ABSTRACT

ZHANG, SHENGHAO. The Role of Basic Cognition and Domain-Specific Knowledge on Everyday Cognition across the Adult Life-Span (Under the direction of Dr. Jason C. Allaire).

The current study examined the relative contribution of basic cognition (episodic memory, processing speed and inductive reasoning) and domain-specific experience and knowledge on memory within 3 everyday domains (i.e., medication use, financial management, and nutrition/food preparation) across the adult life-span. Specifically, the current study had 3 aims: (1) Determine the measurement invariance of everyday memory across the adult life-span; (2) Determine the salience of episodic memory, reasoning, processing speed, and domain-specific knowledge/experience to predict individual differences in everyday memory across the adult life-span; (3) Determine if domains of everyday knowledge and everyday experience (i.e., medication use, financial management, and nutrition/food preparation) are more sensitive in predicting performance on everyday memory in corresponding domains.

Younger (*n*=98, 18 to 39 years), middle-aged (*n*=98, 40 to 59 years), and older (*n*=98, 60 to 80) adults recruited on Amazon's Mechanical Turk (MTurk) completed the Everyday Cognition Battery Memory Test (ECB Memory; Allaire & Marsiske, 1999; everyday memory), the Everyday Cognition Battery Knowledge Test (ECB Knowledge; Allaire & Marsiske, 1999; everyday knowledge), and a battery of basic cognition tests (i.e., Letter Series, Number Comparison, and Rey Auditory Verbal Learning Task [AVLT]).

Results showed that measurement invariance was not achieved for ECB Memory. Loadings for Medication Use, Financial Management, and Nutrition/Food Preparation subscales on ECB Memory were lower for middle-aged adults than younger and older adults. This might be attributed to the ceiling effect and lack of variation in performance on ECB Memory and the lower variance shared among subscales on ECB Memory in the middle-aged group. Path

analyses were used instead of structural equation modeling because of the non-invariance. Results showed that episodic memory, reasoning, processing speed, domain-specific everyday knowledge, and everyday experience contributed similarly to ECB Memory for the younger, middle-aged, and older group. This might be because older adults in the current sample are relatively young and highly functioning, and therefore might not need to overly rely on knowledge and experience to compensate for declines in basic cognitive abilities. Finally, different subscales of ECB Knowledge contributed similarly to ECB Memory in the corresponding domains for all participants, whereas experience in the financial management domain contribute more to memory in financial management domain than experience in the medication use or the nutrition/food preparation on memory in medication use or nutrition/food preparation. This might be because financial management is more complicated and technical, and requires more experience to master. The nature of: the current sample, the MTurk platform, the ECB Memory Test, and the ECB Knowledge Test were also discussed as limitations and directions for future endeavors. In conclusion, current findings suggest that older adults don't rely more on knowledge to solve everyday problems when they are highly functioning, and younger and middle-aged adults also rely on knowledge to solve everyday problems when knowledge is available.

The Role of Basic Cognition and Domain-Specific Knowledge on Everyday Cognition across the Adult Life-Span

by
Shenghao Zhang

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APPROVED BY

Dr. Jason C. Allaire Committee Chair	Dr. Thomas M. Hess
Dr. Anne Collins McLaughlin	Dr. Shevaun D. Neupert

BIOGRAPHY

Shenghao Zhang grew up in Shanghai, China. He completed his Bachelor of Science degree in Psychology at Jilin University in China. He began his graduate education at North Carolina State University in the Lifespan Developmental Psychology program in 2015. He did research on technology use, cognitive interventions, and control beliefs under the direction of Dr. Jason C. Allaire.

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Introduction

Everyday cognition, also known as everyday problem solving, refers to the ability to solve cognitively complex problems of daily life (Allaire & Gamaldo, 2017). Everyday cognition has been studied extensively in older adults due to its close association with everyday functioning and successful aging (Allaire, 2012; Allaire & Gamaldo, 2017; Bielak, Hatt, & Diehl, 2017; Marsiske & Margrett, 2006). Previous research in older adults has suggested that successfully solving everyday problems requires both basic cognitive abilities as well as domain-specific knowledge (Allaire & Marsiske, 1999; Chen, Hertzog, & Park, 2017; Diehl, Willis, & Schaie, 1995). Less research has been done examining the extent to which basic abilities and knowledge underlie the ability of middle-aged and younger adults to solve cognitively complex everyday problems. Consequently, the current study will focus on the role of basic cognition (episodic memory, processing speed, and inductive reasoning) and domain-specific experience and knowledge on everyday cognition over adult lifespan.

Everyday Cognition

The study of everyday cognition was sparked by the skepticism of using basic cognition tests to measure cognitive functioning in older adults (Allaire, 2012; Allaire & Gamaldo, 2017; Willis & Schaie, 1986). Previous research in the field of life-span development argued that the majority of older adults retained their ability to function effectively despite normative age-related declines measured by basic cognition tests (Baltes, 1997). In addition, most basic cognition tests were designed for academic settings and validated in children and young adults, and therefore, might not be appropriate for older adults who had been outside of academic settings for decades. Finally, basic cognition tests were developed to be context-free to reduce cultural bias and better reflect the underlying cognitive processes, which could underestimate older adults' competence

by not allowing them to use their knowledge and experience to solve problems. One way to address these concerns would be to create assessments using problems and stimuli older adults might encounter in their everyday life (Denney, 1989).

The assessment of everyday cognition in previous research is guided by two different theoretical approaches: an ill-defined approach and a well-defined one (Allaire, 2012; Allaire & Gamaldo, 2017; Bielak et al., 2017; Marsiske & Margrett, 2006). The ill-defined approach originates from the creativity and problem solving research (Marsiske & Margrett, 2006). It uses open-ended questions without a single correct solution, and is usually scored by the number of effective solutions generated (e.g., One evening, a person goes to the refrigerator and notices that it is not cold inside but, rather, it's warm. What should the person do? Denney & Palmer, 1981; Haught & Walls, 2007). Unlike the ill-defined approach, the well-defined approach features assessments with a detailed problem context and clearly defined desired goals, and is scored by the accuracy or correctness of the answer (Allaire, 2012; Marsiske & Margrett, 2006). It is grounded in the psychometric and experimental traditions of the cognitive aging literature, and therefore, performance in well-defined assessments can be validly compared back with basic cognition measures (Allaire & Marsiske, 1999; 2002). An example question following the well-defined approach would be to study a medication label and answer questions related to the medication from memory (Allaire & Marsiske, 1999). In this case, (1) all the information needed to solve the problem is provided; (2) there is a single correct answer to the question; and (3) the performance can be compared with standard memory tests.

Performance on both well-defined and ill-defined everyday cognition measures are predictive of everyday functioning above and beyond basic cognition (Allaire & Gamaldo, 2017; Bielak et al., 2017; Marsiske & Margrett, 2006). Higher everyday cognition performance is

associated with better medication adherence (Gelb, Shapiro, & Thornton, 2010; Neupert, Patterson, Davis, & Allaire, 2011) and lower likelihood of death (Allaire & Willis, 2006; Weatherbee & Allaire, 2008) after controlling for basic cognition. Everyday cognition measures also predict of mild cognitive impairment status after controlling for performance on basic cognition and cognitive screening tests (Allaire, Gamaldo, Ayotte, Sims, & Whitfield, 2009; Allaire & Willis, 2006; Burton, Strauss, Bunce, Hultsch, & Hunter, 2009; Thomas & Marsiske, 2014). While ill-defined measures accounted for some unique variance in everyday functioning after controlling for basic cognition and performance in well-defined measures (Allaire & Marsiske, 2002), the current study will adopt the well-defined approach due to its solid psychometric foundations and direct links with different basic cognitive domains.

Antecedents of Everyday Cognition in Older Adults

Everyday cognition is theorized as a "compiled" cognition (Salthouse, 1990; Willis & Schaie, 1986), which is considered to be superordinate to and composed of multiple basic cognitive abilities (e.g., memory and reasoning) and domain-specific knowledge. Findings from both cross-sectional (e.g., Allaire & Marsiske, 1999; Burton, Strauss, Hultsch, & Hunter, 2006; Chen et al., 2017; Diehl et al., 1995; Farias et al., 2013) and longitudinal research (e.g., Gamaldo & Allaire, 2016; Gross, Rebok, Unverzagt, Willis, & Brandt 2011; Yam, Gross, Prindle, & Marsiske, 2014) suggest that everyday cognition is closely associated with multiple basic cognitive abilities. For instance, in a cross-sectional study with older adults, Allaire and Marsiske (1999) found that age was significantly associated with everyday cognition, and about 80% of variance in everyday cognition was accounted for by reasoning and memory. Tucker-Drob (2011) modeled the 5-year longitudinal trajectory of everyday cognition with the no-contact control group in a large-scale cognitive training study with older adults. Results showed that the

rate of change on everyday cognition was associated with that of memory, reasoning, and processing speed. A separate study modeling both training and control groups of the same dataset suggested that baseline performance on basic cognition was predictive of the initial level and change of everyday cognition (Gross et al., 2011). These results were replicated when the 10-year follow-up wave were added into the model (Yam et al., 2014).

Similar to findings from cross-sectional studies (e.g., Allaire & Marsiske, 1999; Diehl et al., 1995), longitudinal estimates showed that the initial level of everyday cognition and reasoning shared as much as 85% of total variance while the change trajectory shared 96% of variance (Yam et al., 2014). Finally, everyday cognition also fluctuates with performance with basic cognition on a daily basis (Gamaldo & Allaire, 2016). Specifically, older adults performed better on everyday problem solving on days when they have better memory and psychomotor speed after controlling for age and other demographics. Taken together, there is fairly convincing evidence that links everyday cognition back to basic cognitive abilities.

Previous research also suggested that knowledge is associated with everyday cognition in older adults (e.g., Allaire & Marsiske, 1999; Burton et al., 2006; Chen et al., 2017; Diehl et al., 1995; Yam et al., 2014). In particular, domain-general knowledge assessed by verbal ability uniquely predicted performance on everyday cognition above and beyond demographics and basic cognition (Burton et al., 2006; Diehl et al., 1995; Yam et al., 2014). Oliveira and colleagues (2018) measured everyday performance on activities of daily living in a virtual environment and found that vocabulary uniquely predicted several performance indexes after controlling for mental status, education, and age. Moreover, verbal ability mediated the effect of memory and processing speed on observed performance on everyday tasks related to independent living (Diehl et al., 1995).

Although frequently used as a measure to reflect crystallized intelligence, verbal ability may not reflect the kind of knowledge and expertise older adults use in everyday problem solving. Allaire and Marsiske (1999) measured everyday knowledge in food preparation, medication use, and financial management with multiple choice questions. They found that knowledge about activities of daily living were related to performance on everyday reasoning but not everyday memory. Since it is the only study to my knowledge that measured everyday knowledge, these results still need to be confirmed by future research.

Antecedents of Everyday Cognition in Younger- and Middle-Aged Adults

Less is known with regard to the contribution of basic cognition and domain-specific knowledge to everyday cognition in middle-aged and younger adults. Life-span theories and the limited evidence on everyday cognition over the adult life-span suggest that (1) basic cognition and everyday knowledge could contribute differently to everyday problem solving for people of different ages, and (2) different basic cognitive domains could play different roles in everyday problem solving for younger, middle-aged, and older adults.

Previous studies show that cognitive abilities represented by fluid intelligence peaked at an early age and decrease rapidly afterwards, whereas knowledge and verbal abilities represented by crystallized intelligence peaked around middle age and maintained at a high level (e.g., Cattell, 1987; Horn, 1982; Li et al., 2004; McArdle, Ferrer-Caja, Hamagami, & Woodcock, 2002; Salthouse, 2019). These results suggest that individuals hold different amounts of cognitive resources and domain knowledge over the adult life-span.

Moreover, previous research also suggested that domain-specific knowledge has a stronger influence on cognitive performance in older adults than in middle-aged and younger adults (e.g., Hedden, Lautenschlager, & Park, 2005; Hess, 2005; Matzen & Benjamin, 2013;

Umanath & Marsh, 2014). For instance, older adults are less likely than younger adults to remember misspellings that contradict with their prior knowledge (McKay, Abrams, & Pedroza, 1999), or recall unusual prices for common grocery items (Castel, 2005). They are also more likely than younger adults to recall a prototypical object (e.g., a knife) that was not presented at a generic scene (e.g., kitchen; Hess & Slaughter, 1990). Hedden and colleagues (2005) examined the role of crystallized ability and fluid ability on a verbal recall task. They found that crystallized ability explained more variance in performance for older adults than middle-aged and younger adults.

Some evidence suggested that different basic cognitive abilities might also contribute differently to everyday cognition over the adult life span. Evidence from both cross-sectional (e.g., Adrover-Roig, Sesé, Barceló, & Palmer, 2012; de Frias, Lövdén, Lindenberger, & Nilsson, 2007; Hedden & Yoon, 2006; Li et al., 2004) and longitudinal (e.g., de Frias et al., 2007; Hertzog, Dixon, Hultsch, & MacDonald, 2003; Hülür, Ram, Willis, Schaie, & Gerstorf, 2015; 2016) studies suggested that increasing age is associated with an increase in the intercorrelations of different cognitive domains (i.e., dedifferentiation), possibly driven by age-related general slowing in information processing (La Fleur, Meyer, & Dodson, 2018). For instance, Hülür and colleagues (2015; 2016) examined up to 9 waves of data over 56 years from subsamples of the Seattle Longitudinal Study. They found increased coupling among basic cognitive abilities, crystallized abilities, and visualization with advancing age and proximity to death. Within the basic cognition component, they also observed increased within-person association between psychomotor speed and inductive reasoning, and psychomotor speed and spatial orientation (Hülür et al., 2016).

Statement of the Problem

Taken together, these results raise questions about whether everyday cognition would maintain the same hierarchical structure over the adult life-span. For example, everyday reasoning could be measuring inductive reasoning, processing speed, episodic memory, and everyday knowledge in older adults, whereas reflecting only inductive reasoning in younger adults. Parsons and McMahan (2017) found that younger adults' performance in an everyday memory test developed in a virtual reality grocery store correlated significantly with an episodic memory test but not with an inhibition test. Although the study was exploratory in nature and the sample size was small (n = 42), these results suggest that everyday cognition might not require multiple basic cognitive abilities in younger adult samples.

Chen and colleagues (2017) analyzed cross-sectional data on basic cognition, knowledge, and everyday reasoning performance in the Dallas Lifespan Brain Study. They found that older adults relied more on the knowledge component in everyday reasoning while younger adults relied mainly on the basic cognition component. Middle-aged adults relied equally on both knowledge and basic cognition, and performed the best on everyday reasoning among the 3 groups. However, the study did not (1) include any everyday memory measure or domain-specific knowledge measure, or (2) examine the relative contribution of different cognitive domains within the basic cognition component, leaving some questions unanswered.

Specific Aims of the Current Study

The overarching goal of the proposed study is to examine the relative contribution of different basic cognitive abilities (e.g., episodic memory and inductive reasoning) and domain-specific knowledge to everyday memory performance across the adult life-span. Specifically there are three aims of the study.

