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Age differences in financial decision making: The benefits of more experience and less negative emotions

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Abstract

The emerging literature on aging and decision making posits that decision-making competence changes with age, as a result of age differences in various cognitive and noncognitive individual-differences characteristics. In a national life-span sample from the United Kingdom (N = 926), we examined age differences in financial decisions, including performance measures of sunk cost and credit card repayment decisions, and self-report measures of money management and financial decision outcomes. Participants also completed four individual-differences characteristics that have been proposed as relevant to financial decision making, including two cognitive ones (numeracy and experience-based knowledge) and two noncognitive ones (negative emotions about financial decisions). First, we examined how age was related to the four financial decision-making measures and the four individual-differences characteristics. Older age was correlated to better scores on each of the four financial decision-making measures, more experience-based knowledge, less negative emotions about financial decisions, whereas numeracy and motivation were not significantly correlated with age. Second, we found that considering both the two cognitive and the two noncognitive individual-differences characteristics increased predictions of financial decision making, as compared with considering either alone. Third, we examined how these four individual-differences characteristics contributed to age differences in financial decision making. Older adults' higher levels of experience-based knowledge and lower levels of negative emotions seemed to especially benefit their financial decision making. We discuss implications for theories on aging and decision making, as well as for interventions targeting financial decisions.

KEYWORDS

cognitive aging, emotions, experience-based knowledge, financial decision making, motivation, numeracy

1 | INTRODUCTION

Populations worldwide are aging, with the segment of those older than 60 being expected to double between 2007 and 2050 (UN, 2016). In the UK, the age group of 65 years and older has already grown by 47% since 1974 (UK government, 2015). Although people of all ages face difficult financial decisions that affect their wealth and well-being, the literature on cognitive aging suggests that especially older adults struggle with cognitively demanding decisions (e.g., Bruine de Bruin, Parker, & Fischhoff, 2012; Del Missier et al., 2017;

Mather & Carstensen, 2005; Tymula, Rosenberg Belmaker, Ruderman, Glimcher, & Levy, 2013).

In recent years, choices about financial products have become more difficult (Hershey, Austin, & Guitierrez, 2015). In many countries, saving for retirement involves increasing personal responsibility and taking more risk due to shifts from defined benefits to defined contribution pension plans (Gough & Niza, 2011). In the United Kingdom, the Pensions Act of 2008 introduced automatic enrollment into pension schemes, with employees having the choice to opt out. Since the introduction of the 2015 freedom and choice agenda, retirees are no longer being asked to purchase an annuity. Rather, they have to choose from among six options, including taking their whole pension pot at once or in chunks or getting an adjustable income (UK government, 2016). Additionally, outstanding credit card debts have risen steadily and have reached record levels of £68 billion in 2017 (as compared with £55 in 2012; Financial Times, 2017). Indeed, the behavioral decision making literature has suggested that people often struggle to make complex financial decisions. For example, in a credit card repayment task, participants were given a choice between paying off one of two credit cards (Amar, Ariely, Ayal, Cryder, & Rick, 2011). Many did not realize that it would be most beneficial to prioritize paying off the credit card with the highest interest rate, rather than the one with the smallest debt (Amar et al., 2011). In another performance task, people were found to violate the economic "sunk-cost rule," which posits that they should discontinue investments that are no longer profitable (Arkes & Blumer, 1985).

Although older adults face well-documented age-related decline in cognitive abilities that could harm their ability to make financial decisions (Gamble, Boyle, Yu, & Bennett, 2015), it has been suggested that they also have more experience-based knowledge that could benefit financial decisions (Bruine de Bruin et al., 2012; Bruine de Bruin, Parker, & Fischhoff, 2007; Kovalchik, Camerer, Grether, Plott, & Allman, 2005; Li, Baldassi, Johnson, & Weber, 2013; Li et al., 2015). Additionally, older adults may experience changes in emotions and motivation, which could be relevant to making decisions (e.g., Bruine de Bruin, 2017; Strough, Bruine de Bruin, & Parker, in press; Strough, Parker, & Bruine de Bruin, 2015). Our paper is part of an emerging literature that aims to understand age differences in decision making, roles of various cognitive individual-differences characteristics (such as numeracy and experience-based knowledge), and noncognitive individual-differences characteristics (such as negative emotions and motivation). We discuss these four individual-differences characteristics below

1.1 | Cognitive individual-differences characteristics potentially relevant to financial decisions

1.1.1 | Numeracy

Numeracy has been defined as the ability to understand and manipulate probabilistic and other numerical information (Schwartz, Woloshin, Black, & Welch, 1997; Weller et al., 2013). Such numeracy has been identified as relevant for making decisions about health insurance (Peters, Hibbard, Slovic, & Dieckmann, 2007), assessing inflation (Bruine de Bruin et al., 2010), understanding risks and benefits of medical screening (Reyna, Nelson, Han, & Dieckmann, 2009), and retirement planning and other financial decisions (Lusardi, 2012; Van Rooij, Lusardi, & Alessie, 2011).

Older adults tend to perform worse on numeracy measures than younger adults (e.g., Bruine de Bruin, McNair, Taylor, Summers, & Strough, 2015; Lusardi, 2012). These findings potentially reflect the cognitive demands of numerical computations (Del Missier, Mäntylä, & Bruine de Bruin, 2012), which may be more difficult for older adults due to age-related decline in fluid cognitive ability (Bruine de Bruin et al., 2012; Park & Reuter-Lorenz, 2009). However, numeracy does not consistently correlate with age across studies (e.g., Bruine de Bruin, Wallin, Parker, Strough, & Hanmer, 2017; Låg, Bauger, Lindberg, & Friborg, 2014; McNair, Okan, Hadjichristidis, & Bruine de Bruin, in press; Sinayev, Peters, Tusler, & Fraenkel, 2015; Weller et al., 2013). In relatively well-educated internet samples, the range of numeracy scores may be restricted, thus limiting the potential for uncovering correlations between numeracy and age (see Sinayev et al., 2015). It has also been argued that some numerical computations follow mathematical rules that can be learned with education and experience, thus reducing cognitive demands and susceptibility to age-related cognitive decline (McArdle, Smith, & Willis, 2009). Experienced accountants and bookkeepers, for example, possess superior memory for numerical information even in older age (Castel, 2007).

1.1.2 | Experience-based knowledge

Becoming an expert in a specific domain requires deliberate practice and building experience-based knowledge (Ericsson, Prietula, & Cokely, 2007). Individuals who self-reported having more experience in relevant financial contexts made better financial decisions, including those involving sunk costs (Fennema & Perkins, 2008). A performance measure of knowledge about financial topics, also referred to as financial literacy (Fernandes, Lynch, & Netemeyer, 2014), was correlated with better financial outcomes such as less debt, even after controlling for demographic variables (Lusardi, 2012; Lusardi & Mitchell, 2014).

