Perception Bias in the Financial Knowledge of American Adults

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Abstract

Perception biases—individuals' tendency to either overestimate or underestimate their abilities—exist in the domain of financial knowledge. This study utilizes data from a nationally representative sample of 26,218 American adults provided by the 2018 National Financial Capability Study. A two-step procedure is used to analyze the data. In the first step, ordered-probit regression models are used to estimate subjective financial knowledge as a function of objective financial knowledge. The surrogate residuals from these models represent the degree to which subjective knowledge deviates from objective knowledge and are interpreted as measures of perception bias. In the second step, variable-intercept mixed-effects models are estimated to identify the predictors of perception bias in financial knowledge. The results show that individuals with higher perceived math ability and higher risk-taking attitudes are more likely to overestimate their financial knowledge. Surprisingly, individuals who participated in financial education programs or lived in states requiring financial education were also more likely to overestimate their knowledge. These findings have important implications for financial educators, advisors, and policymakers.

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Introduction

Even though perception bias—the tendency to either overestimate or underestimate one's abilities in different domains of life—may not reflect a universal aspect of human psychology, most individuals assess their abilities inaccurately (Loughnan et al., 2010). While some philosophers and social scientists believe that individuals' perceptions of themselves (self-perceptions) are accurate because they are mere reflections of their behaviors and experiences, others argue that self-perceptions are fundamentally distorted. Self-perceptions in a specific domain of life consist of both valid and biased components. The nature of the perception bias depends on individual differences in socio-demographic and behavioral traits. Some individuals tend to overestimate their abilities, some tend to underestimate their abilities, and others remain unbiased in any specific situation (John & Robins, 1994).

Perception bias exists in the domain of financial knowledge, which is a form of literacy about financial issues (Khan et al., 2017). Brucks (1985) suggested that individuals' actual level of

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financial knowledge and their perception of it do not always coincide. According to research conducted by Raddon (2018), a 'Fiserv' company, most Americans overestimate their financial knowledge. Based on an online survey conducted in 2017 on a randomly drawn, nationally representative sample of 12,000 U.S. adults ages 18 and older, Raddon (2018) reports that 44% of the respondents claimed to have a very high level of financial literacy. However, when the respondents took a financial quiz, above 50% of them failed to secure a passing grade, while only 6% of them scored 90% or better. Lusardi (2011) states that the majority of American adults are not aware of their low financial knowledge and end up overestimating it.

Several studies have observed discrepancies between Americans' actual and perceived levels of financial knowledge. For instance, research suggests that many individuals tend to overestimate their financial knowledge, while others underestimate it (Khan et al., 2017; Lusardi, 2011; Lusardi & Tufano, 2009). These misalignments are not random; they appear to be patterned by socio-demographic characteristics such as age, gender, education, income, marital status, and employment status (Khan et al., 2017). Understanding the nature and drivers of such perception biases is crucial because individuals who inaccurately assess their financial knowledge may make suboptimal decisions regarding investment, retirement planning, debt management, and insurance (Grežo, 2020).

While previous research has identified these disparities descriptively, few studies have rigorously measured perception bias using appropriate statistical methods. This study aims to fill that gap. A more complete review of the literature on subjective and objective financial knowledge, including overconfidence patterns, follows in the next section.

This study advances the financial capability literature in two key respects. First, it operationalizes perception bias as financial miscalibration by modeling subjective financial knowledge as a function of objective knowledge and interpreting the residual deviation as misalignment conditional on demonstrated literacy (i.e., confidence net of knowledge). Second, using a nationally representative sample and multilevel modeling, the analysis identifies demographic and psychological patterns associated with perception bias, helping clarify how financial overconfidence should be measured and why confidence does not always track competence.

Literature Review

Financial knowledge can be referred to as the basic understanding of day-to-day financial matters, consisting of but not limited to saving, investing, credit, interest, and inflation (Khan et al., 2017). Some researchers have used the terms 'financial knowledge' and 'financial literacy' interchangeably (Sherwood, 2020), while others have defined financial literacy as the combination of financial knowledge, skills, and attitudes that can affect individuals' financial decision-making (Lusardi, 2011; Lusardi & Mitchell, 2013; Xiao et al., 2014). Financial knowledge can directly affect one's financial behaviors and practices. Several authors like Collins (2013), Grinstein-Weiss et al. (2015), and Hui et al. (2016) have emphasized the importance of financial knowledge by identifying a relationship between higher levels of financial knowledge and appropriate financial behaviors. They have also claimed that individuals with lower levels of financial knowledge are more prone to experiencing financial insecurity and poverty.

The level of financial knowledge can be assessed using both subjective and objective measures. Xiao et al. (2014) evaluated subjective financial knowledge from the respondents' perception of it. Khan et al. (2017) defined subjective financial knowledge as individuals' self-assessment of their levels of financial knowledge. Lusardi and Mitchell (2014) assessed objective financial knowledge by measuring people's understanding of inflation and risk diversification and their ability to perform interest rate calculations. Leskinen and Raijas (2006) evaluated objective financial knowledge by identifying how well people understand financial markets and the relevant financial products. Xiao et al. (2014) measured objective financial knowledge by conducting domain-specific numeracy tests.

Subjective and objective financial knowledge have equal significance, as they both influence one's financial decision-making, and neither alone is sufficient to explain one's financial decision-making behavior (Khan et al., 2017). Hilgert et al. (2003) and Xiao et al. (2014) suggested that higher levels of objective financial knowledge and appropriate financial behaviors are positively associated. Lown et al. (2015) and Rothwell et al. (2016) showed that subjective financial knowledge mediates the relationship between objective financial knowledge and financial decision-making.

Even though many studies bear evidence that both subjective and objective financial knowledge influence one's financial behaviors, several studies have identified a disconnect between these two measures of one's financial knowledge. Khan et al. (2017) suggested that most people's perceived level of financial knowledge is very likely to either exceed or fall short of their objective financial knowledge. Lusardi (2011) claimed that most people overestimate their financial knowledge because they are not aware of how little they actually know—that is, there exists a discrepancy between subjective and objective financial knowledge that many individuals fail to recognize.

In addition, multiple studies have observed that the gap between actual and perceived financial knowledge varies systematically by demographic characteristics such as gender, ethnicity, age, and income (Khan et al., 2017; Lusardi, 2011; Lusardi & Tufano, 2009). In particular, Khan et al. (2017) provided evidence that age, gender, income, education, marital status, and employment status significantly influence the likelihood of overestimating financial knowledge. These patterns are consistent with findings in behavioral finance regarding overconfidence, which describes individuals' tendency to overstate their competence in specific domains, including financial literacy.

This demographic pattern of overestimation is particularly important because individuals who believe they are more financially knowledgeable than they actually are may fail to seek financial advice or education, or may take unnecessary risks. Thus, understanding perception bias is not only about identifying a statistical gap, but also about recognizing its behavioral consequences.

