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GENERAL & APPLIED ECONOMICS | RESEARCH ARTICLE

Gender differences in financial literacy among teenagers - Can confidence bridge the gap?

Justus Blaschke^{1*}

Abstract: This paper investigates the moderating effect of confidence on the gender gap in financial literacy based on a nationwide survey of German high school students. Two measures of confidence are applied while controlling for cognitive abilities and several independent variables. This study shows that confidence is indeed a strong force in bridging the gender gap, especially for everyday financial concepts. However, significant sex differences persist for more sophisticated financial literacy tasks when confidence variables are introduced in the regression models. Moreover, this paper indicates a significant confidence gap between male and female participants and finds that explanatory characteristics of confidence vary with gender as well. Expertise in the form of increased mathematical abilities and economic education is suggested as a promising confidence-building measure for women. The results suggest that differentiating financial literacy into basic and sophisticated literacy greatly increases interpretability when studying gender differences. Furthermore, the findings have important practical implications for understanding and, thus, closing the gender gap in financial literacy and highlight the political need for financial education in early stages of life that combines theoretical knowledge with confidence building measures.

Subjects: Economics; Finance; Higher Education

Keywords: Financial Literacy; gender differences; confidence; cognitive abilities; self-perceived financial literacy

JEL classification: D 14 (personal finance); G53 (financial literacy); I21 (analysis of education); J16 (Economics of Gender)

1. Introduction

The gender gap in financial literacy is a well-documented global phenomenon (for an overview, see, Lusardi & Mitchell, 2011; Hung et al., 2012 or Hasler & Lusardi, 2017). Despite enormous political relevance and a vast number of studies covering the topic, even now no exhaustive explanation can be given as to why women appear to be less financially literate compared to men. Financial literacy has an influence on various disciplines from everyday financial behavior to long-term decision-making like retirement planning (Allgood & Walstad, 2016; Bucher-Koenen et al., 2016). Individuals who lack sufficient financial knowledge are more likely to engage in costly, unsophisticated and potentially harmful behavior or abstain completely from financial matters such as stock market participation (Bucher-Koenen et al., 2016; Cole et al., 2011; Lusardi & Mitchell, 2011; Van Rooij et al., 2011). Thus, understanding—and thereby closing—the gender gap in financial literacy is of great importance for overall gender equality, especially given that individual responsibility for retirement savings is increasing.

The roots of the financial literacy gender gap are interesting, yet they remain largely undiscovered. Driva et al. (2016) and Erner et al. (2016), among others, show that when examining high school students, male teenagers appear to be significantly more knowledgeable about financial matters than female teenagers—even when controlling for numeracy skills, which are assumed to have a high influence on financial literacy. This observation is very important for the overall understanding because it means that, together with the numerous confirmations of the financial literacy gender gap in adults around the globe, gender discrepancies in financial literacy can be observed across all stages of life and around the world and must, therefore, be influenced by variables that are gender-specific and substantiated in personality (Grohmann et al., 2015).

This study contributes to the existing research by examining the influence of confidence on the gender gap in financial literacy of German high school students, in combination with a careful exploration of sex differences in confidence itself and a consideration of cognitive ability as an affecting characteristic. At present, no analyses of the influence of confidence on high school students' financial literacy have assessed confidence in the specific domain of financial literacy. Arellano et al. (2014) as well as Driva et al. (2016), who included a confidence variable while studying minors, made use of a Likert-scale question asking for general confidence rather than confidence in respondents' own financial literacy. With Beyer (1990) who laid the groundwork for the understanding of confidence as result of the gender-typedness of the task, and Bucher-Koenen et al. (2021) who included the assessment of confidence as a referenced part of the overall financial literacy elicitation—in contrast to handling it as an attachment—this study extends this train of thought to find an answer to the hypothesis that confidence has the power to close the gender gap in financial literacy.

By introducing two variables capturing domain-specific confidence while assessing financial literacy with the 13-item questionnaire of Lusardi and Mitchell (2017), I show that confidence is a moderating factor for the financial literacy gender gap among high school students. When introducing confidence as an explanatory variable, sex differences in basic financial literacy become insignificant, whereas differences in sophisticated financial literacy become smaller but remain significant. This finding extends the suggestion of Bucher-Koenen et al. (2021) that confidence is an important—but not the sole—source of the financial literacy gender gap, at least for more sophisticated aspects, by pointing out that differences in the domain of basic financial literacy can indeed be bridged through confidence-building interventions for women.

Further insights are revealed by inspecting the two confidence variables; one measures respondents' a priori confidence in their own financial literacy, and the other measures ex post confidence in relation to the own performance on the financial literacy scale. The results show that there is indeed a gender gap in confidence for the domain of financial literacy for both variables with additional evidence that the influencing characteristics of confidence are changing with the measure. It is particularly interesting that the ex post measure appears to be significantly influenced by cognitive abilities for both male and female students, whereas mathematical skills—which are generally perceived as male-typical—show a significant positive relation only for female participants. The a priori confidence measure does not appear to be significantly influenced by cognitive abilities or mathematical skills. The results show not only that both measures are influenced by different explanatory characteristics, but also that influencing factors vary with gender.

In a subsequent analysis of a subgroup, it shows that the influence of confidence disappears when long-term economic education is provided to participants. At higher levels of economic knowledge, no trace of a gender gap can be observed in basic financial literacy. The gender gap in sophisticated literacy persists; however, moderating effects of confidence are found to be small and insignificant, with gender as the only significant predictor of the sophisticated literacy score.

Overall, this study provides several additional building blocks to the existing literature. It highlights the importance of dividing financial literacy into basic and sophisticated skills in order to better

understand the gender gap. It also shows that confidence is immensely important. Moreover, it differentiates between two measures of confidence and their individual influencing characteristics while accounting for the results of different approaches to the gender gap research and applying them to the largely unexplored financial literacy gender gap among high school students.

The remainder is structured as follows. Section 2 comprises the literature, Section 3 lays out the methodology used to measure financial literacy and confidence, as well as an explanation of independent variables. Section 4 describes the sample. Section 5 contains the results of the analyses as well as robustness checks. Section 6 concludes.

2. Literature review

Prior explanatory attempts of the gender gap in financial literacy have concluded that socio-demographic characteristics such as age, education or income have a limited effect on sex differences (Fonseca et al., 2012; Preston & Wright, 2019). Thus, more recent research favors psychological traits as potentially highly influential factors on the knowledge differential. In particular, individuals' confidence in their own abilities is one of the most promising characteristics. Men do not only score higher in financial literacy assessment scales, but they also show structurally higher levels of self-perceived financial literacy (Aristei & Gallo, 2021; Bannier & Schwarz, 2018; Jha & Shayo, 2021). Although this may appear trivial at first, it may well be an important building block of the gender disparity in financial literacy; indeed, it appears that individuals' beliefs about their own literacy level are as important as their actual level of literacy, evincing a strong positive correlation between subjective and objective financial literacy (Anderson et al., 2017; Lusardi & Mitchell, 2017). Moreover, higher levels of confidence also imply more beneficial financial outcomes (Neymotin, 2010; Tang, 2021).