Across the life span, individuals gain experience-based knowledge in different domains, which could positively influence their decision outcomes (e.g., Baltes, Reuter-Lorenz, & Rösler, 2006; Park et al., 2002; Salthouse, 2004). Crystallized intelligence, which may reflect experience with personal finances and other life domains, can counteract age-related cognitive declines and facilitate better financial decision making (Li et al., 2013). For example, older adults are less prone to sunk cost bias, which may be partly accounted for by their higher level of experience (Strough, Karns, & Schlosnagle, 2011). Reliance on gist, or considering qualitative meaning of information rather than relying on precise and quantitative information, also increases with age (Reyna, 2008). Older adults may have learned decision "scripts" that help them to make accurate decisions without much deliberation (e.g., Lambert-Pandraud & Laurent, 2010). Indeed, older adults have life-long practice in implementing learned rules for financial computations, whereas younger cohorts tend to rely more on technology for making calculations (Schaie, 2012). Perhaps as a result, financial knowledge has been shown to be positively correlated with age and years of education as well (e.g., McArdle et al., 2009).

1.2 | Noncognitive individual-differences characteristics potentially relevant to financial decisions

1.2.1 | Negative emotions

Emotions can sometimes facilitate decisions, as they provide meaning to the available options, and help to identify relevant information (e.g., Peters, Finucane, MacGregor, & Slovic, 2000). With cognitively demanding tasks, individuals may find it easier to rely more on emotions than on deliberation to make their decisions (e.g., Shiv & Fedorikhin, 1999). As people get older, they aim to optimize positive emotional experiences in the limited time they have left to live (Carstensen, 2006). They also cope better with negative events (Bruine de Bruin, van Putten, van Emden, & Strough, in press). Perhaps as a result, emotional well-being improves with age, seen in a reduction in negative emotions and an increase in positive emotions (Carstensen, Pasupathi, Mayr, & Nesselroade, 2000; Charles, Reynolds, & Gatz, 2001; Kessler & Staudinger, 2009; Shook, Ford, Strough, Delaney, & Barker, 2017). Individuals who indicate that they rely more on their emotional gut feelings or intuitions tend to make better decisions about sunk costs, while also reporting better financial and life decision outcomes (Bruine de Bruin et al., 2007). Moreover, older adults' better emotional coping has been related to their better performance on sunk cost decisions (Bruine de Bruin, Strough, & Parker, 2014).

1.2.2 | Motivation

Motivation to think hard about complex problems is also referred to as need for cognition (Petty, Cacioppo, & Kao, 1984). Individuals vary in their motivation to engage in complicated tasks, with more effort put into money management being correlated with less debt accumulation and less impulsive buying (Garðarsdóttir & Dittmar, 2012). The role of motivation is also underscored by the finding that consumers who report more interest in financial news are more likely to save (Brounen, Koedijk, & Pownall, 2016).

Compared with younger adults, older adults are less motivated to put effort into complex tasks they perceive as potentially irrelevant to achieving their goals (Bruine de Bruin et al., 2015; Hess, 2014; Strough, Bruine de Bruin, & Peters, 2015). Whether this shift towards more personally relevant goals results in better decisions may depend on the personal relevance of the task at hand (Hess, Queen, & Ennis, 2013) and has not yet been studied in the context of financial decisions.

1.3 | Research questions

We posed three related research questions to examine associations between age, financial decision making, two cognitive individual-differences characteristics (e.g., numeracy and experience-based knowledge), and two noncognitive individual-differences characteristics (e.g., emotions and motivation).

1. How is age related to the financial decision-making measures, as well as the two cognitive and the two noncognitive individual-differences characteristics?
2. Are the two cognitive and the two noncognitive individual-differences characteristics associated with financial decision making, even after controlling for each other?
3. What is the role of the two cognitive and the two noncognitive individual-differences characteristics in statistically accounting for the relationships between age and financial decision making?

2 | METHOD

2.1 | Participants

Through ResearchNow's online panel (https://www.researchnow.com/), we recruited a national UK-wide sample, oversampling adults aged 60 years and older. In total, 1,072 participants completed the full questionnaire. We removed data from 125 individuals who refused to indicate their income and an additional 21 who took 5 min or less to answer. The final sample included 926 participants, with 48.8% being male (49% of the overall UK population is male, Office of National Statistics, 2014).[1] Median age was 49 years with one third of our participants being 60 years or older (M = 48.3, SD = 15.95; range 18–88). By comparison, median age for the UK population is 40 years (Office for National Statistics, 2014). In our sample, 37.9% of participants reported having a college degree, and 43.4% had a net monthly household income at or below the median of £2,100. By comparison, 33% of the UK population has a college degree (Office for National Statistics, 2014) and the median UK household income is £2,133 (Office for National Statistics, 2015).

2.2 | Procedure

The survey received ethical approval at the University of Leeds and is available in the Online Supplemental Materials. ResearchNow's online panel participants received an invitation for a study about "decisions including money matters." They completed four measures of financial decision making, two of which assessed performance and two of which relied on self-reports. They also completed four measures of individual-differences characteristics potentially relevant to financial decisions, which are described in detail below. Participants received £4.50 for completing the survey, which took on average 27.26 minutes (SD = 35.19). At the end of the survey, participants were presented with website URLs for http://stepchange.org and http://citizensadvice.org, which provide financial advice.

2.3 | Performance measures of financial decision making

2.3.1 | Resistance to sunk costs

Our first performance measure of financial decision making was resistance to sunk costs, which included two items from Bruine de Bruin

[1]The 146 excluded participants did not differ significantly from the 926 included participants in terms of age, $t(1{,}070) = 0.05$, $p = 0.95$; gender, $\chi^2(1) = 0.33$, $p = 0.56$; or college education $\chi^2(1) = 0.47$, $p = 0.52$. Neither did they differ in terms of the financial decision-making measures or the individual-differences characteristics (all $p > 0.10$), with the following exceptions: The 146 excluded participants had significantly lower financial DOI scores (M_{excl} = 4.36, SD = 1.98 vs. M_{incl} = 4.91, SD = 1.68; t = 3.55, $p < 0.05$), significantly lower numeracy scores (M_{excl} = 0.39, SD = 0.28 vs. M_{incl} = 0.47, SD = 0.25), $t(1{,}070) = 3.50$, $p < 0.05$, and marginally lower credit card repayment performance (M_{excl} = .88, SD = 0.82 vs. M_{incl} = 1.00, SD = 0.80), $t(1{,}070) = 1.75$, $p = 0.08$.

TABLE 1 Descriptive statistics, number of items, and Cronbach's α

Variable	Mean	*SD*	Median	Min	Max	# items	α
Financial decision-making measures							
Resistance to sunk costs	3.42	1.47	3.50	1.00	6.00	2	.14[a]
Credit card repayment	1.00	.79	1.00	1.00	2.00	2	.42[b]
Money management	3.96	.75	4.09	1.00	5.00	11	.87
Financial DOI	4.91	1.67	5.00	.11	8.20	9	.64 .69
Individual-differences characteristics							
Numeracy	0.47	.25	.50	.00	1.00	8	.71
Experience-based knowledge	0.01	.50	−.02	−1.87	1.84	23	.87
Negative emotions	3.25	.65	3.20	1.00	6.00	6	.88
Motivation	3.32	.58	3.28	1.00	5.00	18	.85

Note. $N = 926$; for Financial DOI the first Cronbach's α is for the opportunity items (e.g., whether participants had a credit card), and the second for the negative outcome items (e.g., whether participants had credit card debt). For 2-item measures, Pearson correlations are more appropriate measures of reliability than Cronbach's α.