Perception bias in financial knowledge (i.e., the disconnect between individuals' subjective and objective financial knowledge) can significantly influence the financial behaviors of not only those who overestimate their financial knowledge (i.e., have higher subjective financial knowledge than objective financial knowledge) but also those who underestimate their financial knowledge (i.e., have higher objective financial knowledge than subjective financial knowledge). Sherraden and Morrow-Howell (2015) identified that older adults are more vulnerable in their financial matters due to a higher perception compared to their actual levels of financial knowledge. They also suggested that individuals who overestimate their financial knowledge may be more likely to engage in risky financial practices at a life stage that requires more conservative decisions.

Although several studies investigated the separate influences of subjective and objective financial knowledge on individuals' financial behaviors (Lusardi, 2011; Lusardi & Tufano, 2009; Robb & Woodyard, 2011; Xiao et al., 2014), very few studies have identified the possible reasons and consequences of the perception bias in financial knowledge. Raddon (2018) reported that a significant majority of American adults have never attended a financial literacy program, which could be the main reason why the tendency to wrongly estimate the levels of financial knowledge is so prevalent among them.

While prior research has explored patterns of financial overconfidence, these studies have not formally estimated perception bias using statistically appropriate methods—such as surrogate residuals derived from ordinal regression models. Therefore, although some studies describe mismatches between subjective and objective knowledge, they do not rigorously model the unexplained variation in perception. This framing is consistent with work distinguishing overall confidence from confidence conditional on demonstrated knowledge (Parker & Stone, 2014) and with studies documenting the behavioral relevance of

financial miscalibration (Kramer, 2016; Anderson et al., 2017).

This study aims to fill that gap by introducing a robust statistical measure of perception bias and examining its predictors using a large, nationally representative sample of American adults. In doing so, it contributes both a methodological advancement and new empirical insights to the financial capability literature.

Theory and Hypotheses

This study derives its motivation from the theory of metacognition. Flavell (1979) defined metacognition as individuals' knowledge and awareness of their own cognitive processes. A key component of metacognitive knowledge is the ability to assess one's competence in specific domains. When individuals lack the ability to accurately assess themselves, they may develop biased self-perceptions—either overestimating or underestimating their abilities.

Such metacognitive errors can explain two well-documented cognitive biases: the Dunning-Kruger effect and the impostor syndrome. The Dunning-Kruger effect describes individuals' tendency to overestimate their capabilities because they lack the metacognitive insight to recognize their limitations (Dunning, 2011). In contrast, the impostor syndrome refers to the underestimation of one's true abilities, even in the presence of competence (Simmons, 2016). Both biases can manifest across a variety of domains, including financial knowledge.

In this study, perception bias refers to the systematic deviation between an individual's subjective (self-reported) and objective (tested) financial knowledge. Specifically, it is operationalized as the surrogate residual from an ordered-probit regression of subjective financial knowledge on objective financial knowledge. Positive values indicate overestimation, while negative values indicate underestimation.

It is important to emphasize that perception bias in this study is an empirically estimated measure of miscalibration rather than a direct measure of a stable psychological trait. Operationally, it captures the systematic deviation of subjective financial knowledge from what would be predicted by objective financial knowledge, conditional on observed performance. Because it is derived as a residual from a model of subjective knowledge on objective knowledge, it represents confidence net of knowledge, rather than overall confidence levels. In this sense, the measure aligns with prior distinctions between descriptive overconfidence and unjustified confidence (Parker & Stone, 2014).

Accordingly, the residual-based measure supports claims about patterned over- and underestimation across individuals and contexts. However, it does not identify underlying cognitive mechanisms, dispositional traits, or causal pathways. Instead, it provides an empirically grounded way to study perception bias as financial miscalibration, consistent with research linking misperceptions of financial literacy to advice-seeking, retirement planning, and savings behaviors (Kramer, 2016; Anderson et al., 2017).

The theory of metacognition suggests that perception biases in financial knowledge may not exist in isolation, but rather co-occur with similar biases in adjacent cognitive domains. For example, individuals who perceive themselves as highly competent in math or confident in making risky financial decisions may generalize that perceived competence to their financial knowledge. This overgeneralization can lead to inaccurate self-assessment and, consequently, to perception bias in financial knowledge. In this framework, perceived ability refers to an individual's self-assessed competence in related domains—specifically, mathematical ability and risk-taking attitude. These are not measures of actual ability or behavior, but rather of how competent individuals believe themselves to be in those areas.

Metacognitive theory, particularly in combination with the Dunning-Kruger framework, supports the expectation that higher perceived ability in math and risk-taking will be associated with greater overestimation of financial knowledge. In other words, individuals who rate themselves highly in math or who express greater willingness to take financial risks may be more likely to assume they are financially knowledgeable, regardless of their actual financial literacy level.

Based on this theoretical foundation, we propose the following hypotheses regarding perception bias in financial knowledge:

H1: Individuals with higher levels of perceived math ability will exhibit greater perception bias in financial knowledge, specifically a higher likelihood of overestimating their financial knowledge.

H2: Individuals with greater willingness to take financial risks will exhibit greater perception bias in financial knowledge, specifically a higher likelihood of overestimating their financial knowledge.

H3: Individuals who have received financial education (in school or at work) will exhibit lower perception bias in financial knowledge compared to those who have not received such education.

These hypotheses aim to test whether individuals' perceived abilities in related domains (math and risk-taking), as well as their exposure to financial education, are systematically associated with their likelihood of overestimating or underestimating their financial knowledge.

Methods

Data

This study utilized data from the 2018 National Financial Capability Study (NFCS), funded by the Financial Industry Regulatory Authority's (FINRA) Investor Education Foundation. The NFCS is designed to measure perceptions, attitudes, experiences, and behaviors on a wide variety of topics (FINRA Investor Education Foundation, 2020). The main objective of the NFCS is to benchmark key indicators of financial capability and evaluate how these indicators vary with underlying demographic, behavioral, attitudinal, and financial literacy characteristics (FINRA Investor Education Foundation, 2020). The 2018 State-by-State survey, the largest component of the NFCS, was conducted online from June through October 2018 among a sample of 27,091 American adults (FINRA Investor Education Foundation, 2020). This survey collected data from approximately 500 individuals per state, plus the District of Columbia, with oversamples of 1,250 in Oregon and Washington (FINRA Investor Education Foundation, 2020).

The 2018 State-by-State Tracking Dataset includes weights that allow researchers to match Census distributions for three levels of studies: national, Census Division, and state. The full sample with all 27,091 observations becomes nationally representative once the national-level weights are applied. This study used 26,218 observations for the analysis, excluding the observations with "don't know" and "prefer not to say" responses for either of the two subjective financial knowledge variables. Table 1 compares the means of several variables with no missing values (e.g., age, gender, race, income, work status, and marital status) between the full sample and the analysis sample. Two-sample t-tests show that the mean difference between the two samples for none of the listed variables is statistically significant at the 95% confidence level.

