Gender differences in financial literacy: The role of stereotype threat

Gustav Tinghög [a,c,*], Ali Ahmed [a,e], Kinga Barrafrem [a], Thérèse Lind [a], Kenny Skagerlund [b], Daniel Västfjäll [b,d]

[a] *Department of Management and Engineering, Division of Economics, Linköping University, Linköping 58183, Sweden*
[b] *Department of Behavioral Sciences and Learning, Linköping University, Linköping 58183, Sweden*
[c] *The National Center for Priority Setting in Health Care, Department of Health, Medicine and Caring Sciences, Linköping University, Linköping 58183, Sweden*
[d] *Decision Research, Eugene, OR, United States*
[e] *The Ratio Institute, Box 3203, Stockholm 103 64, Sweden*

ARTICLE INFO

ABSTRACT

Understanding why women display less financial literacy than men is crucial for developing policies to reduce gender inequalities and improve women's financial behavior. In a series of studies, we investigate whether the observed gender gap in financial literacy can be identified in nonnumerical contexts, if it can be related to confidence in financial matters, and if it can be attributed to stereotype threat, which posits that inbuilt prejudices about gender and finance undermine performance among women in tasks involving finance. We utilized data from the Swedish Standardized Scholastic Aptitude Test ($n = 40{,}662$) to investigate if there is a greater difference in reading comprehension between men and women when reading about topics related to finance. Furthermore, we conducted large-scale online data collection ($n = 1989$), including a survey on financial vocabulary and an experiment that manipulated the salience of the financial content across conditions when assessing financial literacy. The results show that the observed gender gap in financial literacy is robust also in a nonnumerical financial contexts and that it can not be attributed to a difference in (displayed) confidence. Finally, mediation analysis showed a significant indirect effect of gender on financial literacy through financial anxiety suggesting that a stereotype threat for women in the financial domain contributes to the observed gender gap.

1. Introduction

A persistent gender gap, in which men do better than women, is usually observed in financial literacy across the world (Bucher-Koenen et al., 2017; Fonseca et al., 2012; Lind et al., 2020; Lusardi and Mitchell, 2008). This gender gap is puzzling, particularly in industrialized societies, where more women than men attend college and university (Wells et al., 2011). People with Higher levels of financial literacy commonly exhibit greater financial wealth (van Rooij et al., 2012), higher likelihood of participating in the stock market (Almenberg and Dreber, 2015; van Rooij et al., 2011), better provision for retirement (Lusardi and Mitchell, 2007), and less anxiety about financial matters (Lind et al., 2020). Hence, it is evident

---

* Corresponding author at: Department of Management and Engineering, Division of Economics, Linköping University, Linköping 58183, Sweden.
E-mail address: gustav.tinghog@liu.se (G. Tinghög).

that financial knowledge enables the individual to better navigate the complexities of modern financial life. Systematic differences between men and women in financial literacy therefore imply that women have poorer odds to prevail in the financial markets. It also means that, based on gender, the prerequisites for financial wellbeing are unequal. Understanding why and when this gender gap in financial literacy arises is therefore crucial for developing policies aimed at reducing gender inequalities and improving women's financial behavior.

Another commonly observed, and possibly related, difference between men and women is that men are more likely than women to be overconfident (Weinstein, 1980). This has been shown to be particularly true in the financial domain (e.g. Barber and Odean (2001), Camerer and Lovallo (1999)). As Deaux and Farris (1977), (p. 64) puts it: "Overall, men claim more ability than do women, but this difference emerges most strongly on masculine task[s]." Several studies have demonstrated that gender differences in confidence are greatest for tasks and situations that historically have been dominated by men and that are perceived as masculine (Beyer and Bowden, 1997; Deaux and Emswiller, 1974; Lenney, 1977). Although women are increasingly part of the banking and finance sector (von Hippel et al., 2015), finance is still largely regarded as a masculine domain and stereotypical beliefs about gender and finance have been shown to exist alrready in young children (Driva et al., 2016).

Closely linked to differences in men's and women's confidence is stereotype threat. This refers to the psychological predicament in which group stereotypes influence the way in which individuals evaluate themselves, which in turn may affect their performance of tasks that can substantiate those stereotypical beliefs. Stereotype threat (or its opposite, stereotype boost) is purportedly a long-standing contributor to both racial and gender gaps in academic performance (Spencer et al., 1999; Steele and Aronson, 1995; Steele et al., 2002). For women, stereotype threat has been closely linked to settings such as performance on math tests (Schmader, 2002; Spencer et al., 1999). A typical way to explore its role has been to prime subjects before taking a test by telling particpants that the test they are about to take has yielded gender differences in the past. Under these instructions, females perform worse compared to females in a control group who is not primed with information about gender differences (see e.g. Ambady et al. (2001), Keller (2002), Rydell et al. (2009))[1]. The impact of stereotype threat on women has been a major focus of diversity and equity programs designed to address gender imbalances in the recruitment and retention of women in science, technology, engineering, and mathematics (STEM). Less attention has, however, been devoted to stereotype threat in traditionally male-dominated non-STEM domains, such as finance.

In this paper, we examine whether the documented gender gap in financial literacy extends beyond settings that involve numeracy. Furthermore, we investigate if the gender gap in financial literacy can be attributed to stereotype threat and differences in confidence when it comes to financial issues. This paper consists of four complementary studies. In the first, we utilize real life data from the Swedish Standardized Scholastic Aptitude Test (sweSAT) on reading comprehension and explore whether or not the gender gap is present also for verbal understanding of financial matters. In the second, we examine whether a gender gap appears in a reading comprehension task, designed to test the comprehension of terminology from the financial domain. In the third, we conduct an online experiment in which we experimentally test if displayed confidence plays a role by removing the option to answer "do not know" from the standard financial literacy setup, and if removing the financial context but keeping the numerical content of the financial literacy tasks led to a decreased gender gap. Finally, study four further explores the role of stereotype threat as possible explanation for the gender gap in financial literacy by testing the mediating effect of financial anxiety between gender and financial literacy.

2. Study 1

If there is a stereotype threat in relation to the financial domain, we should expect to see a larger gender gap in finance-related tasks, simply by virtue of the financial content. The aim of Study 1 was to investigate if a gender gap in financial literary is present for verbal understanding of financial matters. Data from the Swedish Standardized Scholastic Aptitude Test (sweSAT) provided a unique opportunity to test this. In a reading comprehension designed to test only reading comprehension, not domain-specific knowledge, we can ascertain whether or not a gender gap is larger in financial than in nonfinancial settings. Hypotheses and main analysis were pre-registered: https://aspredicted.org/L62_7N9

2.1. Methods and data

We utilized data from the Swedish Standardized Scholastic Aptitude Test (sweSAT) that is administered twice a year. Taking the test is not mandatory but individuals considering applying to university or college can take the test to improve their chances of admission to their desired institution. To take the test, candidates have to pay a fee of SEK 450 (approximately USD 55). Consequently, people who take the test should be highly motivated to perform as well as possible. The test consists of five parts: mathematical comprehension, statistical comprehension, English reading comprehension, Swedish reading comprehension, and vocabulary.

