Sound credit scores and financial decisions despite cognitive aging

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Edited by Michael S. Gazzaniga, University of California, Santa Barbara, CA, and approved November 24, 2014 (received for review July 16, 2014)

Age-related deterioration in cognitive ability may compromise the ability of older adults to make major financial decisions. We explore whether knowledge and expertise accumulated from past decisions can offset cognitive decline to maintain decision quality over the life span. Using a unique dataset that combines measures of cognitive ability (fluid intelligence) and of general and domain-specific knowledge (crystallized intelligence), credit report data, and other measures of decision quality, we show that domain-specific knowledge and expertise provide an alternative route for sound financial decisions. That is, cognitive aging does not spell doom for financial decision-making in domains where the decision maker has developed expertise. These results have important implications for public policy and for the design of effective interventions and decision aids.

aging | decision-making | cognitive ability | consumer finance | credit score

Over the next decades, the average age of the worlds' population will rise rapidly. One in five Americans is expected to be over 65 y old by 2030, and the number of people 65 and older worldwide will double by 2035.

This "gray tsunami" will propel two trends. The first, described by economics' life cycle model (1), is that more people who have accumulated wealth for retirement will face difficult decumulation decisions: how quickly to consume their wealth and how to ensure it will last for their remaining years of life. Fig. 1 shows wealth accumulation in the United States by age, with bars representing net worth and wealth held in equities (i.e., stocks and mutual funds)—financial holdings requiring more active monitoring and choices. In 2011, Americans over 65 collectively managed 43% of US household wealth and 47% of privately held equities. Furthermore, policy changes [e.g., to defined contribution retirement plans such as 401(k)s] have transferred many complex financial and healthcare decisions to individuals.

The second trend results from one of the most sizable and robust findings in all of psychology: The brain slows with age. Fluid intelligence (G_f)—i.e., speed and capacity for generating, transforming, and manipulating information—falls on average nearly two SDs from age 20–70 (2, 3), a decrease from the 75th to the 25th percentile of adult G_f or 30 IQ points. The gray lines in Fig. 1 illustrate G_f declines for working memory, processing speed, and reasoning. Given mounting evidence that cognitive ability is a key determinant of decision-making ability (4–8), age-related deterioration of G_f raises the specter that older adults facing major financial decisions may find them increasingly challenging.

One factor may mitigate this pessimistic prognosis: The decrease in G_f with age is accompanied by an increase in crystallized intelligence (G_c) (9, 10)—i.e., knowledge, experience, and expertise (2, 11–13). The green line in Fig. 1 illustrates the accumulation of G_c with age into the 60s. G_c may serve as intellectual capital that provides an alternative conduit to sound decisions. Contrast, for example, the bewilderment of an immigrant shopping for the first time in her new country, with new brands selling for prices in an unfamiliar currency, with the comfort of an experienced shopper who knows which brands are better, what prices are cheap, and where their favorite products are located. This accumulated knowledge and expertise greatly reduces the need for information processing and active search (14, 15). By analogy, we ask if older adults' greater G_c can provide an alternative route to good decision-making when less G_f is available.

We examine this question by assembling a dataset that uniquely combines web-based collection of multiple measures of cognitive ability, economic preferences (i.e., risk, loss, and time preferences), and personality traits with field observations of economic performance from credit reports and experimental assessments of realistic financial decisions. This dataset allows us to test whether G_f and G_c relate to financial performance and how age differences in these abilities relate to differences in financial performance. Doing so allows us to test a framework that describes age-related differences in decision-making ability (16) using real-world financial outcomes, namely credit scores.

Cognitive ability and economic preferences were assessed in a four-part web-based study in which 478 US residents between 18 and 86 completed a battery of cognitive, decision-making, and demographic measures (see *SI Appendix* for details). All experimental protocols were approved by the Institutional Review Board at Columbia University. Informed consent was obtained from all participants. G_f measures used standard Raven's Progressive Matrices and Letter Sets tasks, and a combined Numeracy and Cognitive Reflection Test. Domain-general G_c measures used standard vocabulary and general knowledge tasks: Shipley Vocabulary, Antonym Vocabulary, and WAIS-III Information. We supplemented these measures with domain-specific G_c assessments of financial literacy (17) and health insurance knowledge (18).