Table 1: Mean Comparison of Variables between the Full Sample and the Analysis Sample

Variable (category)	Full Sample		Analysis Sample		Mean Difference	t	Pr(|T| > |t|)
	Mean	Std. Dev.	Mean	Std. Dev.			
Female	0.5587	0.4966	0.5571	0.4967	0.0016	0.3748	0.7078
White	0.7419	0.4376	0.7449	0.4359	-0.0030	-0.8032	0.4218
Income ($50k - $75k)	0.1941	0.3955	0.1960	0.3970	-0.0018	-0.5386	0.5902
Work status (full-time)	0.3987	0.4896	0.4020	0.4903	-0.0034	-0.7910	0.4290
Marital status (married)	0.5336	0.4989	0.5367	0.4987	-0.0031	-0.7139	0.4753
Age (65+)	0.2035	0.4026	0.2055	0.4041	-0.0020	-0.5853	0.5583

The t-statistics are from the mean comparison t-tests for two samples with unequal variances. The null hypothesis states that the mean difference between the two samples is zero. Pr(|T| > |t|) value of < 0.05 means that the null hypothesis is rejected at the 95% confidence level.

Variables

This study applied the two-step regression procedure suggested by Chen et al. (2018). In the first step, the two measures of subjective financial knowledge (day-to-day and overall) were used as the dependent variables, and the objective measure of financial knowledge was used as the explanatory variable in separate ordered-probit regressions.

Subjective financial knowledge was measured using two survey items from the 2018 NFCS. Day-to-day subjective financial knowledge was based on the item: *"I am good at dealing with day-to-day financial matters, such as checking accounts, credit and debit cards, and tracking expenses."* Respondents answered on a 7-point Likert scale ranging from 1 = Strongly Disagree to 7 = Strongly Agree. Overall subjective financial knowledge was based on the question: *"On a scale from 1 to 7, where 1 means very low and 7 means very high, how would you assess your overall financial knowledge?"* For both items, responses of "Don't Know" (coded as 98) and "Prefer not to say" (coded as 99) were excluded from the analysis. The remaining ordinal responses were used in ordered-probit regression models to generate surrogate residuals.

The objective measure of financial knowledge was constructed from six questions assessing the respondents' understanding of compound interest, inflation, bond prices, mortgage interest, risk, and return. For each of the objective financial knowledge questions, the respondents who chose the correct answer choice received a score of 1, and the respondents who chose any other answer choice but the correct one received a score of 0. Individual scores for all six questions were summed to generate the objective measure of financial knowledge for each respondent.

The day-to-day measure of subjective financial knowledge was constructed from the respondents' self-reported perception of how good they are at dealing with day-to-day financial matters, based on a seven-point Likert scale. Similarly, the overall measure of subjective financial knowledge was constructed from the respondents' self-reported perception of their overall financial knowledge, based on another seven-point Likert scale.

In the second step, the perception bias in day-to-day financial knowledge (FK) and the perception bias in overall financial knowledge (FK) were used as the dependent variables. Both perception bias in day-to-day FK and perception bias in overall FK were generated as continuous variables by extracting the residuals from the first-step ordered-probit regressions. The positive values of the perception bias in day-to-day FK represent an overestimation, and the negative values represent an underestimation, of day-to-day financial knowledge. Similarly, the positive values of the perception bias in overall FK represent an overestimation, and the negative values represent an underestimation, of overall financial knowledge.

This study included financial education, risk-taking attitude, and math ability as the main explanatory variables at the individual level (i.e., level 1) in the second step of the two-step procedure. Financial education was included as a dichotomous variable that took a value of 1 if the respondent received financial education at a school or college they attended or at a workplace where they were employed. It took a value of 0 if the respondent had never received any financial education, did not know, or preferred not to say. Risk-taking attitude was included as a categorical variable measuring the respondents' willingness to take risks regarding financial investments based on a ten-point Likert scale, ranging from not at all willing to very willing. The lowest level of risk-taking attitude was used as the reference category, and a dichotomous variable was included for each of the other levels of risk-taking attitude. Perceived math ability was also included as a categorical variable measuring the respondents' self-reported perception of how good they are at math, based on a seven-point Likert scale. The lowest level of perceived math ability was used as the reference category, and a

dichotomous variable was included for each of the other levels of perceived math ability.

This study also included a range of individual-level control variables at the individual level (i.e., level 1) in the second step of the two-step procedure to account for demographic variation. These controls include age group, gender, race, income level, work status, marital status, military status, and education level. Each variable was coded into appropriate categories based on the structure of the 2018 NFCS dataset. Detailed coding schemes and category descriptions for all control variables are provided in Appendices A-1 and A-2.

Additionally, a state-level explanatory variable was included to indicate whether a respondent resided in a state that required a high school personal finance education course for graduation. This binary variable took the value of 1 if the course was required and 0 otherwise.

Table 2 presents the descriptive statistics of the variables used in this study. A substantial proportion of respondents reported high levels of subjective financial knowledge. Specifically, approximately two-thirds of the respondents rated their day-to-day financial knowledge in the high category (responses 6–7), while over 40% reported high overall financial knowledge. Similarly, nearly two-thirds of the respondents rated their math ability in the high category.

With respect to risk preferences, the majority of respondents reported low to moderate willingness to take risks in investments, with roughly one-third in the low category and slightly more than one-third in the moderate category.

The perception bias measures for both day-to-day and overall financial knowledge are standardized with a mean of zero and a standard deviation of one. The values ranged from –3.62 to 3.73 for day-to-day perception bias and from –3.78 to 3.66 for overall perception bias.

In terms of demographic characteristics, more than half of the respondents were female, nearly three-fourths identified as White, and approximately 62% were married or living with a partner. The sample spans all adult age categories, with roughly one-fifth aged 65 or older. Nearly half of the respondents reported annual household incomes below $50,000. The largest employment category was full-time work, and over one-third of respondents held at least a bachelor's degree.

All data were drawn from the 2018 NFCS State-by-State survey (n = 26,218).

Table 2. Descriptive Statistics of Key Variables (n = 26,218)

Panel A. Perception Bias Measures

Variable	Mean	SD	Min	Max
Perception Bias in Day-to-Day Financial Knowledge	0	1	-3.62	3.73
Perception Bias in Overall Financial Knowledge	0	1	-3.78	3.66

Panel B. Subjective Measures (Distribution, %)

Measure	Low (1–3)	Moderate (4–5)	High (6–7)	DK/PNTS
Day-to-Day Subjective Financial Knowledge	7.92	25.08	66.99	0
Overall Subjective Financial Knowledge	10.16	48.49	41.34	0
Math Ability	10.79	25.5	63.05	0.64

Panel C. Risk-Taking Attitude (Distribution, %)

Measure	Low (1–3)	Moderate (4–6)	High (7–10)	DK/PNTS

Risk-Taking Attitude	32.47	35.16	29.81	2.54

Note: Data are drawn from the 2018 NFCS State-by-State survey (n = 26,218). Perception bias measures are standardized (mean = 0, SD = 1). Low, moderate, and high categories reflect grouped response scales as indicated in the table. Percentages may not sum to 100 due to rounding.