Beyer (1990) was among the first researchers to recognize that women have low expectations of themselves in tasks that are perceived as masculine. With the general view of finance as a math-heavy, male-dominated area, women's low self-evaluations are compatible with that explanation. Such low expectations for women not only lead to lower self-evaluations but may also cause biased results in actual knowledge evaluations due to lack of confidence (Beyer & Bowden, 1997). Bordalo et al. (2019) investigated how gender stereotypes impact confidence in abilities of different areas. They found that stereotypes lead to an increase of gender performance gaps that is driven by much lower confidence levels among women. This finding can also be observed in the formation of the gender gap in financial literacy (Driva et al., 2016). Therefore, sex differences in financial literacy may be driven by a confidence gap (Bucher-Koenen et al., 2017).

Baldiga (2014) finds that women are far more likely to skip questions when there is an option to do so; this has significant negative impacts on test scores. It is also evident that, compared to men, women answer financial literacy questions more often with "*I don't know*" (Lusardi & Mitchell, 2011, 2014). Bucher-Koenen et al. (2016) show that when the "*I don't know*" option is taken away, the gender gap in financial literacy diminishes significantly. This may lead to a larger measurement error but nevertheless, when forced to be more confident, women show that they know more than they think they know.

As a continuation of these studies, Bucher-Koenen et al. (2021) asked participants to answer financial literacy questions two times, six weeks apart. The first time, there was an "*I don't know*" option, and the second time, there was not—instead, every question was accompanied by a follow-up question asking participants to report their confidence level. They found that about one-third of the gender gap in financial literacy can be explained by lower confidence levels among women; however, their results may have been biased by learning effects. Fonseca and Lord (2019) suggest a roughly equivalent level of influence for confidence on financial literacy.

Especially interesting is that the gender gap in financial literacy is found to be smaller or even insignificant in formerly communist countries where man and woman were societal more equal or

in samples where divorced or widowed women are analyzed suggesting that gender-based self-evaluations are very important in determining financial literacy (Bucher-Koenen et al., 2017; Greimel-Fuhrmann & Silgoner, 2018).

Cognitive abilities are an important predictor of both financial literacy and confidence. People with higher cognition scores tend to make better financial decisions and show higher levels of financial literacy (Tang, 2021). This appears to hold as well for the younger population (Lusardi et al., 2010), which is relevant to this study of high school students. Cognitive abilities in the context of financial literacy are measured in various non-standardized ways. One standardized way of measuring cognitive abilities is the cognitive reflection test (CRT) introduced by Frederick (2005). Besides the potential flaw that cognitive abilities may overlap with numeracy skills which complicates the isolated examination, the CRT appears to be a significant predictor of financial literacy and is strongly correlated with cognitive abilities (Skagerlund et al., 2018; Toplak et al., 2011). Furthermore, in addition to the positive influence, there is another link between the CRT results and financial literacy—namely, an unexplained gender gap. As in financial literacy, women show significantly lower cognitive reflection scores than men (Brañas-Garza et al., 2019). Zhang et al. (2016) show that confidence in quantitative abilities is an important characteristic in narrowing sex differences on the CRT. To the best of my knowledge, no research has investigated the influence of cognitive abilities on the confidence gap in financial literacy.

Prior studies of financial literacy and the gender gap have used very different approaches and methods. One of the most common measures of objective financial literacy is the so-called “big three” question scale designed by Lusardi and Mitchell for the 2004 US Health and Retirement Study (Lusardi & Mitchell, 2011). The three-question scale consists of multiple-choice items identifying respondents’ understanding of interest, inflation and risk diversification, and it has been used extensively due to its ease of use and global applicability. Despite their uncontested importance, it is doubted that three questions are able to grasp the whole complex domain of financial literacy (Allgood & Walstad, 2013; Huston, 2010). The more recent 13-item questionnaire designed by Lusardi and Mitchell (2017),¹ which distinguishes between basic financial literacy and sophisticated literacy, constitutes an advancement. It allows for an isolated investigation of both domains which are found to describe distinct dimensions of financial literacy (Erner et al., 2016). Especially interesting is the finding that there are different effects influencing the gender gap in each respective dimension (Almenberg & Dreber, 2015). Both dimensions appear to be influenced by distinctive variables, and both capture different financial behaviors. However, the gender gap in financial literacy persists even when examining basic and sophisticated literacy separately (Hung et al., 2009). An alternative survey that is also widely applied in the financial literacy research is the OECD/INFE toolkit. The OECD/INFE toolkit is more comprehensive compared to the 13-item scale but more suited for the application on adults.

The overall financial literacy in Germany appears according to Bucher-Koenen and Lusardi (2011) and Schuhen et al. (2022) to be moderate with deficits even in basic financial concepts like knowledge about inflation or debt, although comparable with other developed countries like the US (Lusardi & Mitchell, 2011). Erner et al. (2016) show that the performance of German high school students in the 13-item financial literacy scale is comparable to them of adults emphasizing the importance of financial education in early stages of life while Frühauf and Retzmann (2016) state that besides small sporadic projects there is no structural education in financial literacy in German schools. The overall status of curricular financial education is moreover hard to assess due to the federalism in the German school system.

3. Methods

3.1. The applied financial literacy measure

As mentioned in Section 1, the 13-item financial literacy questionnaire designed by Lusardi and Mitchell (2017) is applied. The questionnaire contains five questions referring to basic literacy skills, assessing knowledge in the following areas: *numeracy, compound interest, inflation,*

money illusion/inflation, and time value of money. The items in the sophisticated literacy domain cover the following topics: *knowledge of mutual funds, stock market functioning, riskiness of stocks compared to mutual funds, interest rate/bond price link, long period returns, riskiness of stocks compared to bonds, highest fluctuation/volatility, and risk diversification*. Unlike Erner et al. (2016), the option to choose “I don’t know” is included, acknowledging that female participants are more likely to choose that option—with the result that the omission may lead to a partial exclusion of confidence as a deciding factor and thus improve the results of female students (Bucher-Koenen et al., 2016). However, due to the items’ limited number of answer possibilities, and especially the difficulty of the sophisticated literacy questions, the probability of large measurement errors due to guessing would be too high. Random-answer replacement was used to further curb measurement error and to increase overall validity. The final literacy scores were determined by counting the number of correct responses, as prior applications of the scale have done.