Significance

At a time when the world's 65-and-older population will double by 2035, policy changes have transferred many complex financial and healthcare decisions to individuals. Age-related declines in cognitive ability raise the specter that older adults facing major financial decisions may find them increasingly challenging. We explore whether knowledge and expertise accumulated from past decisions can offset age-related cognitive declines. Using a unique dataset that combines measures of cognitive ability, knowledge, and credit scores—a measure of creditworthiness that reflects sustained ability for sound financial decision-making—we find that cognitive decline does not spell doom. Instead, domain-specific knowledge and expertise provide an alternative route to sound financial decisions. These results suggest guidelines for designing effective interventions and decision aids across the life span.

Author contributions: Y.L., L.Z., E.U.W., and E.J.J. designed research; Y.L., J.G., and A.Z.E. performed research; Y.L., J.G., A.Z.E., and E.J.J. analyzed data; and Y.L., J.G., A.Z.E., L.Z., E.U.W., and E.J.J. wrote the paper.

The authors declare no conflict of interest.

This article is a PNAS Direct Submission.

Freely available online through the PNAS open access option.

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This article contains supporting information online at www.pnas.org/lookup/suppl/doi:10.1073/pnas.1413570112/-/DCSupplemental.

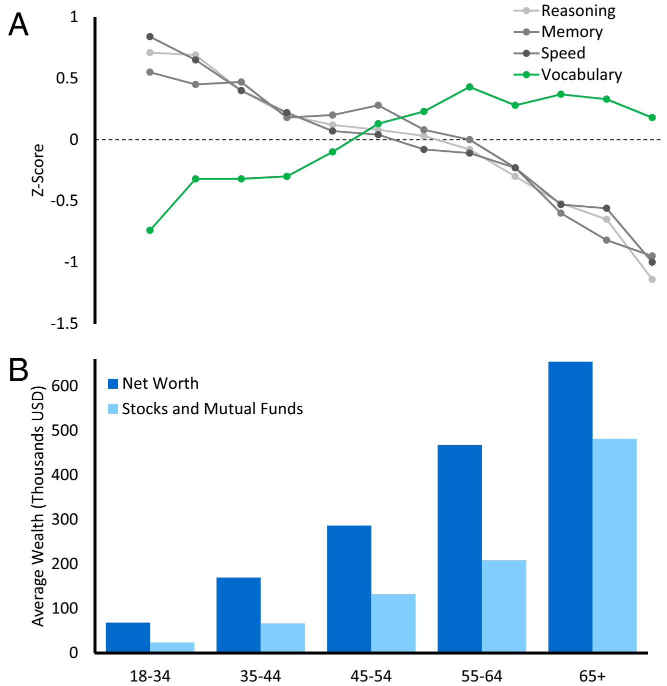

Fig. 1. (*A*) Cognitive abilities (adapted from ref. 11) and (*B*) average US household wealth, and stock and mutual fund holdings in 2011, by age (Survey of Income and Program Participation).

We merged these data with credit scores from a major credit-reporting bureau. Credit scores are a standard metric of creditworthiness widely used by potential lenders, landlords, and employers. Our sample includes a wide range of scores from 449 to 850 (median = 722, M = 699.40, SD = 106.69). Maintaining a high credit score reflects a sustained ability to make good financial decisions over one's lifetime (19) and brings substantial benefits such as lower interest rates and insurance premiums, increased ease of obtaining loans, and higher likelihood of getting a job or apartment.

Results

Our main analyses consist of six models that analyze credit score as a function of age, other demographic variables, cognitive ability, financial experience, economic preferences, and Big Five personality traits. Our goal is to assess the effects of G_f and G_c as we control for other variables previously shown to affect financial decision-making.

We conducted all analyses using structural equation modeling (SEM) but, for ease of exposition, present all results as linear regressions on factor scores from the SEM analysis. Factor scores represent a weighted composite of multiple measures of each construct that provides a more reliable measure. The SEM and linear regressions showed the same pattern of results (see *SI Appendix* for details).

