals.

In addition to implications for the ecological validity of iADL assessments, clinicians and researchers should also consider how a technologically enriched environment may present a double-edged sword for older adults (Lindqvist et al., 2018), particularly those with cognitive impairment. On the one hand, technologies may prevent errors, mistakes, and promote independence for complex activities (Benge & Scullin, 2022; Scullin et al., 2021). For example, an individual whose level of cognitive impairment would prevent them from remembering to mail paper checks on a certain date may be able to minimize financial errors by relying on automatic bill pay methods (Jones, Benge, & Scullin, 2021). The idea that technological skills and enriched environments may allow individuals to function longer and more independently in the face of neurodegenerative disease is at the core of our recently developed technological reserve hypothesis (Benge & Scullin, 2020; Wolff, Benge, Cassel, Monin, & Reuben, 2021). On the other hand, older adults may find digital technologies too complicated or frustrating to use. If so, then some older adults could perceive themselves as having worsened overall functional decline and make more errors in daily tasks than they would if they relied on traditional or analog approaches (e.g., mailing paper checks, paper to-do lists; Malinowsky et al., 2017). Thus, by failing to consider the technological environment as a potential facilitator and barrier for daily technology, additional heterogeneity is introduced into conceptual, research, and clinical decisions related to neurodegenerative disease.

In the current study, we consider two broad issues to advance understanding of the real-world impact of digital technologies on performance in daily activities amongst older adults:

Aim 1: For those older adults that have access to technologies such as computers and internet, we seek to describe how they are employing digital methods to perform iADLs and to explore demographic factors related to using such approaches.

Aim 2: We also sought to explore if digital approaches to managing day-to-day tasks lead to an increase or decrease in perception of daily task errors and satisfaction with task performance.

Method

Recruitment and Sample

Adults over the age of 65 ($N = 248$) completed a survey on digital and non-digital approaches to completing activities of daily living. See Table 2 for demographic

information. Most of the study volunteers came from the Georgetown Neuroscience Foundation (www.georgetownneurosciencefoundation.org) which is a nonprofit organization in Georgetown, TX that is collaborating with academic institutions on studies of brain health in aging populations. Volunteers in this organization reviewed study materials to ensure understandability and usability prior to launching the study. Volunteers were recruited via word-of-mouth, listservs, and web postings of IRB approved recruitment material. Data were collected from April 1, 2021 to July 31, 2021 with REDCAP electronic data capture tools (Harris et al., 2009, 2019). All study activities were reviewed and approved by the institutional review board at The University of Texas at Austin and were conducted in accordance with the Helsinki Declaration.

Measures

Demographic and Self-Reported Health Data. Age was calculated from birthdate provided by participants at study enrollment and participants completed a questionnaire covering demographics and medical history. These questions included self-reported race/ethnicity, educational attainment, and gender. Pertinent to the current study, individuals were asked if they had a history of neurological disorders which could impact cognition, specifically querying for prior diagnoses of mild cognitive impairment or dementia, movement disorders, stroke/transient ischemic attack, or moderate-to-severe traumatic brain injury. Given that these conditions were self-reported and not verified with medical records, we use the term "self-reported central nervous system (CNS) disorder" as a general grouping for individuals with these self-reported diagnoses.

Digital and Analog Daily Activities Survey (DADAS). The DADAS was designed to capture self-reported methods of performing eight iADLs: managing appointments, navigating unfamiliar places, managing lists of things to get or do, managing medications and supplements, managing bills and finances, checking bank and financial statements, making purchases/payments, and shopping. DADAS items are presented in Appendix 1.

A number of approaches for performing the iADL were queried based upon the authors' (JB, AK, MKS) experience working with older adults in clinical and research settings. These approaches included *digital methods* (e.g., online bill pay, digital calendars, etc.), *analog*

Table 2. Descriptive data for the sample and overall self-reported satisfaction with and errors in daily activities ($n = 248$).

Variable		%	Mean	SD
Age			75.34	5.37
Education			16.78	2.00
Gender	Female	52.8		
Race and Ethnicity	Non-Hispanic White	96.8		
At Risk for Neurocognitive Disorder-Total		21		
Reported history of:	Dementia or MCI	4		
	Stroke, TIA, or Brain Tumor	7.3		
	Moderate to Severe TBI	2.4		
	Movement Disorder	9.7		
Perceptions of:	Errors in Daily Activities (1= Never, 5= Very Often)		1.97	0.53
	Satisfaction with Systems for Managing Daily Activities (1= Very Dissatisfied, 5 = Very Satisfied).		4.44	0.52

Note: Errors in daily activities rated on a scale from 1=Never to 5 = Very Often; Satisfaction with strategies for managing daily activities rated on a scale from 1=Very Dissatisfied to 5 Very satisfied.

methods (i.e., using an external tool that does not involve digital technologies such as written to-do lists or paper maps), *other-centered methods* (i.e., relying on someone else to manage finances or bills), or *no external aide methods* (i.e., relying on their own navigational abilities rather than GPS). In addition, for managing medications, information on pill box use and direct-from-bottle medication use were collected, through this information did not group directly into one of the four method types described above.[1]

Participants rated their use of each method of performing an iADL on a scale from 1 (Never) to 5 (Always or Very Often) with one item per each approach. In addition to method of task performance, participants self-reported their errors in a given iADL (as opposed to rating errors with each approach) on a scale of 1 (Very Often) to 5 (Never). Finally, participants rated their satisfaction with their chosen method for task completion on a scale of 1 (Very Satisfied) to 5 (Very Dissatisfied); satisfaction and error scores were also recoded so higher scores equate to more satisfaction and more errors.