3.2. Design of the confidence variables

The first confidence variable measures a priori confidence in line with existing publications such as Asaad (2015) or Lusardi and Mitchell (2017) by simply asking for respondents’ perceived level of financial knowledge before moving on to the test questions. Unlike the existing applications of the scale, the Likert-scale answer options are replaced with options taken from grading scales familiar to the participating students in order to increase the comprehension and meaningfulness of the confidence self-evaluation. Answer possibilities range from *very good knowledge* (grade = 1) to *no knowledge at all* (grade = 6).² The second variable is an ex post measure inspired by Beyer (1990), which asks participants immediately after completing the scale to state the number of questions that they are confident to have answered correctly.

3.3. Covariates

Control variables include the participants’ cognitive abilities as measured by applying the three CRT questions of

Frederick (2005). A variable capturing the association with risk is taken from the widely applied risk tolerance elicitation scale of Grable and Lytton (1999). The level of integration is determined by asking whether the participants’ parents were born in Germany or in a foreign country. The assessment of household income is adapted from Erner et al. (2016), who asked participants whether they lived in a rented or an owned apartment/house. Participants are asked to indicate their gender as well as their age. Two additional variables, which concern participants’ actual experiences with monetary matters represented by an inquire about saving behavior and whether a part-time job is held are retrieved. Finally, the questionnaire captured participants’ social activities (represented by membership in extracurricular clubs), grades in the three main high school subjects (German, English and mathematics), and the type of high school attended as Erner et al. (2016) found the school type to be a significant predictor of financial literacy with lower scores for students from the *Hauptschule* compared to students from the *Realschule* and *Gymnasium*.³

3.4. Multicollinearity

Intercorrelations among independent variables may be an issue, especially due to the inclusion of two variables measuring participants’ confidence in their own financial literacy.

Besides the fact that both confidence measuring variables appear to remain significant in regressions where both variables are included, and in addition to the observation that either variable has alternating explanatory characteristics, an investigation of the variable inflation factors (VIF) demonstrates that all values range between 1.087 and 4.027, which suggests the absence of multicollinearity according to Hair et al. (2010).

4. Data and summary statistics

4.1. Data

The data was gathered during a six-month survey period between January 2021 and July 2021. At first, formal applications have been submitted to the ministry of education in every respective German state. Following the official approval by the state authorities a number of secondary schools were randomly chosen from all secondary schools in the state and asked to participate in the study. In total, 982 final-year high school students in eleven German states (*Baden-Württemberg, Bavaria, Brandenburg, Bremen, Hesse, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatine, Saxony-Anhalt, Schleswig-Holstein and Thuringia*) participated. Participants were recruited from all three main secondary school types: *Hauptschule, Realschule*, and *Gymnasium*. Additionally, a subgroup of students from the economic focused *Fachoberschule* was gathered and will be discussed later on.

The online-based survey consisted of the 13-item financial literacy questionnaire, the three CRT questions, and the aforementioned sociodemographic characteristics. Only final-year students were recruited through their high schools to enable an accurate comparison between school types. The survey contained strict instructions regarding its execution and was at no point accessible to the external world outside the participating students. Due to the Covid-19 pandemic and partial school closures, it is probable that some participants completed the questionnaire at home rather than at their high school. To curb possible misuses of the online questionnaire, a general time limit was imposed, and teachers were asked to let their students complete the questionnaire during supervised lessons. The time stamps of the observations are largely clustered, suggesting that these requirements were met. Of the 982 total participants 302 observations had missing values and were therefore excluded to don't distort the relatively small sample. The final data set consists of 609 observations for the three major secondary school types and 71 observations for the *Fachoberschule* subgroup.

The representativeness of the study is difficult to assess due to the increasing number of students who attend high schools that offer all three degree types. When assuming that the distribution of degrees at the multi-type schools is comparable to the distribution of single-type schools, the data set appears to be quite comparable. According to adjusted data of the Bundesministerium für Bildung und Forschung (BMBF (2019)) 14% of German high school students pursue a degree from a *Hauptschule*, 28% from *Realschule* and 58% from *Gymnasium*, compared to 13% ($n = 79$), 34% ($n = 207$) and 53% ($n = 323$), respectively, in the collected data. Meaningful small deviations can be observed only for *Realschule* und *Gymnasium*; their effects on the overall informative value are likely negligible.

4.2. Summary statistics

Summary statistics of confidence variables, literacy scores and independent variables are shown in Table 1. The first notable observation is that both variables measuring confidence show a significant confidence gap between female and male participants. Females' mean a priori confidence is 12% lower than that of males (3.05 vs 3.45), whereas the mean ex post confidence difference (6.10 vs. 7.93) is even larger with a 30% gender gap. Standard deviations are nearly equal for both genders, suggesting comparable distributions. Therefore, females start with lower levels of confidence, and self-evaluations of their own financial literacy decrease even further and to a larger extent over the course of the questionnaire compared to males' self-evaluations.

In conjunction to this is the accuracy of the self-evaluations, which is calculated by subtracting the actual results from the ex post self-assessment. Both females (−1.22) and males (−0.53) show negative mean values of accuracy; this means that, on average, both genders show underconfident self-assessments of their overall financial literacy scores. Although an underestimation was well expected for females, it was surprising to find the same tendency—albeit of a lesser magnitude—among males. This contradicts the findings of Beyer (1990), Dahlbom et al. (2011), and

Table 1. Summary statistics

	Female (n = 313)		Male (n = 296)	
	Mean	SD	Mean	SD
Confidence Variables				
A priori confidence	3.05***	0.74	3.45	0.75
Ex post confidence	6.10***	3.03	7.93	3.04
Literacy Variables				
Basic literacy score	3.17**	1.35	3.52	1.39
Sophisticated literacy score	4.13***	1.90	4.95	1.78
Total literacy score	7.03***	2.84	8.47	2.78
Accuracy	-1.22**	2.68	-0.53	3.00
Nr. IDK	1.82***	2.25	1.03	1.65
Independent Variables				
Cognitive abilities	1.34*	1.08	1.55	1.15
Under 16 years	0.31		0.31	
Risk association	0.73***		0.50	

(Continued)

Table1. (Continued)

		Female (n = 313)		Male (n = 296)	
		Mean	SD	Mean	SD
Side job	Dummy variable (1 = job, 0 = no job)	0.38		0.41	
Saving	Dummy variable (1 = saving, 0 = no saving)	0.83		0.84	
Household income	Dummy variable (1 = own real estate, 0 = rent)	0.71		0.71	
Integration (parents' birthplace)	Dummy variable (1 = Germany, 0 = elsewhere)	0.80		0.77	
Club membership	Dummy variable (1 = membership, 0 = no membership)	0.59		0.62	
Mathematics grade	Grade in math from the last report card (1 = fail, 6 = excellent)	4.39	1.18	4.42	1.13
German grade	Grade in German from the last report card (1 = fail, 6 = excellent)	4.73***	0.91	4.23	0.98
English grade	Grade in English from the last report card (1 = fail, 6 = excellent)	4.73***	1.02	4.38	1.03
Gymnasium	Attended high school type (1 = Gymnasium, 0 = other)	0.58*		0.48	
Realschule	Attended high school type (1 = Realschule, 0 = other)	0.32		0.36	
Hauptschule	Attended high school type (1 = Hauptschule, 0 = other)	0.10*		0.16	

Note: The order of the grade variables was subsequently reversed to enable a straightforward interpretation of the results. Differences in means were assessed with Welch's unpaired t-test for all but the dichotomous variables where Fisher's exact test was applied. *** p < 0.001, ** p < 0.01, * p < 0.05.