Fig. 2 summarizes our main results. Both domain-specific crystallized intelligence, measured by financial literacy ($G_{c\text{-}FL}$), and fluid intelligence (G_f) were associated with higher credit scores, as shown in the top right and bottom right graph insets. Because crystallized intelligence ($G_{c\text{-}FL}$) is higher for older participants (Fig. 2, *Top Left* graph) and fluid intelligence (G_f) is lower (Fig. 2, *Bottom Left* graph), the effect of age on credit score (shown by the central horizontal arrow) can be better understood, at least in part, as a combined effect of differences in these two capabilities. As we detail below, this result suggests that greater G_c offers older adults a viable alternative to relying on decreased G_f.

Table 1 shows the results of all six models that further explain the nature of this effect. Model 1, which regresses credit score on only demographic variables, shows credit scores are on average 13 points higher per decade. This effect's magnitude is comparable to an additional year of education or a doubling of income. (See *SI Appendix* for alternative measures of income, wealth, and net worth.)

Model 2 adds G_f and domain-general G_c, verifying that the positive relationship between credit score and G_f is not due to differences in cognitive ability captured by sex, education, or income. Domain-general G_c is also positively related to credit scores, but not statistically significantly. This relationship between domain-general G_c and credit score is weaker than in our earlier work (16), which only measured domain-general tasks, and is consistent with the idea that more domain-specific G_c is important for more specific tasks. We therefore substitute a

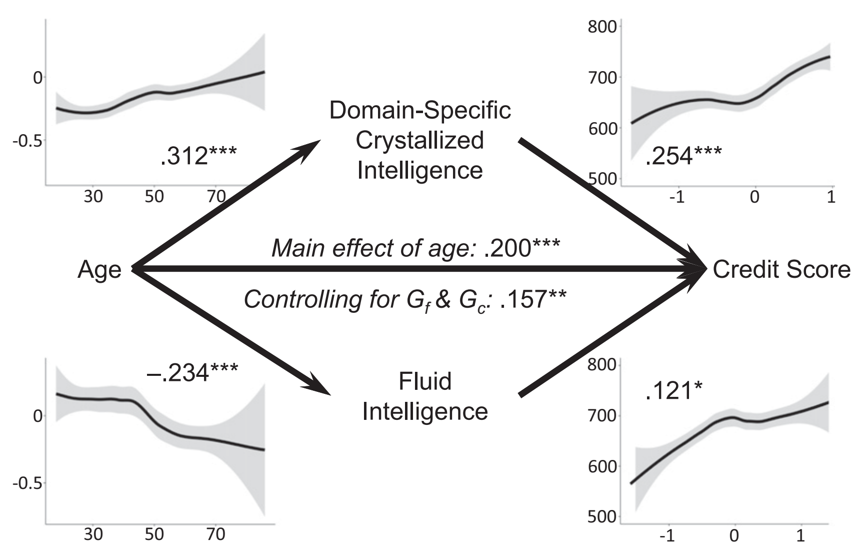

Fig. 2. Credit scores as a function of age, G_f, and domain-specific $G_{c\text{-}FL}$. The lines on the left show the relationships between age, G_f, and $G_{c\text{-}FL}$, along with 90% confidence bands. Numbers by each arrow are standardized path coefficients, which can be interpreted as partial correlations between variables controlling for other dependent variables. ***P < 0.001; **P < 0.01; *P < 0.05.

Table 1. Credit scores depend on cognitive ability, economic preferences, and personality