Panel D. Demographic Characteristics (%)

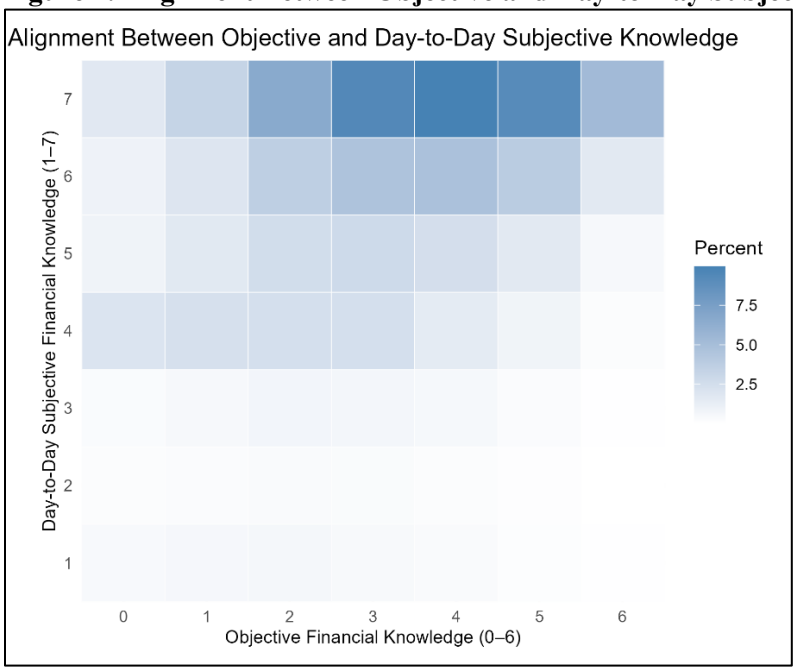
Variable / Category	**%**
Female	55.79
White	74.34
Married/Living with Partner	61.67
Age 18–24	10.32
Age 25–34	17.3
Age 35–44	16.7
Age 45–54	17.23
Age 55–64	18.11
Age 65+	20.35
Income < $15k	11.23
Income $15–25k	10.35
Income $25–35k	10.83
Income $35–50k	14.46
Income $50–75k	19.41
Income $75–100k	14.23
Income $100–150k	12.69
Income > $150k	6.8
Self-employed	7.33
Work Full-Time	39.87
Work Part-Time	8.88
Homemaker	8.06
Full-Time Student	3.36
Unable to Work	5.37
Unemployed	4.56
Retired	22.58
No High School	2.57
High School Graduate	18.08
Some College	33.89
Associate's Degree	10.57
Bachelor's Degree	21.79
Postgraduate Degree	13.07

Note: Data are drawn from the 2018 NFCS State-by-State survey (n = 26,218). Perception bias measures are standardized (mean = 0, SD = 1). Low, moderate, and high categories reflect grouped response scales as indicated in the table. Percentages may not sum to 100 due to rounding.

Figures 1 and 2 plot objective financial knowledge against day-to-day and overall subjective assessments. Although some respondents fall near the diagonal, many do not.

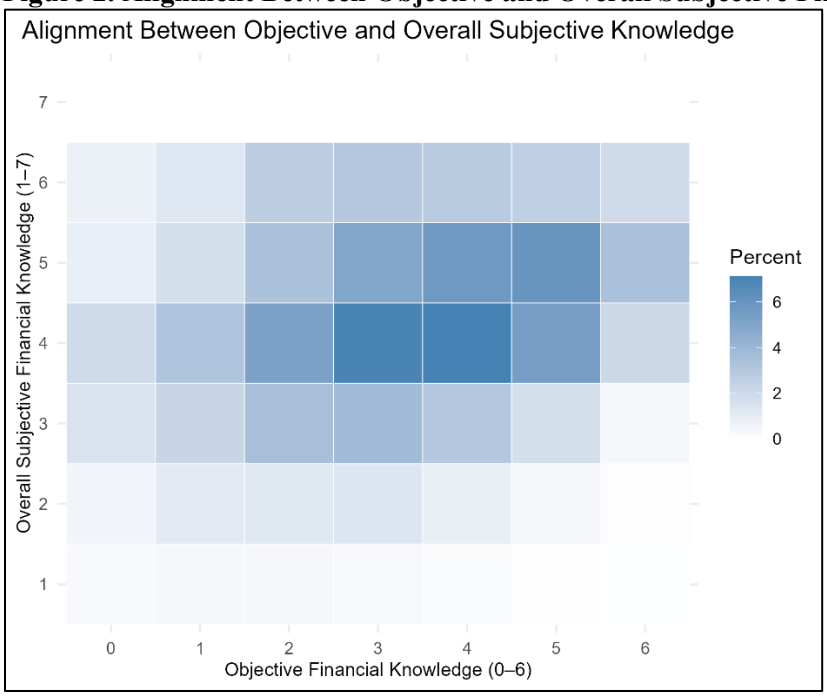
The off-diagonal concentration suggests that over- and underestimation are common, consistent with perception bias as a gap between objective financial knowledge and the perception of it.

Figure 1. Alignment Between Objective and Day-to-Day Subjective Financial Knowledge



Note: Cells display the percentage of respondents in each objective–subjective combination. Darker shading indicates greater concentration. Perfect calibration would appear along the diagonal from lower-left to upper-right.

Figure 2. Alignment Between Objective and Overall Subjective Financial Knowledge



Note: Cells display the percentage of respondents in each objective–subjective combination. Darker shading indicates greater concentration. Perfect calibration would appear along the diagonal from lower-left to upper-right.

Analysis

In much of the published literature regarding the difference between subjective and objective financial knowledge (i.e., the knowledge gap), researchers oftentimes use the difference between these two scores as the dependent variable (Khan et al., 2017). However, using this difference as the dependent variable in a regression model allows for only the difference between the two measures to be explained. This study argued that researchers should be interested in how much variation in subjective financial knowledge exists after controlling for objective financial knowledge. The residuals from such a model would measure the remaining variation in subjective knowledge after controlling for objective financial knowledge. These residuals can then be used as the dependent variable in an auxiliary regression model where the explanatory variables are ones that are a priori believed to be associated with subjective financial knowledge after controlling for objective financial knowledge. This study utilized a two-step regression procedure suggested by Chen et al. (2018).

In the first step, the two measures of subjective financial knowledge (day-to-day and overall) were regressed on the objective measure of financial knowledge in separate ordered-probit regression models. Recall that the residuals from any regression model are defined as $\hat{\varepsilon} = Y_{actual} - Y_{predicted}$. Unlike linear models, ordered-probit models do not produce conventional residuals because the outcome variable is ordinal. Instead, this study uses surrogate residuals, a technique introduced by Liu and Zhang (2017), to recover an interpretable continuous measure of the deviation between observed and expected ordinal responses. These residuals allow us to estimate the difference between an individual's reported subjective financial knowledge and the level predicted by their objective financial knowledge.