Jakobsson et al. (2013), who suggest that male participants are, on average, overestimating their abilities on math-related tests. This, in combination with the absence of significant differences in mathematical grades, descriptively confirms that different numerical abilities indeed may not be a major driver of the gender gap.

Mean differences are highly significant for both basic (3.17 vs. 3.52) and sophisticated financial literacy (4.13 vs. 4.95); this was expected and is in line with the findings of Barboza et al. (2016). It is observable that the gender gap widens as the financial literacy questions grow more challenging. In line with the aforementioned confidence gap suggestion, females' total literacy scores are about 20% lower compared to those of males', whereas the ex post confidence variable measuring the number of items answered confidently correct is as much as 30% lower. Another variable that meets expectations for the examination of adults is the significantly higher number of "I don't know" responses among females (1.82 vs. 1.03), thus strengthening the validity of the data set through comparable implications with prior examinations.

Cognitive abilities are interesting in two ways. First, there is an observable and significant gender gap (1.34 vs. 1.55); second, the sex differences are of a much lesser magnitude compared to differences found by Frederick (2005) (1.03 vs. 1.47). Although further investigations in the context of high school students may therefore be promising, it is not within the scope of this study.

Among the other independent variables, only the association with risk and grades in English and German were found to have significant differences in means with better academic performances of females and higher fractions of associating risk as a chance. The average difference in risk association (0.73 vs 0.50) are particularly interesting because females associate risk to a significantly higher fraction with chances compared to males, which contradicts previous findings such as those of Gibson et al. (2013). These findings were substantiated by an additional inspection of median values.

The most prominent answer among females on the question asking for their association with risk is "opportunity," whereas males' most common response is "uncertainty".⁴ Although this deviation is interesting, little weight is given to it, as only one risk item was used compared to several items in typical risk-measuring surveys and prior publications like Greimel-Fuhrmann and Silgoner (2018) show that when risk is measured in a investing context results appear as expected with higher risk tolerance levels of man.

5. Results

5.1. The role of confidence in bridging the gender gap in financial literacy

In line with prior research methods (for an overview, see, Fernandes et al., 2014), multivariate ordinary least squares (OLS) regression analysis is applied to examine the influence of confidence on the financial literacy gender gap while controlling for a number of independent variables. In the multilevel regression procedure, it is first determined whether there is any significant gender influence on basic and sophisticated literacy while including control variables. In subsequent steps, the confidence variables will be added until the regression resamples Equation (1):

$$Y_{i,d} = \beta_0 + \beta_1 FEM_i + \beta_2 APConf_i + \beta_3 EPConf_i + \beta_4 IV_i + \varepsilon_i, \quad (1)$$

where $Y_{i,d}$ is the financial literacy score depending on the basic or sophisticated literacy dimension. FEM_i indicates whether the participant is a female or a male; $APConf_i$ and $EPConf_i$ represent the a priori self-stated financial literacy and the ex-post confidence self-assessment, and IV_i embodies the set of independent variables introduced in Section 3.2.

Table 2. Influence of confidence in explaining the gender gap in basic literacy

	Basic Literacy			
	(1)	(2)	(3)	(4)
A priori confidence		0.269*** (4.234)		0.140* (2.101)
Ex post confidence			0.366*** (6.492)	0.320*** (5.297)
Female	-0.357*** (-3.561)	-0.263** (-2.588)	-0.192 (-1.918)	-0.164 (-1.623)
Cognitive abilities	0.414*** (8.841)	0.405*** (8.754)	0.367*** (7.987)	0.368*** (8.034)
Under 16 years	-0.233* (-2.013)	-0.229* (-2.010)	-0.206 (-1.843)	-0.208 (-1.854)
Risk association	-0.011 (-0.213)	0.025 (0.494)	-0.007 (0.152)	-0.004 (-0.040)
Side job	-0.038 (-0.386)	-0.026 (-0.275)	-0.037 (-0.388)	-0.031 (-0.328)
Saving	0.265* (2.068)	0.221 (1.740)	0.201 (1.613)	0.186 (1.494)
Household income	0.167 (1.490)	0.149 (1.352)	0.124 (1.143)	0.120 (1.112)
Integration	0.256* (2.055)	0.273* (2.225)	0.252* (2.097)	0.262* (2.181)
Club membership	-0.099 (-0.970)	-0.140 (-1.387)	-0.146 (-1.471)	-0.161 (-1.629)
Mathematics grade	0.110* (2.428)	0.099* (2.220)	0.083 (1.901)	0.081 (1.855)
German grade	0.052 (0.907)	0.047 (0.838)	0.036 (0.646)	0.036 (0.641)
English grade	0.028 (0.532)	0.006 (0.111)	0.039 (0.771)	0.026 (0.514)
Gymnasium	0.448* (2.435)	0.452* (2.492)	0.399* (2.240)	0.407* (2.293)
Realschule	-0.184 (-1.084)	-0.185 (-1.102)	-0.199 (-1.209)	-0.197 (-1.203)
Observations	609	609	609	609
R ²	0.343	0.363	0.387	0.392
Adjusted R ²	0.328	0.347	0.372	0.375
Residual std. error	1.130	1.114	1.093	1.090
F statistic	22.195***	22.502***	24.960***	23.812***

Note: This table reports results of OLS regressions on basic literacy with different inclusions of confidence variables. The Hauptschule variable is omitted as it serves as reference for Gymnasium and Realschule. t-statistics are shown in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.

The baseline model for the basic literacy dimension as shown in Column (1) of Table 2 suggests that gender does indeed have an influence on basic financial literacy. The female variable (which indicates whether a participant is a female) has a strongly significant negative effect on the basic literacy score, even when controlling for widely used covariates.

When a participant is female, the expected basic literacy score is lowered by 0.357 compared to a male participant, holding all else equal. When introducing the a priori confidence measure in Column (2), the magnitude of the female regression coefficient as well as the significance are decreasing, although they remain significant at the 1% level. This changes in Column (3), when the

ex post confidence is included instead of the a priori measure. The results show that when introducing ex post confidence as an independent variable, the significance of gender diminishes.