The first aim of this study is to determine the measurement invariance of everyday memory across the adult life-span. It is expected that measurement invariance will hold for younger, middle-aged, and older adults. The second aim is to determine the salience of episodic memory, reasoning, processing speed, and domain-specific knowledge/experience to predict individual differences in everyday cognition across the adult life-span. It is expected that older adults will rely more on knowledge in everyday memory performance, while younger adults will rely more on basic cognitive abilities. Middle-aged adults will rely equally on both. The third aim is to determine if domains of everyday knowledge and everyday experience (i.e., medication use, financial management, and nutrition/food preparation) are more sensitive in predicting performance of everyday memory in corresponding domains. It is expected that everyday knowledge in a particular domain will predict everyday memory in the corresponding domain better than the knowledge construct predicting the memory construct.

Methods

Procedure

Data were collected using Amazon Mechanical Turk (MTurk). Recruitment on MTurk involved posting a Human Intelligence Task (HIT) with a link to the study. The study description requested participation by adults aged 18 and older who speak English and live in the United States. Participation was restricted to those who had listed the United States as their residence when creating their account and those who had a 95% or higher HIT approval rate using MTurk built-in filters.

When participants clicked the link to the survey, they were redirected to Qualtrics. IP addresses were collected by Qualtrics to prevent the same participants from multiple access or multiple submission. Browser agent strings (i.e., name and version of the operating system and

internet browser used to access the Qualtrics link) along with start and end time for each attempt were also collected automatically by Qualtrics as background information when participants clicked on the link. Participants filled out a demographic questionnaire first. They then finished the everyday knowledge and experience measures and then completed the cognitive tests (see Measures section below). The sequence of administration for the everyday cognition and basic cognition was counterbalanced. Participants were compensated $5 for their participation.

One hundred younger (aged 18 to 39), middle-aged (aged 40 to 64), and older adults (aged 65 and over) were planned to be recruited online in the United States. Following the sample size suggestions by Kline (2015), the current study planned to recruit 100 participants for each age group, leading to a total of 300 adults.

Participants

Data were collected through 10 separate HITs posted on weekdays over a 2-month period, with a range of 20 to 55 participants in each HIT. Participant's IP addresses were captured by Qualtric in its system background, and those using the same IP address were not allowed to access the study again after they completed. When the number of participants reached 100 for younger and middle-aged adults, an age screener question was added at the beginning of the study to prevent those who self-reported their age to be below 65 from participating. Most of the older adult sample was recruited in this way.

Demographic Deception

Adding an age screener question to the study could have been problematic because the study descriptions and information on compensation were not changed, and some people under the age of 65 might be attracted by the incentive and use a VPN to log back into the study after they were told they are not qualified, and provide false information (e.g., false age) to get past it.

Providing false information about one's demographic background to get qualified into a study, also known as demographic deception, has been a rising problem accompanying the prevalent use of crowdsourced platforms such as MTurk in academic research (Kan & Drummey, 2018). Such deceptions threaten data quality and may result in faulty conclusion (Kan & Drummey, 2018). The current study took further precautions to guard against potential deceptions when it comes to the reporting of age during the screening process by deleting the data of suspicious participants based on browser strings, start time, and end time related with each attempt. (e.g., A participant's completed attempt was deleted if there were other attempts using the same browser but were blocked by the age screener within a couple of minutes before the completed attempt started). A total of 36 participants were dropped in the older adult group for this reason. ANOVAs and MANOVAs were used to compare the deleted participants with the remaining participants aged 65 and over in the sample. Results showed that the deleted participants were not significantly different in self-reported age, F (1,97) =0.19, p = .665, η^2=.002, education, F (1,97) =1.54, p = .218, η^2=.02, health, F (1,89.49) =2.44, p = .122, or basic cognitive abilities, F (3,94) =0.26, p = .994, η^2=.001 with the remaining participants. However, the deleted participants performed worse on everyday memory, F (1,97) =11.04, p < .001, η^2=.10 (Deleted: M = 14.94, SD = 6.41; Remained: M = 20.17, SD = 8.10) and everyday knowledge, F (1,97) =15.20, p < .001, η^2=.14 (Deleted: M = 13.75; SD = 5.93; Remained: M = 18.70, SD = 6.16). It is important to note that this is a precaution rather than standard procedure, and it might hurt how well the sample represents the population because it is possible that some of the deleted cases were real older adults with poor everyday performance.

Two-step Sampling

A two-step sampling process was adopted in a later HIT to prevent demographic deception. In step one, a screener HIT was set up to collect basic demographic information including age, education, gender and race, but without informing what study it is screening for. Participants who self-reported to be 65 and older were invited to participate in the study 2 to 3 days after they did the screener. Six participants in the older adult group were recruited in this way.

Younger adults (aged 18 to 39), middle-aged adults (aged 40 to 59), and older adults (aged 60 and over) were recruited for the study. The cut off age of older adults were adjusted from 65 to 60 due to the difficulties encountered when recruiting participants over the age of 65. Moreover, the new cut off age also made the age range within each group more even, with each group encompassing around 20 years. Demographic information of the three age groups were presented in Table 1. Age distribution was shown in Figure 1. ANOVA and chi square tests were used to compare demographic differences among the 3 age groups. There was no difference in education, F (2,291) =1.30, p = .273, η^2=.01 or in self-rated health, F (2,291) =1.44, p = .239, η^2=.01, across the 3 age groups. There were fewer females in the younger group than in the middle-aged and older group, χ^2 (2) = 7.60, p = 0.022. There was no difference in the number of European Americans in each age group, χ^2 (2) = 1.37, p = 0.504, or in income, χ^2 (20) = 31.06, p = 0.054, Contingency Coefficient = .31. Given the small number of African American, Native American, Asian, and Hispanic participants in the sample, they were combined in analysis.

Table 1
Mean and Standard Deviations of Demographic Information for Younger, Middle-aged, and Older Adult Groups

	Younger (*n*=98)	Middle-aged (*n*=98)	Older (*n*=98)
Age	31.60 (5.01)	48.96 (6.29)	66.43 (4.54)
Education (Years)	15.30 (2.98)	15.43 (2.75)	15.95 (3.24)
Income	5.55 (2.40)	6.54 (3.03)	5.45 (2.63)
Number of Females	38	65	60
Number of European Americans	68	81	80
Number of African Americans	17	5	10
Number of Hispanics	5	6	2
Number of Native Americans	2	4	2
Number of Asians	5	4	2
Self-rated Health	3.78 (0.90)	3.65 (0.97)	3.56 (0.86)

Note: Income: 1=Between $0 and $11,999, 2=Between $12,000 and $19,999, 3=Between $20,000 and $29,999, 4=Between $30,000 and $39,999, 5=Between $40,000 and $49,999, 6=Between $50,000 and $59,999, 7=Between $60,000 and $69,999, 8=Between $70,000 and $79,999, 9=Between $80,000 and $89,999, 10=Between $90,000 and $99,999, 11=$100,000 or more.

Measures

All the cognitive tests were administered online through Qualtrics.

Everyday Memory

Everyday memory was measured with the Everyday Cognition Battery Memory Test (ECB Allaire & Marsiske, 1999). The ECB Memory Test measures memory in the everyday domains of medication use, financial management, and nutrition/food preparation with 30 items. Participants were given 60 s to study real world stimuli (e.g., medication labels) and another 60 s to answer multiple choice questions about information in the stimuli (e.g., side effects of medication). Two real-world stimuli were provided for each everyday domain, and each stimulus was followed by five questions. The test was scored by the number of correctly answered items in total for each everyday domain, with higher scores indicating better performance. The scale

had adequate overall reliability (α = 0.90) and reliability for the three age groups (Younger adults: α = 0.92; Middle-aged adults: α = 0.79; Older adults: α = 0.92).

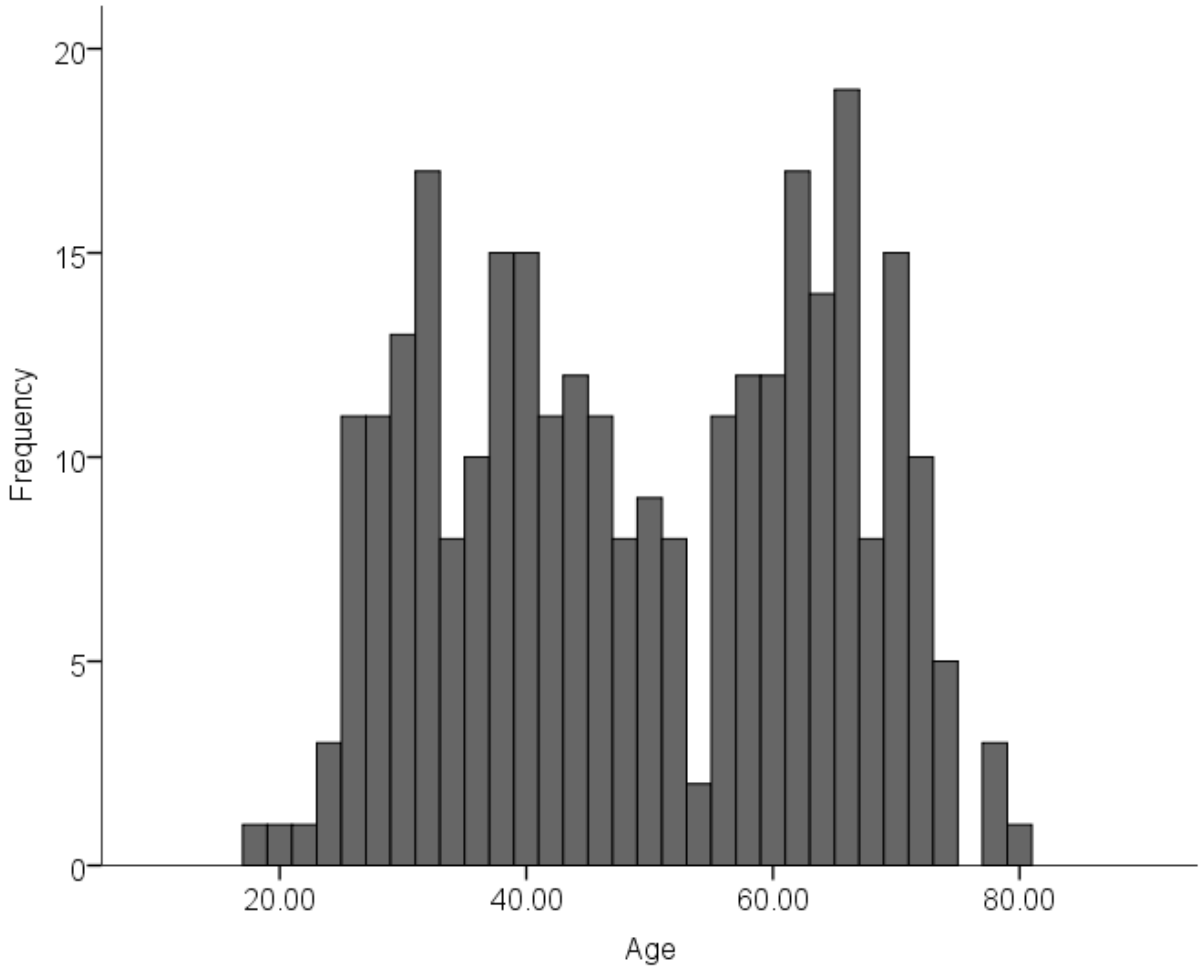

Figure 1. Age distribution of the sample.

Basic Cognition

Basic cognition will be represented by inductive reasoning, processing speed, and episodic memory, and all three tests were administered online. These tests have been successfully administrated on a computer in previous studies (e.g., Gamaldo & Allaire, 2016; Zhang, Gamaldo, Neupert, & Allaire, 2019)

Inductive reasoning. Inductive reasoning was measured by Letter Series Test (Thurstone & Thurstone, 1962). Participants were asked to choose one of the five letters that would come next on the series of letters (e.g., a b a b c d c d __). The task was administered on a computer in a multiple-choice question format. Participants responded to the question by clicking on the answer choices with a mouse. The test was scored by the number of correctly answered items within four min, with higher scores indicating better performance.

Processing speed. Processing speed was measured by the Number Comparison task from the Kit of Factor-Referenced Tests (Ekstrom, French, Harman, & Derman, 1976). Two strings of numbers were presented side by side with a line in between them (e.g., 17634____17634). Participants were asked to check the box next to any number strings that were not the same. There are 48 number strings presented simultaneously and participants can freely scroll up and down the page during the assessment. At the end of 90 s the screen automatically advanced. Scores reflect the number of items correctly answered in 90 s.

Episodic memory. Episodic memory was measured by Rey Auditory Verbal Learning Task (AVLT: Rey, 1941). Participants had 1 min to study a list of 15 semantically unrelated words. At the end of 1 min, the screen automatically advanced and participants were instructed to write down as many words as they could remember within another minute. Scores reflect the total number of unique correct words recalled with no penalty for incorrect or repeated answers.

Knowledge and Experience

Domain-specific knowledge was measured by the ECB Everyday Knowledge Test (Allaire & Marsiske, 1999) which measures everyday knowledge in medication use (e.g., “Dosage is…”), financial management (e.g., “An IRA is…”), and nutrition/food preparation (e.g., “The expiration date or ‘use by’ date on a product means...”). It has 10 multiple choice

items for each domain, leading to 30 items in total. The test was scored by the number of correctly answered items in total for each everyday domain, with higher scores indicating more everyday knowledge. The scale had adequate reliability for both the entire sample ($\alpha = 0.79$) and for each of the three age groups (Younger adults: $\alpha = 0.73$; Middle-aged adults: $\alpha = 0.66$; Older adults: $\alpha = 0.86$).

Experience was measured by three self-report question for each everyday domain (medication use: e.g., "How much experience do you have with following the instructions on prescription medicine labels?"; financial management: e.g., "How much experience do you have in interpreting bank statements?"; nutrition/food preparation: e.g., "How much experience do you have reading nutrition labels?"). Participants rated their experience with the three domains on a 7-point scale, with 1 representing "no experience or very little experience" and 7 representing "a lot of experience". The scale had adequate reliability for both the entire sample ($\alpha = 0.86$) and for each of the three age groups (Younger adults: $\alpha = 0.86$; Middle-aged adults: $\alpha = 0.85$; Older adults: $\alpha = 0.86$).

Covariates

Education, race, gender, and self-rated health were included as covariates. Self-rated health was measured by 4 questions measuring participants' global health (e.g., "I seem to get sick a little easier than other people"). Participants rated how true or false each of the statements is for them on a 5-point scale, with 1 representing "Definitely true" and 5 representing "Definitely false". Items were coded with higher scoring indicating better self-rated health, and the mean rating of the four questions were used as to represent self-rated health.

Data Quality Check

To ensure that participants reported their true age, date of birth and age were asked separately at the beginning and the end of the whole study. Data were excluded from analysis for those whose self-reported date of birth and age showed a discrepancy larger than 2 years. To ensure participants were paying attention to the questions and not clicking on answers randomly, an attention check question was included at the end of the ECB Knowledge measurement in the form of a multiple-choice question. The answer of the question was embedded in the text of the question. Participants who answered incorrectly on the question were excluded from data analysis and not compensated.

Analysis Plan

The current study used structural equation modeling (SEM) to explore each hypothesis.

Aim 1: Determine the measurement invariance of everyday memory across the adult life-span

A confirmatory factor analysis (CFA) was conducted for the everyday memory construct and everyday knowledge construct, with memory scores of the three everyday domains (medication use, financial management, and nutrition/food preparation) regressed on the everyday memory construct and knowledge scores of the three everyday domains regressed on the everyday knowledge construct for the whole sample (Figure 2). Measurement invariance was tested for the everyday memory construct in younger, middle-aged, and older adults groups (Aim 1) in a hierarchical fashion. At the lowest invariance level (configural invariance), the same pattern of factor loadings was estimated in the three groups with no parameters set to be equal. At the second invariance level (metric invariance), all factor loadings were constrained to be the same across the three groups. At the third level (scalar invariance), all measurement intercepts

were constrained to be the same across the three groups. Finally, at the fourth level (residual invariance), all the measurement residuals were constrained to be the same.