To motivate the idea of surrogate residuals, recall that the probit model can be written mathematically as follows:

$$Y^* = X^T\beta + \varepsilon$$

$$\varepsilon \sim N(0,1)$$

where Y^* represents the underlying latent (i.e., non-observed) utility, X^T is the matrix of explanatory variables, β is the vector of regression parameters, and ε is the independent and identically distributed (i.i.d) error term that is normally distributed with mean 0 and standard deviation 1. Note that the underlying and unobservable latent utility is not observed normally; therefore, the model needs to be expressed mathematically in the following form:

$$Y = \begin{Bmatrix} 1 & Y^* > 0 \\ 0 & otherwise \end{Bmatrix} = \begin{Bmatrix} 1 & X^T\beta + \varepsilon > 0 \\ 0 & otherwise \end{Bmatrix}$$

The above mathematical formulation simply says that if the underlying and unobservable latent utility is positive, the dependent variable is coded as a 1, and if the underlying and unobservable latent utility is negative, the dependent variable is coded as a 0. In their study, Liu and Zhang (2017) postulate that one can simulate the underlying latent utilities by creating a surrogate variable S:

$$S \sim \begin{cases} Z|Z \leq 0 & if\ Y = 0 \\ Z|Z > 0 & if\ Y = 1 \end{cases}$$

The continuous underlying latent variable Z takes on a positive value if $Y = 1$ and a negative value if $Y = 0$. The latent variable Z has the following distributional form:

$$Z|Z \leq 0 \sim TN(\alpha + X\beta, 1)\ if\ Y = 0$$
$$Z|Z > 0 \sim TN(\alpha + X\beta, 1)\ if\ Y = 1$$

If $Y = 0$, the value of the latent utility is derived from a right-truncated normal distribution (i.e., a negative value), and if $Y = 1$, the value of the latent utility is derived from a left-truncated normal distribution (i.e., a positive value) The surrogate residuals are extracted using the "SURE" package in R, as suggested by Greenwell et al. (2018).

The surrogate residuals used in this study represent the difference between each respondent's actual ordinal response and the expected response based on their objective financial knowledge. Importantly, these residuals

are interpreted as indicators of perception bias, defined as systematic deviation of subjective financial knowledge from the level predicted by objective knowledge (i.e., miscalibration net of knowledge). A positive surrogate residual means that an individual rated their subjective financial knowledge higher than what would be expected given their objective performance, thus indicating overestimation. Conversely, a negative surrogate residual suggests underestimation of one's financial knowledge.

These residuals are not random noise; they capture systematic deviations in self-perception that remain after accounting for actual knowledge levels. In this framework, perception bias is operationalized as a metacognitive misalignment between perceived and actual knowledge. This approach aligns with prior literature on cognitive bias and miscalibration in self-assessment.

This study termed the unexplained portion of the day-to-day subjective financial knowledge as the perception bias in day-to-day financial knowledge (PBDFK). Similarly, the unexplained portion of the overall subjective financial knowledge is termed as the perception bias in overall financial knowledge (PBOFK). Both perception biases are used as dependent variables in the second step.

In this study, the first step of the two-step procedure estimated two ordered probit models. The ordered probit regression is a special form of ordinal regression analysis used to predict ordinal dependent variables with more than two outcomes. The following ordered probit models are estimated in the first step:

$$DSFK^* = \beta_0 + \beta_1 OFK + \varepsilon \qquad (1)$$

where

$DSFK = 1$ *if* $DSFK^* \leq 0$ *(very low)*

$DSFK = 2$ *if* $0 < DSFK^* \leq \varphi_1$

$DSFK = 3$ *if* $\varphi_1 < DSFK^* \leq \varphi_2$

$DSFK = 4$ *if* $\varphi_2 < DSFK^* \leq \varphi_3$

$DSFK = 5$ *if* $\varphi_3 < DSFK^* \leq \varphi_4$

$DSFK = 6$ *if* $\varphi_4 < DSFK^* \leq \varphi_5$

$DSFK = 7$ *if (very high)*

$DSFK^*$ in Equation (1) represents the latent measure of day-to-day subjective financial knowledge reported by each respondent. The φ_n's represent the unknown threshold at which point a respondent is more likely to perceive their day-to-day financial knowledge to be at a particular level. $OSFK^*$ in Equation (2) represents the latent measure of overall subjective financial knowledge reported by each respondent. The τ_n's represent the unknown threshold at which point a respondent is more likely to perceive their overall financial knowledge to be at a particular level. OFK in both Equations (1) and (2) represents the objective measure of financial knowledge for each respondent. OFK can range from 0 to 6, based on how many correct answers a respondent gave to the financial knowledge questions. β_1 in Equation (1) reflects

$$OSFK^* = \gamma_0 + \gamma_1 OFK + \vartheta \qquad (2)$$

where

$OSFK = 1$ *if* $OSFK^* \leq 0$ *(very low)*

$OSFK = 2$ *if* $0 < OSFK^* \leq \tau_1$

$OSFK = 3$ *if* $\tau_1 < OSFK^* \leq \tau_2$

$OSFK = 4$ *if* $\tau_2 < OSFK^* \leq \tau_3$

$OSFK = 5$ *if* $\tau_3 < OSFK^* \leq \tau_4$

$OSFK = 6$ *if* $\tau_4 < OSFK^* \leq \tau_5$

$OSFK = 7$ *if (very high)*

the change in DSFK for a one-unit change in OFK. γ_1 in Equation (1) reflects the change in OSFK for a one-unit change in OFK. β_1 and γ_1 also identify the sign of the respective coefficients.

In this study, the second step of the two-step procedure estimated two variable-intercept mixed-effects linear regression models. The data in this study consisted of individuals who were nested within states. The mixed effects regression model estimated random effects at the state level and included a state-level explanatory variable. In the absence of random effects, the mixed-effects linear regression was reduced to the standard normal linear regression model. This study conducts a likelihood ratio test to justify using a mixed-effects linear regression model instead of

a normal linear regression model. The likelihood ratio test reports a statistically significant chi-squared difference at the 95% confidence level, suggesting that the mixed-effects linear regression, compared to the normal linear regression model, provided a better model fit in the second step of the two-step procedure. The following variable intercept mixed-effects linear regression models were estimated in the second step:

$$PBDFK_{ij}^{*} = \psi_0 + \psi_k x_{ij} + u_j + \mu_{ij} \quad (3)$$

and

$$PBOFK_{ij}^{*} = \lambda_0 + \lambda_k x_{ij} + v_j + \omega_{ij} \quad (4)$$

$PBDFK_{ij}^{*}$ in Equation (3) represents the perception bias in day-to-day financial knowledge for each respondent nested within the states. $PBOFK_{ij}^{*}$ in Equation (4) represents the perception bias in overall financial knowledge for each respondent nested within the states. The row vector x_{ij} in both Equations (3) and (4) are the explanatory variables for the fixed effects, analogous to the covariates in a normal linear regression model. A straight line with intercept ψ_0 and ψ_k represents the overall (cross-group) relationship between PBDFK and x_{ij} in Equation (3). The intercept for a given group j is $\psi_0 + u_j$, which is higher or lower than the overall intercept ψ_0 by an amount u_j. In Equation (3), u_j is a group effect that is assumed to follow a normal distribution with a mean of zero and variance of σ_u^2. A straight line with intercept λ_0 and λ_k represents the overall (cross-group) relationship between PBOFK and x_{ij} in equation (4). The intercept for a given group j is $\lambda_0 + v_j$, which is higher or lower than the overall intercept λ_0 by an amount v_j. In equation (4), v_j is a group effect that is assumed to follow a normal distribution with a mean of zero and variance of σ_v^2. The fixed part of equation (3) is $\psi_0 + \psi_k x_{ij}$ with fixed part parameters $\psi_0 \; and \; \psi_k$, and the random part is $u_j + \mu_{ij}$ with random part parameters σ_u^2 and σ_μ^2. The fixed part of equation (4) is $\lambda_0 + \lambda_k x_{ij}$ with fixed part parameters $\lambda_0 \; and \; \lambda_k$, and the random part is $v_j + \omega_{ij}$ with random part parameters σ_v^2 and σ_ω^2.