It is interesting to note, that both confidence variables show significant influence on basic literacy when included jointly as shown in Column (4). However, the ex post confidence measure remains highly significant at the 0.1% level, whereas the a priori measure barely clears the 5% significance hurdle. This insight is valuable because it suggests that both confidence variables are not mutually exclusive, regardless of their overlaps, and have alternating explanatory powers for the basic literacy domain even though only the ex post variable has the ability to bridge the gender gap in basic literacy alone.

As with basic literacy, gender remains an important predictor of sophisticated literacy as well. Column (1) of Table 3 shows that being female is again a significant negative indicator of financial literacy. Female participants' sophisticated financial literacy scores are expected to be 0.862 lower compared to males', holding all else equal. Columns (2), (3) and (4) show that in this literacy dimension, neither of the confidence variables alone or in combination have the power to render the gender variable insignificant and thus explain the gender gap in sophisticated literacy. However, both confidence variables are shown to be significant predictors of sophisticated literacy, reflecting the same significance pattern throughout the four models that is found in the basic literacy dimension.

When evaluating the regression results of the basic literacy dimension and the sophisticated literacy dimension collectively, there are interesting conclusions to draw. First and foremost, confidence plays an important role in understanding the financial literacy gender gap among high school students. The confidence variables rendered the gender variable in basic literacy insignificant, thus offering a plausible explanation for the gender gap in financial literacy. Although gender remains a highly significant variable in the sophisticated literacy domain, the magnitude of its regression coefficients decreases with the inclusion of a priori and ex post confidence. This difference in impact compared to basic literacy may be explained by the widening of the gender gap in parallel to the increasing difficulty of questions. Second, yet no less interesting, is the observation that confidence, as measured by most of the existing research in adults (and, specifically, financial literacy self-assessment), is an important predictor; however, this measure of confidence may not be a complete representation of overall confidence. The results suggest that the ex post confidence variable adds significant additional explanatory power to the a priori self-assessment without making it redundant.

Beyond confidence, cognitive abilities also appear to be a highly significant and stable predictor across all models and dimensions. Basic and sophisticated literacy scores are both positively influenced by cognitive abilities. Both baseline models (i.e., models where no confidence variable is included) show a significant gender variable while controlling for cognitive abilities, meaning that cognitive abilities are an important predictor of financial literacy but cannot moderate the gender gap alone.

Also stable for basic and sophisticated literacy is the influence of high school type; students attending the highest-ranked *Gymnasium* have significantly higher expected literacy scores compared to students who pursue degrees at the lowest-ranked *Hauptschule*.

Acknowledging the fact that females account for a significantly larger share of all students attending *Gymnasium* high school education levels may be no enlarging factor for the gender gap in financial literacy underpinning the conclusion of Preston and Wright (2019), who found the same to be true for adults.

To further deepen the understanding of gender differences in financial literacy, a subsequent Blinder–Oaxaca decomposition is performed (Blinder, 1973; Oaxaca, 1973).⁵ This statistical technique is based on regression and seeks to explain which part of group differences in means is due

Table 3. Influence of confidence in explaining the gender gap in sophisticated literacy

	Sophisticated Literacy			
	(1)	(2)	(3)	(4)
A priori confidence		0.498*** (5.363)		0.226* (2.374)
Ex post confidence			0.754*** (9.348)	0.679*** (7.873)
Female	−0.862*** (−5.814)	−0.686*** (−4.619)	−0.523*** (−3.653)	−0.477*** (−3.314)
Cognitive abilities	0.308*** (4.442)	0.290*** (4.283)	0.210** (3.199)	0.212** (3.239)
Under 16 years	−0.196 (−1.148)	−0.189 (−1.135)	−0.140 (−0.874)	−0.142 (−0.894)
Risk association	−0.074 (−1.005)	−0.009 (−0.119)	−0.037 (−0.539)	−0.011 (−0.162)
Side job	0.060 (0.414)	0.080 (0.571)	0.062 (0.459)	0.071 (0.529)
Saving	0.358 (1.888)	0.275 (1.482)	0.225 (1.267)	0.201 (1.133)
Household income	0.225 (1.360)	0.193 (1.190)	0.137 (0.884)	0.131 (0.849)
Integration	0.207 (1.128)	0.240 (1.334)	0.201 (1.167)	0.216 (1.261)
Club membership	0.212 (1.403)	0.135 (0.912)	0.116 (0.820)	0.091 (0.642)
Mathematics grade	0.014 (0.214)	−0.005 (−0.084)	−0.040 (−0.635)	−0.043 (−0.695)
German grade	0.121 (1.424)	0.112 (1.353)	0.088 (1.104)	0.087 (1.101)
English grade	0.052 (0.661)	0.010 (0.134)	0.075 (1.026)	0.0538 (0.735)
Gymnasium	1.017*** (3.741)	1.024*** (3.856)	0.916*** (3.603)	0.929*** (3.669)
Realschule	0.633* (2.516)	0.632* (2.570)	0.603* (2.565)	0.605** (2.585)
Observations	609	609	609	609
R ²	0.234	0.270	0.333	0.339
Adjusted R ²	0.216	0.251	0.316	0.321
Residual std. error	1.670	1.632	1.563	1.554
F statistic	12.990***	14.608***	19.712***	18.983***

Note: This table reports results of OLS regressions on sophisticated literacy with different inclusions of confidence variables. The *Hauptschule* variable is omitted as it serves as reference for *Gymnasium* and *Realschule*. t-statistics are shown in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.

to cross-group differences in explanatory variables and which part cannot be explained by these differences (see, e.g., Jann, 2008 for a more detailed explanation).

The Blinder–Oaxaca decomposition was originally used to analyze wage discrimination between men and women, but Fonseca et al. (2012) and Aristei and Gallo (2021) applied it more recently to study gender differences in financial literacy.

The results of the Blinder–Oaxaca decomposition based on Equation (1) are presented in Table 4. The two confidence variables, cognitive abilities and the other independent variables are able to explain 0.186 of the total 0.311 gender mean difference in basic financial literacy. This means that

Table 4. Decomposition of gender differences for basic and sophisticated literacy

	Basic Literacy	Sophisticated Literacy
A priori confidence	0.062*	0.078*
Ex post confidence	0.131***	0.302***
Cognitive abilities	0.076***	0.053***
Under 16	0.000*	0.000
Risk association	0.004	0.019
Side job	−0.001	−0.000
Saving	0.000	0.000
Household income	0.000	0.000
Integration	−0.011*	−0.012
Club membership	−0.010	0.006
Math Grade	0.003	−0.003
German grade	−0.009	−0.026
English grade	−0.011	−0.032
Gymnasium	−0.046*	−0.061***
Realschule	−0.005	0.013**
Female score	3.160	4.095
Male score	3.471	4.937
Group difference	0.311	0.842
Explained difference	0.186	0.336
Unexplained difference	0.125	0.506

Note: This table reports a two-fold Oaxaca decomposition that includes the indicator variable (female). The *Hauptschule* variable is omitted as it serves as reference for *Gymnasium* and *Realschule*. t-statistics are shown in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.

the included variables are able to explain roughly 60%⁶ of the mean gender differences in basic financial literacy. The greatest contribution stems from the two confidence variables, where ex post confidence explains about 42% (0.131) and a priori confidence about 20% (0.062) of the total difference; this substantiates the results from the previously applied OLS regression while also delivering additional insights about the magnitude of the influence. A large and significant share is explained by cognitive abilities with 24% (0.076). This means that, in combination with the regression results shown before, cognitive abilities are a significant driver of the gender gap in financial literacy. Therefore, higher levels of confidence and cognitive ability in males are able to explain a significant amount of gender differences in basic financial literacy.