Support of a particular level of invariance was determined by chi-square differences between the current model and the proceeding less-constrained model. A non-significant change of chi-square indicates that the more constrained model fit as good as its proceeding less constrained model, suggesting invariance at that level. On the other hand, a significant change of chi-square indicates that at least one of the constrained parameters is not equivalent among the three groups.

In cases where invariance was not achieved on a particular level, a 1 degree of freedom chi-square test was performed for each loading to determine which specific parameter causeds the non-invariance. In each test, two among the three groups were constrained to have the same value on the tested parameter, and the model fit of this model was tested against the model on the previous invariance level. A significant change of chi-square indicates that the tested parameter is not equivalent between the two tested groups. This method has been used in previous studies (e.g., Whitfield, Allaire, Gamaldo, & Bichsel, 2010)

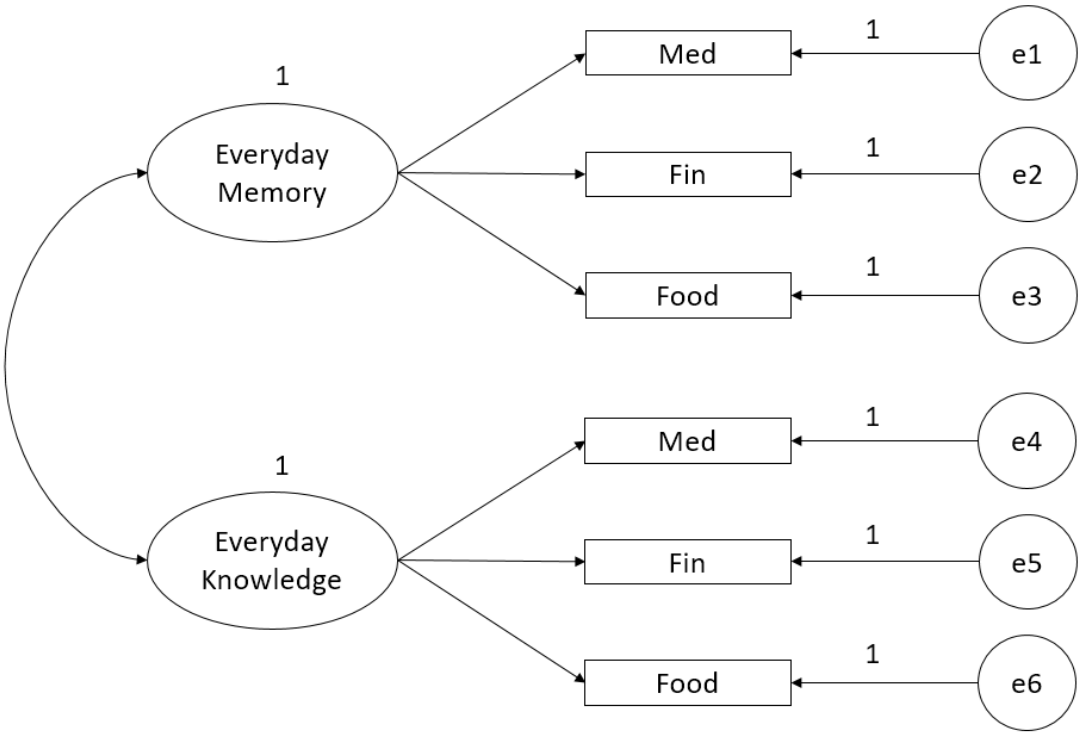

Figure 2. CFA model for the everyday memory and knowledge construct. Med = medication use; Fin = Financial management; Food = Nutrition/food preparation.

Aim 2: Determine the salience of episodic memory, reasoning, processing speed, and domain-specific knowledge/experience to predict individual differences in everyday memory across the adult life-span

Given that measurement invariance is achieved, a multi-group model was constructed to test age-group moderation in aim 2. An unconstrained model in which all regression weights are estimated was set up to examine the structural relationship between different latent constructs and observed variables in the whole sample. The inductive reasoning score, episodic memory score, processing speed score, everyday knowledge construct, and everyday experience construct were regressed on the everyday memory construct (Figure 3). Self-reported health, education, gender, and race were also included in the model as covariates. Regression weights were constrained by setting each path in the younger adult group equal to the corresponding path in

the middle-aged and older adult group. Model fit of this model (i.e., structural weight invariance model) was compared with the model with all paths free to vary, and significant difference in model fit suggests a significant age group moderation. Significant age group moderation was followed up by 1 degree of freedom chi-square test to identify which group differs with the other groups on which path. The test is similar to the 1 degree of freedom test used for Aim 1 of the study.

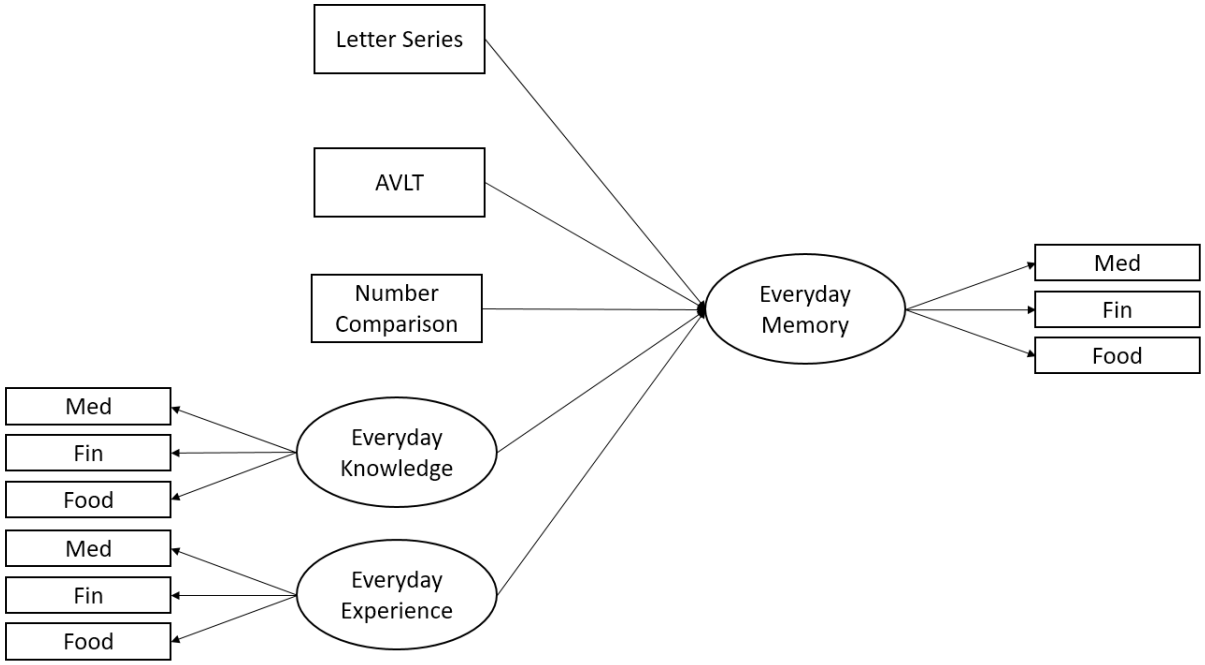

Figure 3. Structural model with inductive reasoning, processing speed, episodic memory, everyday knowledge, and everyday experience regressed on everyday memory. Error terms are not included for simplicity. Med = medication use; Fin = Financial management; Food = Nutrition/food preparation.

Aim 3: Determine if domains of everyday knowledge and everyday experience (i.e., medication use, financial management, and nutrition/food preparation) are more sensitive in predicting performance of everyday memory in corresponding domains.

A multi-group multiple indicator multiple cause (MIMIC) model was built on top of the SEM model in Aim 2. Domain specific experience and knowledge indicators was regressed on corresponding everyday memory performance indicators to adjust for within-person differences in everyday knowledge and experience of different domains (Figure 4). The same procedure outlined in Aim 2 to test age group moderation was applied to the testing of age group moderation in Aim 3.

To compare whether everyday knowledge in an everyday domain is more sensitive in predicting everyday memory in the corresponding everyday domain, a series of 3 degrees of freedom chi-square tests was conducted. For younger adults, path "a" in Figure 4 was constrained to be equal to path "b" and "c" while all other paths were left to be estimated the same as previous models. Model fit of the latter model (in which paths "a", "b", and "c" in younger adults take on the same value) was compared back with model fit of the model in which these paths were not constrained, and significant difference in model fit would suggest that there is sensitivity difference in prediction. If there was sensitivity difference in prediction, three 1-degree of freedom chi-square tests were conducted to find out which among paths "a", "b", and "c" differ from each other (i.e., setting path "a" and "b" to equality and test for model fit difference; setting path "a" and "c" to equality and test for model fit difference; setting path "b" and "c" to equality and test for model fit difference). The same procedure was repeated for middle-aged adults and older adults.

Prediction sensitivity for everyday experience in medication use, financial management, and nutrition/food preparation on everyday memory in corresponding domains was tested the same way as described in the previous paragraph.

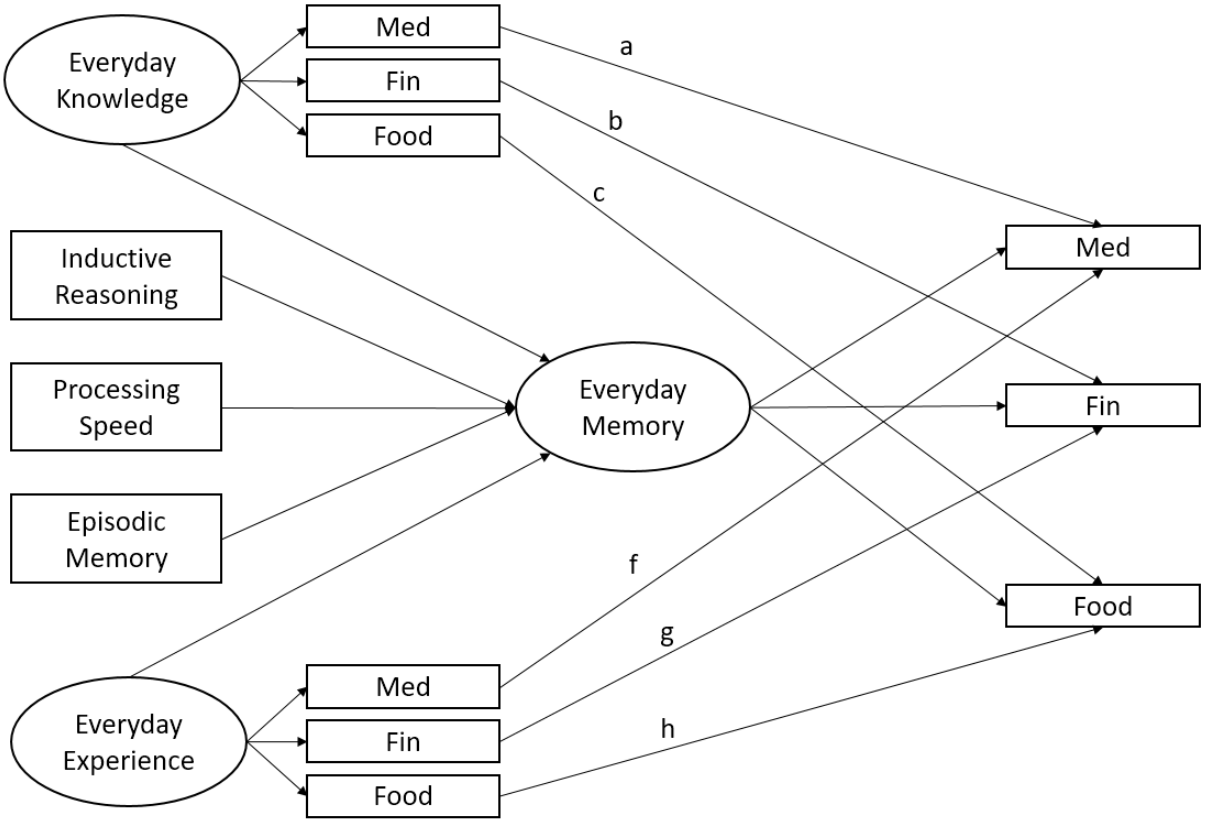

Figure 4. MIMIC model with knowledge of medication use, financial management, and Nutrition/Food preparation regressed on memory of corresponding domains. Error terms are not included for simplicity. Med = medication use; Fin = Financial management; Food = Nutrition/food preparation.

Results

Descriptive Analysis

Distributional properties of subscales of the ECB Memory test and the ECB Knowledge test are presented in Table 2. For ECB Memory, scores on all sub-scales were negatively skewed,

with most of the participants performing at the upper end of the distribution for all three age groups. Mean and variance of the three subscales were compared among age groups using ANOVA with Bonferroni adjustments and Levene's test. Results showed that performance for middle-aged adults clustered more around the group mean for all three subscales (Medication Use: F (2, 289) = 5.95, p=.003; Financial Management: F (2, 290) = 8.57, p<.001; Nutrition/Food Preparation: F (2, 287) = 9.63, p<.001). ANOVA with Welch correction showed that middle-aged adults performed better than younger and older adults on the Nutrition/Food Preparation subscale, F (2, 181) =6.07, p=.009, η^2 = .03, whereas no age group difference were found for performance on the Medication Use, F (2, 188.62) =3.47, p=.099, η^2 = .02, and Financial Management subscale, F (2, 185.08) =3.74, p=.078, η^2 = .02.

Scores for ECB Knowledge were also negatively skewed, with more scores on the upper end of the distribution. Results from the Levene's test showed that the older adult group had larger variance on all three subscales than the younger and middle-aged group (Medication Use: F (2, 291) = 8.49, p<.001; Financial Management: F (2, 291) = 8.13, p<.001; Nutrition/Food Preparation: F (2, 291) = 3.85, p=.022). Middle-aged adults scored higher on the Medication Use subscale than younger and older adults, F (2, 187.64) = 8.94, p=.003, η^2 = .05, whereas middle-aged adults scored higher on the Nutrition/Food Preparation, F (2, 188.71) = 4.25, p=.048, η^2 = .03, and Financial Management, F (2, 188.94) = 5.89, p=.009, η^2 = .03, subscale than older adults.

Scores for self-rated everyday experience were compared across age groups using ANOVA with Bonferroni adjustment. Welch correction was applied when homogeneity of variance was violated. Older adults self-rated to have more experience on medication use than younger adults F (2, 191.73) = 4.54, p=.036, η^2 = .03, and both middle-aged adults and older

adults self-rated to have more experience on financial management than younger adults, F (2, 191.89) = 6.31, p=.006, η^2 = .04. There was no age group difference in experience on nutrition/food preparation, F (2, 291) = 0.55, p=.576, η^2 = .004.

Scores for basic cognitive abilities were compared across age groups using ANOVA with Bonferroni adjustment. Welch correction was applied when homogeneity of variance was violated. Younger and middle-aged adults performed better on Letter Series than older adults, F (2, 189.04) = 8.80, p=.003, η^2 = .05. There were no age group difference in performance on AVLT, F (2, 286) = 2.68, p=.210, η^2 = .02, or Number Comparison, F (2, 288) = 3.60, p=.087, η^2 = .02.

