Department of Economics

Working Paper Series

Financial Competence, Overconfidence, and Trusting Investments: Results from an Experiment

Bryan McCannon, Colleen Tokar Asaad and Mark Wilson

Working Paper No. 15-26

This paper can be found at the College of Business and Economics
Working Paper Series homepage:

http://be.wvu.edu/phd_economics/working-papers.htm

Financial Competence, Overconfidence, and Trusting Investments: Results from an Experiment

Bryan C. McCannon
West Virginia University
& Center for Free Enterprise

Colleen Tokar Asaad
Baldwin-Wallace University

Mark Wilson
St. Bonaventure University

Abstract

Financial transactions sometimes occur in an environment where third-party enforcement is lacking.

Behavioral explanations typically allude to the social preferences, where an individual's utility is directly affected by another's outcome, as the driver of the trusting investments and reciprocal returns.

We hypothesize that, in part, these decisions are determined by an individual's financial literacy.

Experimental evidence is coupled with an innovative financial literacy assessment, which measures general competence, numeracy skills, and overconfidence in one's knowledge. Results indicate that overconfidence is a significant determinant of behavior. Specifically, overconfident individuals make

larger contributions in the investment game. We also document that there is an escalated effect in overconfident individuals who are also exhibit risk loving preferences.

JEL codes: G02, C91, D03

Keywords: experiment, financial literacy, investment, overconfidence, social preferences, risk preferences

This work was supported by the Koch Foundation.

1. Introduction

In both the fields of finance and economics, the investment contract is a fundamental element of investigation. A creditor provides funds to a debtor. This investment is used for expected wealth generating activities whereby a portion of the proceeds, along with the initial investment, are returned to the creditor. Numerous economic problems can arise (e.g., moral hazard, adverse selection, decisionmaking under uncertainty, etc.) and are the focus of countless research studies.

One problem in particular is the uncertainty of the return of the principal and in a sharing of the gains. Two institutional features are typically argued to mitigate these concerns. First, in practice, formal institutions are developed. Contracts are created to specify the terms of trade, and enforcement of contracts use either private dispute resolution (e.g., arbitration) or public mechanisms (e.g., civil courts). Often, though, the formal institutions are incomplete. In the developing world they may be sufficiently unreliable. On a trading floor, for another example, initial oral agreements are struck, but unenforceable by a third-party, until formalized. Additionally, the transaction costs of the formal institutions, such as direct costs of litigation or the opportunity costs of time devoted to the dispute, make the use of them suboptimal. Thus, social norms are also argued to be important factors in facilitating wealth-creating, financial investments (see, for an example, Hong, Kubik, and Stein (2004) for an application to stock market participation).

It is the role of these social factors that is the focus of investigation here. Numerous experimental investigations have shown that individuals are willing to make both investments and returns absent the use of formal, external, enforceable agreements. The arguments presume, then, that social preferences drive these outcomes. Social preferences are the non-monetary components to individuals' utility functions that rely, instead, on the well-being of others. Examples of social preferences investigated by experimental and behavioral economists are altruism, trust, reciprocity, and inequality aversion (to name a few). If one assumes that a person's "care for others" is a crucial driver of someone's financial behavior, then the outcomes of these experiments can be explained.

It is this presumption that we call into question here. Given that financial transactions occur when enforcement of agreements is uncertain, is it really these other-regarding, social preferences that are driving the outcomes? An alternative explanation we explore is that financial competence is an important determinant. One's knowledge of financial risks, potential shortcomings, and overall sophistication may lead one to misunderstand the risks associated with unenforceable financial

contracts. Furthermore, overconfidence in one's ability to appreciate the financial complexities of the situation contributes to suboptimal outcomes. In other words, we hypothesize that, along with social preferences, financial competence and overconfidence drive investing behavior in environments where formal enforceable contracts are costly and scarce.