In the reading comprehension part of the sweSAT, five texts from a range of disciplines (approximately 1000 words each) are presented to the participants. After each text, four multiple-choice comprehension questions follow. Participants have

---

[1] It is important to be mindfull that most studies accrue from the social priming literature which have been shown prone to publication bias and relying on small samples. More recent meta-analyses correcting for publication bias (Doyle & Voyer, 2016; Picho et al., 2013 and pre-registered experiments (Floret et al., 2018) have shown that the magnitude of the effect is likely to have been overstated in the literature.
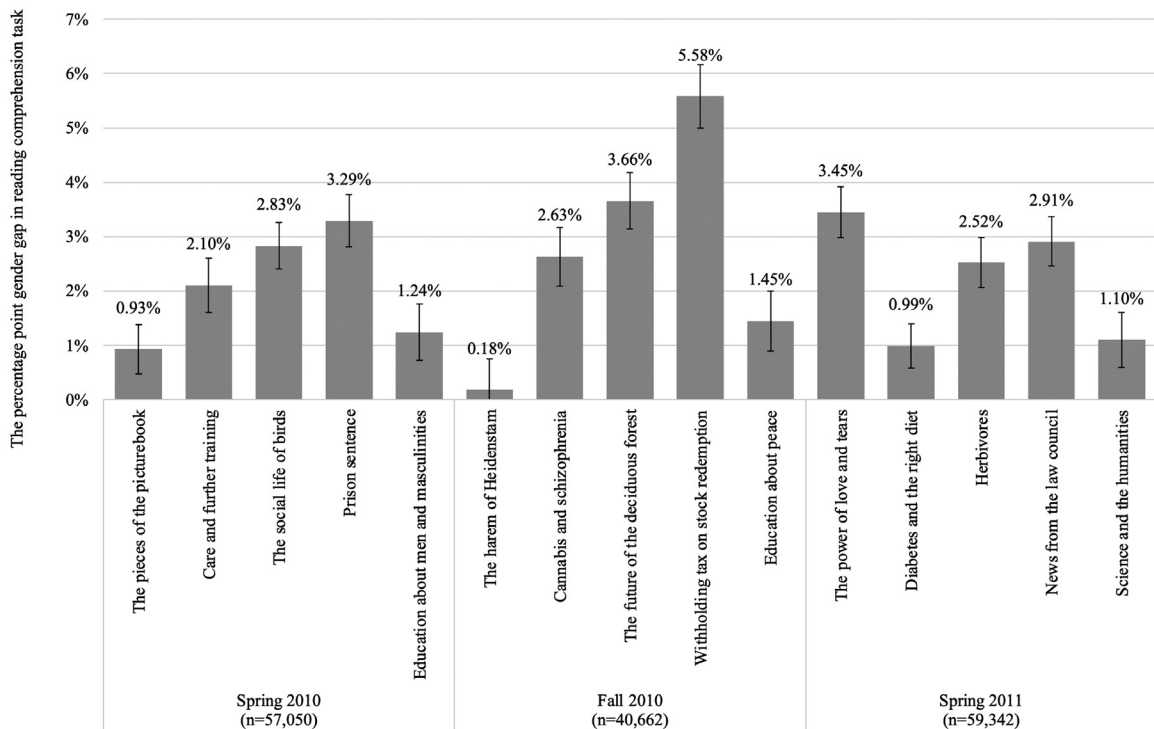
Fig. 1. Gender difference in percentage points for all reading comprehension texts, Note: The graph shows the percentage point difference between men and women in relation to the reading comprehension texts included in the sweSAT. The test always included five 1000-word texts whose titles are at the bottom of the graph. The percentage point differences are based on the answers to four reading comprehension questions that followed each text. As extra controls, the texts from the sweSAT given in the spring of 2010 and the spring of 2011 are included (the semester before and after the test that was administered in the fall of 2010). The first section considers the texts for the sweSAT in the fall of 2010, the second considers the texts for the sweSAT in the spring of 2010, and the last considers the texts for the in the sweSAT in the spring of 2011. Error bars show 95% confidence intervals.

50 min to complete the entire section and can decide for themselves how much or how little time to spend on each text. The reading comprehension part in sweSAT is designed to measure only reading comprehension, not content knowledge.

We used data from the test that was administered in the fall semester of 2010 since it included a reading comprehension text with a clear financial content. Its title was "Withholding tax on stock redemption." This text was about how much tax people should be allowed to deduct when stocks are redeemed or repurchased. Different rules applied, depending on where a person was taxable, and a discrepancy between Swedish and European law was identified. The text elaborated on this issue in relation to a court case pertaining to a French citizen who demanded repayment of the withholding tax. After reading the text, participants answered four questions. One question was: "Which of the following statements is in line with the text when it comes to the French citizen and the current court case? A. She was subject to limited tax liability; B. She was subject to unlimited tax liability; C. She had made a capital gain; D. She had made a capital loss." The task for each text had a maximum score of four points (one point for each correct answer).

The titles of the non-financial texts were "The harem of Heidenstam," "Cannabis and schizophrenia," "The future of the deciduous forest," and "Education about peace." Given that the reading comprehension part in sweSAT is designed to measure only reading comprehension, it served as a good test of the extent to which finance constitute a stereotype threat for women.

2.2. Results

In total 40,662 individuals took the sweSAT in the fall of 2010; 19,175 were men and 21,487 were women. Mean age was 22.21 (SD = 5.67). Fig. 1 shows the differences in correct answers for men and women for each reading comprehension task. As extra controls, the texts from the sweSAT given in the spring of 2010 and the spring of 2011 are included (the semester before and after the test that was administered in the fall of 2010). Men scored significantly higher than women in 14 out of 15 tasks (t-tests, all $p < 0.001$). The only text where men did not perform significantly better than women was the text "The harem of Heidenstam" ($p = 0.531$). The largest difference in reading comprehension between genders was for the text with financial content, "Withholding tax on stock redemption." In this task, the difference between men and women was almost 5.6 percentage points, at least 1.9 percentage points higher than in any of the reading comprehension tasks. A panel regression confirmed that this gender gap was significantly greater in the financial text than other texts in Fall 2010 (see

Table 1

Reading comprehension as a function of test takers' gender, age, and scores on statistical, numerical, word, and english comprehension.