Memory, knowledge, and experience in the domains of medication use, financial management, and nutrition/food preparation were also compared using ANOVA with Bonferroni adjustment. Welch correction was applied when homogeneity of variance was violated. Participants in the sample memorized items for Nutrition/Food Preparation (M = 7.69, SD =2.25) better than items for Medication Use (M = 7.21, SD = 2.30). They also memorized items for Financial Management (M = 8.23, SD = 2.15) better than items for Nutrition/Food Preparation, F (2, 872) = 15.49, p<.001, η^2 = .03. Participants in the sample also scored higher on the Medication Use (M = 6.96, SD = 1.95) and Nutrition/Food Preparation subscale (M = 7.17, SD =1.84) of the ECB Knowledge test than on the Financial Management subscale (M = 6.12, SD = 1.63), F (2, 582.70) = 30.15, p<.001, η^2 = .06. Finally, participants in the sample had higher self-rated experience on Financial Management (M = 6.21, SD = 1.08) than on Nutrition/Food Preparation (M = 5.98, SD = 1.13), and they had the least experience on Medication Use (M = 5.77, SD = 1.34) among the three domains, F (2, 581.59) = 10.14, p<.001, η^2 = .02.

Table 2

Distributional Properties of the ECB Subscales

	Younger Adults				Middle-aged Adults				Older adults			
	Mean	*SD*	Skewness	Kurtosis	Mean	*SD*	Skewness	Kurtosis	Mean	*SD*	Skewness	Kurtosis
ECB Memory												
Med	7.03	2.55	-0.91	-0.27	7.65	1.87	-1.25	1.24	6.92	2.37	-0.83	-1.75
Fin	8.13	2.19	-1.18	0.41	8.65	1.59	-1.54	2.30	7.91	2.53	-1.44	1.11
Food	7.43	2.52	-0.97	0.09	8.24	1.60	-0.77	0.02	7.38	2.43	-1.08	0.39
ECB Knowledge												
Med	6.51	1.85	-0.89	0.85	7.50	1.48	-1.01	1.17	6.87	2.33	-1.25	0.72
Fin	6.08	1.68	-0.67	-0.08	6.51	1.28	-0.37	1.18	5.76	1.82	-0.88	0.20
Food	7.15	1.64	-0.39	-0.32	7.54	1.47	-1.79	5.26	6.77	2.25	-1.15	0.91
Everyday Experience												
Med	5.46	1.52	-0.92	0.14	5.82	1.26	-1.20	1.12	6.03	1.15	-1.57	2.67
Fin	5.90	1.23	-1.29	1.57	6.07	1.03	-0.98	0.04	5.99	1.13	-1.17	0.76
Food	5.91	1.17	-0.87	-0.35	6.44	0.92	-1.79	2.44	6.30	1.07	-1.77	2.81
Basic Cognition												
AVLT	7.93	3.77	-0.61	-0.22	9.06	3.29	-0.55	0.57	8.68	3.36	-0.47	0.11
Letter Series	11.22	4.92	0.37	0.25	11.65	5.10	0.68	0.17	9.22	3.86	0.94	1.94
Number Comparison	10.21	3.85	0.74	2.71	10.76	3.44	-0.07	0.63	9.31	4.08	1.03	2.58

Note: Med = Medication Use. Fin = Financial Management. Food = Nutrition/Food Preparation. Subscales of ECB Memory and ECB Knowledge ranges from 0 to 10. Everyday Experience ranges from 0 to 7.

Aim 1: Determine the measurement invariance of everyday memory across the adult life-span

Measurement invariance of the ECB Memory test and the ECB Knowledge test across younger, middle-aged, and older adults was tested using a series of multi-group CFA models. The model fit and model comparison results are presented in Table 3. The configural invariance model was tested first and the fit of the model was good (χ^2 (57) = 17.87, p=.809, NFI=.98, CFI=1.00, RMSEA < .001 [.00, .03], p_{RMSEA} = .996). Factor loadings for the model are shown in Figure 5. Next, the metric invariance model was tested with factor loadings set to equality for the three groups. The fit of the metric invariance model was adequate (χ^2 (45) = 79.69, p <.001, NFI=.91, CFI=.95, RMSEA = .07 [.05, .08], p_{RMSEA} = .100), but when compared to the configural invariance model the fit was significantly worse ($\Delta\chi^2$ (12) = 61.83, p<.001). The significant increase in the χ^2 suggests that one or more of the factor loadings was not equivalent among the three age groups.

Table 3
Measurement Invariance for Younger, Middle-aged, and Older Adult Groups

Level of Invariance	χ2	*df*	*P*	NFI	CFI	RMSEA	P_{RMSEA}	Comparison to Previous Model		
								$\Delta\chi$2	*df*	*P*
Configural	17.87	57	.809	.98	1.00	<.001 [.00, .03]	.996	--	--	--
Metric	79.69	45	<.001	.91	.95	.07 [.05, .08]	.100	61.83	12	<.001

Follow-up analysis tested the invariance of each of the factor loadings with one degree of freedom chi-square tests, and results are presented in Table 4. For the ECM Memory factor, loadings for the Medication Use, Financial Management, and Nutrition/Food Preparation domain were invariant between the younger adult and older adult groups, but were not invariant between

younger and middle-aged, or middle-aged and older groups. Factor loadings of the middle-aged groups were lower than the younger and older group (Figure 5). For the ECB Knowledge factor, loadings for Medication and Nutrition/Food Preparation variables were invariant between younger adults and middle-aged adults, but were not invariance between younger and older, or middle-aged and older adults. Loadings for Financial Management were invariant between younger and older adults and marginally invariant between younger and middle-aged adults, but were not invariant between middle-aged and older adults. Loadings of the older group were higher than the younger and middle-aged group for Medication Use and Nutrition/Food Preparation, whereas loading of the middle-aged group was lower than the younger and older group for Financial Management (Figure 5). Taken together, more than half of all the factor loadings were non-invariant, suggesting non-invariance at the metric level (Steenkamp & Baumgartner, 1998; Vandenberg & Lance, 2000).

Because metric invariance was not achieved, scalar invariance and residual invariance was not tested.

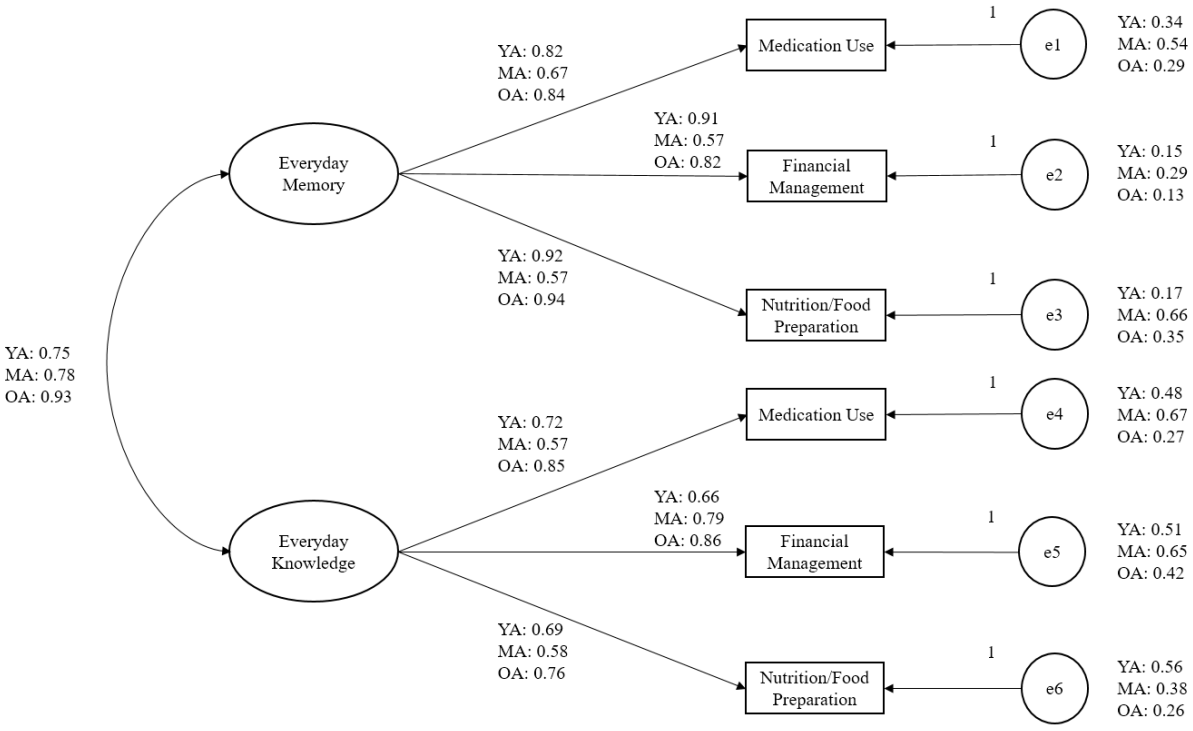

Figure 5. The configural invariance model with standardized factor loading, error variance, and correlation between factors for younger, middle-aged, and older adults. YA = younger adults; MA = middle-aged adults; OA = older adults.

Table 4

Pairwise Comparison of Non-equivalent Measurement Weights

Model	$\chi 2(1)$	*P*
Everyday Memory Factor		
Medication Use		
YA=MA	9.022	0.003
YA=OA	0.169	0.681
MA=OA	7.456	0.006
Nutrition/Food Preparation		
YA=MA	28.975	<0.001
YA=OA	1.089	0.297
MA=OA	17.135	<0.001
Financial Management		
YA=MA	8.796	0.003
YA=OA	2.475	0.116
MA=OA	19.613	<0.001
Everyday Knowledge Factor		
Medication Use		
YA=MA	3.774	0.052
YA=OA	6.228	0.013
MA=OA	21.197	<0.001
Nutrition/Food Preparation		
YA=MA	0.122	0.727
YA=OA	11.478	0.001
MA=OA	10.647	0.001
Financial Management		
YA=MA	3.854	0.050
YA=OA	0.764	0.382
MA=OA	9.234	0.002

Note: YA= Younger Adults. MA=Middle-aged Adults. OA=Older Adults

Aim 2: Determine the salience of episodic memory, reasoning, processing speed, and domain-specific knowledge/experience to predict individual differences in everyday memory across the adult life-span

Because measurement invariance was not established within the current data, factors could take on different meanings for younger, middle-aged, and older adults. Therefore, comparisons between groups could not be made reliably on the latent-factor level. Consequently, path analysis was used instead to analyze with only observed variables. Figure 6 showed a graphic representation of the path model. The path model was set up similar to the proposed SEM model. The total scores of ECB Memory and ECB Knowledge were used instead of latent constructs, and all predictors were allowed to correlate. Self-reported health, education, gender, and race were included in the model as covariates.

As laid out in the method section, an unconstrained model in which all regression weights were freely estimated was set up first as a baseline model. In the second model, the constrained model, each regression weight was set to equality across the three age groups. For instance, the regression weight for ECB Knowledge predicting ECB Memory was fixed to equality in each of the three age groups, while the paths from Everyday Experience to ECB Memory were set to equality across the three age groups. Because the unconstrained model is a just-identified model which has the same number of observed and estimated parameters, degrees of freedom equals zero and χ^2 was not estimated.

Model fit results showed that the constrained model had a good fit (χ^2 (18) = 19.05, p = .389; NFI = .97; CFI = 1.00; RMSEA = .01 [.00, .06], p_{RMSEA} = .916), and this model was not significantly different from the unconstrained model (χ^2 (18) = 19.05, p = .389). These results suggest that Reasoning, Episodic memory, Processing speed, Everyday Knowledge, and

Everyday Experience contribute similarly to everyday memory in younger, middle-aged, and older adults.

Standardized regression results from the constrained model showed that people who performed better on Letter Series, AVLT, and ECB Knowledge also performed better on the ECB Memory test. Moreover, those who had lower education and better self-rated health also performed better on the ECB Memory test. Performance on the Number Comparison test and self-rated Everyday Experience did not significantly predict everyday memory. Neither did gender and race. Standardized regression weights for younger, middle-aged, and older adults are presented in Figure 6. Correlations between all predictor variables are shown in Table 5.

The model explained 43% of variance in performance on the ECB Memory test in younger adults, 53% in middle aged adults, and 74% in older adults.

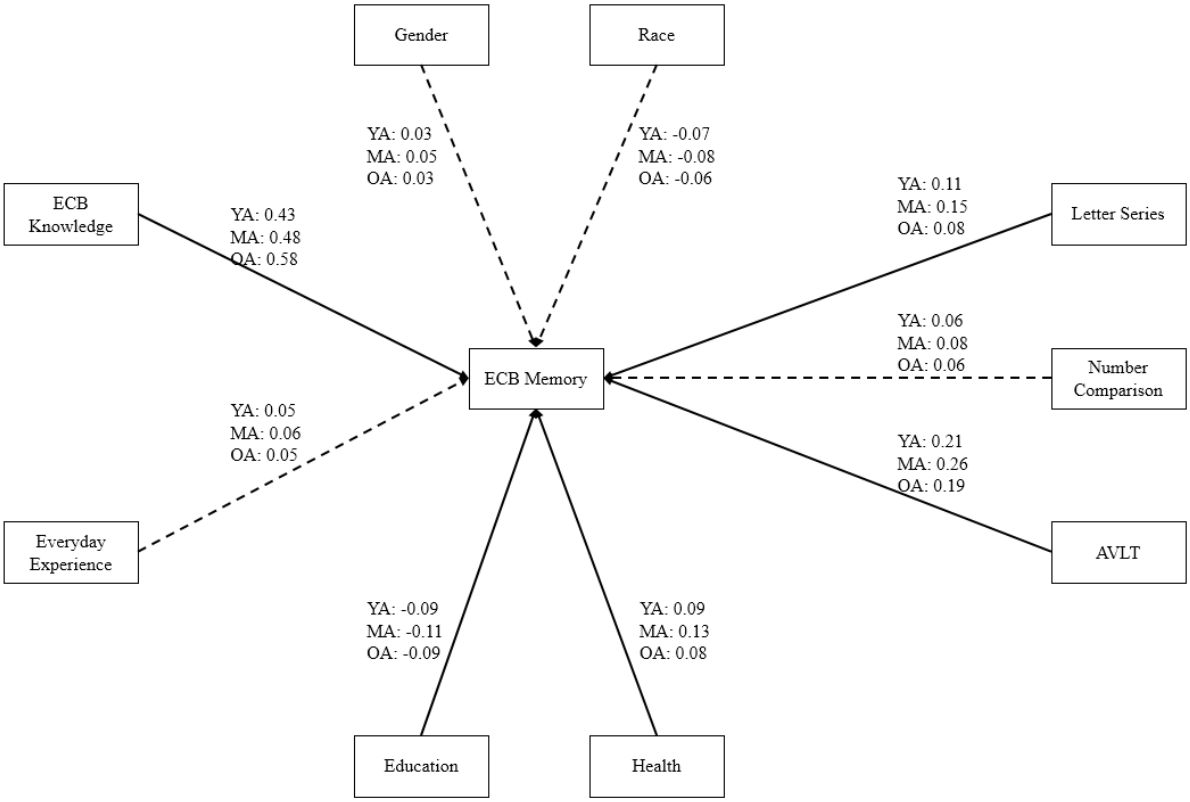

Figure 6. Path model with inductive reasoning, processing speed, episodic memory, everyday knowledge, and everyday experience regressed on everyday memory. Standardized regression weight for younger, middle-age, and older adults were shown in the figure. Dotted path indicates non-significant regression weights. YA = younger adults; MA = middle-aged adults; OA = older adults.