To investigate this hypothesis, an investment game was administered. In the game, which is commonly referred to as the Trust Game in experimental economics (Berg, Dickhaut, and McCabe, 1995), subjects are paired and one is endowed with money. She can choose how much of her endowment to invest in the other player, keeping the residual for herself. The investment grows and the recipient selects how much of the wealth to return. Thus, the game represents a simplified version of an investment relationship without any enforceable contracts or third-party dispute resolution. Usually, the amount initially given is thought of as a quantification of the social preference of trust, while the amount returned is argued to capture the level of reciprocity (Berg, Dickhaut, and McCabe, 1995). Along with collecting background information, we administer a common financial literacy assessment, which includes not only questions about basic financial market information, knowledge, and numeracy skills, but also asks subjects to rate the level of confidence they have in their responses. Thus, the assessment is able to measure both financial competence and overconfidence.

We show that, specifically, overconfidence in one's financial knowledge is an important determinant of trusting investments. Thus, it is not only social preferences of trust and social norms of repayment that drive behavior, but also inaccurate understandings of finance. Additionally, it is shown that risk preferences are correlated with behavior. Along with the Trust Game, subjects made choices in a commonly-used risky decisionmaking instruments developed by Holt and Laury (2002). The risk assessment is able to distinguish risk averse from risk neutral and risk loving individuals and is able to quantify degrees of risk aversion and risk love. Our second main finding is that while risk-taking individuals and overconfident individuals make larger trusting but unenforceable investments, there is a strong escalation effect where risk-taking, overconfident subjects make the large uncertain investments. Thus, financial overconfidence, interacted with risk preferences, explains much of the behavior, rather than social preferences alone.

One work closely related to ours is that of Kluger and Wyatt (2004). They use experimental methods to identify whether judgment errors are reflected in market prices. Using choices in a decisionmaking under uncertainty problem, individuals in a market game who have misjudged probabilities also misjudge market prices. Our work complements theirs as we expand beyond the

understanding of the updating of probabilities to numeracy skills and financial competence, as well as directly measure overconfidence in their decisionmaking. Also, by studying the Trust Game we are able to attack the issue of whether social preferences or financial literacy is driving the results.

McCannon and Peterson (2014) also conduct similar research in that they study the Trust Game, but instead investigate the role of an education in finance on behavior. They show that finance students both make larger trusting investments and reciprocate at higher levels. This is congruent with our results that when returns are expected, investments should be made. Another related work is that of Becchetti, Caiazza, and Coviello (2013) who investigate the impact of a financial education on investment attitudes amongst high school students using a similar financial literacy tool.

Section 2 first briefly discusses the literature on financial literacy, competence, and overconfidence, along with social preferences. Section 3 presents the experimental design and methods. Econometric results are presented in Section 4, while a concluding discussion is contained within Section 5.

2. Financial Competence, Overconfidence, and Social Preferences

Lusardi and Mitchell (2014) define financial literacy as “peoples’ ability to process economic information and make informed decisions about financial planning, wealth accumulation, pensions, and debt.” Financial literacy is competency in money management, involving both the understanding and the application of knowledge (Huston, 2010). Higher levels of financial literacy are associated with daily financial management skills (Hilgert, Hogarth, and Beverly, 2003), retirement planning (Lusardi and Mitchell, 2007), investments in stocks (van Rooij, Lusardi, and Alessie, 2011), and wealth accumulation (Behrman, Mitchell, Soo and Bravo, 2012). Lower levels of financial literacy are associated with increased borrowing (Stango and Zinman, 2009), costly mortgages (Moore, 2003), and increased mortgage defaults (Gerardi, Goette, and Meier, 2010).

An individual’s actual level of financial competence, however, may differ from his or her self-assessed level of knowledge. The extent of this difference varies considerably across individuals. Overconfidence is the “discrepancy between knowledge and knowledge perception” (Lichtenstein, Fischhoff and Phillips, 1982), specifically “that upward gap between what we know and what we think we know” (Cordell, Smith and Terry, 2011). Overconfident individuals have narrow confidence

intervals, resulting in an overestimation of accuracy and an underestimation of risk. This leads to behaviors that are less careful and less controlled.

Overconfidence is associated with riskier behaviors, often with suboptimal results. In experimental asset markets, overconfident individuals trade more (Deaves, Lüders and Luo, 2009), and this aggressive trading is associated with losses and underperformance (Barber and Odean, 2000). Overconfidence can also help explain why the market under- and over-reacts (Daniel *et al*, 1998), why individuals hold under-diversified portfolios (Odean, 1998), and why people are susceptible to the winner's curse (Biais, Hilton, and Mazurier, 2005).