Analytic Plan

Two approaches were taken to characterize participants' methods for performing a given iADL. The first approach was to determine the *most frequently used method* (rated as "usually" or "always") for each iADL domain; for example, if someone needed to keep track of an appointment, would they usually reach for a written or digital calendar? We coded the most frequently used method as being digital, analog, hybrid of digital and analog, or other. We noted that some individuals frequently used GPS in their vehicle or in an app; to ease interpretation, frequent use of either of these GPS items were combined for subsequent analysis. The total number of digital and digital hybrid approaches across iADL domains was summed, and participants were divided into high (upper 25%), middle (25^{th} to 75% percentile of use), or low (lower 25^{th} percentile) digital adopters (cf. to continuous data approach described below). This approach allowed for evaluation of how demographic factors influenced those who are unambiguously frequent adopters of digital techniques vs. those that employee few digital techniques. Chi-square tests of independence were used for categorical data, and one-way analyses of variance for continuous data were used to compare demographics of high, middle, and low digital adopters.

The second approach was to consider *relative digital preference* for performing iADL tasks. This approach has the strength of allowing for continuous variable comparisons with demographic factors as well as preserving variability in the data. The relative digital preference approach involved subtracting frequency of use for analog approaches in a given iADL from its respective digital approach (i.e., higher number represent greater reliance on digital methods). The following item pairs were evaluated: managing appointments (electronic vs. written calendar), navigating unfamiliar places (GPS in car or app vs. paper maps), managing lists of things to get or to do (app versus written list), managing bills (autobill pay versus checking mail and sending checks), checking bank and financial statements (online versus paper), making purchases/payments (credit cards versus checks), and shopping (online versus in stores). The relative digital preference scores across these tasks was averaged each participant. The relationship between demographic and relative digital preference was evaluated with correlations and *t*-tests as appropriate.

For comparisons of satisfaction and perceived errors in daily tasks between digital and non-digital method users (Aims 2), we conducted independent samples *t*-tests and

Table 3. Self-reported frequency of various approaches to managing daily activities.

	Digital Approach			Analog Approach			Other Centered Approach			No External Aide Approach		
Domain	Item	Mean	SD	Item	Mean	SD	Item	Mean	SD	Item	Mean	SD
Managing Appointments	Electronic Calendar	3.52	1.56	Written Calendar	3.38	1.65	Reminders from Others	1.66	0.90	Self, No System	1.86	1.03
Managing Lists of Things to Get and to Do	To Do App	2.44	1.38	Written List	4.09	1.03	Someone Else Reminds Me	1.86	0.88	Rely on Own Memory	3.05	0.91
Navigating to Unfamiliar Places	GPS-Phone	3.56	1.12	Paper Maps	2.11	0.99	Rely on Others	1.96	0.80	Ask Directions and Memorize	2.15	1.12
	GPS-Car	2.87	1.38							Rely on Own Ability	2.32	1.07
Managing Medications And Supplements*	Use alarm or timer	1.44	1.00				Someone else reminds	1.20	0.57	Rely on own memory*	3.83	1.54
Paying Bills and Finances	Automatic Bill Pay	3.75	0.99	Get Bills in Mail and Pay with Check	2.27	0.91	Someone else pays bills	1.60	1.17			
	Pay Bills Over Phone	1.59	0.71									
Checking Bank and Financial Statements	Online	4.19	1.15	Paper copies	2.93	1.48						
	Over phone	1.67	1.03									
Making purchases	Credit/Debit Cards	4.11	0.51	Paper Money and Coins	2.38	0.64						
	Mobile App	2.09	1.07	Write Checks	1.94	0.62						
Location for Shopping	Online	3.40	0.73	In Stores	3.22	0.65						
	Over Phone	1.89	0.77									

Note: Frequency of use was rated on a scale from 1 (never) to 5 (always); *For medication/supplement management, approaches that do not fit directly into a given category were also queried. These included taking medications from bottles directly ($M = 3.01$; $SD = 1.37$) and using Pillboxes (M=4.00, 1.55).

correlations. Significance level was set at $p = .05$ for all tests; as stated in the aims, the current study is exploratory, and readers should therefore interpret the p values with an eye toward future replications.

Results

Characterizing the Most Frequently Used Method of Performing iAdls

Descriptive data for all DADAS items are found in Table 3. Overall participants rated using digital and analog methods for performing daily tasks most frequently (vs. using no aide or relying on others). Figure 2 demonstrates that digital approaches to daily tasks in particular were commonly endorsed for financial management activities (for example, 92.3% of the sample using credit/debit cards frequently vs using paper currency or other approaches for making purchases (X^2 (3, $N = 243$) = 621.71, $p < .001$); auto-pay was endorsed as the primary method for bill pay in 67.7% sample (X^2 (3, $N = 242$) = 276.15, $p < .001$); and 74.2% of the sample reported using GPS either in their car or on an app when navigating somewhere new versus 6% of the sample reporting using only paper maps (X^2 (3, $N = 240$) = 349.03, $p < .001$).