Table 5
Correlations between Predictors of ECB Memory for Younger, Middle-aged, and Older Adults

	YA	MA	OA
LS with AVLT	0.39***	0.18	0.39***
LS with NC	0.56***	0.45***	0.50***
LS with Exp	0.05	0.28**	0.05
LS with ECBk	0.37***	0.30**	0.21*
LS with Educ	-0.01	-0.09	<0.01
LS with Race	-0.22*	-0.17	-0.24*
LS with Health	-0.15	-0.10	0.23*
LS with Gender	0.06	0.17	0.13
AVLT with NC	0.33**	0.18	0.32**
AVLT with Exp	0.09	0.05	0.25*
AVLT with ECBk	0.34**	0.20	0.38***
AVLT with Educ	-0.03	0.17	-0.10
AVLT with Race	-0.04	-0.08	-0.47***
AVLT with Health	-0.17	-0.10	0.34**
AVLT with Gender	-0.06	0.26*	0.31**
NC with Exp	-0.01	0.16	0.22*
NC with ECBk	0.24*	0.17	0.14
NC with Educ	0.16	-0.07	-0.07
NC with Race	-0.24*	-0.15	-0.07
NC with Health	-0.20	0.14	0.19
NC with Gender	-0.04	0.04	0.19
Exp with ECBk	0.32**	0.33**	0.50***
Exp with Educ	0.06	0.05	-0.19
Exp with Race	0.11	>-0.01	-0.09
Exp with Health	0.01	-0.01	0.21*
Exp with Gender	0.23*	<0.01	0.36***
ECBk with Educ	-0.17	-0.20	-0.41***
ECBk with Race	-0.03	-0.10	-0.37***
ECBk with Health	0.08	-0.23*	0.36***
ECBk with Gender	0.24*	0.05	0.35**
Educ with Race	-0.10	0.18	0.08
Educ with Health	0.05	0.12	-0.14
Educ with Gender	0.06	0.23*	-0.29**
Race with Health	0.27*	0.19	-0.13
Race with Gender	-0.06	0.04	-0.11
Health with Gender	0.01	-0.10	0.18

*Note: LS=Letter Series. NC=Number Comparison. Exp=Everyday Experience. Educ= Education. Gender: 0=Male, 1=Female. Race: 0= European Americans, 1=Minorities. *p<.05. **p<.01. ***p<.001.*

Aim 3: Determine if domains of everyday knowledge and everyday experience (i.e., medication use, financial management, and nutrition/food preparation) are more sensitive in predicting performance of everyday memory in corresponding domains.

Similar to Aim 2, analysis for Aim 3 were conducted with path models. Three separate path models were conducted with memory performance in the three everyday domains as the dependent variable and Letter Series, Number Comparison, AVLT, along with ECB Knowledge, self-rated Everyday Experience in the corresponding domain as predictors. The same set of covariates controlled in analysis for Aim 2 were also controlled in the current models. Figures 7 to 9 present graphic representations of the models used.

Similar to analyses for Aim 2, unconstrained models and constrained models were estimated and model fits were compared to determine age-group moderation. An unconstrained model and a constrained model were estimated for medication use, financial management, and nutrition/food preparation separately.

Medication Use

The constrained model with memory in the medication use domain as dependent variable had a good fit (χ^2 (18) = 21.10, p = .274; NFI = .96; CFI = .99; RMSEA = .02 [.00, .06], p_{RMSEA} = .863), and this model is not significantly different from the unconstrained model (χ^2 (18) = 21.10, p = .274), suggesting that reasoning, episodic memory, processing speed, knowledge, and experience on medication use contribute similarly to everyday memory in medication use in younger, middle-aged, and older adults.

People who had better reasoning ability, better episodic memory, or more knowledge within the domain of medication use performed better on everyday memory within the domain of medication use. Those who had lower education also performed better on memory in the

medication use domain. Processing speed and self-rated experience on medication use did not predict everyday memory. Neither did health, gender, and race. Standardized regression weights for each age group were presented in Figure 7. The model explained 33% of variance in everyday memory performance in both younger and middle-aged adults and 54% of variance in older adults. Correlations between all predictor variables for this model were presented in Table 6.

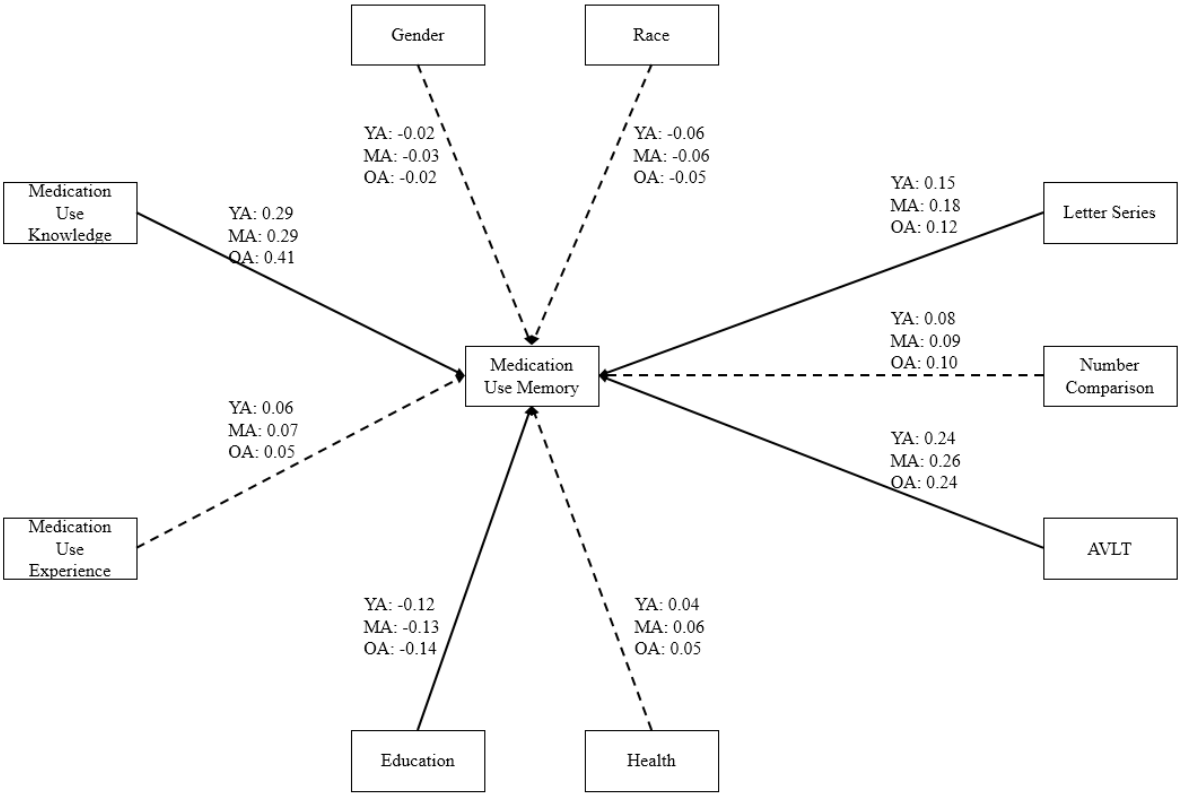

Figure 7. Path model with inductive reasoning, processing speed, episodic memory, everyday knowledge, and everyday experience on medication use regressed on everyday memory of medication use. Standardized regression weight for younger, middle-age, and older adults were shown in the figure. Dotted path indicates non-significant regression weights. YA = younger adults; MA = middle-aged adults; OA = older adults.

Table 6
Correlations between Predictors of ECB Memory in Medication Use for Younger, Middle-aged, and Older Adults

	YA	MA	OA
LS with AVLT	0.38***	0.18	0.39***
LS with NC	0.56***	0.45***	0.50***
LS with Exp	0.04	0.21*	0.01
LS with ECBk	0.32**	0.26*	0.21*
LS with Educ	-0.02	-0.09	<0.01*
LS with Race	-0.21*	-0.17	-0.24*
LS with Health	-0.15	-0.10	0.23
LS with Gender	0.05	0.17	0.13
AVLT with NC	0.32**	0.18	0.32**
AVLT with Exp	-0.02	0.02	0.04
AVLT with ECBk	0.30**	0.18	0.36**
AVLT with Educ	-0.03	0.17	-0.11
AVLT with Race	-0.04	-0.08	-0.46***
AVLT with Health	-0.17	-0.10	0.34**
AVLT with Gender	-0.06	0.26*	0.31**
NC with Exp	-0.01	-0.04	0.11
NC with ECBk	0.16	0.19	0.08
NC with Educ	0.17	-0.07	-0.07
NC with Race	-0.24*	-0.15	-0.06
NC with Health	-0.21*	0.14	0.19
NC with Gender	-0.04	0.04	0.19
Exp with ECBk	0.18	0.22*	0.29**
Exp with Educ	0.13	0.16	-0.17
Exp with Race	0.04	0.02	<0.01
Exp with Health	-0.16	-0.25*	-0.02
Exp with Gender	0.34**	0.08	0.25*
ECBk with Educ	-0.16	-0.07	-0.38***
ECBk with Race	-0.06	-0.10	-0.39***
ECBk with Health	0.01	-0.08	0.31**
ECBk with Gender	0.20	0.10	0.32**
Educ with Race	-0.10	0.18	0.09
Educ with Health	0.05	0.12	-0.14
Educ with Gender	0.06	0.23*	-0.29**
Race with Health	0.27*	0.19	-0.13
Race with Gender	-0.06	0.04	-0.11
Health with Gender	0.01	-0.10	0.18

*Note: LS=Letter Series. NC=Number Comparison. Exp=Everyday Experience. Educ= Education. Gender: 0=Male, 1=Female. Race: 0= European Americans, 1=Minorities. *p<.05. **p<.01. ***p<.001.*

Financial Management

The constrained model with memory in the financial management domain as dependent variable had a good fit (χ^2 (18) = 26.84, p = .082; NFI = .95; CFI = .98; RMSEA = .04 [.00, .07], p_{RMSEA} = .647), and this model was not significantly different from the unconstrained model (χ^2 (18) = 26.84, p = .082), suggesting that reasoning, episodic memory, processing speed, knowledge, and everyday experience in the financial management domain contribute similarly to everyday memory in financial management in younger, middle-aged, and older adults.

People who had better reasoning ability, better episodic memory, more knowledge about Financial Management, or self-report to have more experience in financial management domain performed better on everyday memory in the financial management domain. Those who had lower education and better health also had better memory in the financial management domain. Number Comparison, gender, and race did not significantly predict memory in the financial management domain. Standardized regression weights for each age group were presented in Figure 8. The model explained 45% of variance in everyday memory performance in younger adults, 43% in middle-aged adults, and 55% in older adults. Correlations between all predictor variables for this model were presented in Table 7.

Nutrition/Food Preparation

The constrained model with memory in the nutrition/food preparation domain as dependent variable had a good fit (χ^2 (18) = 23.39, p = .176; NFI = .96; CFI = .99; RMSEA = .03 [.00, .07], p_{RMSEA} = .786), and this model was not significantly different from the unconstrained model (χ^2 (18) = 23.39, p = .176), suggesting that reasoning, episodic memory, processing speed, knowledge about nutrition/food preparation, and everyday experience in the nutrition/food

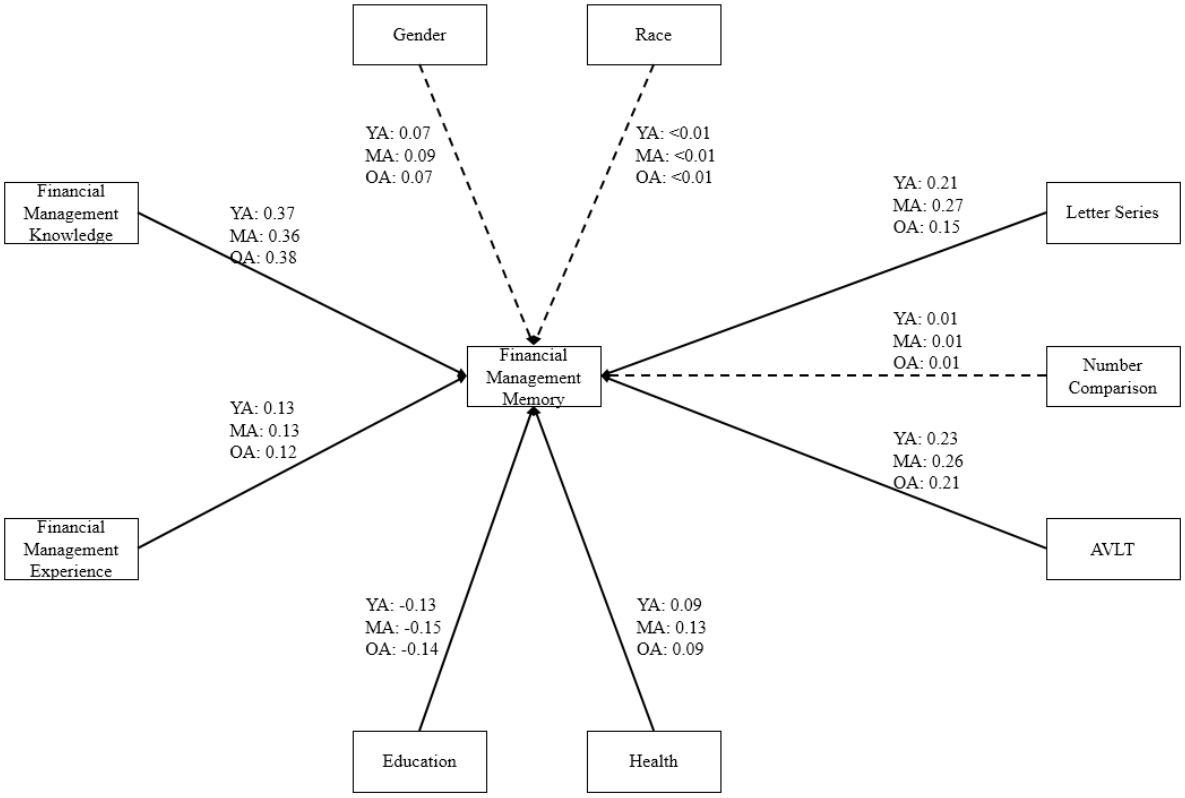

Figure 8. Path model with inductive reasoning, processing speed, episodic memory, everyday knowledge, and everyday experience on financial management regressed on everyday memory of financial management. Standardized regression weight for younger, middle-age, and older adults were shown in the figure. Dotted path indicates non-significant regression weights. YA = younger adults; MA = middle-aged adults; OA = older adults.