Individuals exhibit overconfidence, even when given high incentives for accuracy. In an experimental setting examining business failure, Camerer and Lovo (1999) find more overconfidence in skill-based payoff groups than random-based payoff groups. They attribute this effect to reference group neglect, or people's tendency to "be insufficiently sensitive to the quality of the competition" when competing based on skill.

People learn to be overconfident by attributing success to personal abilities and failures to uncontrollable circumstances, overweighting information gained from personal experience and underweighting information gained from social interactions (Chiang, Hirshleifer, Qian and Sherman, 2011). Overconfidence can be harmful. For example, Malmendier and Tate (2008) find that overconfident CEOs make value-destroying acquisitions. Puri and Robinson (2007) find that excessive optimism is associated with imprudent financial behaviors, while moderate optimism is not problematic.

Thus, it is hypothesized that with uncertain financial choices in the Trust Game, overconfident individuals will underestimate risk, provide unsupported investments, and receive suboptimal returns.

Social preferences, on the other hand, posit that a component of an individual's utility function depends on the outcome obtained by other players (Fehr and Fischbacher, 2002). Depending on the context and the way the preferences are modeled, social preferences can be used to capture altruism, fairness, or inequality aversion. The defining feature of social preferences is that individuals are motivated, in part, by the impact of their decision on others.

Social preferences have been studied in a diverse array of settings. For example, it can be used to explain the "warm glow" of charitable giving (Andreoni, 1995), a tool to understand redistribution policies in democracies (Tyran and Sausgruber, 2006) and limits to the sanctioning of criminals (Polinsky and Shavell, 2000). Experimental economics research has used arguments of social

preferences to explain public goods contributions (Marwell and Ames, 1981), depletion of resources (Fehr and Leibbrandt, 2011), bargaining outcomes (Charness and Gneezy, 2008), and corruption (Barr and Serra, 2009), to name a few.¹ In short, allusion to social preferences provides an explanation of behavior detrimental to the wealth/well-being of the decisionmaker, but beneficial to others.

Thus, both low financial competence and overconfidence, along with social preferences can explain personally costly choices that benefit others. While experimental and behavioral economics typically defaults to the latter explanation, our objective is to identify whether the former has merit.

The Trust Game studied here is ideal for making this distinction. In the game, one individual selects how much of her endowment, if any, to give to another. The contribution grows and the recipient is given the opportunity to return a portion of the wealth. Without communication, contracts, sanctions or third-party enforcement, optimal behavior depends on expectations regarding others' choices. If individuals have the social preference for reciprocity, then they will return some of the money and, thus, an initial contribution is warranted. Therefore, the giving that is commonly observed is thought of as a measurement of trust. Alternatively, in experiments recipients typically not only do not provide an interest/profit on the initial investment, but do not fully return the principal (see McCannon and Peterson (2014) for evidence and a discussion). Thus, with reasonable expectations investments in this environment can be expected to be unprofitable. Therefore, one can argue that giving is a measurement of financial mistakes, which can be driven by incompetence and overconfidence. The differentiation between social preferences and financial acumen has not been attempted, and is the objective here.

3. Experimental Design

We conducted experiments with undergraduate students at a small, private university in upstate New York. Subjects were recruited from classes within the business school, targeting students in both classes taken by underclassmen and those taken by upperclassmen. An online reservation manager was used to recruit and schedule the sessions. The number of participants in each session ranged from thirteen to twenty-six, with ninety-five experimental subjects in total.² Five experimental sessions, each lasting approximately one hour in the evening, were conducted in February 2014. Within each

¹ The experimental economics literature studying the Trust Game is too vast to adequately discuss here.

² The reservation manager scheduled twenty subjects per session. In four sessions, some subjects did not show-up, while in the fifth session, a programming glitch allowed for the more than the twenty-subject cap to enroll.

session subjects completed four tasks. After providing informed, signed consent subjects engaged in an experiment. Second, a risk assessment was completed. Finally, at the end of each session, subjects completed a background information questionnaire and took a financial literacy quiz.