	(1) Withholding tax on stock redemption	(2) The harem of Heidenstam	(3) Cannabis and schizophrenia	(4) The future of the deciduous forest	(5) Education about peace
Female	-0.054***	0.183***	0.108***	-0.015	0.104***
	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)
Age	0.009***	-0.009***	-0.007***	0.003***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Statistical comprehension score	0.635***	0.570***	0.760***	0.466***	0.489***
	(0.038)	(0.036)	(0.035)	(0.036)	(0.036)
Numerical comprehension score	0.294***	0.254***	0.521***	0.228***	0.274***
	(0.036)	(0.034)	(0.032)	(0.033)	(0.034)
Word comprehension score	1.297***	1.655***	1.037***	1.160***	1.364***
	(0.044)	(0.041)	(0.040)	(0.040)	(0.041)
English comprehension score	1.002***	1.349***	1.175***	0.790***	1.082***
	(0.037)	(0.035)	(0.034)	(0.034)	(0.035)
R^2	0.213	0.280	0.246	0.167	0.212
Number of observations	40,662	40,662	40,662	40,662	40,662

Note: All regressions are ordinary least squares over the text scores included in the sweSAT during the fall of 2010. Each specification corresponds to one of the texts included in sweSAT in the fall of 2010. The dependent variable is the score for each of the included reading comprehension texts. The score can be between 0 (no correct answers) and 4 (all questions correctly answered). Statistical comprehension score, numerical comprehension score, word comprehension score and English comprehension score, all refer to the scores on the other part of the test and were normalized to take value between 0 and 1.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table S1 in the Supplementary Material). This suggests that finance as a topic might intimidate women more than men, whether it contains numerical information or not.

Table 1 shows the results of the regression analyzes. Model 1 presents the results for the finance-related text. The estimated coefficient for female is negative and statistically significant. This result holds also when controlling for how participants scored in the other parts of sweSAT. Models 2–5 show the results for the non-financial texts, which serve as natural controls to the finance-related text. The estimates for female are positive in three cases and not statistically significant different from zero in the forth. Thus the effect of gender on reading comprehension is different for the text on a financial topic compared to the texts covering nonfinancial topics.

2.3. Conclusion

The results show that when men and women read a text on a financial topic, there is a larger-than-average gender gap in reading comprehension. Since reading comprehension is supposed to test the ability to understand the general content of a text, the results show that the gender differences observed in financial literacy extends to nonnumerical financial contexts. Thus, it hints that there could be a stereotypical threat or difference in confidence related to the financial context that contributes to the gender gap in financial literacy.

3. Study 2

Standard measures of financial literacy are largely comprised within a numerical framework. Since stereotype beliefs is especially salient for women in the mathematical domain (Schmader, 2002; Spencer et al., 1999), separating the effects of understanding financial terms from the numerical nature of the standard financial literacy questions becomes difficult.[2] The aim of Study 2 was to develop and test a non-numerical word-comprehension, mirroring the financial concepts used involved in the numerical financial literacy test. If the gender gap in financial literacy is driven by the numeric information in the questions, we should not observe a gender differences. Hypotheses and main analysis were pre-registered: https://aspredicted.org/7SH_4V3.

3.1. Method and data

An online survey was conducted, using Amazon Mechanical Turk. Participants were paid US\$ 1.20 for completing the survey. 105 participants failed an included attention check and were therefore excluded from the analysis. The final sample consisted of 1989 participants, of whom 1054 were women and 935 were men. Participants' age ranged from 19 to 82 years

---

[2] An example of a standard financial literacy question is: Suppose you had \$100 in a savings account and the interest rate is 2% per year and you never withdraw money or interest payments. After one year, how much would you have in this account in total?
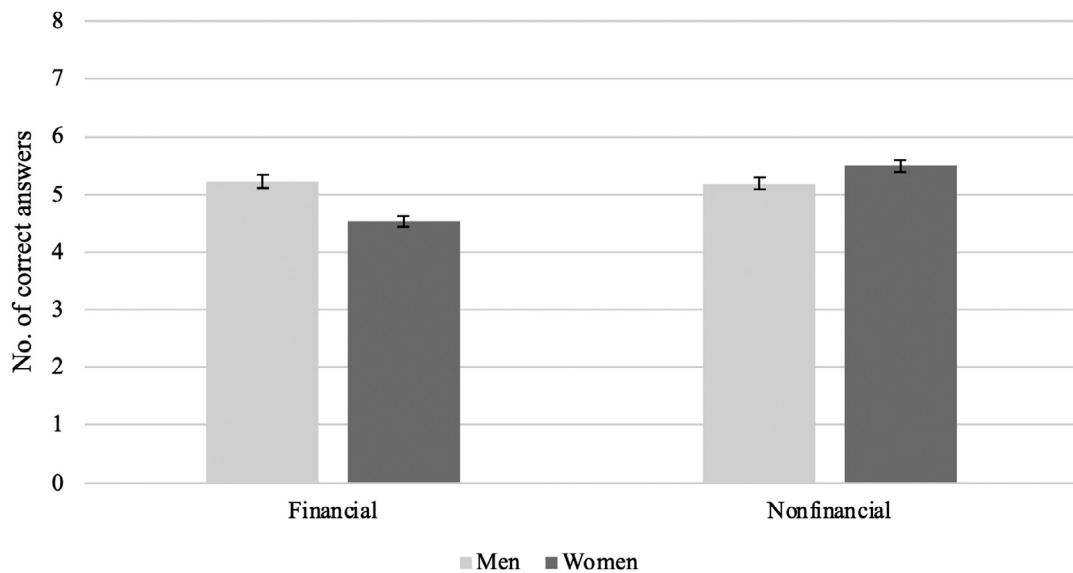
Fig. 2. Verbal comprehension score for financial and nonfinancial words separated by gender, Note: The score ranges from 0 to 8. Error bars show 95% confidence intervals.

($M = 39.3$, $SD = 11.97$). The median respondent belonged to the income category of US\$ 25,000–49,999 a year. More than 38% of the respondents reported having an associate's degree. The full distribution of the demographic variables can be found in the Supplementary Material, Table S1.

All participants answered 16 non-numerical multiple-choice comprehension questions. Eight questions concerned financial words and eight concerned non-financial words. The financial words were chosen to reflect financial concepts from standard financial literacy tasks (Fernandes et al., 2014; Lusardi and Mitchell, 2011). The nonfinancial words were picked at random from the vocabulary section of the sweSAT (Study 1). The structure of the questions were also similar to the setup in the sweSAT. The structure of all 16 questions was the same: A target word were accompanied by five alternative descriptions. The participants were instructed to choose the most accurate description.

For example, for the financial word "deflation", participants chose from the following descriptions: (a) Increase in exchange rate; (b) Fall in exchange rate; (c) Increase in price level; (d) Decrease in tax rate; and (e) Decrease in price level. Other financial words were "bond", "dividend", "diversification" "stock", "volatility", "mutual fund", and "leverage". An example of a nonfinancial word was "amnesty, with the following descriptions: (a) Pressure; (b) Defense; (c Suspension; D. Prohibition; and E. Pardon. Other nonfinancial terms were "anthropology", "to glorify" "crinoline" "aspartame" "culvert" "numnah" and "atrocious" The score for both the financial and nonfinancial words could range from a minimum of zero to a maximum of eight. Data and code are available at: https://osf.io/be8hp/.

3.2. Results

Fig. 2 presents the average score on the verbal comprehension task for men and women. Men performed significantly better than women on the financial words. The mean number of correct answers for men was 5.23, and for women 4.52. This difference is statistically significant, $t(1987)= 9.68$, $p < 0.001$. For the nonfinancial words, women outperformed men. The mean score for men was 5.19 and the mean score for women was 5.50. This difference is statistically significant, $t(1987)= -3.97$, $p < 0.001$.