Table 7
Correlations between Predictors of ECB Memory in Financial Management for Younger, Middle-aged, and Older Adults

	YA	MA	OA
LS with AVLT	0.39***	0.18	0.39***
LS with NC	0.56***	0.45***	0.50***
LS with Exp	-0.01	0.22*	0.12
LS with ECBk	0.29**	0.13	0.08
LS with Educ	<0.01	-0.09	<0.01
LS with Race	-0.22*	-0.17	-0.24*
LS with Health	-0.15	-0.10	0.23*
LS with Gender	0.06	0.17	0.13
AVLT with NC	0.33**	0.18	0.32**
AVLT with Exp	-0.02	0.06	0.35**
AVLT with ECBk	0.21*	0.14	0.30**
AVLT with Educ	-0.03	0.17	-0.11
AVLT with Race	-0.05	-0.08	-0.46***
AVLT with Health	-0.18	-0.10	0.34**
AVLT with Gender	-0.06	0.26*	0.31**
NC with Exp	0.01	0.28**	0.19
NC with ECBk	0.32**	0.01	0.13
NC with Educ	0.16	-0.07	-0.07
NC with Race	-0.24*	-0.15	-0.07
NC with Health	-0.20	0.14	0.19
NC with Gender	-0.04	0.04	0.19
Exp with ECBk	0.27**	0.05	0.50***
Exp with Educ	0.01	<0.01	-0.16
Exp with Race	0.12	<0.01	-0.21*
Exp with Health	0.15	0.15	0.30**
Exp with Gender	0.20	-0.07	0.27*
ECBk with Educ	-0.13	-0.16	-0.41***
ECBk with Race	-0.14	-0.08	-0.32**
ECBk with Health	0.08	-0.16	0.29**
ECBk with Gender	0.24*	-0.02	0.36***
Educ with Race	-0.09	0.18	0.08
Educ with Health	0.05	0.12	-0.14
Educ with Gender	0.06	0.23*	-0.29**
Race with Health	0.27*	0.19	-0.12
Race with Gender	-0.06	0.04	-0.11
Health with Gender	0.01	-0.10	0.18

*Note: LS=Letter Series. NC=Number Comparison. Exp=Everyday Experience. Educ= Education. Gender: 0=Male, 1=Female. Race: 0= European Americans, 1=Minorities. *p<.05. **p<.01. ***p<.001.*

preparation domain contribute similarly to everyday memory in nutrition/food preparation in younger, middle-aged, and older adults.

People who had better episodic memory or more knowledge about nutrition/food preparation performed better on everyday memory in the nutrition/food preparation domain. Those who self-reported better health and self-identified as a European American also had better memory in the nutrition/food preparation domain. Number comparison, self-reported experience in nutrition/food preparation, education, and Gender did not significantly predict memory in the nutrition/food preparation domain. Standardized regression weights for each age group were presented in Figure 9. The model explained 26% of variance in everyday memory performance in younger adults, 33% in middle-aged adults, and 50% in older adults. Correlations between all predictor variables for this model were presented in Table 8.

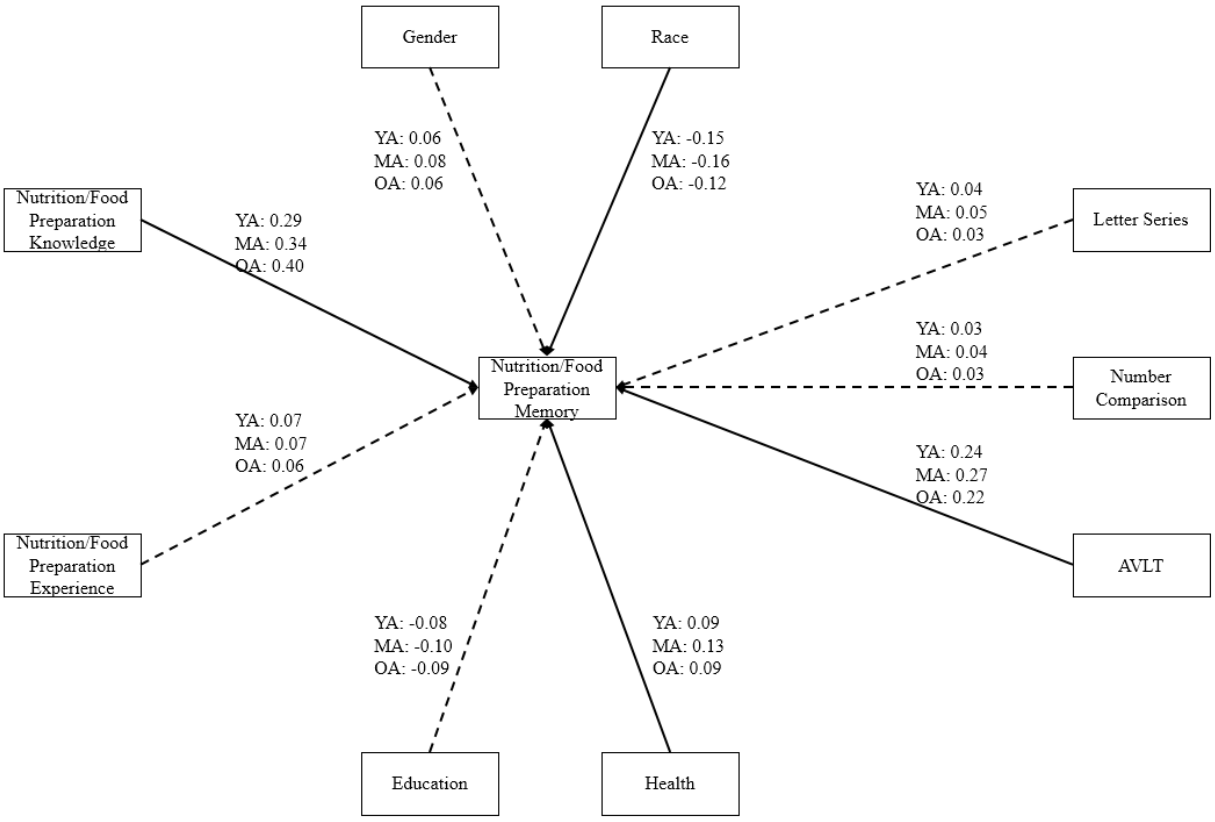

Figure 9. Path model with inductive reasoning, processing speed, episodic memory, everyday knowledge, and everyday experience on nutrition/food preparation regressed on everyday memory of nutrition/food preparation. Standardized regression weight for younger, middle-age, and older adults were shown in the figure. Dotted path indicates non-significant regression weights. YA = younger adults; MA = middle-aged adults; OA = older adults.

Table 8
Correlations between Predictors of ECB Memory in Nutrition/Food Preparation for Younger, Middle-aged, and Older Adults

	YA	MA	OA
LS with AVLT	0.38***	0.18	0.39***
LS with NC	0.56***	0.45***	0.50***
LS with Exp	0.08	0.23*	<0.01
LS with ECBk	0.27**	0.31**	0.24*
LS with Educ	-0.01	-0.09	<0.01
LS with Race	-0.21*	-0.17	-0.24*
LS with Health	-0.16	-0.10	0.23*
LS with Gender	0.05	0.17	0.13
AVLT with NC	0.32**	0.18	0.32**
AVLT with Exp	0.26*	0.04	0.23*
AVLT with ECBk	0.30**	0.15	0.35**
AVLT with Educ	-0.03	0.17	-0.09
AVLT with Race	-0.04	-0.08	-0.46***
AVLT with Health	-0.17	-0.10	0.34**
AVLT with Gender	-0.06	0.26*	0.31**
NC with Exp	-0.03	0.19	0.21*
NC with ECBk	0.08	0.18	0.15
NC with Educ	0.17	-0.07	-0.07
NC with Race	-0.24*	-0.15	-0.07
NC with Health	-0.21*	0.14	0.19
NC with Gender	-0.04	0.04	0.19
Exp with ECBk	0.35**	0.34**	0.28**
Exp with Educ	-0.03	-0.08	-0.11
Exp with Race	0.11	-0.03	-0.01
Exp with Health	0.07	0.13	0.23*
Exp with Gender	-0.03	-0.03	0.34**
ECBk with Educ	-0.13	-0.24*	-0.30**
ECBk with Race	0.14	-0.06	-0.26*
ECBk with Health	0.11	-0.29**	0.35**
ECBk with Gender	0.15	0.04	0.26*
Educ with Race	-0.10	0.18	0.08
Educ with Health	0.05	0.12	-0.14
Educ with Gender	0.06	0.23*	-0.29**
Race with Health	0.27*	0.19	-0.13
Race with Gender	-0.06	0.04	-0.11
Health with Gender	0.01	-0.10	0.18

*Note: LS=Letter Series. NC=Number Comparison. Exp=Everyday Experience. Educ= Education. Gender: 0=Male, 1=Female. Race: 0= European Americans, 1=Minorities. *p<.05. **p<.01. ***p<.001.*

Comparing Sensitivity

Sensitivity of prediction was compared with a student *t* distribution with *v* degrees of freedom. The formula was outlined by Dupont and Plummer (1998):

$$D = \frac{(\beta_1 - \beta_2)\sqrt{n_2}}{S_R}$$

where β_1 and β_2 stand for the two standardized regression weights under comparison, n_2 stands for the sample size for the independent variable related with β_2, and S_R stands for the pooled estimate of error variance. The details and specifics required for the calculation are presented as following:

$$v = n_1 + n_2 - 4$$

$$m = \frac{n_1}{n_2}$$

$$S_R^2 = s^2\left[\frac{1}{m\sigma_{X_1}^2} + \frac{1}{\sigma_{X_2}^2}\right]$$

$$\sigma_{X_1}^2 = \frac{1}{n_1}\sum_j \left(X_{1j} - \bar{X}_1\right)^2$$

$$\sigma_{X_2}^2 = \frac{1}{n_2}\sum_j \left(X_{2j} - \bar{X}_2\right)^2$$

$$s^2 = \frac{1}{n_1 + n_2 - 4}\sum_{ij} \left(Y_{ij} - \hat{Y}_{ij}\right)^2$$

where n_1 and n_2 stand for the sample size for the independent variable related with β_1 and β_2, $\sigma_{x_1}^2$ and $\sigma_{x_2}^2$ stand for the variance of the independent variable related with β_1 and β_2, and s^2 stands for pooled mean square error for the dependent variables in the two regression models.

Results from the calculation for ECB Knowledge predicting ECB Memory were presented in Table 9. These results indicate that none of the regression weights are significantly different from each other, suggesting that knowledge about medication use was not more sensitive in predicting memory in the medication use domain than knowledge about financial

management predicting memory in the financial management domain or knowledge about nutrition/food preparation predicting memory in the nutrition/food preparation domain. This pattern holds true for younger, middle-aged, and older adults.

Regression weight comparisons for Everyday Experience predicting ECB Memory were not calculated because self-rated experience did not significantly predict everyday memory within the domains of medication use and nutrition/food preparation.

Table 9
Comparing Predictive Sensitivity of Domains of Everyday Knowledge on Their Corresponding Domains of Everyday Memory

	Younger Adults		Middle-aged Adults		Older Adults	
	t (192)	*p*	*t* (192)	*p*	*t* (192)	*p*
Med vs. Fin	0.50	0.310	0.41	0.339	0.19	0.424
Med vs. Food	0.02	0.491	0.36	0.361	0.10	0.461
Fin vs. Food	0.41	0.342	0.07	0.473	0.10	0.462

Notes: Med =Knowledge on Medication Use Predicting Memory on Medication Use. Fin = Knowledge on Financial Management Predicting Memory on Financial Management. Food = Knowledge on Nutrition/Food Preparation Predicting Memory on Nutrition/Food Preparation.

Discussion

The overarching goal of the current study was to examine the relative contribution of different basic cognitive abilities (e.g., episodic memory, processing speed, and inductive reasoning) and domain-specific knowledge to understanding individual differences in everyday memory performance across the adult life-span. It specifically examined: (1) measurement invariance of everyday memory for younger, middle-aged, and older adults; (2) the predictive salience of basic cognitive abilities and domain-specific knowledge/experience on individual differences in everyday memory across the adult life-span; and (3) the predictive salience of different domains of everyday knowledge and Everyday Experience (i.e., medication use, financial management, and nutrition/food preparation) on individual differences in everyday memory in corresponding domains.

In short, the current findings did not support the initial hypotheses. The current study did not find measurement invariance for the ECB Memory and ECB Knowledge tests across the three age groups. Memory ability within the domain of medication use, financial management, and nutrition/food preparation loaded on the ECB Memory factor similarly for younger and older adults. Knowledge about medication use and nutrition/food preparation loaded on everyday knowledge equally for younger and middle-aged adults, whereas knowledge about financial management loaded on younger and older adults equally. Contrary to expectation, basic cognitive abilities and everyday knowledge contribute similarly to performance on everyday memory. Participants who had better reasoning or memory ability and participants who had more everyday knowledge also had better everyday memory. Finally, comparison on sensitivity of prediction of everyday knowledge on everyday memory in the medication use, financial

management, and nutrition/food preparation domain showed that everyday knowledge predicted everyday memory similarly for all everyday domains.

Findings from the 3 aims were discussed in detail in the following sections, followed by strengths and limitations of the current study.

Aim 1: Determine the measurement invariance of everyday memory across the adult life-span

The current study is one of the first study to examine everyday memory across the adult life-span. It is also the first attempt to study cross-sectional differences in everyday cognition as a latent factor. The findings of measurement non-invariance on everyday memory might be due to range restriction on the everyday measures used. The ECB Memory test and ECB Knowledge test were designed for older adults and validated in older adult populations (Allaire & Marsiske, 1999; Gamaldo & Allaire, 2016). Therefore, it is possible that the memory questions were too easy for younger and middle-aged adults. This is also confirmed by distributional properties of the ECB Memory subscales (Table 2), which showed that scores for all subscales were negatively skewed for the three age groups.

Moreover, the results also showed that memory performance on medication use, financial management, and nutrition/food preparation loaded on everyday memory differently for middle-aged adults compared with younger and older adults. This is consistent with the analysis on distribution properties of the subscales, which showed that the range restriction problem have a stronger impact on the middle-aged group. Specifically, analysis on the subscales showed that middle-aged adults performed better on the Nutrition/Food Preparation subscale than younger and older adults. Although there was no age group difference in mean performance on the

Medication Use or Financial Management subscale, performance in the middle-aged group had a smaller variation around the group mean for these two subscales.

This lack of individual difference in everyday memory in middle adulthood is not surprising because everyday cognition measures was designed to capture and reflect performance related to the cognitive aspects of activities of daily living (Allaire, 2012; Allaire & Gamaldo, 2017). Meanwhile, middle-aged adults had plenty of everyday knowledge, experience, and cognitive abilities (Chen et al., 2017) to perform well. It is interesting to note that the standardized factor loadings for the middle-aged group were lower than those for the younger and older groups. This might be because the three subscales of everyday memory shared a smaller percentage of variance in the middle-aged group than in the younger and older group. This is confirmed by exploratory analysis showing that the three subscales are less correlated in middle-aged adults than in younger and older adults. Without further information, this pattern can be interpreted in two different ways. It is possible that the three subscales in the ECB Memory test did not adequately and reliably capture everyday cognition in middle-aged adults. The ECB Memory test is a relatively narrow representation of everyday memory. Memory in other everyday situations related to activities of daily living, such as shopping and using cellphone, are not covered. Neither were common everyday situations for younger/middle-aged adults and highly functioning older adults outside the scope of activities of daily living (e.g., time management, event planning, engaging in hobbies, communication for social reasons). A broader everyday memory assessment with a better representation of other domains in everyday life might provide a different result. On the other hand, it could also be the case that middle-aged adults were more diversified in their performance across different everyday domains (e.g., have

high performance in one everyday domain and average performance on the others). Replications with larger sample sizes are needed before drawing conclusions.