Hybrid digital/analog methods were commonly endorsed, especially for daily tasks like managing to-do lists and appointments where nearly 1 in 5 respondents reported use of hybrid methods (i.e., a digital and written calendar). Analog (written) to-do list methods were still more commonly endorsed (52%) than digital only (6.9%) or hybrid digital/analog methods (17.3%), and this was the only daily task where frequent use of an analog-only approach was endorsed by the majority of the sample ((X^2 (3, $N = 245$) = 112.79, $p < .001$). The use of self- or other-directed medication reminders (64.1%) were endorsed much more

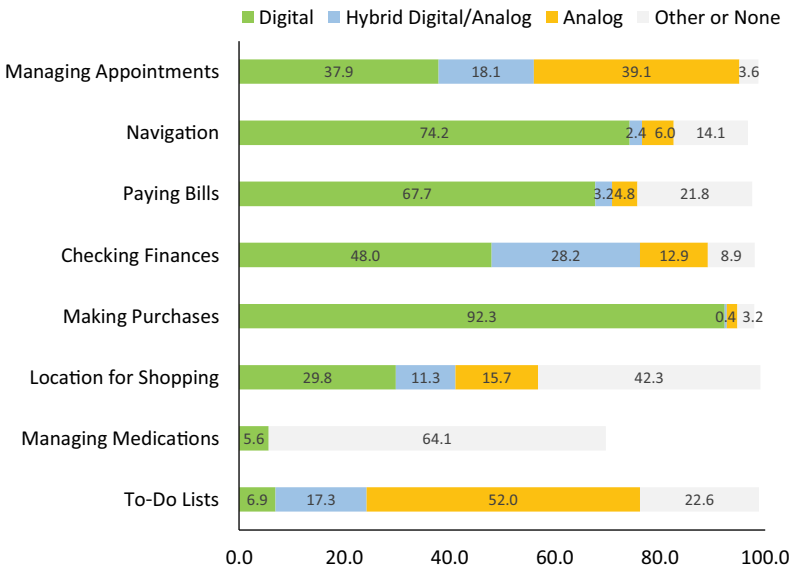

Figure 2. Percentage of sample endorsing digital, analog, hybrid or no/other approach as their most frequently used strategy for each instrumental activity of daily living.

commonly than timers (endorsed by only 6% of the sample; (X^2 (1, $N = 173$) = 121.53, $p < .001$).

On average, participants endorsed frequently using digital methods, alone or in combination with other strategies, for 4.43 ($SD = 1.62$) of the 8 daily tasks. For the subsequent analyses, endorsement of digital methods for three or fewer daily tasks was considered low adoption (at or below the 25th percentile) and endorsement of digital methods for 7 or more daily tasks was considered high adoption (>75%).

Demographic and Clinical Factors That Relate to High Vs. Low Digital Adoption

Age differed between high, mid, and low digital adoption groups (F(2, 245) = 12.24, $p < .001$), with Tukey's post-hoc tests indicating that low tech adopters ($M = 78.00$, $SD = 5.65$) were about 3.5 years older than middle ($M = 74.42$, $SD = 4.75$) and high tech adopters $M = 74.27$, $SD = 5.25$). No other demographic differences between the groups were observed (gender: X^2 (2, $N = 221$) = .625, $p = .73$; race/ethnicity: X^2 (2, $N = 242$) = .34, $p = .85$; self-reported CNS disorder: X^2 (2, $N = 221$) = .35, $p = .83$; years of education: F(2, 238) = .18, $p = .956$).

Characterizing Relative Digital Preference for Performing iAdls

On average, the sample demonstrated a relative preference for using digital approaches rather than analog approaches for daily tasks. This digital preference was statistically significant (mean value = 0.76, sd = 1.03, was greater than 0.0, which would represent equal preference for digital and analog approaches, $t(246) = 11.685$, $p < .001$).

Figure 3 demonstrates the relative preference for digital versus analog approaches for each of the iADLs (as noted above, medication management approaches were excluded due to lack of clear comparator conditions). Similar to the most frequently used method approach described above, a relative digital preference was observed in our sample for all activities except for managing appointments and to-do lists, where analog approaches were relatively more frequently used. Financial tasks, particularly automatic bill pay and purchases with credit cards were the most strongly digitally based approaches.

Demographic and Clinical Factors That Relate to Relative Digital Preference

Greater age weakly correlated with less digital preference (Figure 4a). There were no significant associations between digital preferences and years education (Figure 4b), gender ($t(218) = 1.732$, $p = .084$; Figure 4c), or self-reported CNS disorder ($t(245) = -.837$, $p = .403$; Figure 4d).

Digital Vs. Other Strategy Use and Perception of Errors in Daily Activities

Overall perception of errors averaged across the 8 tasks did not differ by high, middle, or low technological method use (F(2, 245) = 1.64, $p = .195$). This finding suggests that the older adults who frequently used digital methods for iADLs were able to use those