This two-step modeling strategy allows us to isolate the misalignment between perceived and actual knowledge and then examine which individual- and state-level factors are associated with systematic over- or underestimation.

Results

The relationships between the perception biases in financial knowledge and the explanatory variables from the mixed-effects linear regression model are presented in Table 6. The perception bias in day-to-day financial knowledge is used as the dependent variable in model (1), and the perception bias in overall financial knowledge is used as the dependent variable in model (2). As these dependent variables are generated from the residuals of ordered-probit regressions, they do not necessarily have any unit of measure, making it difficult to interpret the regression coefficients of models (1) and (2). Hence, this study only interprets the qualitative results (i.e., how the explanatory variables are associated with the dependent variables) presented in Table 6.

Table 3 shows that higher perceived mathematical ability is associated positively with perception biases in both day-to-day and overall financial knowledge. The respective coefficients suggest that these positive associations are both statistically (at the 99.99% confidence level) and substantively significant. These positive associations also suggest that individuals with higher levels of perceived mathematical ability are more likely to overestimate both their day-to-day and overall financial knowledge. This result aligns with the hypothesized relationship in light of the main motivating theory for this study, which suggests that individuals with higher levels of perceived ability in other domains (i.e., math ability) are more likely to overestimate their levels of financial knowledge.

Table 3 also shows that individuals who have participated in financial education programs either in schools or at their workplaces, compared to those who never participated in any financial education programs, are more likely to overestimate their overall financial knowledge. The respective coefficient suggests that this positive association is both statistically (at the 99.99% confidence level) and substantively significant. However, individuals who have

participated in financial education programs overestimating their overall financial knowledge do not align with the hypothesized relationship in light of this study's main motivating theory. The theory and existing literature (Lusardi, 2011; Raddon, 2018) suggest that individuals who participate in financial education programs would be able to estimate their financial knowledge fairly. The perception biases found in this study, even for those who participated in financial education programs, are possibly due to the lack of effectiveness of the traditional financial education programs being offered in schools and workplaces.

Furthermore, Table 3 shows that higher levels of risk-taking attitude are associated positively with perception biases in both day-to-day and overall financial knowledge. The respective coefficients suggest that these positive associations are both statistically (at the 99.99% confidence level) and substantively significant. These positive associations also suggest that individuals with higher levels of risk-taking attitude are more likely to overestimate both their day-to-day and overall financial knowledge. This result also aligns with the hypothesized relationship in light of the main motivating theory for this study, which suggests that individuals with higher levels of perceived ability in other domains (i.e., risk-taking) are more likely to overestimate their levels of financial knowledge.

Among the other explanatory variables, higher age, higher levels of income, and higher levels of education are associated positively with perception biases in both day-to-day and overall financial knowledge. These results do not align with the theoretical expectations because individuals are expected to fairly estimate their financial knowledge as their metacognitive abilities improve with age, income, and higher education. Females tend to overestimate both their day-to-day and overall financial knowledge more than males. Married individuals tend to underestimate their day-to-day financial knowledge but overestimate their overall financial knowledge compared to those who are single. White individuals tend to underestimate their overall financial knowledge compared to non-white individuals. Individuals who are currently in the military tend to overestimate both their day-to-day and overall financial knowledge compared to those who have never been in the military.

Table 3 also shows that individuals who live in a state where a high school personal finance education course is required to be taken tend to overestimate both their day-to-day and overall financial knowledge compared to those who live in a state where a high school personal finance course is not required to be taken. This finding suggests that individuals, who live in a state where a high school personal finance course is required to be taken, have a higher perceived level of financial knowledge (both day-to-day and overall) compared to those, who live in a state where a high school personal finance course is not required to be taken, given the same level of actual financial knowledge (both day-to-day and overall).

Table 6: Relationships between the Perception Biases in Financial Knowledge and the Explanatory Variables: Mixed-effects Linear Regression Model with Variable Intercepts

Explanatory variables	(1) Perception bias in day-to-day financial knowledge	(2) Perception bias in overall financial knowledge
Perceived math ability (reference: level 1)		
level 2	0.164***	0.119***
	(0.045)	(0.045)
level 3	0.432***	0.190***
	(0.039)	(0.038)
level 4	0.454***	0.341***
	(0.032)	(0.031)
level 5	0.606***	0.396***

	(0.032)	(0.031)
level 6	0.769***	0.565***
	(0.030)	(0.030)
level 7	1.189***	0.890***
	(0.029)	(0.029)
don't know	0.366***	0.357***
	(0.133)	(0.130)
prefer not to say	0.416**	0.745***
	(0.182)	(0.179)
Financial education (reference: no program)		
did not participate	-0.003	0.083***
	(0.021)	(0.021)
did participate	0.005	0.162***
	(0.015)	(0.015)
don't know	0.005	-0.096***
	(0.017)	(0.017)
prefer not to say	0.025	0.149
	(0.098)	(0.096)
Risk-taking attitude (reference: level 1)		
level 2	-0.016	-0.039
	(0.026)	(0.025)
level 3	-0.097***	-0.060***
	(0.023)	(0.022)
level 4	-0.070***	0.041*
	(0.023)	(0.023)
level 5	-0.062***	0.075***
	(0.021)	(0.021)
level 6	-0.047**	0.175***
	(0.023)	(0.023)
level 7	-0.013	0.260***
	(0.023)	(0.022)
level 8	0.019	0.371***
	(0.026)	(0.025)
level 9	0.129***	0.612***
	(0.035)	(0.034)
level 10	0.278***	0.779***
	(0.029)	(0.029)
don't know	-0.030	0.086**
	(0.044)	(0.044)
prefer not to say	-0.082	0.277***
	(0.094)	(0.092)
Age (reference: 18 – 24)		
25 - 34	0.075***	0.080***
	(0.024)	(0.023)
35 - 44	0.085***	0.078***
	(0.024)	(0.024)
45 - 54	0.129***	0.096***
	(0.025)	(0.024)