Table 2 presents the regression results. Models 1-2 mirror what we see in Fig. 2. For the financial words, women underperformed men. All else equal, women scored 0.75 points below men. For the non-financial words, women performed significantly better; all else equal women scored 0.25 points higher than men. In Models 3-4 we examine the sensitivity of the results by estimating the probability of scoring 7-8 correct answers. Previous studies have made a distinction between "basic financial Literacy" and "advanced financial literacy", where one may be correlated with financial behavior while the other is not (e.g. Almenberg and Dreber (2015)). Hence, we created a dependent dummy variable which was equal to 1 if participants made none or only one mistake, 0 if they made more than one mistake. Model 3 shows that women were 15.8% points less likely than men to achieve at least seven correct answers. This is a substantial and statistically significant difference. For the nonfinancial words, the relationship is reversed, Model 4 shows that, compared to men, women were 12.5% points more likely to get a score of seven and above, all else equal.

Table 2

Participants' verbal comprehension score as a function of participants' gender and other demographics.

	(1) Financial terms - Score	(2) Nonfinancial terms - Score	(3) Financial terms – High score	(4) Nonfinancial terms – High score
Female	-0.749***	0.251***	-0.158***	0.125***
	(0.070)	(0.072)	(0.016)	(0.019)
Some college or trade/technical/vocational training	0.390***	0.330**	0.045*	0.038
	(0.135)	(0.147)	(0.024)	(0.034)
Associate degree or bachelor's degree	0.753***	0.564***	0.093***	0.093***
	(0.127)	(0.139)	(0.022)	(0.032)
Master's degree or higher	0.867***	0.617***	0.139***	0.101***
	(0.155)	(0.159)	(0.032)	(0.038)
Age	0.028***	0.044***	0.004***	0.009***
	(0.003)	(0.003)	(0.001)	(0.001)
Income $1–$9 999	0.369	0.119	-0.014	-0.046
	(0.296)	(0.353)	(0.069)	(0.079)
Income $10,000–$24,999	0.156	0.014	-0.003	0.066
	(0.285)	(0.341)	(0.067)	(0.075)
Income $25,000–$49,999	0.207	0.038	-0.000	-0.035
	(0.280)	(0.336)	(0.066)	(0.074)
Income $50,000–$74,999	0.240	0.044	-0.012	-0.035
	(0.280)	(0.338)	(0.067)	(0.075)
Income $75,000–$99,999	0.398	-0.065	0.044	-0.061
	(0.297)	(0.352)	(0.071)	(0.079)
Income $100,000–$149,999	0.594*	0.050	0.098	-0.077
	(0.307)	(0.356)	(0.077)	(0.084)
Income $150,000 and greater	0.629	0.260	0.154	-0.052
	(0.396)	(0.386)	(0.102)	(0.103)
R^2	0.131	0.141	0.087	0.112
Number of observations	1989	1989	1989	1989

Note: Regressions are ordinary least squares. The dependent variable in Models 1-2 is the verbal comprehension score ranging from 0 to 8. The dependent variable in Models 3-4 is a dummy equal to 1 if the score was larger or equal to 7, 0 otherwise. Corresponding marginal effects for female following a logistic regression yield effect sizes as in specification 3 and 4. All models include controls for educational attainment, age, income level and a dummy for what experimental condition participants were assigned to (not shown), these conditions are elaborated upon in greater detail in the methods section of Study 3. Robust standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

3.3. Conclusion

In a word comprehension task involving financial words, women performed significantly worse than men. This result strengthens and extends the findings from Study 1, by showing that the gender gap observed in financial literacy extends to another setting completely devoid of numerical exercises. However, from these studies alone we can still not draw firm conclusions about whether this gender gap is attributable to a difference in familiarity with and understanding of the financial terms or if it the effect can be explained in terms of the stereotype threat related to financial topics for women.

4. Study 3

The results of Study 1 and Study 2 showed that a gender gap in financial literacy is present in settings that are devoid of the numerical context, otherwise commonly intertwined with standard financial literacy questions. Hence, the numerical context can not alone explain the observed gender gap. If a stereotype threat is present when considering standard financial literacy questions the gender gap should reduce by changing the context of the standard financial literacy questions to a non-financial domain. To test this, we re-design the financial literacy test by removing the financial content, while keeping the numerical content the same, in a behavioral experiment. Likewise, some of the gender differences in the previous studies could potentially be attributed to lower familiarity with the financial terms among women. To test this, we experimentally test if including information that explain the meaning of the financial terms affect the gender gap. Furthermore, previous studies have found that women are more likely to choose the "do not know" alternative in the standard financial literacy questions (Lusardi, 2011; Mottola, 2013). This is an indication that women are less confident about their ability when it comes to financial literacy questions. Thus, the observed gender gap in financial literacy could potentially be explained by the fact that women to a greater extent answer "do not know" on the financial literacy questions. To test this possible explanation, we remove the possibility to answer do not know in one experimental condition. The aim of Study 3 was to manipulate all three aspects (i. exclude financial content ii. explain financial content iii. exclude "do not know" option)

in a behavioral experiment to explore if gender differences remain. Hypotheses and main analysis were pre-registered: https://aspredicted.org/7SH_4V3

4.1. Methods

An online experiment was conducted, using Amazon Mechanical Turk. The data used in this study was collected at the same time as Study 2 took place and with the same (1989) participants, 1054 of whom were women and 935 were men. Participants ranged in age from 19 to 82 years ($M = 39.3$, $SD = 11.97$).

Participants were randomly assigned to one out of four conditions: 1. Financial; 2. Nonfinancial; 3. Financial with explanations; and 4. Financial without the "do not know" response option. In the financial condition (baseline) participants responded to eight standard financial literacy questions that are widely used in the literature (Fernandes et al., 2014; Lusardi and Mitchell, 2011). For example: "Suppose you had $100 in a savings account and the interest rate is 20% per year and you never withdraw money or interest payments. After 5 years, how much would you have on this account in total?" Participants could respond: "more than $200", "exactly $200", "less than $200", or "do not know". In the nonfinancial condition, participants were asked similar questions but stripped from financial content. For example: "Suppose that there are 100 mice in a population. Every year the population grows with 20%. After 5 years, how many mice will there be if none of the mice die?" In the financial condition with explanation, the same statements and questions were used as in the baseline condition but an explanation to further clarify the financial terms in the statement was included. For example, diversification was explained as "a technique that reduces risk by allocating investments among various financial instruments, industries, and other categories. It aims to maximize return by investing in different areas that would each react differently to the same event". Finally, in the financial condition without "do not know" alternative the same statements and questions were used as in the two other financial conditions but the participant could not choose "do not know" as a response.

We also measured participants' numeric ability, which has been shown to be an important explanatory factor for financial literacy (Skagerlund et al., 2018). Numeric ability was measured using the Berlin Numeracy Test (Cokely et al., 2012) and three additional items from (Schwartz et al., 1997). Scores could range from 0 to 7. This allowed us to investigate whether the gender gap persists when the differences in numeric ability are accounted for.