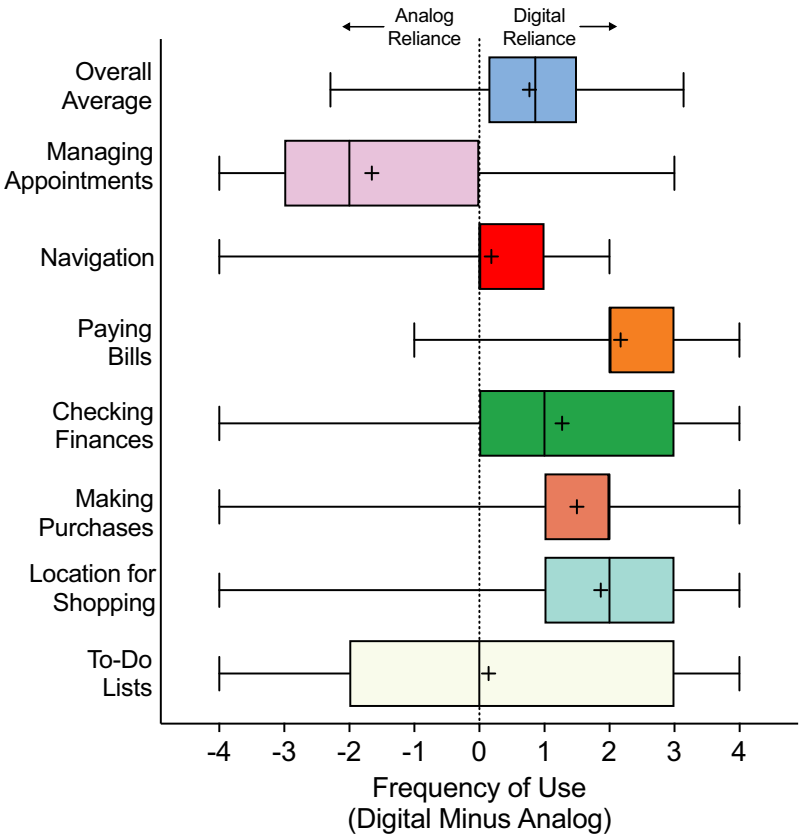

Figure 3. Box plots to illustrate median and interquartile range of relative reliance on digital versus analog methods across task categories. whiskers represent range and + signs represent the mean.

methods as effectively as analog or other approaches. When considered as a continuous variable, a digital preference for daily tasks was associated with a modest, but statistically significant, benefit in the number of daily task errors (i.e., fewer errors overall; Figure 5). When individuals with a self-reported CNS disorder were considered independently (21% of sample), there again were no differences in overall perceived mistakes in day-to-day activities across the high, middle, or low digital adoption groups ($F(2, 49) = .39$, $p = .678$).

No differences were observed in task-specific errors between those who frequently used digital or digital hybrid vs other methods for 6 of the 8 activities (Table 4). Two exceptions were noted. First, individuals who reported a digital or hybrid digital/analog method for managing bills reported fewer bill pay errors relative to those who employed non-automatic bill pay method ($t(124)=-3.38$, $p < .001$, $d=-.21$)). Second, a statistically significant difference $t(170)=2.42$, $p < .001$, $d=-.67$) in errors was reported for medication management. As noted above, medication management was a relatively unique daily task where a digital method (using alarms) did not have a clear analog comparator and was rarely ($n = 14$) endorsed as the sole frequently used method for medication management. As such, these results are considered cautiously. Using the relative digital preference approach (Table 6), a digital

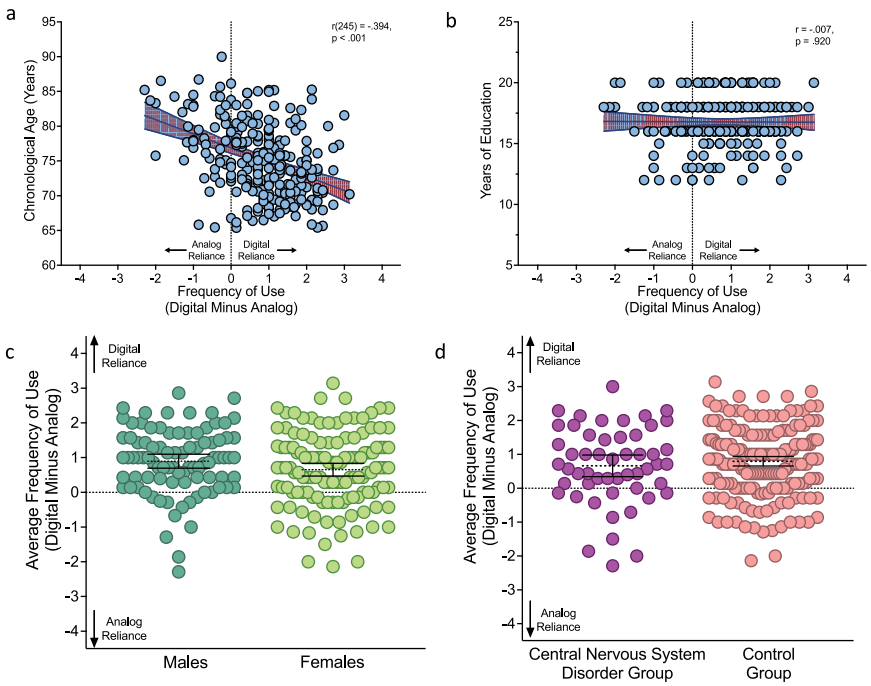

Figure 4. A) greater age was associated with relative reliance on analog methods whereas those younger than 5 years old relied more on digital methods. error bands reflect 95% confidence intervals. B) years of education were not associated with relative reliance on digital versus analog methods. C) males and females showed similar levels of relative reliance on digital methods. error bars reflect the mean and 95% confidence intervals. D) older adults showed a relative reliance on digital over analog methods, regardless of whether they self-reported a prior diagnosis of mild cognitive impairment (or other central nervous system disorder). bars reflect the means and 95% confidence intervals.

preference was associated with fewer perceived errors in managing purchases, bill pay, and to-do lists.

Digital Method Use in Daily Tasks and Perceived Satisfaction with Daily Task Method

Overall satisfaction with frequently used daily task method (averaged across the 8 tasks) did not differ by high, middle, or low tech adoption ($F(2, 244) = .97$, $p = .956$), a finding also found in those who self-reported a history of CNS disorder ($F(2, 49) = 2.38$, $p = .103$). Digital preference for daily tasks demonstrated a small but statistically significant correlation with greater satisfaction with daily task system (Figure 5).

At the level of individual task domains, digital and non-digital approaches were viewed similarly, with relatively high reported satisfaction for both digital and other methods for performing daily tasks (Table 5). Of note, individuals who endorsed using a digital method for navigation (GPS) reported greater satisfaction with the system they use for navigating than those using other approaches ($t(77) = 2.12$, $p = .04$, Cohens $d = .33$). Table 6 also demonstrates that a relative digital preference for navigation and credit card purchases in particular were significantly related to greater satisfaction.