55 - 64	0.281***	0.206***
	(0.025)	(0.025)
over 65	0.342***	0.308***
	(0.029)	(0.029)
Income (reference: less than 15k)		
15k - 25k	0.019	0.059**
	(0.025)	(0.024)
25k - 35k	0.053**	0.093***
	(0.025)	(0.025)
35k - 50k	0.107***	0.128***
	(0.025)	(0.024)
50k - 75k	0.129***	0.169***
	(0.024)	(0.024)
75k - 100k	0.182***	0.220***
	(0.027)	(0.026)
100k - 150k	0.186***	0.203***
	(0.028)	(0.027)
over 150k	0.273***	0.258***
	(0.033)	(0.032)
Work status (reference: retired)		
self employed	-0.097***	-0.083***
	(0.027)	(0.027)
full time	-0.106***	-0.111***
	(0.021)	(0.021)
part time	-0.101***	-0.125***
	(0.026)	(0.025)
homemaker	-0.078***	-0.108***
	(0.028)	(0.028)
student	-0.212***	-0.224***
	(0.039)	(0.039)
disabled	-0.167***	-0.165***
	(0.031)	(0.031)
unemployed/laid-off	-0.233***	-0.289***
	(0.033)	(0.033)
Marital status (reference: single)		
married	-0.024*	0.052***
	(0.014)	(0.014)
living w/ partner	-0.029	0.008
	(0.022)	(0.022)
Gender (reference: male)		
female	0.194***	0.042***
	(0.013)	(0.012)
Race (reference: non-white)		
white	0.005	-0.053***
	(0.013)	(0.013)
Education level (reference: no high school)		
high school (regular)	0.129***	0.143***

	(0.039)	(0.038)
high school (alternative)	0.132***	0.130***
	(0.042)	(0.041)
some college	0.053	0.063*
	(0.038)	(0.038)
associate degree	0.080**	0.042
	(0.041)	(0.040)
bachelor's degree	0.035	0.035
	(0.039)	(0.039)
postgraduate	0.003	0.015
	(0.041)	(0.040)
Military status (reference: never)		
currently a member	0.177***	0.453***
	(0.038)	(0.037)
previously a member	-0.013	0.004
	(0.019)	(0.019)
prefer not to say	-0.075	0.112**
	(0.049)	(0.048)
Required financial education (state level)	0.027**	0.036**
	(0.013)	(0.016)
Constant	-1.165***	-1.063***
	(0.054)	(0.054)
Observations	26,218	26,218
Number of groups	51	51
$\chi 2$	df (55) = 6221.40	df (55) = 7580.09

*Note: Values shown above are regression coefficients estimated from variable-intercept mixed-effects linear models. Standard errors are reported in parentheses below each coefficient. Significance levels are indicated as follows: ***p < 0.01, **p < 0.05, *p < 0.10. Data came from the 2018 State-by-State survey of the National Financial Capability Study (NFCS); national-level weights were applied to make the data nationally representative.*

Discussion of Results

The results of the mixed-effects regression models provide clear support for the hypothesized relationships between perceived ability in related domains and perception bias in financial knowledge. Consistent with Hypothesis 1, individuals with higher levels of perceived math ability exhibited greater perception bias in both day-to-day and overall financial knowledge. This pattern suggests that self-perceived competence in numeracy contributes to overestimation of financial literacy, which aligns with the metacognitive framework and Dunning-Kruger effect.

Similarly, results support Hypothesis 2: individuals who reported a greater willingness to take financial risks also tended to overestimate their financial knowledge. This association underscores the role of domain-adjacent self-perceptions in shaping financial confidence, regardless of actual ability.

Findings related to Hypothesis 3, however, were mixed. While financial education was positively associated with overestimation in overall financial knowledge, it did not significantly reduce perception bias in day-to-day financial knowledge. This result is counterintuitive, as financial education is generally expected to calibrate one's self-perceptions more accurately. One possible explanation is that exposure to financial education increases subjective confidence without proportionally improving actual knowledge or retention. Another explanation may be that the financial education programs surveyed—whether delivered in schools or workplaces—vary in depth, duration, and quality, thus affecting perceptions unevenly.

Beyond the primary hypotheses, several demographic patterns emerged. Older individuals, higher-income groups, and those with higher levels of education were more likely to overestimate their financial knowledge. This is somewhat surprising given that metacognitive ability and life experience might be expected to reduce bias. It is possible that higher-educated or higher-income individuals have more confidence in their decision-making abilities and financial control, even when not fully supported by objective measures.

Interestingly, individuals currently serving in the military showed strong overestimation tendencies. This may reflect institutional confidence-building or perceived self-sufficiency. White respondents, in contrast, were more likely to underestimate their overall financial knowledge than non-white respondents, raising questions about cultural variation in confidence reporting.

Finally, respondents who lived in states where personal finance education was a high school requirement also exhibited greater overestimation. This suggests that curriculum mandates alone may not be sufficient to reduce perception bias unless accompanied by robust assessments and personalized feedback mechanisms.

Limitations

This study has several limitations, primarily stemming from the structure of the dataset. First, the analysis is based on a cross-sectional survey, which limits the ability to draw causal inferences between variables. Future studies using longitudinal data would allow for stronger claims about directionality.

Second, many explanatory variables were categorical or binary in nature (e.g., income brackets, education levels), which may have limited the model's precision. Measuring these variables as continuous or ordinal with more granular intervals may provide deeper insights.

Third, the dataset lacked information on when respondents participated in financial education or how comprehensive the training was. Without such detail, we cannot assess the long-term retention of financial concepts or distinguish between superficial and in-depth education experiences.

Fourth, the survey did not ask whether respondents had access to informal financial learning—such as advice from family members—which may affect perceived and actual financial knowledge. Future work could include these social and contextual factors to account for potential spillover effects.

Finally, while surrogate residuals offer a statistically robust method for estimating perception bias in ordinal data, this technique may be unfamiliar to some readers. We have made efforts to clarify its application and interpretation, but future work might compare this method with alternative estimation approaches (e.g., latent difference scores or structural equation modeling) to validate robustness.

Implications for Financial Advisors, Educators, and Policymakers

Financial advisors face challenges in accurately assessing their clients' actual level of financial knowledge due to the perception bias identified in this study. Since perception bias itself is not directly measurable, financial advisors can use the correlates identified in this study to anticipate where miscalibration may be more likely. By considering factors such as age, race, gender, education, income, marital status, work status, perceived math ability, and risk-taking attitude, financial advisors can gain insights into their clients' likely perception bias in financial knowledge. Moreover, financial advisors have a crucial role in educating their clients about personal financial matters. It is essential for advisors to emphasize the importance of developing an accurate self-assessment of financial knowledge. Failure to address perception bias can inadvertently contribute to reinforcing clients' inaccurate beliefs about their financial knowledge. Therefore,

financial advisors should prioritize providing calibration-oriented guidance to help clients make informed decisions and mitigate perception bias in financial knowledge. In practice, this can include brief objective knowledge checks paired with client self-assessments during onboarding or periodic reviews to identify discrepancies between perceived and demonstrated understanding. Advisors can also use structured scenario analysis, probability-based risk illustrations, and reflective questioning (e.g., asking clients to estimate outcomes before reviewing projections) to help clients align confidence with knowledge. In this context, "unbiased guidance" involves not only neutral information delivery but also supporting more accurate self-assessment.