Results for the sophisticated literacy domain are largely comparable to the results of the basic literacy domain, albeit with lower coefficient magnitudes. Explanatory variables are able to explain 0.336 (40%) of the total 0.842 mean sex difference in sophisticated literacy. A priori confidence accounts for 9% (0.078) of the sophisticated literacy, ex post confidence for 36% (0.302), and cognitive abilities for 6% (0.053). Both a priori confidence and cognitive abilities appear to lose disproportionately large fractions of explanatory power from the basic literacy domain to the sophisticated literacy domain compared to ex post confidence. Therefore, the gender gap in sophisticated literacy appears to be more strongly affected by unobserved variables and, to a lesser extent, by a priori confidence and cognitive abilities than the gender gap in basic literacy, whereas ex post confidence appears to be a stable influential factor across both domains.

5.2. On the determinants of confidence

The descriptive statistics as well as the applied analyses suggest that there are indeed differences in the confidence levels of female and male participants. A question that remains largely

unanswered is what determines confidence in financial literacy and whether determinants vary with gender. There is scant evidence on interplays between factors previously found to influence financial literacy and their possible impacts on confidence in the own financial literacy, except for the finding that males are more likely than females to show overconfident behavior in financial matters (Barber & Odean, 2001; Dahlbom et al., 2011). Among the explored explanatory variables, only cognitive abilities are discussed in the existing literacy, with the finding that cognition positively influences confidence (Tang, 2021).

Table 5 shows the results of OLS regressions with a priori confidence and ex post confidence as dependent variables and an isolated consideration of female and male participants. Before interpreting variables individually, there are two general observations. First, there are no variables that show a significant influence over both measures and both genders; second, for both confidence measures, explained variation represented by R^2 is noticeably higher for the male subgroup. Therefore, variations in confidence of male participants are to a larger extent explainable by the aforementioned sociodemographic characteristics compared to the confidence of female

Table 5. Determinants of confidence

	A priori stated confidence		Ex post confidence	
	Female	Male	Female	Male
Cognitive abilities	0.017 (0.383)	0.054 (1.294)	0.619*** (3.619)	0.558*** (3.459)
Under 16 years	-0.074 (-0.728)	0.051 (0.465)	0.224 (0.565)	-0.669 (-1.578)
Risk association	-0.153 (-1.613)	-0.284** (-3.316)	-0.162 (-0.442)	-0.437 (-1.323)
Side job	-0.162 (-1.838)	0.094 (1.054)	-0.385 (-1.115)	0.153 (0.446)
Saving	0.197 (1.742)	0.113 (0.941)	0.666 (1.506)	0.412 (0.890)
Household income	0.160 (1.629)	-0.047 (-0.433)	0.319 (0.833)	0.212 (0.505)
Integration	-0.071 (-0.615)	-0.100 (-0.859)	0.323 (0.722)	-0.120 (-0.270)
Club membership	0.206* (2.235)	0.119 (1.247)	0.426 (1.186)	0.333 (0.908)
Mathematics grade	0.028 (0.686)	0.058 (1.391)	0.501** (3.106)	0.187 (1.172)
German grade	-0.008 (-0.143)	0.039 (0.783)	0.101 (0.463)	0.224 (1.178)
English grade	0.087 (1.799)	0.090 (1.887)	-0.220 (-1.169)	0.032 (0.177)
Gymnasium	-0.099 (-0.585)	0.092 (0.544)	0.437 (0.662)	1.092 (1.684)
Realschule	0.025 (0.156)	-0.008 (-0.053)	0.499 (0.807)	-0.009 (-0.015)
Observations	313	296	313	296
R^2	0.085	0.133	0.161	0.218
Adjusted R^2	0.045	0.093	0.125	0.182
Residual std. error	0.726	0.717	2.833	2.753
F statistic	2.129**	3.324***	4.424***	6.057***

Note: This table reports results of OLS regressions on a priori and ex post confidence by gender. The *Hauptschule* variable is omitted as it serves as reference for *Gymnasium* and *Realschule*. t-statistics are shown in parentheses.
 *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

participants in either measure. Together, both observations amplify the presumption that the confidence measures not only differ in explanatory power for financial literacy but are also influenced by distinct and highly gender-specific characteristics.

For the a priori confidence measure, cognitive abilities show no significant influence for either gender. The confidence of male participants is significantly influenced only by association with risk. When risk is perceived as chance, a priori confidence decreases by 0.284, holding everything else equal.

This may be explained by assuming that participants who stated lower levels of confidence in their own financial literacy have lower levels of actual experience with financial matters and are therefore less sensitive regarding financial risks whereas participants who stated higher levels of perceived financial literacy have more experience in financial matters and have likely been exposed to losses, which they equate with risk. In contrast to the a priori confidence variable, cognitive abilities show a strongly significant influence on ex post confidence. This holds true for both female and male participants and thus confirms the suggestion of Tang (2021) while using a measure that targets participants' confidence in their own financial literacy.

There is also a significant positive influence of mathematics grades on confidence for female participants. This is very interesting when considering that finance is a topic perceived to be very dependent on mathematical abilities—which, again, are perceived as masculine (Hackett & Betz, 1989). Thus, when females have good math grades, their confidence in their own financial literacy performance increases, whereas males' confidence in their financial literacy is independent from their numeracy skills. Beliefs that males have natural numerical strengths and that financial skills are related to numerical abilities may therefore be very important in explaining the confidence gap.

5.3. Overcoming gender stereotypes

Beyer and Bowden (1997) suggest that gender differences in self-evaluations appear only in tasks that are defined as “masculine” by the general perception, such as financial matters. Such stereotypes cause exaggerations of the perceived performance differences and result in reduced confidence levels among women, which in turn leads to underestimation and actual underperformance (Bordalo et al., 2019).

Beckmann and Menkhoff (2008) hypothesize that expertise in a field can dominate gender effects, and they find that gender differences in professional fund managers are not significant.⁷ Expertise may therefore be a very interesting factor to overcome confidence and performance losses for females in male-typical tasks. In the following, their line of thought will be pursued to verify whether expertise can moderate gender effects in the financial literacy of high school students while controlling for confidence.