	1	2	3	4	5	6
Constant	693.032***	695.583***	696.996***	696.996***	693.051***	694.753***
	(6.009)	(5.950)	(5.792)	(5.796)	(5.910)	(5.711)
Demographics						
Age	1.293***	1.498***	1.017**	1.205**	0.986**	0.763*
	(0.297)	(0.356)	(0.335)	(0.377)	(0.343)	(0.343)
Sex, female = 1	−0.213	−6.093	−15.542	−15.768	−8.204	−11.601
	(10.291)	(10.392)	(10.133)	(10.163)	(10.621)	(9.979)
Education, y	11.536***	7.441**	5.845*	5.871*	7.834**	7.043**
	(2.443)	(2.618)	(2.505)	(2.509)	(2.617)	(2.490)
Log income	18.839***	15.788**	13.877**	16.370**	17.222**	14.520**
	(5.368)	(5.292)	(5.194)	(5.714)	(5.443)	(5.119)
Financial experience				−13.799		
				(13.136)		
Intelligence variables						
G_f		32.725**	21.553*	21.734*	15.713	20.269*
		(10.587)	(9.503)	(9.524)	(10.303)	(9.448)
G_c		9.492				
		(8.680)				
$G_{c\text{-}FL}$			46.943***	50.432***	33.629**	45.233***
			(10.516)	(11.125)	(10.942)	(10.460)
Economic preferences						
Discount factor					26.480*	
					(10.691)	
Present bias					0.734	
					(6.967)	
Loss aversion					0.482	
					(6.778)	
Probability distortion					−9.569	
					(5.950)	
Risk aversion					−6.221	
					(6.731)	
Personality (standardized)						
Intellect						−11.638*
						(5.485)
Emotional stability						6.726
						(6.365)
Extraversion						−15.693*
						(6.738)
Agreeableness						−9.258
						(7.587)
Conscientiousness						1.976
						(6.890)
N	415	415	415	414	387	415
R^2	0.161	0.202	0.237	0.238	0.259	0.275
Adjusted R^2	0.153	0.190	0.225	0.225	0.238	0.255

Note: SEs in parentheses. Level of significance: ****P* < 0.001; ***P* < 0.01; **P* < 0.05.

domain-specific measure of financial G_c in Model 3 and subsequent analyses: Financial literacy ($G_{c\text{-}FL}$) measures ability to understand financial information and decisions (17, 20). People with greater $G_{c\text{-}FL}$ have been found to be more likely to accumulate and manage wealth effectively (21), invest in the stock market (22), and choose mutual funds with lower fees (23).

Model 3 verifies that credit scores relate positively to both G_f and $G_{c\text{-}FL}$. Consistent with Fig. 2, this suggests that higher levels of financial knowledge and expertise provide a distinct and alternative route to sound financial decision-making to older adults for whom G_f is less available (16). One SD more G_f corresponds to 22 more points of credit score, whereas 1 SD more $G_{c\text{-}FL}$ corresponds to 47 more points of credit score.

The fact that $G_{c\text{-}FL}$ is positively related to credit scores might be due to older adults' longer financial histories and greater experience using financial products (7). To separate mere experience from knowledge and expertise, we additionally measured financial experience as self-reported on 20 different types of financial instruments (e.g., checking accounts, credit cards, mortgages, mutual funds, etc.). Model 4 controls for financial experience and shows that the effect of $G_{c\text{-}FL}$ remains strong, suggesting that good financial decisions require people to comprehend financial products, not just have experience using them.

We next consider the role of economic preferences, i.e., preferences regarding risk, loss, and time that influence a wide range of real-world decisions with important financial and health consequences (see *SI Appendix* for details). Economic preferences have been found to vary with cognitive ability (16, 24) and age (24–26). We measured individual differences in economic preferences using adaptive choice tasks designed to assess time and risk preferences (27), averaged over two administrations each. Model 5 adds these model estimates for risk aversion, loss aversion, and time preference as controls to Model 3. Credit scores were higher for people with more patient time preferences, consistent with recent findings (28). Importantly, the effect of G_f is no longer significant after controlling for time preference, consistent with a positive relationship between G_f and patient time preferences (16, 24).

Finally, Model 6 controls for Big Five personality traits, which are thought to influence a wide range of behaviors (6, 29). Our results for the effects of G_f and $G_{c\text{-}FL}$ do not change when we control for Big Five personality traits, even though intellect (level of creativity) and extraversion (level of sociability) were associated with lower credit scores.

Performance on Other Financial Decisions. Credit scores reflect a cumulative series of financial decisions, but we also wanted to generalize our results by assessing the effects of fluid and crystallized intelligence on two specific financial decisions for which normative answers exist, one in debt management, the other in health insurance choices. In the first task, participants chose how to allocate a fixed budget to repaying debts on two credit card accounts (30), one with a higher annual percentage rate (APR). Although participants should pay off the higher APR credit card first, the tempting but naive choice in this task is to pay off the lower APR credit card in full. The second task asked participants to pick the most cost-effective healthcare plan, given a specific health profile (e.g., 11 doctor visits per year and $250 in prescriptions) from options that varied on premium, deductible, and copay (18).