[a]$r = 0.08$, $p < 0.05$.

[b]$r = 0.26$, $p < 0.001$.

et al. (2007). The first item asked participants to imagine that they already paid £100 on a £200 ring, upon discovering the same ring on sale for £90 at another store. Participants gave their answers on a 6-point scale, with (1) being "*most likely to continue paying at the old store*" and (6) "*most likely to buy from the new store*." The second item asked participants to imagine that they had already paid to watch a pay TV movie at a hotel, upon discovering a more interesting free cable channel movie (Bruine de Bruin et al., 2007). The response scale for this item ranged from (1) for "*most likely to watch pay TV*" to (6) for "*most likely to watch free cable*." Cronbach's α was relatively low, possibly due to the measure having only two items (Table 1). Because Cronbach's α may be inappropriate for measures consisting of two items (Eisinga, Te Grotenhuis, & Pelzer, 2013), we also report the significant Pearson correlation (Table 1). The two items were taken from a full 6-item measure with demonstrated reliability and validity (Bruine de Bruin et al., 2007). We took the average across ratings for the two items, so higher scores reflected more resistance to sunk costs, and, therefore, better performance.

2.3.2 | Credit card repayment

Our other performance measure of financial decision making asked participants to make credit card repayment decisions (Amar et al., 2011; see Figure 1). Participants received two scenarios in random order, with one appearing at the beginning of the survey and one appearing near the end of the survey. Item A asked participants to imagine that they had two credit card accounts, a Master Card with a £100 balance and a 10% annual percentage rate (APR), and a Visa

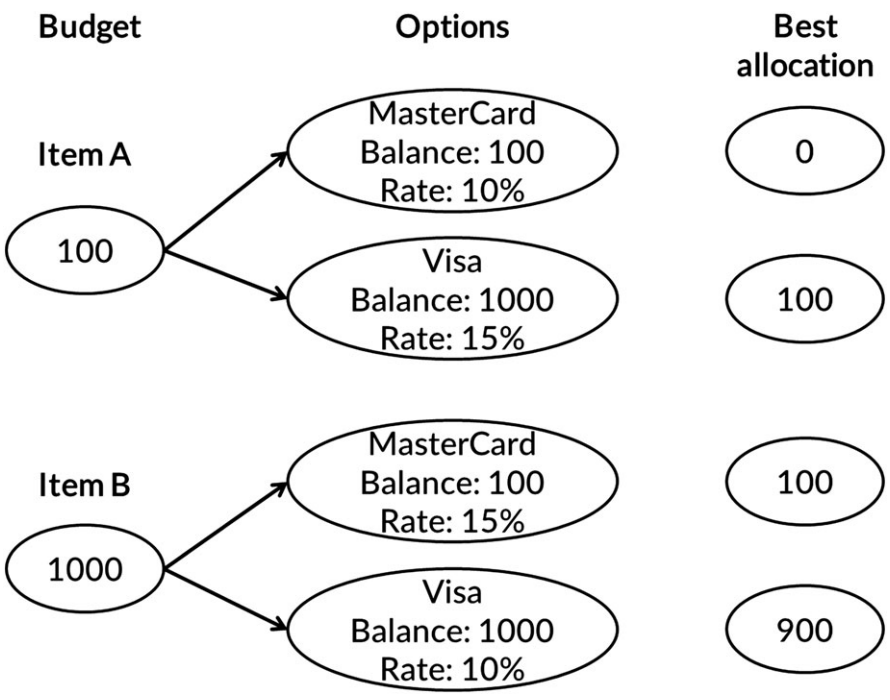

FIGURE 1 Schematic representation of credit card repayment task

Card with a £1000 balance and a 15% APR. They were then told that they received a government stimulus rebate of £100 and were asked to indicate how much they would repay on each account. In item B, the account balances were the same, but the Master Card had a 15% APR, the Visa Card had a 10% APR, and the government stimulus rebate was £1000. For optimal financial outcomes in both cases, participants should repay the account with the higher APR first. Responses were coded as correct (1) if the full amount for the card with the higher APR was selected for repayment, and incorrect (0) if otherwise. Cronbach's α was relatively low, likely due to the measure having only two items (Table 1). We report the significant Pearson correlation (Table 1), which is in line with previous findings (Eisinga et al., 2013; Li et al., 2015). We computed the number of correct answers across the two items, with higher scores reflecting better credit card repayment performance.

2.4 | Self-report measures of financial decision making

2.4.1 | Money management

We used the 9-item money management self-report scale developed by Garðarsdóttir and Dittmar (2012). An example item stated "I stay within my budget (s)". Participants indicated their agreement on a scale ranging from (1) "*does not describe me at all*" to (5) "*very descriptive of me*." We added two items about savings, including "I tend to make sure I save for the short to mid-term e.g. to go on holiday, put a deposit down for a house" and "I tend to make sure I save for the long term so I can retire comfortably." Cronbach's α across the 11 items was sufficient to warrant the computation of an overall score (Table 1). We computed the mean across the 11 items, with higher scores indicating better self-reported money management.

2.4.2 | Financial decision outcome inventory

Although experienced decision outcomes partly reflect chance, good decision-making processes should on average lead to better decision outcomes (Keren & Bruine de Bruin, 2003). We therefore asked participants to self-report whether or not they had experienced seven negative financial outcomes from the decision outcome inventory (DOI; henceforth: financial DOI; Bruine de Bruin, Parker, & Fischhoff (2007, Parker, Bruine de Bruin, & Fischhoff, 2015): having electricity, cable, gas, or water shut off because one did not pay on time, having been foreclosed on a mortgage or loan, having paid rent or mortgage payment at least 2 weeks too late, having had a check bounce, having had more than £5,000 in credit card debt, having lost more than £1,000 on a stock market investment, and having gone bankrupt. We added two negative outcomes related to saving for retirement, which is one of the most complex and uncertain financial decisions (Hershey et al., 2015). Those items asked about opting out of a pension scheme, and losing money after switching funds in a pension scheme.

All but one item on the DOI consisted of two parts. The first part of these items asked participants to indicate whether or not they had engaged in a behavior that provided an opportunity for a negative financial outcome (e.g., had a credit card). In the second part, they indicated whether or not they experienced a related negative financial outcome (e.g., had more than £5,000 in credit card debt). For those two-part items, participants were credited for avoiding the negative outcome only if they had been in the opportunity to experience it. Because everyone faces financial decisions that could potentially lead to bankruptcy, the item about having declared bankruptcy asked directly about the outcome without a preceding question (see Online Supplemental Materials).

Following Bruine de Bruin et al. (2007), we weighted each experienced outcome by the proportion of participants who did not experience it (among those who had the opportunity). Less common outcomes received more weight, as a proxy for severity, because more severe outcomes tend to be less common (Bruine de Bruin et al., 2007). We then took the proportion of experienced outcomes from across the items on which participants reported having had opportunities to experience them and subtracted it from zero, so higher scores reflected better decision outcomes. Cronbach's α is presented in Table 1.