To assess this, an additional dataset was collected following the same principles as the main data set. The questionnaire was applied to a subtype of high schools called *Fachoberschule*. This type of high school awards degrees comparable to the *Gymnasium* but with specifications regarding the subject and is usually attended after completing *Realschule* (Hartl, 2011). The sample ($n = 71$) stems from final year students of a high school in the German state of Hesse with a focus on the subject of economics. The two-year program is founded on courses in various economic disciplines combined with a one-year part-time internship in business-related divisions at a company. Finance courses are not specifically included.

Regression results for the basic literacy dimension are shown in Table 6. Column (1) shows that even without the inclusion of the confidence variables, the gender variable shows no significant influence on the basic literacy score. The regression coefficient is even above zero (0.011), suggesting a positive influence on the basic literacy when a participant is female.

Table 6. Determinants of basic literacy on high school students with economic expertise

	Basic Literacy			
	(1)	(2)	(3)	(4)
A priori confidence		0.025 (0.135)		−0.003 (−0.015)
Ex post confidence			0.115 (0.751)	0.116 (0.732)
Female	0.011 (0.040)	0.013 (0.045)	0.069 (0.232)	0.069 (0.230)
Cognitive abilities	0.330* (2.355)	0.328* (2.306)	0.334* (2.372)	0.334* (2.336)
Under 16 years	−0.666 (−0.515)	−0.672 (−0.516)	−0.664 (−0.512)	−0.663 (−0.506)
Risk association	−0.163 (−1.265)	−0.155 (−1.095)	−0.174 (−1.339)	−0.175 (−1.209)
Side job	−0.129 (−0.454)	−0.130 (−0.455)	−0.154 (−0.535)	−0.154 (−0.530)
Saving	−0.130 (−0.254)	−0.144 (−0.273)	−0.037 (−0.070)	−0.035 (−0.064)
Household income	1.965 (1.037)	1.889 (0.948)	2.075 (1.088)	2.085 (1.033)
Integration	0.499 (0.593)	0.535 (0.602)	0.517 (0.612)	0.513 (0.575)
Club membership	−0.164 (−0.551)	−0.171 (−0.560)	−0.155 (−0.515)	−0.154 (−0.502)
Mathematics grade	−0.089 (−0.625)	−0.089 (−0.622)	−0.123 (−0.822)	−0.123 (−0.814)
German grade	0.023 (0.124)	0.028 (0.148)	0.013 (0.069)	0.012 (0.064)
English grade	0.048 (0.258)	0.047 (0.251)	0.036 (0.195)	0.036 (0.193)
Observations	71	71	71	71
R ²	0.221	0.221	0.228	0.228
Adjusted R ²	0.060	0.043	0.052	0.035
Residual std. error	1.110	1.120	1.115	1.125
F statistic	1.369	1.244	1.298	1.184

Note: This table reports results of OLS regressions on basic literacy with different inclusions of confidence variables. t-statistics are shown in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.

In Columns (2), (3) and (4) where the confidence measures are included, this does not change and, surprisingly, no confidence measure alone nor both confidence variables together show a significant influence on basic financial literacy.

The only variable with a significant and positive influence across all models is cognitive abilities. These findings are interesting, first because they suggest that expertise in the field of economics leads to the disappearance of the gender gap in financial literacy with even a slight but insignificant advantage for female students; second, participants' confidence in their own financial literacy no longer has a significant explanatory power, which may suggest that expertise moderates confidence.

Regression results for the sophisticated literacy score are provided in Table 7. In contrast to the basic literacy score, there appear to be sex-dependent differences in sophisticated literacy; the variable capturing whether a participant is female has a significant negative influence on the

Table 7. Determinants of sophisticated literacy on high school students with expertise

	Sophisticated Literacy			
	(1)	(2)	(3)	(4)
A priori stated confidence		0.099 (0.341)		0.039 (0.132)
Ex post confidence			0.075 (1.079)	0.074 (1.023)
Female	−1.033* (−2.286)	−1.026* (−2.251)	−0.980* (−2.081)	−0.982* (−2.066)
Cognitive abilities	0.371 (1.682)	0.362 (1.622)	0.386 (1.749)	0.382 (1.705)
Under 16 years	1.296 (0.638)	1.271 (0.620)	1.340 (0.660)	1.329 (0.648)
Risk association	−0.150 (−0.738)	−0.119 (−0.535)	−0.164 (−0.807)	−0.151 (−0.672)
Side job	−0.707 (−1.579)	−0.712 (−1.579)	−0.729 (−1.608)	−0.731 (−1.598)
Saving	−0.027 (−0.034)	−0.082 (−0.099)	0.138 (0.169)	0.112 (0.133)
Household income	1.410 (0.473)	1.109 (0.354)	1.662 (0.556)	1.536 (0.486)
Integration	1.651 (1.245)	1.791 (1.281)	1.688 (1.275)	1.743 (1.247)
Club membership	0.152 (0.323)	0.128 (0.267)	0.202 (0.427)	0.191 (0.395)
Mathematics grade	0.123 (0.549)	0.122 (0.541)	0.043 (0.183)	0.045 (0.188)
German grade	0.018 (0.064)	0.038 (0.130)	−0.010 (−0.033)	−0.001 (−0.003)
English grade	0.327 (1.127)	0.323 (1.106)	0.337 (1.163)	0.335 (1.146)
Observations	71	71	71	71
R ²	0.269	0.270	0.284	0.284
Adjusted R ²	0.118	0.104	0.120	0.105
Residual std. error	1.748	1.761	1.745	1.761
F statistic	1.923	1.626	1.633	1.496

Note: This table reports results of OLS regressions on sophisticated financial literacy with different inclusions of confidence variables. t-statistics are shown in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

sophisticated literacy score. Confidence variables and cognitive abilities appear to have no significant influence. Gender is the only significant variable in this financial literacy dimension.

It is observable throughout this subgroup that there are non-negligible differences between basic literacy and sophisticated literacy. Whereas expertise is able to close the gender gap in basic literacy, it cannot close the gender gap in the sophisticated literacy domain at least not to the same extent. The results of this subgroup suggest that the explanatory power of confidence for closing the gender gap in financial literacy disappears when participants have economic expertise, but the influence of expertise is as limited as the influence of confidence when it comes to explaining the gender gap in the sophisticated literacy dimension. Therefore, an interrelation of economic education and participants' confidence in their own financial literacy appears plausible. Additionally, the finding that education in economics curbs the influence of gender on financial literacy a very valuable one.