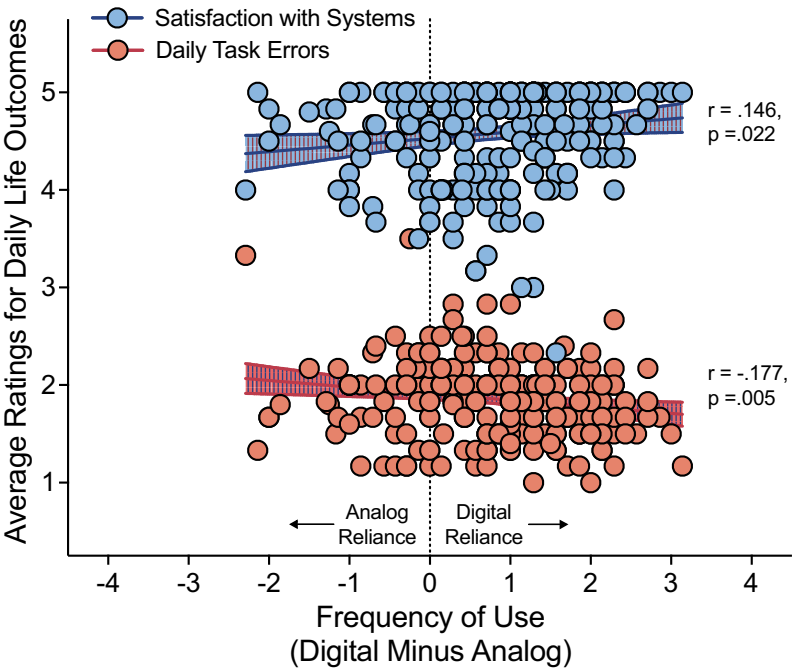

Figure 5. Relative reliance on digital methods was associated with greater satisfaction (blue) and lower daily task errors (red). error bands represent 95% confidence intervals. .

Table 4. Perception of mistakes in daily activities by digital or non-digital approach.

Domain	Digital or Digital Hybrid Approach			Non-Digital Approach						
	N	Mean	SD	N	Mean	SD	*t*	df	*p*	*d*
Managing Appointments	139	1.86	0.55	105	1.80	0.66	0.73	242	0.47	0.09
Navigating Unfamiliar Places	190	2.07	0.65	49	2.10	0.71	−0.27	237	0.79	−0.04
Managing Lists of Things to Get and to Do	60	2.22	0.72	184	2.35	0.57	−1.45	242	0.15	−0.22
Managing Medications and Supplements	14	2.14	0.66	158	1.73	0.60	2.42	170	0.02	0.67
Paying Bills and Finances *	174	1.60	0.54	66	1.85	0.50	−3.38	124	0.00	−0.47
Checking Bank and Financial Statements	187	1.64	0.51	53	1.75	0.62	0.50	101	0.62	−0.21
Making purchases	229	1.49	0.54	13	1.54	0.66	−0.29	240	0.77	−0.08
Location for Shopping	102	1.46	0.56	142	1.53	0.54	−0.95	242	0.34	−0.12

Note: *Indicates test adjusted for unequal variance; Errors in daily activities rated on a scale from 1=Never to 5 = Very Often.

Discussion

How are Older Adults Using Digital Methods for Performing Daily Tasks?

In our study, there was widespread digital-method adoption for performing a number of iADLs in this sample of older individuals who had access to digital technologies. This finding is most evident for financial tasks in which credit card purchases, automatic bill pay, and checking statements online were frequently used by over 2/3 of the sample. Utilization of GPS aids for navigation was also reported as frequently used by ¾ of participants.

Of note, uptake of digital methods for addressing prospective memory tasks, such as recalling appointments, to-do lists, or medication was more variable. For example, over 56% of the sample reported using a digital calendar for upcoming events, either solely (37%) or

Table 5. Satisfaction with systems used for daily activities by digital or non-digital approach.

	Digital or Digital Hybrid Approach			Non-Digital Approach						
	N	Mean	SD	N	Mean	SD	t	df	sig	*d*
Managing Appointments	139	4.72	0.51	105	4.59	0.66	1.72	242	0.09	0.22
Navigating Unfamiliar Places	189	4.53	0.67	49	4.31	0.65	2.12	77	0.04	0.33
Managing Lists of Things to Get and to Do*	60	4.50	0.75	183	4.37	0.73	1.23	241	0.22	0.18
Managing Medications and Supplements*	14	4.57	0.94	159	4.65	0.69	−0.38	171	0.70	−0.11
Paying Bills and Finances	175	4.62	0.70	65	4.65	0.67	−0.23	238	0.82	−0.03
Checking Bank and Financial Statements	188	4.64	0.72	52	4.60	0.57	0.44	238	0.66	0.07
Making purchases	229	4.65	0.65	13	4.62	0.51	0.17	240	0.87	0.05
Location for Shopping*	101	4.72	0.57	143	4.59	0.69	1.68	236	0.09	0.21

Note: *Indicates test adjusted for unequal variance; Satisfaction with strategies for managing daily activities rated on a scale from 1=Very Dissatisfied to 5 Very satisfied.

Table 6. Correlation of relative digital preference for each iADL with perception of errors and satisfaction.