2.5 | Cognitive individual-differences characteristics potentially relevant to financial decisions

2.5.1 | Numeracy

Participants received the 8-item numeracy scale composed by Weller et al. (2013). For example, one item asked "Imagine that we roll a fair, six-sided die 1000 times. Out of 1000 rolls, how many times do you think the die could come up as an even number?" Answers were scored as *correct* (1) or *incorrect* (0). Missing responses were scored as incorrect. Cronbach's α was sufficient (Table 1) to compute an overall score by taking the mean of all eight items. Higher overall score indicated higher numeracy.

2.5.2 | Experience-based knowledge

Our measure of experience-based knowledge consisted of two parts. First, participants answered the 20-item financial experience scale developed by Li et al. (2015). They indicated whether they had experience with 20 financial products, including savings accounts and credit cards. Responses were provided on a scale from 1 ("*never heard of it*") to 6 ("*have a lot of personal experience with it*"). Because the scale was created for the United States, we adapted it for the United Kingdom by revising four items (401 k replaced by personal pension scheme; IRA plan replaced by ISA plan; auto loan replaced by car loan; car title loan replaced by logbook loan). In the second part, participants answered the 3-item financial literacy measure developed by Lusardi and Mitchell (2011). An example item asked "Suppose you had £100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?" Because the items had different response scales, we *z*-transformed each item score before computing each participant's average across item *z*-scores. Cronbach's α was sufficient to warrant this computation of an overall score (Table 1). Higher scores indicated greater experience-based knowledge.

2.6 | Noncognitive individual-differences characteristics potentially relevant to financial decisions

2.6.1 | Negative emotions about financial decisions

Participants received a 5-item scale of negative emotions (Thompson, 2007). They rated their agreement with whether they had felt upset, hostile, nervous, afraid, or ashamed when making financial decisions (1 = *never*; 5 = *always*). We added "guilty" to the scale, because previous research in the financial domain indicated the relevance of guilt in financial decision making (e.g., Ackert, Church, & Deaves, 2003). Cronbach's α across the five items was sufficient to warrant the computation of an overall score (Table 1), which reflected the mean rating across the six items. Higher scores indicated higher levels of negative emotions.

2.6.2 | Motivation

Participants completed the 18-item scale of need for cognition (Petty et al., 1984) to rate their motivation to put effort into deliberation. Participants rated how they felt about statements like "I like to have the responsibility of handling a situation that requires a lot of thinking" (1 = *completely false*–5 = *completely true*). Cronbach's α was sufficient (Table 1) to warrant the computation of an overall score. It reflected the mean rating across items, such that higher scores indicated higher need for cognition.

2.7 | Data analysis plan

Our analyses were designed to answer our three research questions. Our first research question asked about the relationships of age and with the four financial decision-making measures, as well as with the two cognitive and the two noncognitive individual-differences characteristics. To answer this first research question, we computed Pearson correlations between these variables. We also conducted linear regressions predicting each of the financial decision-making measures and individual-differences characteristics, so as to examine its relationship with age while controlling for other demographic characteristics. The one exception was the credit card repayment task, for which we used a multinomial regression due to the categorical nature of the associated performance variable. The second step of each regression model examined the quadratic relationship with age (or age*age). The third step of each regression model examined the cubic relationship with age (or age*age*age). Age was treated as a continuous variable in all analyses. To facilitate interpretation of our findings, we also produced a corresponding plot of mean *z*-scores across six age groups, for the four financial decision-making measures (Figure 2) and the four individual-differences characteristics (Figure 3).

Our second research question asked whether the two cognitive and the two noncognitive individual-differences characteristics are associated with financial decision making, even after controlling for each other. We therefore computed Pearson correlations, as well as a set of three regression models to predict scores on each of the financial decision-making tasks (resistance to sunk costs, credit card repayment, money management and financial DOI.) In the first model, we entered only the two cognitive variables (numeracy and experience-based knowledge). In the second model, we entered only the two noncognitive variables (negative emotions and motivation). In

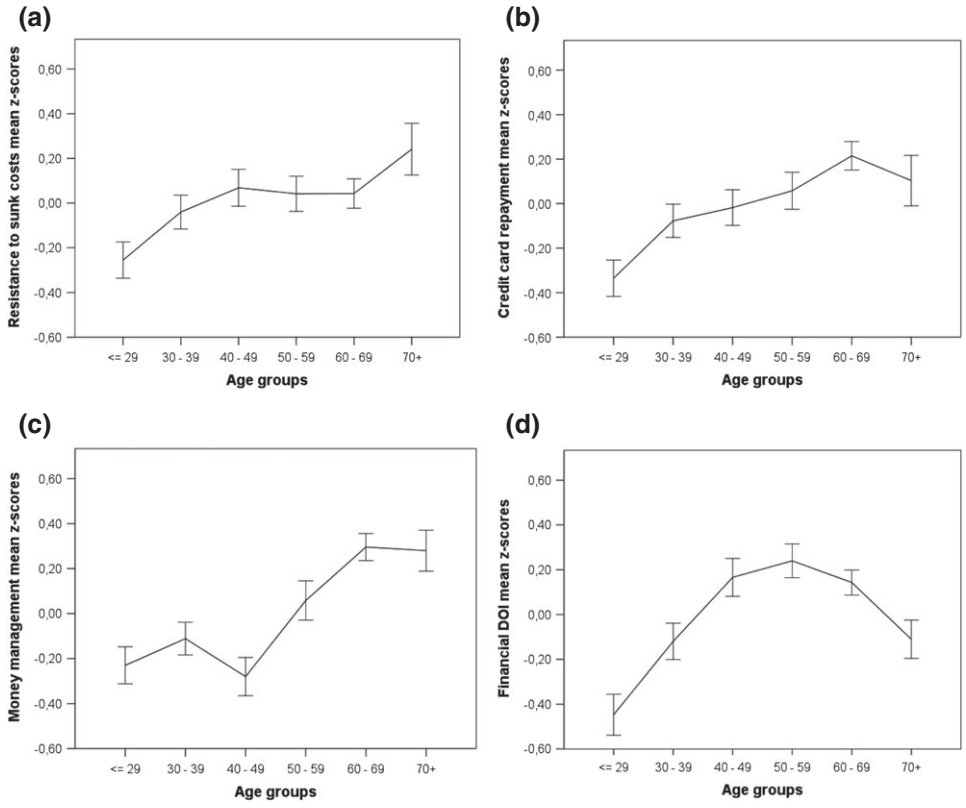

FIGURE 2 Mean z-scores for financial decision-making measures by age group, for (a) resistance to sunk costs; (b) credit card repayment; (c) money management; (d) financial DOI. *Note*: Error bars are shown for ± 1 standard error. Sample sizes for each age group are 143 (<=29 years), 182 (30–39 years), 153 (40–49 years), 149 (50–59 years), 227 (60–69 years), and 72 (70 + years)