In the experiment, subjects played the Trust Game initially created by Berg, Dickhaut and McCabe (1995). In this game, the subjects were randomly paired whereby one person in the group was randomly selected to be “Player A” while the other became “Player B”. Player A is endowed with five experimental dollars and chooses how much to give to Player B. The subjects were instructed that any amount (0, 1, 2, 3, 4, or 5) could initially be given and informed that the amount contributed to Player B tripled. Player B, then, is given the choice of how much of the tripled amount to give back. Thus, an investment is made by the first-mover. There is no external enforcement mechanism to ensure a return of the principal or encourage an interest payment. Thus, the environment analyzed replicates one where institutions have broken down so that social preferences drive, or fail to drive, wealth-creating activities. In the experiments, though, loaded words, such as reciprocate, trust, invest, wealth, etc., were avoided. Instead, the choices were presented as the amount to give and give back.

In all five experimental sessions, the subjects played the game four times in separate rounds. In each round a new random pairing was made. Subjects were informed of their earnings from the previous round before making their selections in the next. They did not know who they were paired with when making their choices. Therefore, decisions could not depend on factors such as gender (Landry *et al*, 2006) and race (Fong and Luttmer, 2011). Each subject made his/her choices if selected to be Player A and also if selected to be Player B on a paper form distributed, thus providing a full contingency plan. Responses were collected and randomly separated into two stacks (an “A” group and a “B” group). One from the A group was paired with one in the B group, scored, and the results were posted on a spreadsheet projected at the front of the room. The pairing and scoring was done in front of the subjects. This procedure was used to ensure that the subjects knew that pairings were random and arbitrary and is the same method employed by McCannon and Peterson (2014).

As stated, in each round each subject provided a full contingency plan. They first had to respond to the question, “if you are selected to be Player A how much of your 5 E\$ would you like to give to Player B?” The amount selected by a player in a round is denoted *Trust* in the analysis. Second, each subject had to respond to a series of five questions, “if you are selected to be Player B and Player A gives you 5 E\$ (which triples to 15 E\$), how much of your 15 E\$ would you like to give back?” The amount selected for this question is the variable *Reciprocity*. The following four questions were

phrased identically, except the amount given was 4, 3, 2, and 1 respectively, creating the variables *Reciprocity-4*, *Reciprocity-3*, *Reciprocity-2*, and *Reciprocity-1*. Printed instructions were distributed and PowerPoint slides were presented providing the rules. After explanation of the game, subjects were given the opportunity to ask questions. Finally, a short proficiency quiz was administered before the first round of play to ensure that the rules of the game were completely understood.

In sessions with an odd number of subjects, one subject was randomly selected to sit out of each round. The selection made by this player, though, was done prior to being chosen and, thus, the data is available.

The second component of each experimental session was the completion of a risk assessment. To gauge subject's risk preferences, the tool developed by Holt and Laury (2002) was given. Specifically, the exact same set of choices and payoffs as used in Deck, Lee, Reyes, and Rosen (2012) was administered. In the risk assessment, subjects made ten separate choices. For each choice two lotteries were presented and the subject selected the one s/he preferred. The first option was for a relatively safer gamble where either \$10 or \$8 could be earned. The second option was for a riskier lottery receiving either \$19.25 or \$0.50. The ten choices differed in the probability of obtaining the higher of the two outcomes as a random number generator selected an integer between one and ten to determine which outcome arose. Table 1 presents the risk assessment used.

[Insert Table 1 here.]

Thus, a risk neutral individual would select option (a) for the first five choices and option (b) for the last five. A risk averse individual will select (a) for more than five choices and the more risk averse an individual is the more times (a) will be selected. Alternatively, a risk loving subject will select option (a) fewer than five times. Define *Safe* as the number of times option (a) is selected by the subject.³ Consequently, as used in previous research on decisionmaking under uncertainty (Deck, Lee, Reyes, Rosen, 2012), *Safe* is used to measure the degree to which a subject is risk averse in the experiment.⁴

³ Choice 1 is included to have a nice, even ten question instrument but, also, to identify unreliable decision making. In no circumstance did a subject choose (b) for Choice 1.