Domain	Correlation with Perceived Errors	Correlation with Satisfaction
Managing Appointments	.062	.114
Navigating Unfamiliar Places	−.085	.164*
Paying Bills and Finances	−.170**	−.018
Checking Bank and Financial Instruments	−.074	.096
Making Purchases	−.206**	.136*
Location for Shopping	−.047	.037
Managing Lists of things to Get or Do	−.127*	.041

Note: *Correlation is significant at the .01 level; ** correlation is significant at the .05.

in combination with an analog calendar (18%). The spontaneous adoption of these techniques is critical for neuropsychologists to consider when designing rehabilitative strategies for several reasons. First, a well-established principle in cognitive rehabilitation is that building on existing skills, habits, and techniques is associated with better uptake and efficacy of cognitive rehabilitation efforts (Sohlberg & Mateer, 2001). Furthermore, intervention studies have shown that digital calendaring and to-do list reminder applications can improve day-to-day prospective memory in those with mild cognitive impairment and dementia (Scullin et al, 2021; Benge & Scullin, 2022) and such offloading techniques seem to be the most effective manner of improving prospective memory (Jones, Benge, & Scullin, 2021). Thus, further development of digital cognitive prosthetics would seem to fit well both with an increasing number of older adults who are developing familiarity and spontaneous use of these tools, though individual differences in existing skill sets should be considered. Expanding the scope of memory rehabilitation efforts to include other daily tasks, like helping to set up automatic bill pay, may be goals of future technology-focused intervention strategies.

Who is More Likely to Be Using Digital Methods for Daily Tasks?

Individuals with high, middle, and low adoption of digital methods for daily tasks were similar in terms of gender and education. Further, those with self-reported CNS diagnoses that might impact cognition used digital technologies to a similar extent as their older adult peers. That being said, low technology adopters were older than high adopters by about 3–4 years and age was negatively correlated with digital preference. This finding highlights what is likely to be an important cohort effect in this research; the generation that brought the

internet into mainstream use is now reaching retirement age where age-related neurodegenerative diseases begin to manifest, and subsequent rates of digital adoption are likely to increase with time. These findings parallel those from community (Cotten, Schuster, & Seifert, 2021), clinical (Benge et al., 2020), and population survey approaches (Research Center, 2021), which have noted increases in technology use more broadly among older adults over the years, though our findings suggest at least a degree of continued generation gap in daily technology use.

What is the Impact of Daily Task Use on Perceived Errors and Satisfaction with Daily Task Performance?

Given the high usage of digital methods for iADLs amongst other adults, a next question is whether these approaches help or hinder day-to-day functioning. This is especially true as prior research suggests older adults find some digital technologies challenging to navigate (Nimrod, 2020). Our current results suggest that overall satisfaction with daily task performance is high and perceived errors are relatively low for digital as well as analog approaches to daily tasks. This finding is encouraging because it suggests that the increasingly digital environment does not seem to be markedly increasing the perception of day-to-day difficulties or negatively impacting satisfaction with the systems being employed. That being said, a degree of self-selection may be apparent in our findings, where older adults utilize and maintain approaches only if they are perceived as useful and efficacious (other contributing factors such as social desirability bias in responding were not assessed in our data). Thus, those with difficulties in navigating digital technologies may have abandoned them, those with particular difficulty with technologies may not have been able to navigate a digital survey or been on an e-mail list to receive the study notification, and individuals may under report difficulties with daily tasks.

Implications and Future Directions

The need for exploration of digital and analog approaches in broader and representative samples. The current study focused on initial exploration of digital approaches in a predominantly white, well-educated, older adult sample that had access to the internet and e-mail. Such demographic factors may be associated with the high digital use in this sample of individuals who have crossed the digital divide (Charness & Boot, 2022). There exists a distinct likelihood that use of, satisfaction with, and perceptions of success in using digital devices for daily activities might vary across demographic groups. For example, in a focus group study of a sample of racially and socioeconomically diverse participants, 2016) found evidence that older adults from lower SES groups may experience their devices as less reliable, have more negative experiences with devices, and have more apprehension of technologies than higher SES cohorts. Thus, the current results may not generalize across samples that have different socio-economic attributes, which may impact technology use and adoption. Although digital disparities in technology adoption are diminishing somewhat in population studies (Research Center, 2021), it is critical to capture information on approach to daily activities in broader population samples. To this end, our results suggest an approach for gathering this information. Future studies can refine items administered and utilize the DADAS to begin capturing this information in broader samples.

The need to consider revisions to existing instruments. With appropriate considerations of the limitations of generalizability of our sample, our results do suggest that current iADL measures utilized in clinical and research contexts may have limitations with ecological validity in how older adults approach management of iADLs in those individuals that have crossed the digital divide. To be clear, existing measures still seem to perform well at making diagnostic distinctions and relate fairly well with neuropsychological testing (Benge, Artz, & Kiselica, 2020; Chaytor & Schmitter-Edgecombe, 2003; González, Gonzales, Resch, Sullivan, & Soble, 2021). That being said, as technological innovation continues, a major question for researchers and clinicians alike is whether or how best to iterate measures to validly capture day-to-day functioning.

A relevant consideration for researchers and clinicians is whether wholesale development of new iADL measures to capture day-to-day technology use is warranted. Such measures have been designed previously (Kottorp & Nygård, 2011). However, adoption of new measures risks lack of backward compatibility with legacy measurements, which is antithetical to the notion of data harmonization – a major concern for the modern neurodegenerative disorder enterprise (Shishegar et al., 2021). Further, if access to digital approaches is limited in some socioeconomically disadvantaged groups, instruments that focus solely on digital approaches may not be valid in disadvantaged groups.