Furthermore, at the end of the experiment we measured the participants attitudes toward finance by asking them to respond to nine statements about financial matters. Their answers, scored along a five-point Likert scale, ranged from "Do not at all reflect how you think or feel" to "Fully reflect how you think or feel". For example, two statements were: "Financial matters are interesting" and "Financial matters are an annoyance that I have to deal with". A mean score over the 9 items was calculated for each participant, where higher score indicated more positive attitudes. There was a significant difference between men's and women's attitudes. Men showed slightly more positive attitudes ($M = 3.38$, $SD = 0.84$) to finance than women ($M = 3.05$, $SD = 0.86$), $t(1987) = 8.53$, $p < 0.001$. As a final task participants were asked about their beliefs about gender differences in financial knowledge. For example, particpants responded to the question "At the beginning of the survey you answered eight multiple choice questions about financial concepts. For example, one of them read: Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy: (a) More than today with the money in this account; (b) Exactly the same as today with the money in this account; (c) Less than today with the money in this account; (d) Do not know. In relation to these questions, do you think that, on average (i) Men and women perform equally well; (ii) Men perform better than women; (iii) Women perform better than men. It was not possible for participants to go back in the survey and change their previous responses. Data and code are available at: https://osf.io/be8hp/

4.2. Results

Fig. 3 illustrates the mean financial literacy score for men and women in the four experimental conditions. Men outperformed women in all four conditions; the differences were statistically significant in all cases. The first pair of bars shows the result for the standard financial literacy questions, where men on average provided 6.29 correct answers and women 5.30 correct answers, $t(493) = 6.83$, $p < 0.001$. Thus, we confirm previous findings of a gender gap in financial literacy. The difference between genders remains similar in the nonfinancial condition: on average, men provided 4.80 and women 4.21 correct answers, $t(496) = 3.86$, $p < 0.001$. Explaining financial concepts in the financial literacy test increased the number of correct answers for both men and women: on average, men answered 6.28 and women 5.48 questions correctly, $t(496) = 5.17$, $p < 0.001$. Removing the "do not know" alternative increased the number of correct answers, with men scoring an average of 6.38 and women scoring an average of 5.48 correct answers, $t(496) = 6.79$, $p < 0.001$. Hence, the gender gap remains stable across all experimental conditions.

Table 3 shows the results of regression analyzes. Models 1–4 show how the financial literacy score was affected by participant's gender in different conditions while controlling for numeric ability, attitudes towards finance and stereotypical beliefs, education level, age, and income. Table 3 shows that the results in Fig. 4 hold for all four conditions, even with the inclusion of control variables. The coefficients for female participant are negative and statistically significant in all specifica-
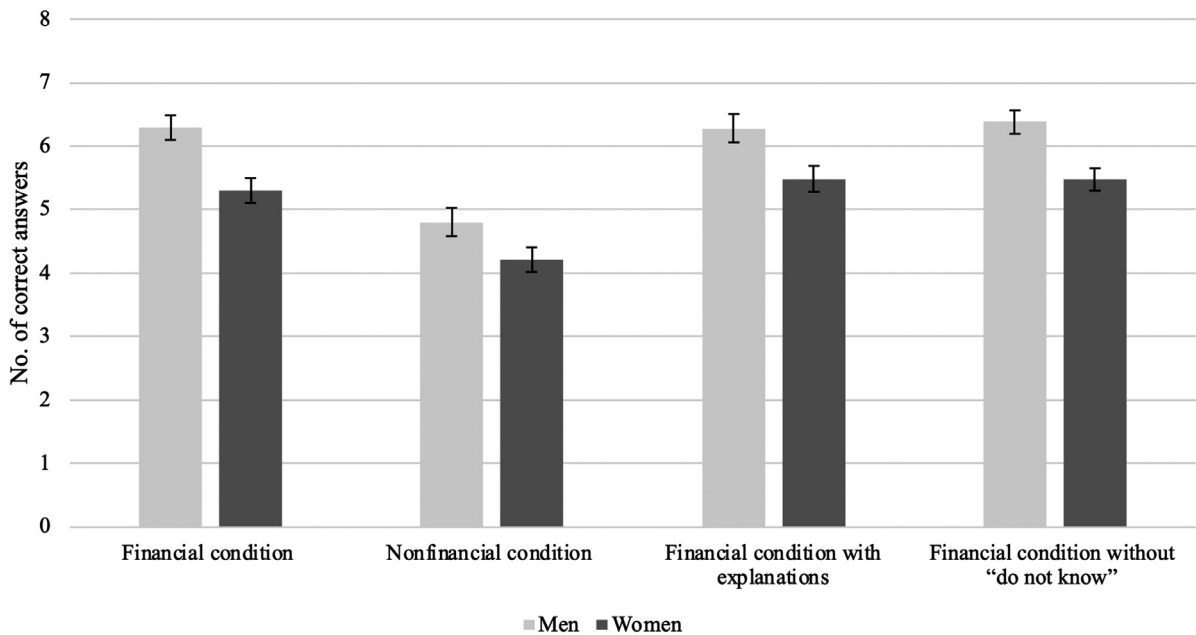
Fig. 3. Financial literacy score for men and women in the four experimental conditions, Note: The figure shows the mean financial literacy score for men and women across the four experimental conditions. The score ranges from 0 to 8. Error bars show 95% confidence intervals.

tions. The magnitude of the coefficient varies somewhat across the conditions. The largest effect is observed in the standard financial literacy condition. If a stereotype threat is present, the coefficient for female participant should be smaller in the second specification than in the first. A Z-test showed that the coefficients are different at 10% significance level, $z = $ -1.78, $p < 0.10$. Although the difference does not survive a 5% significance level it is still an indication that presence of a stereotype threat is likely to play a role. The coefficient for female participant in the third specification is not significantly different from the coefficient in the baseline condition ($z = $ -0.13, $p = 0.894$) indicating that including information that explained the financial concepts did not affect the gender gap. The last specification represents the condition in which the alternative to answer "do not know" has been removed. If the coefficient for female participant in the last specification is different from that in the first specification, then part of the observed gender gap in financial literacy could be attributed to differences in confidence between men and women in financial matters. However, a Z-test shows no significant difference between the coefficients for female participant in Models 1 and 4, $z = $ -0.66, $p = 0.507$.

The estimates of control variables in Table 3 show no surprises. Numeracy has a positive and statistically significant effect on the financial literacy score in all specifications. Thus we replicate the findings from previous studies in this area (Skagerlund et al., 2018). Moreover, a more positive attitude toward financial matters in general is associated with a higher financial literacy score in all specifications. Reported stereotypical beliefs about gender competence in financial literacy tasks are not associated with the financial literacy score in any specification.

4.3. Conclusion

The results of Study 3 provide further suggestive evidence in support for the hypothesis that stereotype threat contributes to the observed gender gap in financial literacy. We find no support for the hypothesis that confidence contributes to the observed gender gap since removing the "do not know" alternative did not affect the gender gap. Simlarly, including information that explicitly explained the financial concepts in the financial lieteracy test did not affect the gender gap.