⁴ One can be concerned about the behavior of a subject without "standard" risk preferences, since in expected utility theory, regardless of the type of risk preference a person has, a switching point in the decision problem arises. A small portion of the sample switched between (a) and (b) more than once. A dummy variable capturing these subjects can be included in the

Along with a full explanation of the decision problem, subjects were informed that they would be financially compensated for their selection in one of the ten choices. Which choice would be paid would be determined at random. Specifically, they were informed that a random number generator would be used to determine, for each subject, which choice would be paid, and a random number generator would be used to determine how much would be paid (select an integer between one and ten).

The total monetary gains of a subject in the experiment is comprised of the amount earned in a randomly selected round from the Trust Game and the choice between the lotteries made in the randomly-selected decision problem. A minimum wage was imposed for each subject in each session where we guaranteed that \$10 would be earned. Thus, subjects earned between \$10 and \$34 in the experiment, with a mean payout of \$16.45.

Finally, at the end of each session, subjects completed a background questionnaire and took a financial literacy quiz. The background questionnaire compiled basic information to be used as controls. The variables *Male*, *USA*, *NY*, and *Vote* are dummy variables capturing whether the subject is a male, a US citizen, a resident of New York state, and voted in the November 2012 election. This last control is used to account for pro-group behavior (i.e., civic behavior) and has been shown in previous experimental work to be important to understanding other-regarding preferences with public goods contributions (McCannon and Peterson, 2014). Furthermore, the variable *Year* captures which year of school the subject is in, while a number of controls for academic major are included. Table 2 provides descriptive statistics for the demographic control variables used in the analysis.⁵

[Insert Table 2 here.]

Additionally, a financial literacy quiz was given. We administered a sixteen question instrument to gauge literacy. The questions are based on Gamble, Boyle, Yu, and Bennett's (2013)

specification. This variable, though, is insignificant and its inclusion does not affect the results presented (in the next section).

⁵ The descriptive statistics are based on the individual-level data set. The distribution of years is 37.9%, 20.0%, 25.3%, 15.8%, and 1.1% for years 1, 2, 3, 4, and 5 respectively. For those not from New York, 5.3% reported no state, 7.4% and 5.3% are from PA and NJ respectively, while 10.5% report "other". Business majors include Finance (31.6%), Accounting (27.4%), Marketing (13.7%), Management (10.5%), or "undecided business" (10.5%). At this institution, there is no Economics major; only a minor.

financial literacy instrument from the Rush Memory and Aging Project.⁶ For eight of the items, basic numeracy questions are asked to assess the subjects' degree of quantitative understanding. For the other eight items, financial competence questions were asked. This financial literacy assessment imbeds within it four of five-questions from FINRA's National Financial Capability Study, but also adds both more and less sophisticated topics.⁷ These questions have shown that higher levels of financial literacy are associated with better financial outcomes (see for example Robb and Woodyard, 2011 or de Bassa Scheresberg, 2013).

The number of questions that the respondent answered correctly out of sixteen creates the variable *Competence*. If a subject selected the option "don't know" or failed to answer, the response is considered incorrect. Furthermore, *Numeracy Competence* and *General Competence* break down this total into the number of correct responses for the two components of the assessment. These metrics are used to quantify financial competence to investigate its relationship with financial decisionmaking, particularly trusting investments.

After each of the sixteen questions, a follow-up question was requested where each subject was asked to gauge, on a scale from one to four, how confident they were with the accuracy of their response.⁸ From these responses the variable *Overconfidence* is created, following the method of Gamble, Boyle, Yu, and Bennett (2013). The total, self-granted confidence points they gave their own answers, for all of their incorrect answers, is added together. Hence, overconfidence, which "can arise because of excessive confidence or insufficient knowledge (or a combination of both)" (Bhandari and Deaves, 2006), can be quantified using this method. Used in conjunction with *Competence*, *Overconfidence* captures the degree to which a subject believes his or her wrong answers are correct. Hence, *Overconfidence* allows for us to differentiate actual knowledge from perceived knowledge.⁹ Also, similarly, the variable is decomposed into *Numeracy Overconfidence* and *General*

⁶ A copy of their survey can be found at: <http://arno.uvt.nl/show.cgi?fid=132378>. In our survey, numeracy question 1 and financial knowledge question 5 are excluded, and financial knowledge question 1 is replaced with a question from FINRA's financial literacy survey: "True or false: A 15-year mortgage typically requires higher monthly payments than a 30-year mortgage, but the total interest paid over the life of the loan will be less."