It is also interesting to note that knowledge in the medication use and nutrition/food preparation domains loaded higher on everyday knowledge for older adults compared with younger and middle-aged adults. Moreover, knowledge in the financial management domain loaded lower on everyday knowledge for the middle-aged group compared with the other two groups. The high loadings of the knowledge subscales in older adults is consistent with previous research using the ECB Knowledge test (e.g., Allaire & Marsiske, 1999). But the reason for the low loadings in the other two group can only be speculative. Further exploratory analysis showed that the Medication Use and Nutrition/Food preparation subscale on the ECB Knowledge test correlated stronger in older adults than in younger and middle-aged adults. Moreover, the Financial Management subscale correlated stronger with Medication Use in older adults than in middle-aged adults, and it also correlated stronger with Nutrition/Food Preparation in older adults than in younger adults. These results suggest that the three knowledge subscales seem to share more variance in older adults than in middle-aged and younger adults. This could be attributed to the measurement itself. The ECB Memory test was made specifically for older adults, and specific everyday knowledge relevant and important for older adults might not reflect the kind of everyday knowledge the younger generations and cohorts possessed. For example, the Financial Management subscale contains multiple questions on financial problems after retirement (e.g., IRA, social security). Although the younger and middle-aged adults should know about these things, they might not yet be as relevant for the younger generations.

Aim 2: Determine the salience of episodic memory, reasoning, processing speed, and domain-specific knowledge/experience to predict individual differences in everyday memory across the adult life-span

It was unexpected that younger, middle-aged, and older adults relied similarly on basic cognitive abilities, everyday knowledge, and everyday experience to memorize items in everyday life. Findings were discussed mainly in comparison with the study by Chen and colleagues (2017), which is the only study to my knowledge to examine everyday cognition across the adult lifespan.

The finding that younger adults also rely on everyday knowledge to solve everyday problems is inconsistent with previous findings. For instance, Chen and colleagues (2017) found that age moderated the influence of crystalized ability on everyday cognition. However, their simple slope analysis did not show any difference on everyday cognition between adults aged 40 and below who had high and low crystalized ability, suggesting that crystalized ability did not significantly contribute to everyday cognition in younger adults. This difference in findings might be attributed to differences in measurement. The ECB Knowledge test used in the current study measured domain-specific everyday knowledge related with medication use, financial management, and nutrition/food preparation, which is conceptually closer to everyday cognition than verbal ability measures used by Chen and colleagues (2017). Therefore, the domain-specific everyday knowledge measure might predict domain-specific everyday memory better than domain-general knowledge measures predicting domain-specific everyday performance. Moreover, everyday cognition, although shared a large amount of variance with basic cognition and fluid abilities (e.g., Allaire & Marsiske, 1999; Yam et al., 2014), has a significant amount of unique variance that might reflects task-specific skills, task-specific knowledge, and domain-

specific overlearned behaviors in everyday life (Bielak et al., 2017). It is also possible that younger adults, although spending much fewer years carrying out those everyday activities, have accumulated a large enough skill and knowledge base to help with everyday problem solving. Taken together, this finding suggest that younger adults use everyday knowledge to help with everyday memory when such knowledge is available.

The finding that older adults did not rely more on everyday knowledge in everyday cognition is also inconsistent with previous findings. Chen and colleagues (2017) found a positive association between crystalized ability and everyday cognition for middle-aged adults and older adults, with the effect significantly stronger for older adults. This might be because older adults in the current study are relatively young and healthy, and did not need to use more knowledge to compensate. The middle-age and older age used to decompose the age x crystalized ability interaction was 59 and 78 respectively, whereas middle-aged adults had a mean age of 48.96 years (*SD* = 6.29) and older adults in the sample had a mean age of 66.42 years (*SD* = 4.54), and fewer than 5% of those participants were above the age of 75. The mean age and age range of older adults in the current studies are also relatively younger than that of previous studies with older adults. For instance, everyday cognition studies with older adults using both cross-sectional (e.g., Allaire & Marsiske, 1999; Diehl et al., 1995) and longitudinal design (e.g., Gamaldo & Allaire, 2016; Gross et al., 2011; Tucker-Drob, 2011; Yam et al., 2014) usually have a sample mean age in the 70s, and a longitudinal study showed that older adults maintained a high level of everyday cognition until they reach their 80s (Yam et al., 2014). Therefore, it might be the case that older adults in the sample could adequately solve all the everyday memory problems without overly relying on their knowledge about everyday life for

compensation. This is confirmed by the lack of age group difference in the 3 ECB Memory subscales between younger and older adults in the study.

The current findings also contradict a memory study by Hedden and colleagues (2005), in which they compared cued recall in younger and older adults, and found that verbal knowledge contributed to cued recall performance more in older adults. The difference between their study and the current one might be attributed to the differences in difficulty levels of the task. The everyday memory task in the study is a test of recognition, which is much easier than the cued recall task which requires participants to recall a random word from a cue word from random word pairs studied earlier. Perhaps older adults would rely more on everyday knowledge than younger and middle-aged adults if the everyday task was much more difficult.

To take it a step further, the current finding could reflect a sampling bias caused by sampling online with Mturk. Older adults who participate studies on Mturk could be biased to be younger and healthier than the general population even if the current study managed to acquire an older adult sample with equivalent mean age and age range to previous studies. Although a growing number of older adults are embracing newer technologies, the older adult population still falls behind in computer and mobile device use (Anderson & Perrin, 2017). Meanwhile, studies on computer use and computer proficiency have also identified basic cognitive abilities as a barrier to using computers (Czaja et al., 2006; Zhang, Grenhart, McLaughlin, & Allaire, 2017). Therefore, older adults who self-select to be working on Mturk would likely be those who had better cognitive performance compared with their peers regardless of their age. This is confirmed by the ceiling effect observed in all three ECB Memory subscales for older adults.

Finally, the differences might also be due to methodological differences between the two studies. The current study used a path analysis in which differential contribution of basic

cognitive abilities and everyday knowledge were tested with age-group moderation, whereas Chen and colleagues (2017) used the continuous age variable as the moderator in their regression analysis. Moreover, the two studies used two different sets of measures. Specifically, Chen and colleagues (2017) aimed at examining everyday reasoning using the Everyday Problem Test (EPT), whereas the current study focused on performance on everyday memory and used the ECB Memory test. Although both everyday reasoning and everyday memory are part of everyday cognition, they can be very different in nature. For instance, Allaire and Marsiske (1999) found in an older adult sample that everyday reasoning performance on the ECB reasoning test was mainly contributed by inductive reasoning and everyday knowledge while performance on ECB Memory test was contributed by inductive reasoning, episodic memory, and knowledge. These methodological differences need to be taken into consideration when interpreting the differences in findings between the two studies.

It is also worth noting that although basic cognitive abilities, everyday knowledge, and everyday experience had the same relative contribution to everyday memory performance across the adult life-span, they explained different amount of variance in everyday memory in the three age groups. The model explained 43% of variance in younger adults, 53% in middle-aged adults, and 74% in older adults. The amount of variance explained in older adults is comparable to previous cross-sectional studies (Allaire & Marsiske, 1999). The differences in variance explained might be caused by the differences in strengths of correlations between all the predictors in the three age group (Table 6 to 8). It might also be related with the unequal variance of the everyday memory across different age groups. Given that this is the first study to compare everyday memory in the adult life-span, the reason of the differences could only be speculative.

The results suggested that everyday cognition is more complicated than previously thought, and future studies are needed to uncover the source of the differences.

The finding that younger and older adults relied the same extent on reasoning and memory in those everyday memory problems is inconsistent with predictions based on the dedifferentiation trend in older adults. It was expected that younger adults would be mainly relying on memory for the ECB Memory test given the lower correlation between different cognitive domains. Older adults would rely more evenly on memory, reasoning, and processing speed for the same task, possibly because those cognitive domains are more closely associated with each other, and they might need to use abilities in different cognitive domains together to compensate for declines in one. The findings did not support this expectation probably because older adults in the sample had relatively high performance.

Aim 3: Determine if domains of everyday knowledge and everyday experience (i.e., medication use, financial management, and nutrition/food preparation) are more sensitive in predicting performance of everyday memory in corresponding domains.

The current study found that everyday knowledge predicted everyday memory similarly for all everyday domains across the adult lifespan. These results extended the findings that everyday knowledge contributed similarly to everyday memory in younger, middle-aged, and older adults (Aim 2) into specific subdomains within everyday life. Consistent with findings in Aim 2, self-reported experience in medication use and nutrition/food preparation did not predict everyday memory performance in those two subdomains. However, experience on financial management was predictive of memory in financial management. This might be explained by the mean differences between knowledge and self-rated experience in financial management and the other two everyday domains. Participants in the sample had more experience with financial

management, but scored lower on knowledge about financial management than medication use and nutrition/food preparation. This inconsistency seems to have some face validity in that financial documents are usually thought to be more technical, and could be harder to interpret than food and medication labels. Therefore, it is possible that participants in the sample did not have as good of an understanding of the technical aspects and specific terms of financial documents, and drew more on their previous experience in reading bank statements to help with their memory in the financial management domain.

Although not part of Aim 3, it is interesting to note that Letter Series significantly predicted memory in the medication use and financial management domains, but not memory in the nutrition/food preparation domain. The same pattern was found across the adult life-span. Without further information, the reason for this result is unclear. This result pattern opens up the possibility that people might rely on different sets of basic cognitive abilities to solve everyday memory problems in different everyday domains, although further research and replication would be needed to determine if this is specific to the sample or the measure.

Limitations and Future Directions

There are some limitations that need to be addressed in the current study. First, the sample size is relatively small. One hundred participants in each group is the minimum requirement for multi-group models to converge (Kline, 2015). It is possible that the sample is biased towards higher performance and not reflecting the population well. A study with a larger sample size might capture more people with lower performance and mitigate the influence of range restriction problems that potentially caused the measurement invariance in Aim 1.

Second, the current sample lacks diversity in cognitive performance and racial backgrounds. The current study had a relatively young and well-functioning older adult group

compared with previous studies examining everyday cognition in older adults (e.g., Allaire & Marsiske, 1999; Yam et al., 2014). Therefore, older adults in the sample might not need to use more everyday knowledge to compensate for losses in basic cognition in everyday memory performance. Moreover, the sample mainly consist of European Americans, with few African Americans, Asians, and other racial groups, especially in the middle-aged and older groups. Therefore, the finding that younger, middle-aged, and older adults relied the same amount of basic cognitive abilities and everyday knowledge to solve everyday memory problems is by no means conclusive. Future research on everyday cognition also needs sample with community dwelling adults to improve the generalizability of the findings.

Third, data collected on Mturk are not representative of the older adult population and could be subjective to demographic deception. As mentioned earlier, Mturk is an online platform, and older adults who use computers and the Internet are likely to have better cognitive functioning than those who don't. Given that only 67% of people over the age of 65 in the US use the Internet (Anderson & Perrin, 2017), older adult samples recruited on Mturk are potentially subject to selection biases. Moreover, Mturk is anonymous and there's no way to verify the self-reported demographic backgrounds. The current study initially applied an age-screener question to screen out participants under the age of 65 after the number of participants reached the planned number for the younger and middle-aged group. However, the current setting was not adequate to prevent people to log back into the study using VPN after they were told they are not qualified. Although the study dropped some participants in affected HITs, some of the data included in analysis might be compromised.

Fourth, the everyday memory test used in the current study is a limited assessment of everyday memory competency. First, the focus of the ECB Memory test is rather narrow. The

test only has 3 everyday domains (medication use, financial management, nutrition/food preparation). Other domains important to maintaining independent living, such as shopping and using cell phone, are not included. Second, the ECB Memory test is made 20 years ago, and has not been updated ever since. Therefore, some of the stimuli may be outdated (e.g., the check book ledger stimuli used for financial management), whereas some other important developments might be left out (e.g., online banking for financial management). Third, there are only two everyday stimuli and ten corresponding multiple-choice questions for each everyday domain. This might not be enough for a thorough assessment of memory competence within each domain. Fourth, the ECB Memory test examined recognition instead of recall. As mentioned earlier, recall was cognitively more demanding than recognition, and age-related declines are typically greater in recall than in recognition (e.g., Danckert & Craik, 2013). Future research can compare everyday memory across adult lifespan with different everyday memory measures (e.g., The Virtual Environment Grocery Store: Parsons & McMahan, 2017; The Virtual Shop: Ouellet, Boller, Corriveau-Lecavalier, Cloutier, & Belleville, 2018; VR-Memory: Pflueger, Stieglitz, Lemoine, & Leyhe, 2018). Future research can also focus on revising and updating ECB to make it a more comprehensive test.

Conclusions

In conclusion, the current study found that subscales of the ECB Memory test had weaker loadings on everyday memory for middle-aged adults. Moreover, reasoning, memory, and everyday experience contribute to everyday memory in similar ways across adult lifespan. Limitations notwithstanding, findings from the current study suggest that older adults don’t necessarily rely more on knowledge and experience in everyday cognition than younger and middle-aged adults if they have high cognitive abilities. Similarly, younger and middle-aged

adults might function like older adults and use knowledge as a compensation for everyday cognition when everyday knowledge are available. Future studies with a larger community-based sample using an updated version of the ECB Memory test are needed to confirm or challenge these findings.

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APPENDIX

Demographic Questionnaire

Age

As of today's date, how old are you? _____years.

Sex

What is your sex? (check one)

- Male
- Female

Race

Which do you feel best describes your racial background? (Multiple answers are possible!)

- White/European American
- Black/African American
- Hispanic
- Native American or Alaskan Native
- Asian
- Native Hawaiian or Pacific Islander
- Other (please specify) _____

Education

Check the highest level of education you have completed.

- Grade School 1
- Grade School 2
- Grade School 3
- Grade School 4
- Grade School 5
- Grade School 6
- Junior/High school 7
- Junior/High school 8
- Junior/High school 9
- Junior/High school 10
- Junior/High school 11
- Junior/High school 12
- Trade school or College 1
- Trade school or College 2
- Trade school or College 3
- Trade school or College 4
- College 5 or Graduate School 1
- Graduate School 2
- Graduate School 3
- Graduate School 4
- Graduate School 5
- Graduate School 6
- Graduate School more than 6

Age check

What is your year and month of birth? _____

Health

How TRUE or FALSE is each of the following statements for you?

	Definitely true	Mostly true	Don’t know	Mostly false	Definitely false
I seem to get sick a little easier than other people					
I am as healthy as anybody I know					
I expect my health to get worse					
My health is excellent					

ECB Memory Test

Allaire, J. C., & Marsiske, M. (1999). Everyday cognition: age and intellectual ability correlates. *Psychology and Aging, 14*(4), 627-644

1

Code No _____

ECB Recognition Questionnaire

In the following questionnaire you will be asked to study different everyday printed material such as medicine labels and nutrition labels for 1 minute. You will then be asked memory questions. You will be asked to turn the page and circle the correct answer to each memory question. Because this is a memory test, you cannot turn back to look at the printed material after you have studied it.

Please try to answer all the questions as well as you can, and do not worry if the problems seem difficult. Just do your best. Any questions?

You will have 1 minute to study each printed text. Please study very carefully. You will then have 1 minute to turn the page and circle your answers. If you are ready, turn the page and study the three labels now.

You will have 1 minute to study the medication labels below. Please study them very carefully. Do not turn the page until you are told. **2**
BEGIN STUDYING NOW.