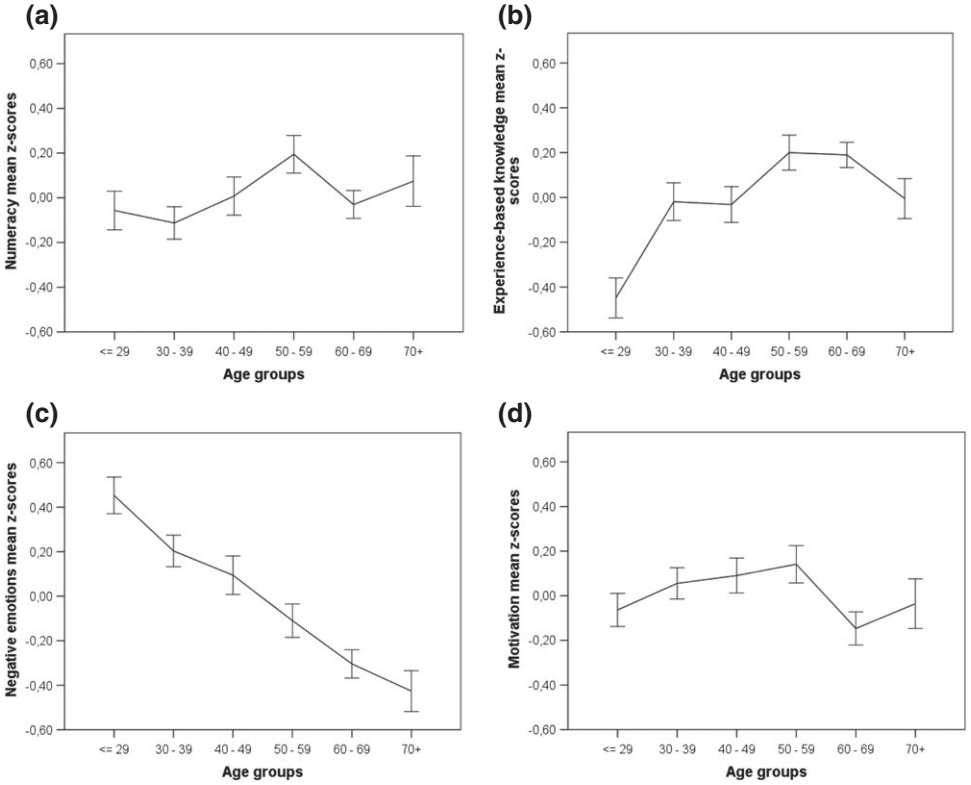

FIGURE 3 Mean z-scores of individual-differences characteristics by age group, for (a) Numeracy; (b) experience-based knowledge; (c) negative emotions; (d) motivation. *Note*: Error bars are shown for ± 1 standard error. Sample sizes for each age group are 143 (<=29 years), 182 (30–39 years), 153 (40–49 years), 149 (50–59 years), 227 (60–69 years), and 72 (70+ years)

the third model, we entered both the two cognitive and the two non-cognitive variables. We also additionally examined the interaction between numeracy and need for cognition, or the motivation to think hard about complex problems. All models controlled for demographic variables gender (0 = male; 1 = female), college education (0 = no; 1 = yes), and income (0 = below median of £2100; 1 = at or above median of £2100). We used linear regressions to predict resistance to sunk costs, money management, and financial DOI because these measures were continuous. Again, we used multinomial regressions to predict performance on the credit card repayment task because this measure was categorical. For each financial decision-making measure, we compared the first two models with the third model to identify the predictive ability of including cognitive and noncognitive variables as opposed to either alone. We compared models on the Akaike Information Criterion, which can be computed for both linear and multinomial regressions and is better when it is lower (DeCarlo, 2003).

Our third research question asked about the role of the two cognitive and the two noncognitive individual-differences characteristics in statistically accounting for the associations between age and financial decision making. To this end, we used the PROCESS macro for SPSS

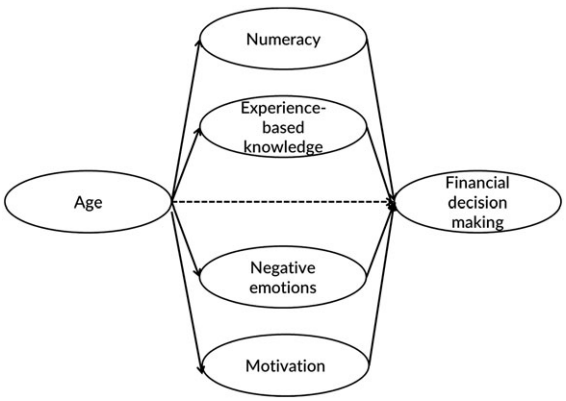

FIGURE 4 Conceptual model showing the relationship between age, individual-difference characteristics and financial decision making. *Note*: Table 5 shows the associated coefficients for the PROCESS model as conducted for each of the four financial decision-making measures. Age is the independent variable, and financial decision making is the dependent variable, with numeracy, experience-based knowledge, negative emotions and motivation reflecting the potential mediators. Before controlling for potential mediators, the dashed line between age and financial decision making reflects the total effect of age on financial decision making. After controlling for the potential mediators, it reflects the direct effect of age on financial decision making

to test for parallel multiple mediation with 1,000 bootstrap samples (Figure 4; Preacher & Hayes, 2008; Hayes, 2013). That is, we computed one PROCESS parallel multiple mediation model for each financial decision-making measure (a) resistance to sunk costs, (b) credit card repayment, (c) money management, and (d) financial DOI. In each of these four models, the financial decision-making measure was entered as the dependent variable, with age as the independent variable and each of the two cognitive measures (numeracy and experience-based knowledge) and the two noncognitive measures (negative emotions and motivation) as the four potential mediators. For each PROCESS parallel multiple mediation model, we analyzed the three steps recommended by Baron and Kenny (1986): (a) the association between age and each potential mediator; (b) the association between each potential mediator and the financial decision-making measure; and (c) the association between age and financial decision making, before and after controlling for the potential mediators. For each PROCESS parallel multiple mediation model, we also computed whether each of the four individual-characteristics accounted for a significant portion of the shared variance between age and the financial decision-making measure, as seen in a 95% confidence interval that did not include zero (Hayes, 2013). All models controlled for the demographic variables of gender (0 = male; 1 = female), college education (0 = no; 1 = yes), and income (0 = below median of £2100; 1 = at or above median of £2100). All analyses were conducted in SPSS version 23.

3 | RESULTS

3.1 | How is age related to the financial decision-making measures, as well as the two cognitive and the two noncognitive individual-differences characteristics?

Descriptive statistics showed sufficient variation to warrant analyses of individual differences (Table 1). The Pearson correlations in Table 2 show that age was significantly associated with better scores on all four financial decision-making measures, including the two performance measures (resistance to sunk costs and credit card repayment) and the two self-report measures (money management and financial DOI). Age was also significantly correlated with more experience-based knowledge, and a decrease in negative emotions about financial decisions, whereas numeracy and motivation were not significantly correlated with age. Figures 2 and 3 show the mean z-scores by age.

In linear regressions that controlled for demographic variables, the direction of the relationships of age with the four individual-differences characteristics and the four financial decision-making measures were unchanged (Table 3). When adding a quadratic age effect to each model, it was only significant for money management, financial DOI, and experience-based knowledge (Table 3). Thus, scores on each of these measures generally showed age-related improvements, but the rate of improvement varied across age groups with money management showing a dip in middle age followed by better performance into older age, and experience-based knowledge and financial DOI showing a dip in later life (Figures 2, 3). When further adding cubic age effects to each model, none were significant (all $p > 0.10$).