⁷ The FINRA survey is available from: <http://www.usfinancialcapability.org/quiz.php>. The FINRA question, "Buying a single company's stock usually provides a safer return than a stock mutual fund" is similar to the financial knowledge question 5 that is excluded due to poor wording.

⁸ A rating of 1 was described in the survey as "not at all confident", 2 was "a little confident", 3 was "fairly confident", and 4 was "extremely confident".

⁹ In two instances, subjects selected two confidence levels for a question (they bubbled two numbers on the Scranton sheets provided). We coded these choices as the mean of the two selected. Thus, for example, if a person selected both "not at all confident" (scored as a 1) along with "a little confident" (scored as a 2), then that person's confidence score is recorded as 1.5.

Overconfidence from the two parts of the survey. Table 3 provides the results from the financial literacy quiz and the risk assessment.

[Insert Table 3 here.]

Thus, subjects correctly answered 10.96 of the questions correct (68.5%) on average, with a reasonably wide variance, doing better on the numeracy questions than the specific financial competence questions. Interestingly, while the inaccuracy of the general knowledge is 47.6% higher than numeracy skills, the overconfidence in the wrong general, financial literacy questions is 88% greater. This suggests that overconfidence is lower in basic numeracy questions.

Subjects, on average, demonstrated some risk aversion. In the sample, 45% of subjects are scored as risk averse, 19% as risk neutral, and 36% as risk loving. The mean value of *Safe* is similar to findings in previous research. For example, Baker, Laury, and Williams (2008) report a mean value of 5.67 with a standard deviation of 2.12.

A study of the statistical significance of simple correlation coefficients reveals patterns that replicate results of previous studies. Males score higher on the financial competence assessment, similar to the findings of Lusardi and Mitchell (2007) and Lusardi, Mitchell, and Curto (2010), lower on the overconfidence measure (likely due to their high literacy score), and choose to accept more uncertainty in the risk assessment, as also found in Barsky, Juster, Kimball, and Shapiro (1997) and Sunden and Surette (1998). Foreign students score lower on financial knowledge (Lusardi and Mitchell, 2014). Also, upper-class students make riskier choices, and register higher levels of literacy.

The research question to be addressed, though, is how does financial competence and overconfidence affect investing behavior in environments where institutional safeguards are incomplete? It is this question that we turn our attention to now.

4. Results

First, a summary of the results of the experiments are provided in Table 4.

[Insert Table 4 here.]

Subjects in the experiment, on average, contributed 58.6% of their endowment. As has arisen in previous experiments (McCannon and Peterson, 2014), for any amount of trusting investment made, the amount returned is less. The marginal impact of one more experimental dollar contributed, though, is approximately one more dollar returned, but on average a penalty is assessed by the recipient. Approximately one-half of the subjects did not return as much experimental dollars as was given to them. Thus, a rational, wealth-maximizing individual, correctly anticipating this level of reciprocity, would not be inclined to provide the initial investment unless nonmonetary, social preferences provided a sufficient amount of utility, or an individual lacked the financial sophistication to appreciate the incentives of the game.

Hence, the research question to be addressed is whether the two components of financial literacy, financial competence and overconfidence in decisionmaking, correlate with behavior in the investment game.

To address this, OLS regression models are estimated with *Trust* as the dependent variable, *Competence* and *Overconfidence* as the primary independent variables, and the background characteristics as controls. Round fixed effects are included to control for any potential learning or adaptation that may occur as subjects gain experience with the game. Also, session fixed effects are included to control for any systematic differences in the composition of the session participants. Standard errors clustered by round of play are presented. This is necessary since selections by an individual over time may exhibit less variance than selection between individuals within a round. Table 5 presents the results.

[Insert Table 5 here.]

The first column presents the baseline results without the round and session controls. The second column includes them, along with controlling for the level of reciprocating choices. The third column adds the interaction between overconfidence and risk taking behavior.