DATE OF PRESCRIPTION: 07-31-97
DR: Deems, J. M. **RX:** 081221

Melissa Hardin **REFILLS** 1

EXPIRES: 09-23-97

TAKE 1 CAPSULE ON TUESDAY AND THURSDAY, AT BREAKFAST
LANOXIN - 0.125 mg 60 CAPSULES

DATE OF PRESCRIPTION: 07-31-97
DR: Cooper, M. W. **RX:** 081222

Melissa Hardin **REFILLS** 1

EXPIRES: 09-30-97

TAKE DAILY WITH MEALS AND AT DINNER
VASOTEC - 10 mg 60 CAPSULES

DATE OF PRESCRIPTION: 07-31-97
DR: Deems, J. M. **RX:** 081223

Melissa Hardin **REFILLS** 1

EXPIRES: 09-17-97

TAKE DAILY, EVERY MORNING AND BEFORE BED
PRINIVIL - 5 mg 60 CAPSULES

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

Answer the following questions with out looking back on the previous page. **Do not look back on previous page.**

1) On which days is Mrs. Hardin suppose to take her Lanoxin?
   a. Tuesday and Thursday
   b. Monday and Sunday
   c. Tuesday and Wednesday
   d. whenever she wants

2) In which month do all three of her medications expire?
   a. January
   b. September
   c. May
   d. August

3) Which one of these medications was Mrs. Hardin **not** prescribed?
   a. Lanoxin
   b. Vasotec
   c. Prinivil
   d. Furosemide

4) Who are the two doctors that prescribed these drugs medications for Mrs. Hardin?
   a. Dr. Deems and Dr. Hong
   b. Dr. Cooper and Dr. Deems
   c. Dr. Cooper and Dr. Stevens
   d. Dr. Hill and Dr. Buck

5) How many capsules was Mrs. Hardin given in each prescription?
   a. 60 capsules
   b. 50 capsules
   c. 100 capsules
   d. she was given a different amount for each prescription

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

4

You will have 1 minute to study the nutrition label below. Please study it very carefully. Do not turn the page until you are told. **BEGIN STUDYING NOW**.

Butter

Nutrition Facts	
Serving Size 1 tbsp (14 g)	
Servings Per Container about 32	
Amount Per Serving	
Calories 100	Calories from Fat 100
	% Daily Values*
Total Fat 11g	**17%**
Saturated Fat 7g	**36%**
Cholest. 30mg	**10%**
Sodium 90mg	**4%**
Total Carbohydrate 0g	**0%**
Protein 0g	**0%**
Vitamin A 8%	
Not a significant source of dietary fiber, sugars, vitamin c, calcium and iron.	
* Percent Daily Values are based on a 2,000 calorie diet	

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

5

Answer the following questions with out looking back on the previous page. **Do not look back on previous page.**

1) How many servings will you get out of this product before you have to buy it again?
   a. 1 serving
   b. 32 servings
   c. 10 servings
   d. 22 servings

2) This product is a source for what vitamin?
   a. Vitamin C
   b. Vitamin D
   c. Vitamin A
   d. Vitamin E

3) How many calories does this product have per serving?
   a. 100 calories
   b. 200 calories
   c. 50 calories
   d. 300 calories

4) What is the serving size of this product?
   a. 1 tsp.
   b. ½ tsp
   c. 1 tbsp
   d. ½ tbsp

5)What percentage of calories come from fat?
   a. 25 %
   b. 50 %
   c. 75 %
   d. 100 %

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

6

You will have 1 minute to study Mrs. Davis' checkbook ledger. Please study it very carefully. Do not turn the page until you are told. **BEGIN STUDYING NOW**.

NUMBER	DATE	DESCRIPTION OF TRANSACTION	PAYMENT /DEBIT	DEPOSIT/CREDIT	BALANCE
					4000.00
110	4/11	RENT	375.00		3625.00
111	4/12	DINNER	10.00		3615.00
112	4/15	PHONE BILL	75.00		3540.00
113	4/15	SOCIAL SECURITY CHECK		500.00	4040.00
114	4/20	CORNER MARKET	50.00		3990.00

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

7

Answer the following questions with out looking back on the previous page. **Do not look back on previous page.**

1) How much did Mrs. Davis pay for rent?
   a. $ 375.00
   b. $ 400.00
   c. $ 300.00
   d. $ 3625.00

2) Where did Mrs. Davis buy $ 50.00 worth of groceries?
   a. Meijer's
   b. K-Mart
   c. Farmer Jack
   d. Corner Market

3) How much did Mrs. Davis have in her account to start off with?
   a. $ 3000.00
   b. $ 4000.00
   c. $ 1000.00
   d. $ 500.00

4) In addition to rent, what other household/utility bill did Mrs. Davis pay?
   a. electric bill
   b. phone bill
   c. gas bill
   d. no other bill

5) What check did Mrs. Davis deposit into her account?
   a. IRS check
   b. check from a friend
   c. Social Security check
   d. did not deposit any money

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

8

Mr. Jones is 82 years old. Because of a recent health problem his family doctor prescribed the drug **Captopril.**

Mr. Jones medicine bottle has the following labels:

DATE OF PRESCRIPTION: 05-31-96
DR: Herbst, D. E. **RX**: 081224
HOWARD JONES **REFILLS** 1
EXPIRES: 08-31-97
TAKE 1 TABLET EVERY 6 HOURS (TAKE AT EVEN INTERVALS AROUND THE CLOCK)
CAPTOPRIL - 25 mg 90 TABLETS

TAKE MEDICATION ON AN **EMPTY STOMACH** 1 HOUR BEFORE OR 2 TO 3 HOURS AFTER A MEAL UNLESS OTHERWISE DIRECTED BY YOUR DOCTOR

THIS DRUG MAY IMPAIR YOUR ABILITY TO DRIVE OR OPERATE MACHINERY, **USE CARE** UNTIL YOU BECOME FAMILIAR WITH ITS EFFECTS

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

Answer the following questions with out looking back on the previous page. **Do not look back on previous page.**

1) How often should Mr. Jones take these tablets?
   a. every 2 hours
   b. when needed
   c. every 6 hours
   d. when he wants to

2) How long should Mr. Jones wait to eat a meal after taking a dosage?
   a. he doesn't have to wait
   b. 6 hours
   c. 1 hour
   d. 2 hours

3) Who is the doctor Mr. Jones should call if you have a problem with your prescription?
   a. Dr. Meyers
   b. Dr. Hebb
   c. Dr. Stevens
   d. Dr. Herbst

4) If Mr. Jones takes this medication, what might he be too impaired to do?
   a. write a letter
   b. drive a car
   c. talk on the phone
   d. walk

5) How many pills should he take every day?
   a. 4 pills
   b. 6 pills
   c. as many as he needs
   d. 1 pill

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

10

You will have 1 minute to study the listing of what Mrs. Smith ate for dinner last night. Please study it very carefully. Do not turn the page until you are told. **BEGIN STUDYING NOW**.

Meal A:

Food Item	Carbohydrate (grams)	Fiber (grams)
3 oz baked chicken	0	0
1/2 cup mashed potatoes	15	1.6
1/2 cup green beans	0	1.2
1/2 cup fruit cocktail	15	1.0
1 cup 2% milk	12	0
TOTAL	**42**	**3.8**

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

Answer the following questions with out looking back on the previous page. **Do not look back on previous page.**

1) How much **total** fiber does the meal contain?
   a. 3.8
   b. 1.6
   c. 4.2
   d. 3.1

2) What kind of milk did she drink with her dinner?
   a. Skim Milk (0 %)
   b. Low Fat Milk (1 %)
   c. Reduced Fat Milk (2 %)
   d. Vitamin D Milk (4 %)

3) What kind of fruit did she eat?
   a. an apple
   b. a banana
   c. she didn't eat any fruit
   d. fruit cocktail

4) Which of the following high-carbohydrate foods did Mrs. Smith eat?
   a. rice
   b. noodles
   c. potatoes
   d. bread

5) What kind of meat was in her meal?
   a. beef
   b. fish
   c. chicken
   d. no meat

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

12

You will have 1 minute to study Mr. Mast's credit card statement. Please study it very carefully. Do not turn the page until you are told. **BEGIN STUDYING NOW**.

ACCOUNT NUMBER	PAYMENT DUE DATE	PAST DUE AMOUNT	MINIMUM PAYMENT DUE	BALANCE	AMOUNT ENCLOSED
2344 2525 4654 6754	O5/24/97	20.00	40.00	540.00	35.00

DATE	TRANSACTIONS	AMOUNT (-) IS A CREDIT
04/10/97	SEARS	35.76
04/17/97	KMART	29.99
04/24/97	BILL KNAPP'S FAMILY RESTAURANT	9.50
04/30/97	FARMER JACK	45.00

PLEASE DO NOT TURN THE PAGE UNTIL YOU ARE TOLD

13

Answer the following questions with out looking back on the previous page.
Do not look back on previous page.

1) How much is Mr. Mast's credit card balance?
   a. $ 540.00
   b. $ 600.00
   c. $ 100.00
   d. $ 50.00

2) What restaurant did Mr. Mast charge a meal at?
   a. International House of Pancakes
   b. Denney's
   c. Bill Knapp's Family Restaurant
   d. she did not charge a meal

3) What store did he **not** use his credit card at?
   a. Farmer Jack
   b. Sears
   C. Meijer's
   d. K-Mart

4) How much did Mr. Mast pay the credit card company this month?
   a. $ 20.00
   b. $ 35.00
   c. $ 30.00
   d. $ 500.00

5) In what month were these purchases on this credit card statement made?
   a. December
   b. November
   c. August
   d. April

ECB Knowledge Test

Allaire, J. C., & Marsiske, M. (1999). Everyday cognition: age and intellectual ability correlates. *Psychology and Aging, 14*(4), 627-644

1

Code No _____

ECB Knowledge Questionnaire

In this questionnaire you will be presented with a number of questions that ask you about everyday facts.

We will do a practice question together. Look at the question below and from the choices offered circle the correct answer.

EXAMPLE:

1) If you wanted to find out how many fat grams were in a can of beans, where would you find this information?

a. ask the grocer
b. read the encyclopedia
c. the can's nutrition label
d. the "Fat Guide for Beans"

You should have circled "c" because the nutrition label on any food product is where you would find how many fat grams were in that product.

When you are told to turn the page, begin working on the questions. Work quickly and attempt every problem. If you are ready, turn the page and begin now.

1) Which of the following is highest in sodium?
   a. bacon
   b. mayonnaise
   c. canned tomato juice
   d. bagel

2) Which of the following is highest in fiber?
   a. green peas
   b. cheese
   c. hot dog
   d. white bread

3) Let's say your Social Security check is not enough for you to live on. What is your next logical source of income?
   a. welfare
   b. supplemental social security
   c. GAINS program for seniors
   d. your previous employer

4) An IRA is:
   a. an Irish war fund to reduce your taxes
   b. private contribution to a privately held fund
   c. a savings option for low income families
   d. an employer-sponsored fund that provides retirement income

5) The problem with cutting coated pills in half is that:
   a. the medicine is in the coating
   b. they may upset your stomach
   c. you get more medication
   d. this raises the price

6) Dosage is:
   a. the amount of the drug you take each time
   b. the time of the day you take the drug
   c. the form the medication came in
   d. the cost of the prescription

7) Current research indicates that eating foods lower in fat decreases your risk for:

a. high blood pressure
b. nerve disease
c. kidney disease
d. heart disease

8) A mutual fund is:

a. a collection of shares in various firms
b. a savings account you share with another person (e. g. spouse).
c. a supplemental income program for low income families
d. a charitable program for low Social Security recipients

9) Social Security is:

a. untaxable
b. unavailable to convicted felons
c. taxable
d. means tested

10) Which of the following is highest in total fat?

a. saltine cracker
b. corn
c. roast beef
d. honey

11) Which classification is not a major group in the food pyramid?

a. grain
b. meat
c. dairy
d. desserts

12) Beans is a member of which food group in the food pyramid?

a. dairy
b. grain
c. vegetable
d. meat

13) Don't take aspirin on an empty stomach because:
   a. it will cause an upset stomach
   b. it will make your head hurt
   c. the aspirin won't enter your blood stream
   d. it can be poisonous

14) When taking a bulk laxative like Metamucil:
   a. drink lots of water
   b. don't drink water to dilute drug
   c. don't add artificial flavors
   d. don't eat a big meal before or after

15) An expiration or "use by" date on a product means:
   a. the last date the food should be used
   b. last day the product can be expected to be at its peak quality
   c. the date the food was processed or packaged
   d. none of the above

16) In order to retain as many vitamins as possible, when preparing vegetables, you should:
   a. cook them thoroughly
   b. cook them as little as possible
   c. boil them
   d. steam them till they are limp

17) When a drug expires:
   a. you should use it up quickly
   b. you should stop taking it
   c. you should see your doctor
   d. you should cut your pills in half to make them the prescription last longer

18) The "refills" listed on your prescription label means:
   a. the number of refills of that drug you are allowed
   b. the number of pills to take
   c. the code for renewing your prescription
   d. the time of day you take your medication

19) Which of the following is likely to yield the highest interest rate on your money?

a. checking account
b. savings account
c. money market account
d. mattress savings

20) Which of the following is the greatest financial risk?

a. checking account
b. savings account
c. money market account
d. mattress savings

21) If you have a high cholesterol level, you have a greater chance of having a:

a. heart attack or stroke
b. cancer
c. diabetes
d. none of the above

22) The relationship between cholesterol and fat is:

a. foods high in cholesterol are high in fat
b. foods high in cholesterol are low in fat
c. the relationship varies with food
d. there is no relationship

23) If you do not have a checking account, which is probably not a good way to pay your bills?

a. in person at a bank
b. send cash in the mail
c. in person at utility company or mortgage
d. get a money order

24) Medicaid is means tested. The meaning of this is?

a. many states are likely to award benefits
b. the amount you are eligible for depends on your income
c. you must pass a physical examination to qualify
d. you must pass a mental examination to qualify

25) The "risk/reward" factor when making investments refers to:
   a. the more risk you are willing to take, the greater the reward may be.
   b. the less risk you are willing to take, the greater the reward may be.
   c. the more risk you are willing to take, the less the reward may be
   d. the less risk you are willing to take, the more the reward may be

26) Which of the following is probably not a good room in which to store most medications?
   a. bedroom
   b. living room
   c. bathroom
   d. dining room

27) You should discontinue antibiotics when:
   a. all finished
   b. fever or other infectious symptoms go away
   c. diarrhea results
   d. you feel better

28) When investing for the short-term as opposed to the long-term you should:
   a. make more risky investments
   b. make conservative investments
   c. not worry about the risk involved
   d. save your money under the bed

29) Digoxin is the most common heart medication. Before taking you should:
   a. drink 8 oz. water
   b. take pulse
   c. take blood pressure
   d. take a potassium supplement

30) After taking a drug, you feel dizzy. You should:
   a. stop taking medication
   b. call doctor in a few days
   c. drink more water with pill
   d. reduce dosage by half

Everyday Experience

Please indicate how experienced are you with regard to the following activities on a scale of 1 to 7, where 1= no experience and 7= a lot of experience

How much experience do you have with following the instructions on prescription medicine labels?
How much experience do you have in taking prescription medications?
How much experience do you have remembering to take prescription medications?
How much experience do you have reading nutrition labels?
How much experience do you have comparing the nutrition information of different food products?
How much experience do you have in preparing your own meals?
How much experience do you have in interpreting bank statements?
How much experience do you have in interpreting credit card statements?
How much experience do you have in managing your finances?