3.2 | Are the two cognitive and the two noncognitive individual-differences characteristics associated with financial decision making, even after controlling for each other?

The Pearson correlations in Table 2 show that better scores on all four decision-making tasks were associated with higher levels of numeracy, more experience-based knowledge, more motivation, and less negative emotions about financial decisions—though the latter did not reach significance for resistance to sunk costs. As can be seen in Table 4, predictions of each financial decision-making measure were improved in the combined model (Model 3), which considered both the two cognitive individual-differences characteristics (numeracy, experience-based knowledge) and the two noncognitive individual-differences characteristics (negative emotions, motivation) as compared with models that included each alone (Model 1, Model 2). For each financial decision-making measure, Table 4 shows that Model 3 has the lowest Akaike Information Criteria values and therefore the best fit—as compared with Model 1 and Model 2 (DeCarlo, 2003).

In the models that predicted each financial decision-making measure from the cognitive and the noncognitive individual-differences characteristics (Model 3; Table 4), at least one of the cognitive individual-differences characteristics was significantly related to better scores on each financial decision-making measure. Specifically, experience-based knowledge alone was relevant to better performance on resistance to sunk costs and money management; numeracy alone was relevant to better performance on credit card repayment; and both numeracy and experience-based knowledge were relevant to higher financial DOI scores. When considering the two noncognitive individual-differences characteristics in the combined model (Model 3; Table 4), increased motivation was marginally associated with better performance on resistance to sunk costs; decreased negative emotions about financial decisions was marginally associated with better performance on credit card repayment; and both were significantly associated with better money management and better financial DOI.[2]

3.3 | What is the role of the two cognitive and the two noncognitive individual-differences characteristics in statistically accounting for the relationships between age and financial decision making?

Next, we used PROCESS parallel multiple mediation models (Hayes, 2013) to investigate the role of the two cognitive and the two

[2]An additional analysis step for each model examined interaction effects of age and each of the four individual-differences characteristics. There was only a significant interaction between age and numeracy for financial DOI ($B = -1.38$, $se = 0.42$, $p < 0.001$). To further examine this interaction, we conducted the regression on financial DOI separately for three age groups of similar sizes (age < = 38 $N = 316$; age 39–59, $N = 311$; and age 60+, $N = 299$). Numeracy was positively related to financial DOI in the younger age group ($B = 1.24$, $se = 0.21$, $p < 0.001$) and in the middle age group ($B = 2.07$, $se = 0.40$, $p < 0.001$), but not in the older age group ($B = 0.15$, $se = 0.32$, $p > 0.10$). We also found no significant effect of adding interactions between numeracy and motivation to each of the models predicting the four financial decision-making measures in Table 4.

TABLE 2 Pearson correlations

	1. Age	2. Resistance to sunk costs	3. Credit card repayment	4. Money management	5. Financial DOI	6. Numeracy	7. Experience-based knowledge	8. Negative emotions	9. Motivation
1. Age	–								
Financial decision making measures									
2. Resistance to sunk costs	0.11***	–							
3. Credit card repayment	0.17***	0.11**	–						
4. Money management	0.20***	0.06^{+}	0.09**	–					
5. Financial DOI	0.17***	0.03	0.20***	0.24***	–				
Individual-differences characteristics									
6. Numeracy	0.03	0.08**	0.38***	0.08*	0.25***	–			
7. Experience-based knowledge	0.22***	0.16***	0.13***	0.29***	0.36***	0.19***	–		
8. Negative emotions	−0.28***	−0.06^{+}	−0.15***	−0.39***	−0.23***	−0.14***	−0.25***	–	
9. Motivation	−0.04	0.09**	0.09**	0.20***	0.21***	0.22***	0.28***	−0.15***	–

Note. N = 926.

***p < 0.001; **p < 0.01; *p < 0.05; ^{+}p < 0.10.

TABLE 3 Linear regressions showing relationships between individual-differences characteristics and financial decision-making measures with age, controlling for other demographic characteristics

	Financial decision-making measures				Individual-differences characteristics			
	Resistance to sunk cost	Credit card repayment	Money management	Financial DOI	Numeracy	Experience-based knowledge	Negative emotions	Motivation
Age	0.01*** (0.00)	0.02*** (0.00)	0.01*** (0.00)	0.02*** (0.00)	0.00^{a+} (0.00)	0.01*** (0.00)	−0.02*** (0.00)	0.00 (0.00)
Gender	−0.37*** (0.10)	0.20^{+} (0.12)	0.04 (0.05)	−0.21* (0.11)	−0.10*** (0.01)	−0.26*** (0.04)	0.14* (0.05)	−0.01 (0.05)
College education	0.21* (0.10)	0.64*** (0.13)	0.08 (0.05)	0.67*** (0.11)	0.10*** (0.10)	0.17*** (0.13)	−0.08 (0.06)	0.21*** (0.04)
Income	−0.05 (0.10)	0.08 (0.13)	0.07 (0.05)	0.29** (0.11)	−0.01 (0.02)	0.15*** (0.04)	−0.06 (0.06)	0.08* (0.04)
AIC	698.10	−1258.043	−560.84	890.82	−2649.27	−882.20	−333.07	−1006.62
Adjusted R^2	0.03	0.06	0.04	0.07	0.07	0.10	0.09	0.03

Note. Unstandardized B-values from linear regressions (se) are reported for resistance to sunk costs, money management and financial DOI; Unstandardized B-values from ordinal regressions (se) are reported for credit card repayment. For credit card repayment, we report the Nagelkerke R^2 instead of adjusted R^2. An additional quadratic age effect (when added to each model) was only significant for experience-based knowledge (B = 0.000320, se = 0.000087, p < 0.001), money management (B = 0.000246, se = 0.000104, p = .02) and financial DOI (B = −0.0014, se = 0.000225, p < 0.001). We found no additional effects of cubic age in any of the models (p > 0.10); N = 926.

[a]B = 0.001; ***p < 0.001; **p < 0.01; *p < 0.05; ^{+}p < 0.10.

noncognitive individual-differences characteristics in statistically accounting for age differences in the measures of financial decision making (Figure 4). For each model, Table 5 shows the statistics for the three mediation analysis steps (Baron & Kenny, 1986). The bottom section of Table 5 shows which of the four individual-differences characteristics were significant mediators (Preacher & Hayes, 2008). To estimate the result of a 20-year or 40-year age difference, the relevant estimate should be multiplied by the appropriate number. Table 5 provides estimates with three digits to facilitate that calculation.

For resistance to sunk costs, Table 5 shows that t older adults' better performance was partially accounted for by experience-based knowledge. The three mediation analysis steps indicated that (a) older age was positively related to more experience-based knowledge, (b) more experience-based knowledge was linked to better performance on resistance to sunk costs, and (c) the positive relationship between age and resistance to sunk costs was reduced after taking into account the cognitive and noncognitive individual-differences characteristics.

Additionally, Table 5 shows that age differences in money management and financial DOI were partially accounted for by experience-based knowledge and by negative emotions. For each, the mediation analysis steps showed that (a) older age was related to more experience-based knowledge and less negative emotions about financial decisions, (b) more experience-based knowledge and less negative emotions were associated with better financial decision making, and (c) the relationship between older age and the financial decision making measure was reduced after taking into account the individual-differences characteristics or potential mediators.