5. Study 4

Study 1–3 have provided results suggesting that stereotypical threat related to financial matters among women contribute to the observed gender gap in financial literacy. To explore the effect stereotype threat more directly we utilized data from a previously conducted study (Skagerlund et al., 2018) that measured both financial anxiety and financial literacy and conducted a mediation analysis. Our hypothesis was that if stereotype threat is linked to why women attain lower financial literacy, we should observe an indirect effect of gender on financial literacy through financial anxiety.

Table 3
Participants' financial literacy score as a function of participants' gender, numeric ability and other traits.

	(1)Financial	(2)Nonfinancial	(3)Financial with explanations	(4)Financial without "do not know"
Female	-0.563***	-0.237*	-0.539***	-0.447***
	(0.121)	(0.138)	(0.133)	(0.126)
Numeracy	0.402***	0.463***	0.487***	0.359***
	(0.032)	(0.037)	(0.038)	(0.033)
Positive attitude towards finance	0.456***	0.231***	0.174**	0.221***
	(0.072)	(0.084)	(0.076)	(0.071)
Gender beliefs on financial literacy competence, Men>Women	0.103	-0.246	-0.084	-0.082
	(0.139)	(0.172)	(0.171)	(0.136)
Gender beliefs on financial literacy competence,Women>Men	0.201	-0.097	0.181	0.322
	(0.356)	(0.330)	(0.282)	(0.270)
Some college or trade/technical/vocational training	0.345*	0.343	0.058	0.393
	(0.205)	(0.255)	(0.240)	(0.249)
Associate degree or bachelor's degree	0.512***	0.467*	0.501**	0.355
	(0.190)	(0.242)	(0.215)	(0.236)
Master's degree or higher	0.469**	0.545**	0.507*	0.550**
	(0.230)	(0.277)	(0.263)	(0.272)
Age	0.029***	0.021***	0.032***	0.025***
	(0.005)	(0.006)	(0.005)	(0.004)
Income $1–$9999	0.556	0.312	0.037	1.299
	(0.474)	(0.382)	(0.609)	(1.032)
Income $10,000–$24,999	-0.145	0.227	-0.100	0.829
	(0.464)	(0.350)	(0.601)	(1.013)
Income $25,000–$49,999	-0.088	0.058	0.096	1.086
	(0.459)	(0.334)	(0.585)	(1.009)
Income $50,000–$74,999	0.019	0.319	-0.083	1.083
	(0.459)	(0.336)	(0.588)	(1.016)
Income $75,000–$99,999	-0.304	0.087	-0.081	0.878
	(0.493)	(0.364)	(0.610)	(1.030)
Income $100,000–$149,999	-0.073	0.407	0.488	0.909
	(0.505)	(0.416)	(0.660)	(1.048)
Income $150,000 and greater	-0.523	0.733	-0.248	1.153
	(0.562)	(0.715)	(0.635)	(1.032)
R^2	0.432	0.334	0.384	0.351
Number of observations	495	498	498	498

Note: All regressions were ordinary least squares. The dependent variable all specifications is the participants financial literacy score. The possible score ranges between 0 and 8, irrespectively of condition. In the Supplementary Material, corresponding regression but with standardized coefficients are available, see Table S3. Furthermore, in the Supplementary Material, a robustness check restricted to the sample who reported never to have seen the financial literacy questions before can be found in Table S4. Robust standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
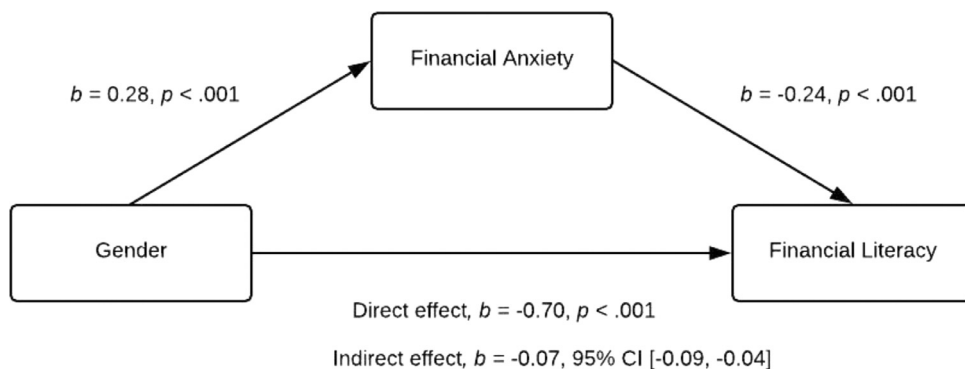
Fig. 4. Mediation model of gender, financial anxiety and financial literacy.

5.1. Method and data

An online survey was created and sent out to a representative sample of Swedish adults (N = 2063, 51% women and 49% men). The survey collected demographic information concerning age, education and income. The mean age in the sample was 49.15 years (SD = 16.10) and 28.4% of the sample had a bachelor's degree or higher. Self-reported monthly income, at the household level, showed that 15% below earned 15,000 SEK before tax and 14% reported having a monthly income exceeding 55,000 SEK.

To measure financial literacy, we used four knowledge-based questions. The questions are as follows: (1) "Suppose you had 100 SEK 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?", (2) "Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than, exactly the same as or less than today with the money in this account?", (3) "Buying a single company's stock usually provides a safer return than a stock mutual fund.", (4) "If interest rates rise, what will typically happen to bond prices?". The total number of correctly answered questions (0–4) was used as an index of financial literacy.

Financial anxiety was measured using a four-item questionnaire containing statements that the respondent had to indicate the degree to which they agree on a 5-point Likert scale. The financial anxiety scale (Fünfgeld and Wang, 2009; Strömbäck et al., 2020) contains four statements like "I am anxious about financial and money affairs" and "I get unsure by the lingo of financial experts". Respondents were asked to indicate to what extent they agree with the statements presented, with scale options ranging from 1 (not at all) to 5 (completely agree). The sum of the responses was used as an index of financial anxiety.

5.2. Results

As predicted, gender was related to financial anxiety (b = 0.28, $p < 0.001$), and financial anxiety was related to financial literacy irrespective of gender (b = -0.24, $p < 001$). Even though there is a significant direct effect of gender on financial anxiety (b = -0.70, $p < 0.001$) the mediation analysis also showed that gender influences financial literacy indirectly through financial anxiety. The mediation analysis used a percentile bootstrapped sample of 10,000 and showed a significant indirect effect of gender on financial literacy through financial anxiety, b = -0.07, 95% BCa CI [-0.09, -0.04].

5.3. Conclusion

By showing a significant indirect effect of gender on financial literacy through financial anxiety we show that the increased anxiety that women feel toward financial matters contributes to explain the gender gap in financial literacy. Still, the mediation analysis suggests that this indirect effect is small (b = -0.07) compared to the direct effect of gender (b = -0.70). So even though we have established a mechanism by which gender influence financial literacy (i.e., through financial anxiety as a result of stereotype threat), there are other "unexplained" mechanisms left to unveil (i.e., the direct effect of gender).