It must be noted, however, that no regression model in this subset shows a significant *F*-statistic which may be attributed to the relatively small sample size compared to the number of independent variables and especially in the basic literacy domain to the fact that all participants seem to be on an comparable level of financial literacy with no substantial differences possibly due their economic education. *P*-values of regression models for the sophisticated literacy move closer towards significance (between 0.05 and 0.15) indicating that differences in the sample start to rise with difficulty. A repetition with a larger sample of economic students would thus be of high value whilst present results must to be used with caution.

5.4. Reverse causality

A potential issue that must be discussed is that of reverse causality. In the context of this study, reverse causality would imply that higher levels of financial literacy result in higher levels of confidence. This means that students had to know their level of financial literacy to base their confidence on, which seems implausible, especially when recognizing that financial literacy is not included in the curriculum of German high schools.

To statistically investigate the issue, an additional regression based on *Equation (1)* is estimated with the total literacy score as the dependent characteristic. This regression contains the same independent variables as in Section 4.1 as well as an additional accuracy variable that captures the difference between the ex post confidence variable, which measures the number of items the participant is confident to have answered correctly and the actual number of correct answers. Thus, a positive accuracy indicates a participant's overestimation of their own abilities, i.e., overconfidence; a negative accuracy indicates under-confidence and a null value represents perfect calibration.

If reverse causation would be an issue, one would expect accuracy to have no significant effect on financial literacy at all, because confidence would rely on actual performance, which rules out an over- or underestimation by participants of their own financial literacy, i.e., participants who know more state higher levels of confidence, and participants who know less state lower levels of confidence.

When examining *Table A1*, it becomes clear that accuracy is not only highly significant, but also of negative magnitude. An incremental increase of 1 leads to an estimated lower total score of -0.351 , holding all else equal. Thus, it may be concluded that confidence determines financial literacy, not the other way around.

This makes sense, because if actual financial knowledge determined participants' confidence in their own financial abilities and not vice versa, there would be a much smaller gender gap because it could not be inflated by confidence and, subsequently, the gender-typedness of the task.

6. Conclusion

This paper analyzed survey data of German high school students to investigate the influence of confidence on the gender gap in financial literacy whilst controlling for cognitive abilities. This study finds that confidence has a steady and significant influence on financial literacy with a moderating effect on the sex differences. The moderating influence is especially strong in the basic literacy domain, where the confidence variables are able to completely bridge the gap. In the sophisticated literacy domain, however, the gender gap remains significant even after the inclusion of the confidence variables.

Further evidence is provided by examining the sex differences of high school students with a specification in economics, which finds that a gender gap in the basic literacy domain is absent when economic education is provided, with cognitive abilities as the only significant predictor. However, there remains a significant gender gap for the sophisticated literacy domain. Confidence variables are found to be insignificant overall in this subgroup. Lastly, this paper shows that the

two confidence variables have distinct explanatory powers for financial literacy as well as different explanatory characteristics that are influenced by gender.

The findings of this study have three major important implications, both practical and scientific. First, participants' confidence in their own financial literacy appears to be a powerful predictor of financial literacy with strong moderating abilities for the gender gap. It should, therefore, be of high interest to raise confidence in females to overcome sex differences and enable independent financial participation by women especially when recognizing the growing responsibility for pension planning, but also for everyday life. Moreover, this study shows that social activities as well as good mathematical skills are able to increase females' confidence in their own financial abilities in addition to economic. The role of domain-specific expertise, which may be understood through both mathematical and economic education, appears to be particularly valuable in overcoming sex differences. Second, it is important to consider the way in which confidence is measured.

Future research should take care when including only perceived financial literacy as a confidence variable. This paper shows that perceived financial literacy as well as the ex post confidence assessment are both valuable proxies for confidence with measure- and gender-specific deviations from each other. Third, this study shows throughout all undertaken analyses that it is highly important to differentiate between basic and sophisticated literacy in order to understand the gender gap in financial literacy. The use of a one-dimensional financial literacy assessment may produce results with reduced meaningfulness. The differentiation in this paper shows that gender differences in basic literacy appear to be quite surmountable, whereas gender differences in sophisticated literacy appear partly influenced by very gender-specific characteristics that are not yet fully revealed.

Financial literacy is important to live a self-determined life and thus everyone should have a solid knowledge basis. Women are structurally worse prepared when it comes to financial decision making. A discrepancy that starts as early as in high school. A change is needed to increase the overall financial literacy and specifically that of woman which is only possible when combining theoretical knowledge with confidence building measures.

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Notes

1. The first publication of the 13-item scale was as a working paper in 2009.
2. Medium grades (3 and 4) were summarized to one option resulting in 5 different answer possibilities. The variable order was subsequently reversed to enable a straightforward interpretation of the results so that *very good knowledge* is grade 6 and *no knowledge at all* is grade 1.
3. The educational system in Germany is overseen by the individual states. Nevertheless, the general organization is comparable across all 16 German states (Dustmann, 2004). After completing four years of elementary school (six years in the states of Berlin and Brandenburg), students advance to secondary education. Students receive a recommendation for one of the three main

secondary school types, based on academic performance (Winkelmann, 1996). Students with the lowest academic achievements in elementary school proceed to the *Hauptschule*, where the aim is to prepare them for vocational training. Students with intermediate grades are recommended for the *Realschule/Mittelschule* with the aim to prepare for vocational training or further studies. The best students progress to the *Gymnasium* with a focus on further studies (Erner et al., 2016; Lührmann et al., 2015).

4. The risk association was assessed as suggested by Grable and Lytton (1999) by providing four answer possibilities: two in the context of chances and two in the context of threats.
5. I follow the logic of Jann (2008) by applying a pooled regression with an inclusion of gender as the group indicator within the regression. The R package of 2018 was used for the application.
6. Calculated by dividing the explained difference by the total difference.
7. However, they conclude that gender differences persist, even among professional fund managers.

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Appendix

Table A1. Linear regression on Total Literacy with Accuracy as independent variable

	Total Literacy
Accuracy	−0.351*** (−11.215)
Female	−1.398*** (−7.333)
Cognitive abilities	0.664*** (7.473)
Under 16 years	−0.348 (−1.590)
Risk association	−0.129 (−1.369)
Side job	−0.032 (−0.175)
Saving	0.606* (2.497)
Household income	0.369 (1.740)
Integration	0.371 (1.572)
Club membership	0.209 (1.080)
Mathematics grade	0.193* (2.245)
German grade	0.185 (1.700)
English grade	0.010 (0.097)
Gymnasium	1.185*** (3.394)
Realschule	0.330 (1.022)
Observations	609
R ²	0.4558
Adjusted R ²	0.442
Residual std. error	2.143
F statistic	33.11***

Note: This table reports results of a OLS regression on total literacy that includes an accuracy variable. The *Hauptschule* variable is omitted as it serves as reference for *Gymnasium* and *Realschule*. t-statistics are shown in parentheses. *** p < 0.001, ** p < 0.01, * p < 0.05.



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