Educators, especially those involved in financial education at schools and workplaces, should reevaluate the effectiveness of current financial education programs in addressing perception bias in financial knowledge. The study's findings suggest that simply participating in financial education programs or requiring high school personal finance education courses may not be sufficient to eliminate perception bias. Mandated economics and personal finance coursework can improve objective and subjective financial knowledge, particularly among younger individuals (Quadria & Jahan, 2025). However, knowledge gains alone may not improve calibration, so programs should also target confidence accuracy. Educators should focus on developing programs that not only improve participants' level of financial knowledge but also help them develop accurate perceptions of their financial knowledge. This could involve incorporating activities that challenge participants' biases and providing feedback on their understanding of financial concepts. For example, educators can incorporate pre- and post-assessments in which students rate their confidence in their answers before receiving feedback, followed by brief reflection on mismatches. Experiential learning approaches, such as case-based financial planning assignments, simulations, or applied budgeting and investment scenarios, may further strengthen metacognitive awareness by requiring students to test assumptions in structured environments. Additionally, educators should consider the influence of age, race, gender, education, income, marital status, and work status on perception bias and tailor programs accordingly.

Policymakers have a role in shaping financial education requirements and initiatives at the state and national levels. The study's findings suggest that simply mandating high school personal finance education courses may not effectively address perception bias in financial knowledge. Policymakers should prioritize evidence-based evaluation on how financial education programs can effectively reduce perception bias in financial knowledge. This may involve evaluating existing programs, identifying best practices, and developing guidelines for designing more effective programs. Pairing curriculum mandates with assessment-based benchmarks that track both knowledge acquisition and confidence accuracy may also be considered. Standardized tools that measure discrepancies between subjective and objective knowledge can help monitor whether initiatives improve calibration, not just exposure. Policymakers should also consider the demographic factors that influence perception bias and ensure that financial education initiatives are inclusive and tailored to diverse populations.

Overall, collaboration between financial advisors, educators, and policymakers is essential to develop comprehensive strategies for addressing perception bias in financial knowledge and improving financial decision-making outcomes for individuals and communities. Future research can further explore how perception bias influences consumer behaviors and inform the development of targeted interventions and policies.

Conclusion

Perception bias in financial knowledge is widespread among American adults and varies systematically across demographic and psychological traits. This study contributes to the literature by providing a rigorous, statistically grounded measure of perception bias and identifying key predictors—including perceived

math ability, risk-taking attitude, and exposure to financial education.

The findings offer important implications for financial educators, policymakers, and advisors. Interventions aimed at improving financial literacy must not only transmit information but also help individuals calibrate their self-assessments. For example, incorporating feedback mechanisms or reflection tasks in financial education programs could help align perceived and actual knowledge. Similarly, financial advisors may need to screen for overconfidence before making investment recommendations or risk assessments.

Ultimately, this research highlights the importance of addressing not just financial knowledge deficits, but financial metacognition—how people evaluate what they know. Future research should investigate how perception bias in financial knowledge affects downstream behaviors such as saving, borrowing, or retirement planning. A better understanding of these cognitive gaps could lead to more tailored and effective financial capability interventions.

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Appendices

Appendix A-1: Control Variables

This study included the respondents' age, gender, race, income, work status, marital status, military status, and education level as the control variables at the individual level (i.e., level 1) in the second step of the two-step procedure. Age was measured as a categorical variable with six age ranges: 18–24, 25–34, 35–44, 45–54, 55–64, and 65 or more. The 18–24 age group was used as the reference group, and a dichotomous variable was included for each of the other five age groups. Female was included as a dichotomous variable that took a value of 1 if the respondent was female and 0 if the respondent was male. White was included as a dichotomous variable that took a value of 1 if the respondent was white and 0 if the respondent was non-white. Income was included as a categorical variable with eight ranges: less than $15,000; at least $15,000 but less than $25,000; at least $25,000 but less than $35,000; at least $35,000 but less than $50,000; at least $50,000 but less than $75,000; at least $75,000 but less than $100,000; at least $100,000 but less than $150,000; and $150,000 or more. Income less than $15,000 was used as the base category, and a dichotomous variable was included for each of the other seven income categories.

A dichotomous variable was included for each of the following seven categories of the respondents' work status: self-employed, work full-time for an employer, work part-time for an employer, homemaker, full-time student, unable to work, and unemployed or temporarily laid off; retired is used as the base category. Marital status was included as a dichotomous variable that took a value of 1 if the respondent was married or living with a partner, and 0 if the respondent was single. A dichotomous variable was included for each of the following two categories of the respondents' military status: previously in the military and currently in the military; never in the military was used as the base category. A dichotomous variable was included for each of the following five categories of the respondent's level of education: did not complete high school, high school graduate—regular or GED, some college (no degree), associate's degree, and bachelor's degree; postgraduate degree was used as the base category.

This study also included a dichotomous variable for required financial education as the explanatory variable at the state level (i.e., level 2) in the second step of the two-step procedure. The dichotomous variable for required financial education took a value of 1 if a high school personal finance education course was required to be taken in the state where the respondent was living. It took a value of 0 if a high school personal finance education course was not required to be taken in the state where the respondent was living. As of 2018, Alabama, Arizona, Arkansas, Florida, Georgia, Idaho, Michigan, Missouri, New Hampshire, New Jersey, New York, North Carolina, North Dakota, Tennessee, Texas, Utah, and Virginia were the states where a high school personal finance education course was required to be taken before high school graduation (Council for Economic Education, 2018).

Appendix A-2: Coding of the Control Variables

- **Age**: Categorical variable with six ranges: 18–24 (reference), 25–34, 35–44, 45–54, 55–64, and 65 or older.
- **Gender**: Binary variable coded as 1 = female, 0 = male.
- **Race**: Binary variable coded as 1 = white, 0 = non-white.
- **Income**: Categorical variable with eight ranges:
    - Less than $15,000 (reference)
    - $15,000–$24,999
    - $25,000–$34,999
    - $35,000–$49,999
    - $50,000–$74,999
    - $75,000–$99,999
    - $100,000–$149,999
    - $150,000 or more
- **Work Status**: Categorical variable with the following groups (reference = retired):
    - Self-employed
    - Work full-time
    - Work part-time
    - Homemaker
    - Full-time student
    - Unable to work
    - Unemployed or temporarily laid off
- **Marital Status**: Binary variable coded as 1 = married or living with a partner, 0 = single.
- **Military Status**: Binary indicators for “currently in the military” and “previously in the military,” with “never in the military” as the reference.
- **Education Level**: Categorical variable with the following levels (reference = postgraduate degree):
    - Did not complete high school
    - High school graduate (regular or GED)
    - Some college (no degree)
    - Associate’s degree
    - Bachelor’s degree