For credit card repayment, Table 5 shows no significant mediational role for the individual-differences characteristics.

TABLE 4 Regressions showing relationships between financial decision-making measures and individual-differences characteristics, controlling for demographic variables

Model	Resistance to sunk costs 1	2	3	Credit card repayment 1	2	3	Money management 1	2	3	Financial DOI 1	2	3
Numeracy	0.23 (0.20)	–	0.17 (0.21)	3.04*** (0.28)	–	2.99*** (0.28)	0.20* (0.09)	–	0.03 (0.09)	1.43*** (0.21)	–	1.24*** (0.21)
Experience-based knowledge	0.25** (0.07)	–	0.22* (0.08)	−0.04 (0.11)	–	−0.07 (0.11)	0.27*** (0.04)	–	0.19*** (0.04)	0.65*** (0.08)	–	0.56*** (0.08)
Negative Emotions	–	−0.00 (0.06)	0.02 (0.06)	–	−0.19** (0.07)	−0.13+ (0.08)	–	−0.29*** (0.03)	−0.28*** (0.03)	–	−0.31*** (.06)	−0.24*** (0.06)
Motivation	–	0.22** (0.08)	0.16+ (0.09)	–	0.20+ (0.11)	0.01 (0.11)	–	0.18*** (0.04)	0.14*** (0.04)	–	0.44*** (0.09)	0.22** (0.09)
Age	0.01** (0.00)	0.01* (0.00)	0.01** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.01*** (0.00)	0.01*** (0.00)	0.01** (0.00)	0.02*** (0.00)	0.02*** (0.00)	0.01*** (0.00)
Gender	−0.28** (0.09)	−0.37*** (0.09)	−0.30** (0.10)	0.05 (0.13)	−0.16 (0.12)	0.06 (0.13)	0.13** (0.05)	0.08+ (0.04)	0.13** (0.05)	0.10 (0.11)	−0.16 (0.10)	0.09 (0.10)
College education	0.14 (0.10)	0.16 (0.10)	0.12 (0.10)	0.42** (0.14)	0.58*** (0.13)	0.42** (0.14)	0.00 (0.05)	0.01 (0.05)	−0.01 (0.05)	0.41*** (0.11)	0.56*** (0.11)	0.39*** (0.11)
Income	−0.09 (0.10)	−0.07 (0.00)	−0.10 (0.10)	0.13 (0.14)	0.06 (0.13)	0.13 (0.14)	0.03 (0.05)	0.04 (0.05)	0.02 (0.05)	0.22* (0.11)	0.24* (0.11)	0.20+ (0.11)
AIC	689.88	694.68	689.52	1862.91	1973.42	1862.76	−612.12	−704.69	−726.58	787.64	838.40	768.95
Adjusted R^2	0.03	0.03	0.04	0.20	0.07	0.20	0.09	0.18	0.21	0.17	0.13	0.19

Note. Unstandardized *B*-values from linear regressions (se) are reported for resistance to sunk costs, money management and financial DOI; Unstandardized *B*-values from ordinal regressions (se) are reported for credit card repayment. For credit card repayment, we report the Nagelkerke R^2 instead of adjusted R^2. An additional interaction effect between motivation and numeracy was not significant, when added to each model ($p > 0.10$); $N = 926$.

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; $^+p < 0.10$;

4 | DISCUSSION

This paper examined associations between measures of financial decision making, two cognitive and two noncognitive individual-differences characteristics, and age. Based on an online survey among a U.K. national sample ($N = 926$), we reported on three main findings.

First, older age was significantly correlated to better scores on all of our four financial decision-making measures. We replicated previous findings that older adults performed better on sunk cost decisions (Bruine de Bruin et al., 2007; Del Missier et al., 2013; Strough, Mehta, McFall, & Schuller, 2008; Strough, Schlosnagle, Karns, Lemaster, & Pichayayothin, 2014) and credit card repayment tasks (Li et al., 2015). We additionally found age-related improvements in money management and financial decision outcomes, thus showing relationships that had not previously been investigated. Although scores on each of these measures generally showed age-related improvements, money management dipped in middle age, and financial DOI increased with older age but decreased in later life (following Agarwal, Driscoll, Gabaix, & Laibson, 2009).

Moreover, we replicated findings that older age was associated with more experience-based knowledge (Li et al., 2015; Lusardi & Mitchell, 2011; Park et al., 2002; Salthouse, 2004), although it decreased for older age groups. Older participants had less negative emotions about financial decisions, which is in line with older adults' general tendency towards experiencing less negative emotions than younger adults (Carstensen et al., 2000; Charles et al., 2001). Older age was unrelated to motivation to think hard about complex problems and numeracy. As discussed in more detail below, the latter is in line with other studies of relatively educated samples (Bruine de Bruin et al., 2017; Låg et al., 2014; McNair et al., in press; Sinayev et al., 2015; Weller et al., 2013).

Our second main finding revealed that both our two cognitive individual-differences characteristics and our two noncognitive individual-differences characteristics contributed to better financial decision making. Specifically, better scores on the four financial decision-making measures were correlated to higher levels of numeracy, more experience-based knowledge, and more motivation. For three of the four financial decision-making measures (except for resistance to sunk costs), scores were also correlated with reporting less negative emotions. Moreover, regression analyses suggested that considering both our two cognitive and our two noncognitive individual-differences characteristics improved predictions of financial decision making compared with considering each of these sets alone. Fluid cognitive abilities and experience-based knowledge (or crystallized cognitive abilities) had already been associated with better credit scores, making less credit-related mistakes and better retirement planning (Agarwal et al., 2009; Li et al., 2015; Lusardi & Mitchell, 2014). A separate line of research had suggested the importance of emotions in making financial decisions about for example stock market trading (e.g., Guiso, Sapienza, & Zingales, 2008; Hirshleifer & Shumway, 2003) as well as borrowing and spending (McNair, Summers, Bruine de Bruin, & Ranyard, 2016). Here, we found that motivation and negative emotions played a role in obtaining better financial decision-making scores for money management and financial decision outcomes, even when taking into account cognitive individual-difference characteristics.