6. General discussion

In a world characterized with increasingly complex financial products and services, a basic understanding of financial concepts has become increasingly important. It is therefore troubling that a persistent gender gap in financial literacy is observed. Financial literacy has been linked to an array of sound financial practices and differences in this ability contribute to unequal opportunities for financial prosperity (see Lusardi and Mitchell (2014) for a review). The gender gap in financial literacy is also puzzling, particularly in more developed countries, were women often to a greater extent than men attend university or college and are well integrated into the banking and finance industry (von Hippel et al., 2015). In this paper we have investigated a series of underlying mechanisms that potentially could play a role in explaing some of the difference observed between men and women. We show that the gender gap observed in financial literacy extends to other financial settings that completely devoid of numerical exercises (Study 1-2). We find suggestive evidence that the gender gap is reduced when removing financial aspects of the financial literacy test (Study 3). Finally, we show that financial anxiety mediates the relation between gender and financial literacy. Altogether our cumulative results strongly indicate that a stereotype threat contributes to explain why women perform worse compared to men when it comes to financial literacy

Stereotype threat in the financial domain could affect the observed gender gap in financial literacy in different non-mutually exclusive ways. One possibility is that the gender gap due to stereotype threat arises short term through situational cues which inhibit women from performing at full cognitive capacity at the moment of conducting the financial literacy test. Another possible pathway is that a stereotype threat affects the educational and occupational choices that long term leads to the currently held stock of financial knowledge. Which pathway of stereotype threat that has the strongest influence in explaining the gender gap in financial literacy could be explored in future studies by also controlling for type of education and/or occupation.

Previous studies have shown that women are more likely than men to answer "do not know" to the standard financial literacy questions. By removing this response option, we tested the extent to which the observed gender gap could be at-

tributed to a difference in displayed confidence. This change in response structure yielded no significant effect on the on the gender gap in financial literacy. This null finding is in sharp contrast to a recent study by Bucher-Koenen et al. (2021) who found that removing the "do not know" response option reduced the gender gap in financial literacy with almost one-third. This discrepancy in results is difficult to understand. One possible explanation that partly could explain the discrepancy in results is that we had a lower frequency choosing the "do not know" response option. Moreover, Bucher-Koenen et al. (2021) conducted their survey with a representative sample of the Dutch speaking population, while we in this study surveyed a more homogonoes, incenticived M-turk sample. It would be instructive to re-investigate this type of change in task structure to further explore the role of confidence in understanding the gender gap in financial literacy across different samples.

Lastly, it is important to consider whether or not the gender gap in financial literacy is economically relevant. Does an average lower score matter in everyday economic life? A limitation of the study is that we cannot comment on the effect size in relation to actual financial outcomes, such as accumulated wealth and participation in the stock market. However, on its own, financial literacy has been shown to instill good financial practices and foster financial wellbeing. Considering the combination of other factors commonly observed to differ between men and women, such as risk-tolerance (Byrnes et al., 1999; Charness and Gneezy, 2012), willingness to compete in general (Niederle and Vesterlund, 2007) and in the labor market (Flory et al., 2015), the still-present gender wage gap (Blau and Kahn, 2017) and, a longer life expectancy for women (Rochelle et al., 2015) it is likely that the combined effect has a notable impact on financial life outcomes. Furthermore, theoretical work suggests that differences in financial literacy could account for a sizable proportion of wealth inequality (Lusardi et al., 2017).

Funding

Declaration of Competing Interest

Acknowledgment

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jebo.2021.10.015.

References

Almenberg, J., Dreber, A., 2015. Gender, stock market participation and financial literacy. Econ. Lett. 137, 140–142. doi:10.1016/j.econlet.2015.10.009.

Ambady, N., Shih, M., Kim, A., Pittinsky, T.L., 2001. Stereotype susceptibility in children: effects of identity activation on quantitative performance. Psychol. Sci. 12 (5), 385–390. doi:10.1111/1467-9280.00371.

Barber, B.M., Odean, T., 2001. Boys will be boys: gender, overconfidence, and common stock investment. Q. J. Econ. 116 (1), 261–292. doi:10.1162/003355301556400.

Beyer, S., Bowden, E.M., 1997. Gender differences in self-perceptions: convergent evidence from three measures of accuracy and bias. Personal. Soc. Psychol. Bull. 23 (2), 157–172. doi:10.1177/0146167297232005.

Blau, F.D., Kahn, L.M., 2017. The gender wage gap: extent, trends, and explanations. J. Econ. Lit. 55 (3), 789–865. doi:10.1257/jel.20160995.

Byrnes, J.P., Miller, D.C., Schafer, W.D., 1999. Gender differences in risk taking: a meta-analysis. Psychol. Bull. 125 (3), 367. doi:10.1037/0033-2909.125.3.367.

Bucher-Koenen, T., Alessie, R., Lusardi, A., van Rooij, M., 2021. Fearless Woman: Financial Literacy and Stock Market Participation. National Bureau of Economic Research (NBER) Working Paper 28723 http://www.nber.org/papers/w28723 .

Bucher-Koenen, T., Lusardi, A., Alessie, R., van Rooij, M., 2017. How financially literate are women? An overview and new insights. J. Consum. Aff. 51 (2), 255–283. doi:10.1111/joca.12121.

Camerer, C., Lovallo, D., 1999. Overconfidence and excess entry: an experimental approach. Am. Econ. Rev. 89 (1), 306–318. doi:10.1257/aer.89.1.306.

Charness, G., Gneezy, U., 2012. Strong evidence for gender differences in risk taking. J. Econ. Behav. Organ. 83 (1), 50–58. doi:10.1016/j.jebo.2011.06.007.

Cokely, E.T., Galesic, M., Schulz, E., Garcia-Retamero, R., Ghazal, S., 2012. Measuring risk literacy: the berlin numeracy test. Judgm. Decis. Mak. 7 (1), 25–47.

Deaux, K., Emswiller, T., 1974. Explanations of successful performance on sex-linked tasks: what is skill for the male is luck for the female. J. Pers. Soc. Psychol. 29 (1), 80–85. doi:10.1037/h0035733.

Deaux, K., Farris, E., 1977. Attributing causes for one's own performance: the effects of sex, norms, and outcome. J. Res. Pers. 11 (1), 59–72. doi:10.1016/0092-6566(77)90029-0.

Doyle, R.A., Voyer, D., 2016. Stereotype manipulation effects on math and spatial test performance: a meta-analysis. Learn. Individ. Differ. 47, 103–116. doi:10.1016/j.lindif.2015.12.018.

Driva, A., Lührmann, M., Winter, J., 2016. Gender differences and stereotypes in financial literacy: off to an early start. Econ. Lett. 146 (September), 143–146. doi:10.1016/j.econlet.2016.07.029.

Fernandes, D., Lynch, J.G., Netemeyer, R.G., 2014. Financial literacy, financial education, and downstream financial behaviors. Manag. Sci. 60 (8), 1861–1883. doi:10.1287/mnsc.2013.1849. http://mansci.journal.informs.org/content/by/year.