Neuropsychologists are in a unique position to address these concerns, given expertise and training in psychometrics and assessment to help develop "living" iADL measures that can evolve with changing environments while still allowing comparable backward compatible scores to be generated. As an example, utilization of the linking and equating approach (Lee & Lee, 2018) may allow for adding new items alongside existing ADL measure content, which could allow for estimating various ADL metrics on a similar scale with legacy instruments.

It should also be noted that the digital performance of iADLs may allow for ways of objectively measuring iADL performance in a manner not previously available. For example, while current performance-based iADL measures require participants to perform activities in artificial environments with unfamiliar tools, internet-based data aggregation, activity detection, and in home monitoring may allow for objective measurements of daily performance in the digital sphere in real time and in lived environments.

Implications for "Technological Reserve." A final consideration for neuropsychologists is whether living in such technologically enriched environments may be leveraged to support the independence and well-being of older adults. As our findings indicate, adoption of digital techniques is relatively high at least amongst some older adults, and we hypothesize that these habits, techniques, and environments may in turn allow for greater independence throughout disease progression (Benge & Scullin, 2020; Wolff, Benge, Cassel, Monin, & Reuben, 2021). However, understanding the complex interaction between person, environment, and device will likely prove critical to optimize these technologies and achieve these aims (Gathercole et al., 2021).

Limitations

The current study was exploratory in nature and as such has important limitations. First, as noted above, our current findings are biased by having an online survey completion be the data collection method, which would under sample individuals without digital technology

or e-mail access in the community. Repeating such work with broader samples that include an offline data collection is important to understand digital prevalence data more accurately amongst older adults. Further, our current sample was predominantly white and well educated. Given the expense and lack of funding for many of these digital technologies by health insurance, these findings may not generalize to individuals of varying socio-economic backgrounds and may introduce a further barrier to independent care for disadvantaged older adults. Given that socioeconomic disadvantage is in and of itself a risk factor for developing neurodegenerative disease (Shiekh et al., 2021), disadvantaged individuals may be at dual threat of having both increased risk of developing disease and residing in environments that do not readily allow for digital compensation for deficits. While there are encouraging trends that the digital divide may be lessening for some technologies, such as smartphone ownership (Research Center, 2021), the ripple effects of lack of access to digital literacy earlier in life and the differential accessibility of modern technologies may take decades to fully manifest itself. Other limitations of the study include the reliance of self-report as opposed to objective measurement of digital strategy use, which may allow for fine-grained assessment of particular behaviors and activities. Such procedures have are being developed and their inclusion in future studies will help ensure the validity of such ratings (Adaimi, Yong, & Thomaz, 2021; Liang & Thomaz, 2019). Finally, we note that despite our relatively large sample size, multiple statistical comparisons are made for particular daily tasks in this initial study; replication with larger sample sizes and control for multiple comparisons is encouraged to replicate some of the smaller individual effects observed in our current study.

Further refinements of the DADAS are in order as well. For example, some daily tasks that could have a digital counterpart were not assessed with the DADAS, such as digital communication with peers, and future studies will address these gaps. Next, removing items that still have low frequency of endorsement (i.e. using apps to make payments) may ease reporting. Further expanding digital and analog descriptions for managing supplements and medications (i.e. using a written vs. digital note to keep track of medications) may allow for greater understanding of strategy use in this critical health domain. Future work may also want to evaluate the optimum metrics for defining digital, analog, hybrid, and other strategies to allow for comparisons across samples and studies.

Finally, we note that the current paper assessed self-reported at risk for cognitive disorders that might impact cognition. Not directly assessed were individuals with clinically confirmed neurocognitive disorder diagnosis, nor the impact of other neurological symptoms such as tremor or neuropathy on use of digital technologies.

Conclusions

The impact of digital technology use on neuropsychology extends far beyond digital assessment methods for traditional neuropsychological tests. Our study suggests that at least a subset of older adults utilize a broad array of digital methods for performing aspects of iADL and rate these methods as equally effective and satisfying as analog methods. For neuropsychology to maintain its relevance in a digital age, these habits, preferences, and technologies need to be considered in research and clinical practice.

Note

1. We conceptualized these as non-digital approaches, but the original wording of the question did not allow for dissociating whether the pill box/medication bottle are being used as external aids (e.g., setting them in salient locations such as on the pillow), whether others are helping to provide reminders, or if the medication is being remembered without any external aide methods. The DADAS could be improved by making these specifications clearer.

Acknowledgments

We appreciate the input of the Georgetown Neuroscience Foundation Medical Advisory Board for helpful input in designing the survey and disseminating study materials to its members.

The authors report no conflicts of interest. No funding source was utilized for this project.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported in part by the National Institutes of Aging at the National Institutes of Health (grant number 1R01AG077017) and Alzheimer's Association (AARG-22-924771).

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Appendix 1: Digital and Analog Daily Activities Survey

Note: Individual items are marked to indicate whether this item was classified as an analog strategy [A], digital [D], no external aide [NEA], or other-centered [OC] strategy approach. These markings are not included in the actual items to be administered to participants.

Instructions: The purpose of this survey is to understand the approaches you take to different daily activities. This questionnaire has a few parts, where you will rate how you approach a particular task, like managing finances or managing your appointments. Read each item carefully and rate what you usually would do to tackle each task. There are no right or wrong answers.