TABLE 5 PROCESS parallel multiple mediation models for each of the four financial decision-making measures

Path	1. Resistance to sunk costs	2. Credit card repayment	3. Money management	4. Financial DOI
(a) From age to potential mediator				
Numeracy	0.001^{+} (0.001)	0.001^{+} (0.001)	0.001^{+} (0.001)	0.001^{+} (0.001)
Experience-based knowledge	0.009*** (0.001)	0.009*** (0.001)	0.009*** (0.001)	0.009*** (0.001)
Negative emotions	−0.016*** (0.002)	−0.016*** (0.002)	−0.016*** (0.002)	−0.016*** (0.002)
Motivation	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
(b) From potential mediator to financial decision making measure				
Numeracy	0.168 (0.204)	1.123*** (0.102)	0.031 (0.095)	1.235*** (0.213)
Experience-based knowledge	0.220** (0.080)	−0.026 (0.040)	0.189*** (0.037)	0.555*** (0.083)
Negative emotions	0.020 (0.059)	−0.055^{+} (0.029)	−0.278*** (0.027)	−0.235*** (0.061)
Motivation	0.158^{+} (0.087)	0.010 (0.044)	0.140*** (0.040)	0.217*** (0.091)
(c) From age to financial decision-making measure				
Before controlling for potential mediators	0.010*** (0.003)	0.010*** (0.002)	0.010** (0.002)	0.023*** (0.003)
After controlling for potential mediators	0.009** (0.003)	0.008*** (0.002)	0.004* (0.002)	0.013*** (0.003)
Estimate of mediation effect (95% confidence interval)				
Numeracy	0.000 (0.000, 0.004)	0.001 (0.000, 0.002)	0.000 (0.000, 0.000)	0.001 (0.000, 0.003)
Experience-based knowledge	0.002[a] (0.001, 0.004)	0.000 (−0.001, 0.000)	0.002[a] (0.001, 0.003)	0.005[a] (0.003, 0.008)
Negative emotions	0.000 (−0.002, 0.002)	0.001 (0.000, 0.002)	0.004[a] (0.003, 0.006)	0.004[a] (0.002, 0.006)
Motivation	0.000 (0.000, 0.001)	0.000 (0.000, 0.000)	0.000 (0.000, 0.000)	0.000 (−0.001, 0.001)

Note. Associated conceptual model is shown in Figure 4. In each model, age is the dependent variable, financial decision making is the independent variable, and numeracy, experience-based knowledge, negative emotions and motivation are the potential mediators. Because age is a continuous variable, parameter estimates reflect the difference in the dependent variable that is associated with a difference of only one year of age. To estimate the result of a 20-year or 40-year age difference, the relevant estimate should be multiplied by the appropriate number. We provide estimates with three digits to facilitate that calculation.

[a]Significant mediation, as seen by 95% confidence interval not including 0.

***p < .001; **p < .01; *p < .05; ^{+}p < .10.

Our third main finding was that older adults' better financial decision making, as measured on resistance to sunk costs, money management, and financial DOI, may at least be partially accounted for by their greater experience-based knowledge. Our findings support prior suggestions that some financial decisions are partially experience-based (Lusardi & Mitchell, 2007), and that experience-based knowledge benefits these financial decisions in older age, despite age-related cognitive decline (Li et al., 2013, 2015). Money management and financial DOI benefited from lower levels of negative emotions, which were more common in older adults.

Our finding that older adults outperform younger adults on financial decisions may be limited to relatively common tasks, for which older adults have an opportunity to develop experience-based knowledge and reduced negative emotional responsiveness over time. Indeed, our participants completed tasks which involved decisions about dealing with irrecoverable losses (or sunk costs), managing money, and avoiding negative financial outcomes. Yet older adults may also face many other complex financial decisions that do not allow them to rely on their prior experiences. The modern-day financial environment keeps posing new challenges due to new rules and regulations (Hershey et al., 2015). Some of these complex financial decisions, such as those about decumulation of retirement funds, may not be encountered until relatively late in life. Older adults may struggle at least as much as younger adults when faced with such difficult financial decisions for the first time.

Fraud susceptibility may also be higher among older adults, who may find new financial scams harder to especially when facing time pressure and high arousal—though reports of age differences in fraud susceptibility vary (AARP Foundation, 2011; Acierno et al., 2010; Beals, Carr, Mottola, Deevy, & Carstensen, 2015; Consumer Financial Protection Bureau, 2017; Kircanski et al., 2018; Ross, Grossmann, & Schryer, 2014; Titus & Gover, 2001). Even when older adults have relevant financial experiences, they may sometimes find it cognitively too demanding to implement their experience-based knowledge correctly (Korniotis & Kumar, 2011), or change their habits to react to new information (Lambert-Pandraud & Laurent, 2010; Lambert-Pandraud, Laurent, & Lapersonne, 2005).

Another limitation of our research is that our sample was relatively well-educated, as compared with the U.K. population. As a result, the range of numeracy scores may have been restricted, thus limiting our ability to uncover correlations of numeracy with, say, age (see also Sinayev et al., 2015). Other studies with relatively educated samples have also found no significant correlation between numeracy and age (Bruine de Bruin et al., 2017; Låg et al., 2014; McNair et al., in press; Sinayev et al., 2015; Weller et al., 2013). Yet the tradition to recruit younger adults from among college students and older adults from the community may have confounded older age with lower educational attainment and therefore exaggerated the correlation between older age and lower numeracy skills (Strough, Parker, & Bruine de Bruin, 2015).

A third limitation of our research is that we conducted correlational analyses. Indeed, correlations do not necessarily mean causation. Rather, a correlation between negative emotions and better self-reported money management and financial outcomes may have

three potential explanations. First, it is possible that reduced negative emotions caused better decisions relevant to money management and financial outcomes. Second, being faced with better money management and financial outcomes may cause a reduction in negative emotions. Finally, a third unmeasured variable may have caused both. To examine the effect of emotions on money management and financial outcomes, we would need to randomly assign participants to interventions that reduce negative emotions or a no-intervention control group, and test the effect of subsequent money management and financial outcomes.

A fourth limitation of our research is that we conducted cross-sectional but not longitudinal analyses. As a result, our findings are relevant to understanding age differences—but are unable to distinguish the relative role of maturational changes or cohort differences (Schaie, 2012). Variables identified as important in our cross-sectional mediation analyses may prove to be less relevant in longitudinal studies that investigate change over time (Lindenberger, von Oertzen, Ghisletta, & Hertzog, 2011). Our cross-sectional design precludes conclusions about age-related improvements in for example experience and emotions contributing to older adults' better financial decisions (Maxwell & Cole, 2007).

Yet our cross-sectional findings have potential implications for promoting better financial decision making in age-diverse audiences, including through ongoing efforts at the U.K.'s Money Advice Service (Bagwell, Hestbaek, Harries, & Kail, 2014) and the US Consumer Finance Protection Bureau (2017). In effect, the audience of any intervention is cross-sectional at the first instance, thus highlighting the importance of understanding cross-sectional age differences as well as longitudinal changes with age over time. Our findings suggest that communications that aim to improve older adults' financial decisions may be more effective if they focus on experience and emotional skills rather than only on cognitively demanding facts (Williams & Drolet, 2005). Other cognitive individual-differences characteristics may of course also be relevant for financial decisions, including working memory (Del Missier et al., 2013; Del Missier et al., 2017; Rosi, Bruine de Bruin, Del Missier, Cavallini, & Russo, in press), as may other noncognitive individual-differences such as learning from victimized peers about avoiding financial elder abuse (Consumer Financial Protection Bureau, 2017).

Moreover, some complex financial computations may follow mathematical rules that can be learned with training and experience, thus reducing cognitive demands and susceptibility to age-related cognitive decline (McArdle et al., 2009). Young adults may also benefit from building experience-based knowledge and emotional skills as part of financial education programs (see Fernandes, Lynch Jr, & Netemeyer, 2014) and practice with youth savings accounts (Shobe & Sturm, 2007). Intervention efforts should be designed to address the needs of the specific audience, by helping them to overcome any weaknesses and building on their strengths (Bruine de Bruin & Bostrom, 2013). When carefully evaluated, such efforts could help us to understand how to best improve financial decisions across the life span.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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