Flore, P., Mulder, J., Wicherts, J., 2018. The influence of gender stereotype threat on mathematics test scores of Dutch high school students: a registered report. Compr. Results Soc. Psychol. 3, 140–174. doi:10.1080/23743603.2018.1559647.

Flory, J.A., Leibbrandt, A., List, J.A., 2015. Do competitive workplaces deter female workers? A large-scale natural field experiment on job entry decisions. Rev. Econ. Stud. 82 (1), 122–155. doi:10.1093/restud/rdu030.

Fonseca, R., Mullen, K.J., Zamarro, G., Zissimopoulos, J., 2012. What explains the gender gap in financial literacy? The role of household decision making. J. Consum. Aff. 46 (1), 90–106. doi:10.1111/j.1745-6606.2011.01221.x.

Fünfgeld, B., Wang, M., 2009. Attitudes and behaviour in everyday finance: evidence from Switzerland. Int. J. Bank Mark. (2) 108. doi:10.1108/02652320910935607.

Keller, J., 2002. Blatant stereotype threat and women's math performance: self-handicapping as a strategic means to cope with obtrusive negative performance expectations. Sex Roles 47, 193–198. doi:10.1023/A:1021003307511.

Lenney, E., 1977. Women's self-confidence in achievement settings. Psychol. Bull. 84 (1), 1–13. doi:10.1037/0033-2909.84.1.1.

Lind, T., Ahmed, A., Skagerlund, K., Strömbäck, C., Västfjäll, D., Tinghög, G., 2020. Competence, confidence, and gender: the role of objective and subjective financial knowledge in household finance. J. Fam. Econ. Issues 41, 626–638. doi:10.1007/s10834-020-09678-9.

Lusardi, A., 2011. Americans' Financial Capability. National Bureau of Economic Research (NBER) Working Paper Series. Available at https://www.nber.org/papers/w17103 .

Lusardi, A., Michaud, P.C., Mitchell, O.S., 2017. Optimal financial knowledge and wealth inequality. J. Polit. Econ. 125 (2), 431–477. doi:10.1086/690950.

Lusardi, A., Mitchell, O.S., 2007. Financial literacy and retirement preparedness: evidence and implications for financial education. Bus. Econ. 42 (1), 35–44. doi:10.2145/20070104.

Lusardi, A., Mitchell, O.S., 2008. Planning and financial literacy: how do women fare? Am. Econ. Rev. 98 (2), 413–417. doi:10.1257/aer.98.2.413.

Lusardi, A., Mitchell, O.S., 2011. Financial literacy around the world: an overview. J. Pension Econ. Financ. 10 (4), 497–508. doi:10.1017/S1474747211000448.

Lusardi, A., Mitchell, O.S., 2014. The economic importance of financial literacy: theory and evidence. J. Econ. Lit. 52 (1), 5–44. doi:10.1257/jel.52.1.5.

Mottola, G.R., 2013. In our best interest: women, financial literacy, and credit card behavior. Numeracy 6 (2). doi:10.5038/1936-4660.6.2.4, Article 4.

Niederle, M., Vesterlund, L., 2007. Do women shy away from competition? Do men compete too much? Q. J. Econ. 122 (3), 1067–1101. doi:10.1162/qjec.122.3.1067.

Picho, K., Rodriguez, A., Finnie, L., 2013. Exploring the moderating role of context on the mathematics performance of females under stereotype threat: a meta-analysis. J. Soc. Psychol. 153 (3), 299–333. doi:10.1080/00224545.2012.737380.

Rochelle, T.L., Yeung, D.K.Y., Bond, M.H., Li, L.M.W., 2015. Predictors of the gender gap in life expectancy across 54 nations. Psychol. Health Med. 20 (2), 129–138. doi:10.1080/13548506.2014.936884.

Rydell, R.J., McConnell, A.R., Beilock, S.L., 2009. Multiple social identities and stereotype threat: imbalance, accessibility, and working memory. J. Pers. Soc. Psychol. 96 (5), 949–966. doi:10.1037/a0014846.

Schmader, T., 2002. Gender identification moderates stereotype threat effects on women's math performance. J. Exp. Soc. Psychol. 38 (2), 194–201. doi:10.1006/jesp.2001.1500.

Schwartz, L.M., Woloshin, S., Black, W.C., Welch, H.G., 1997. The role of numeracy in understanding the benefit of screening mammography. Ann. Intern. Med. 127 (11), 966–972. doi:10.7326/0003-4819-127-11-199712010-00003.

Skagerlund, K., Lind, T., Strömbäck, C., Tinghög, G., Västfjäll, D., 2018. Financial literacy and the role of numeracy-how individuals attitude and affinity with numbers influence financial literacy. J. Behav. Exp. Econ. 74 (June), 18–25. doi:10.1016/j.socec.2018.03.004.

Spencer, S.J., Steele, C.M., Quinn, D.M., 1999. Stereotype threat and women's math performance. J. Exp. Soc. Psychol. 35 (1), 4–28. doi:10.1006/jesp.1998.1373.

Steele, C.M., Aronson, J., 1995. Stereotype threat and the intellectual test performance of African Americans. J. Pers. Soc. Psychol. 69 (5), 797–811. doi:10.1037/0022-3514.69.5.797.

Steele, C.M., Spencer, S.J., Aronson, J., 2002. Contending with group image: the psychology of stereotype and social identity threat. Adv. Exp. Soc. Psychol. 34, 379–440. doi:10.1016/S0065-2601(02)80009-0.

Strömbäck, C., Skagerlund, K., Västfjäll, D., Tinghög, G., 2020. Subjective self-control but not objective measures of executive functions predicts financial behavior and well-being. J. Behav. Exp. Financ doi:10.1016/j.jbef.2020.100339.

van Rooij, M., Lusardi, A., Alessie, R., 2011. Financial literacy and stock market participation. J. Financ. Econ. 101 (2), 449–472. doi:10.1016/j.jfineco.2011.03.006.

van Rooij, M., Lusardi, A., Alessie, R., 2012. Financial literacy, retirement planning and household wealth. Econ. J. 122 (560), 449–478. doi:10.1111/j.1468-0297.2012.02501.x.

von Hippel, C., Sekaquaptewa, D., McFarlane, M., 2015. Stereotype threat among women in finance: negative effects on identity, workplace well-being, and recruiting. Psychol. Women Q. 39 (3), 405–414. doi:10.1177/0361684315574501.

Weinstein, N.D., 1980. Unrealistic optimism about future life events. J. Pers. Soc. Psychol. 39 (5), 806–820. doi:10.1037/0022-3514.39.5.806.

Wells, R.S., Seifert, T.A., Padgett, R.D., Park, S., Umbach, P., 2011. Why do more women than men want to earn a four-year degree? Exploring the effects of gender, social origin, and social capital on educational expectations. J. High. Educ. 82 (1), 1–32. doi:10.1080/00221546.2011.11779083.