The following questions will look at strategies you use to help you manage appointments

[A]1) I use a written calendar to remind me of appointments
Never Rarely Sometimes Usually Always

[D]2) I use an electronic calendar to manage appointments (for example, an app, online calendar, etc.)
Never Rarely Sometimes Usually Always

[OC] 3) I rely on other people to remember or remind me of my appointments (for example, a spouse, friend/family member will communicate with me the day I need to do something)
Never Rarely Sometimes Usually Always

[NEA]4) I rely on my own memory to keep track of appointments, and don't use a calendar or reminder system.
Never Rarely Sometimes Usually Always

5) I use another system to manage my appointments (describe):
[Free Response Text Box]

6) I feel that I miss or make mistakes with appointments
Never Rarely Sometimes Usually Always

7) How satisfied are you with the system you use to manage appointments or events?
Very Satisfied Satisfied Neutral Dissatisfied Very Dissatisfied

The following questions will look at strategies you use to help find your way around, particularly in less familiar places

[D]8) When going someplace new or less familiar, I use a GPS system built into my car to help find my way around.
Never Rarely Sometimes Usually Always

[D]9) When going someplace new or less familiar, I use a GPS or maps app on my phone to help me find my way around.
Never Rarely Sometimes Usually Always

[A]10) When going someplace new or less familiar, I use paper maps to help me find my way around.
Never Rarely Sometimes Usually Always
[Analog Strategy]

[OC] 11) When going someplace new or less familiar, I rely on other people to help me find my way around
Never Rarely Sometimes Usually Always

[NEA]12) I look up or ask others for directions and memorize them when finding my way around some place that is new or unfamiliar.
Never Rarely Sometimes Usually Always

[NEA]13) I rely on my own abilities to find my way around some place that is new or unfamiliar without using maps, apps, or asking for directions.
Never Rarely Sometimes Usually Always

14) I use another system to help figure out my way around
[Free Response Text Box]

15) I feel that I often get lost or make mistakes with directions when going some place new or unfamiliar
Never Rarely Sometimes Usually Always

16) How satisfied are you with the systems you use to help find your way around places you are unfamiliar with.
Very Satisfied Satisfied Neutral Dissatisfied Very Dissatisfied

Managing Bills and Finances

[D]17) I use automatic bill pay to manage my bills.
Never Rarely Sometimes Usually Always

[A]18) I get bills in the mail and pay them with a check
Never Rarely Sometimes Usually Always
[Analog Strategy]

[D]19) I pay my bills over the phone.
Never Rarely Sometimes Usually Always

[OC] 20) Someone else pays the bills for me
Never Rarely Sometimes Usually Always

[D]21) I check my bank statements or other financial paperwork online (either through a website or an app).
Never Rarely Sometimes Usually Always

[A]22) I check paper copies of bank statements or other financial paperwork.
Never Rarely Sometimes Usually Always
[Analog Strategy]

[D]23) I check my accounts over the phone.
Never Rarely Sometimes Usually Always

24) I use another system to help with bills or finances.
[Free Response Text Box]

25) I feel that I make mistakes with my finances or bills
Never Rarely Sometimes Usually Always

26) How satisfied are you with the system you use to manage your finances and purchases?
Very Satisfied Satisfied Neutral Dissatisfied Very Dissatisfied

Shopping and Purchases

[A]27) When making purchases, I use paper money and coins
Never Rarely Sometimes Usually Always

[A]28) When making purchases, I write checks
Never Rarely Sometimes Usually Always

[D]29) When making purchases, I use credit or debit cards.
Never Rarely Sometimes Usually Always

[D]30) I make online purchases
Never Rarely Sometimes Usually Always

[A]31) I make purchases in stores
Never Rarely Sometimes Usually Always

[D]32) I make purchases over the phone (for example, ordering something from a catalog over the phone)
Never Rarely Sometimes Usually Always

[D]33) I use a mobile application, such as Venmo or PayPal, to pay for goods and services
Never Rarely Sometimes Usually Always

34) I use another system to manage purchases.
[Free Response Text Box]

35) I feel that I make mistakes with the financial transaction when I am purchasing things.
Never Rarely Sometimes Usually Always

36) How satisfied are you with the system you use to manage your purchases?
Very Satisfied Satisfied Neutral Dissatisfied Very Dissatisfied

Managing Medications and Supplements

[A]37) I take medications or supplements directly from their bottles
Never Rarely Sometimes Usually Always

[A]38) I use a pill box to manage my medications or supplements
Never Rarely Sometimes Usually Always

[D]39) I use an alarm or timer to remind me when to take my medication or supplements
Never Rarely Sometimes Usually Always

[OC] 40) Someone else reminds me when to take my medication or supplements
Never Rarely Sometimes Usually Always

[NEA]41) I rely on my own memory to remember to take my medications and supplements, and do not use any particular system to help me take them.
Never Rarely Sometimes Usually Always

42) I use another system to manage my medications
[Free Response Text Box]

43) I feel that I miss or make mistakes with my medications and supplements
Never Rarely Sometimes Usually Always

44) How satisfied are you with the system you use to manage your medications and supplements?
Very Satisfied Satisfied Neutral Dissatisfied Very Dissatisfied

To get or To Do

[A]45) I use written lists to help me keep track of things I need to get or things I need to do.
Never Rarely Sometimes Usually Always

[D]46) I use a to-do list app on my phone or other device to help me keep track of things I need to get or things I need to do
Never Rarely Sometimes Usually Always

[NEA]47) I rely on my own memory to remember things I need to get or to-do
Never Rarely Sometimes Usually Always

48) Someone else reminds me of things I need to get or to do.
Never Rarely Sometimes Usually Always

49) I use another system to manage things I need to get or things I need to do.
[Free Response Text Box]

50) I feel that I forget things I need to get or things I meant to do
Never Rarely Sometimes Usually Always

51) How satisfied are you with the system you use to manage things you are supposed to get or to do?
Very Satisfied Satisfied Neutral Dissatisfied Very Dissatisfied