For both tasks, greater G_f and domain-specific G_c corresponded to more optimal responses. Results of models shown in *SI Appendix*, Tables S7–S9 additionally indicate that this pattern continues to hold when controlling for demographics, economic preferences, and personality traits (see *SI Appendix* for detailed results). Strikingly, we found no main effect of age on the quality of health insurance selection, even though there are positive effects of G_f and healthcare-specific G_c. This result suggests that both effects are important, but may be hidden when simply looking for age effects, because they can cancel each other out.

Discussion

The combination of older adults' greater wealth and lower fluid intelligence could be a source of social concern. Instead, crystallized intelligence, particularly domain-specific knowledge and expertise, seems to provide an alternative route to sound financial decisions—one that can improve with age.

To better appreciate the financial ramifications of the relationships between these two cognitive abilities and credit scores, consider a median study participant, Anne, a 44-y-old woman with a college degree earning $50,000/y and of average cognitive ability. Her predicted credit score would be 693, which would currently qualify her for a 4.223% APR on a fixed 30-y, $300,000 mortgage, with payments of $1,471/mo (calculated on July 16, 2014 using www.myfico.com/myfico/creditcentral/loanrates.aspx). If Anne had 1 SD more G_f, her credit score would be 21 points higher, whereas 1 SD more $G_{c\text{-}FL}$ would raise her credit score by 47 points. Combined, these increases would qualify for a lower 3.824% APR (the best tier) and save Anne $69/mo, for a total saving of $24,879 in interest paid over the course of her mortgage. If she instead had 1 SD less of both G_f and $G_{c\text{-}FL}$, Anne's credit score would be in the lowest tier above subprime, resulting in a 5.413% APR and $216 higher monthly payments, for a total additional interest paid of $77,741.

Our results suggest that it can be misleading to only assess the effect of age on decision quality. Instead, research should focus on the interplay of decreasing G_f and increasing G_c. Although recent research on archival datasets has found inverted U-shaped age effects for mistakes in using financial services (4) and successfully applying investing rules-of-thumb in real-life portfolios (7) that are consistent with the combination of decreasing G_f and increasing G_c, these studies fail to provide direct measures of cognitive abilities. In contrast, our study provides such measures and demonstrates that an ability that improves with age (i.e., $G_{c\text{-}FL}$) predicts better financial outcomes.

Our results suggest two different avenues to improve financial decisions, with differing importance across the life span. Reducing reliance on fluid intelligence, a more important intervention for older people, might be accomplished by reducing cognitive load, for example, by limiting the number of provided options or by allowing decision makers to sort options by attributes. Increasing crystallized intelligence through education and training, although potentially quite difficult (17), could provide a benefit that is more effective for younger people. However, increasing G_c comes with two important caveats: First, G_c increases tend to plateau, suggesting an eventual downward trend in decision ability in later years. This is consistent with a peak in financial capabilities around age 60 (4, 7). Second, because its relevance is mainly domain-specific, G_c may not help with decisions in radically new financial situations, e.g., older people may be at a disadvantage for domains such as reverse mortgages or digital currency.

Like much of the research in aging, we do not use a fully representative sample. To address potential concerns, we replicated these analyses using regressions weighted on age and education, with weights derived from iterative poststratification according to the US census (31). Weighted regression results were qualitatively identical to the unweighted results (see *SI Appendix* for more detail). Therefore, although our research relies on web-based, cross-sectional data collection, our results do not seem to depend on the nature of the sample.

The ability of older adults to make financial decisions should be an important consideration for anyone who presents financial information, be they policy makers or financial services firms. Developing tools to help this aging population manage their accumulated assets, as well as a host of other difficult decisions, will be best served not by simply examining the effect of age on performance, but the distinct roles of decreasing cognitive abilities and increasing (but eventually plateauing) domain-specific knowledge and expertise. Age-specific decision aids and interventions that build on these two conduits to good decisions will not only produce better outcomes for individuals, but reduce potentially large costs to society.

ACKNOWLEDGMENTS. We thank Dan Bartels, Dan Goldstein, Julian Jamison, Stephan Meier, Tim Salthouse, and two anonymous reviewers for helpful comments. This research was supported by National Institute on Aging Grant 1R01AG044941 to E.J.J. and E.U.W. and National Endowment for Financial Education Grant 5236 to Y.L. and E.J.J.

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