Across the specifications, *Overconfidence* has a positive and statistically significant effect on trusting investments. Using the specification in column II, a one standard deviation increase in *Overconfidence* increases the amount invested by 5.8% at the mean. Thus, investment without proper incentives or institutional safeguards occurs by those who are overconfident in their financial competence, even controlling for demographics, risk preferences, and actual knowledge.

The subject's financial competence is unrelated to trusting investments.¹⁰ Thus, it is perceived rather than actual financial knowledge that explains behavior.

As to be expected, the risk preference of the subject is also strongly related to trusting investments. Those who score as being more risk averse on the assessment reduce the trusting investment, while risk loving individuals contribute more.

The third column considers the interaction effect. Is overconfidence in financial knowledge related to the risk preferences of the individual? The highly significant coefficient on the interaction term indicates that the two are closely associated with each other. While it is the case that overconfident individuals contribute more, the investments are concentrated in those who express themselves as risk loving individuals. The rate of trust is escalated within this group. Thus, it is not solely social norms that are driving these investments, but preferences for risk and expectations that explain the outcomes.

While not presented here, these results are robust. If one, instead, calculated heteroskedastic-robust standard errors, the results from the hypothesis testing continue to hold. Furthermore, the significance of reciprocal giving continues to be an important driver of behavior when the other measures (i.e., *Reciprocity-4* and *Reciprocity-3*) are substituted in. Also, the results are not sensitive to the specific econometric method employed. The results continue to hold if, rather than using OLS, a Poisson Count Data model or an Ordered Logit model is estimated. Additionally, the significance of *Overconfidence* and *Safe* remain when the overall level of confidence is controlled for. Thus, the results are from overconfidence on incorrect responses rather than overall confidence on all answers submitted. Furthermore, one may be concerned about the endogeneity of including the reciprocity variable as an independent variable, as the factors that drive reciprocity can also determine trust. The results in the first and second columns show that its inclusion, while improving the goodness of fit, does not affect the significance of *Overconfidence* and *Safe*. Additionally, a two-stage least squares estimations is conducted instrumenting for *Reciprocity*. The variable selected as the instrument is *Vote* since in all specifications it is independent of trusting investments ($r = 0.02$, $p\text{-value} > 0.63$) but highly correlated with reciprocity ($r = 0.11$, $p\text{-value} < 0.04$). Also, voting in an election can be thought of as expressive behavior benefitting others without personal gain, which should relate to reciprocation

¹⁰ If one drops choice of major, the financial literacy score becomes a statistically significant variable. Studying correlation coefficients, it is revealed that finance majors, oversampled in the recruitment process, score very high on the financial literacy quiz and also provide large investments. Thus, the insignificance of the financial literacy variable comes from it having no independent effect outside of educational background.

rather than trust. The significance of *Overconfidence* remains in the second-stage. Thus, this is evidence endogeneity does not affect our results.

The estimated model can be used to approximate how much of the investment in the game is driven by overconfidence in one's financial knowledge. Using the mean values of the control variables, the fitted value of *Trust* for a fully competent, risk-neutral individual can be compared to the fitted value of *Trust* for a maximally-overconfident subject (using column II). The contribution of the latter is 56.8% higher than the former. Thus, overconfidence can explain much of the behavior.

While the previous results show that overconfidence, but not actual knowledge, is the important driver, the natural follow-up question is which type of knowledge is driving the results. Does overconfidence in the numeracy questions or the general financial literacy topics correlate with trusting investments? Table 6 presents the results from re-estimating the main specification (column II in Table 5), but decomposing *Overconfidence* and *Competence* into their two components.

[Insert Table 6 here.]

The results in Table 6 indicate that it is overconfidence in both the numeracy questions and the general financial literacy questions that explain trusting behavior. Interestingly, numeracy knowledge is also related to trusting investments, but not one's general financial literacy.

5. Conclusion

In the absence of formal enforceable contracts, do social preferences drive investment outcomes? Or are there other factors at play? In an experimental setting, we investigate whether financial literacy can explain investment behaviors. Results of the Trust Game show that an inaccurate assessment of one's financial knowledge is an important determinant of trusting investments. Specifically, overconfident individuals, or those who perceive their level of financial knowledge as higher than it actually is, make more trusting investments. This improper knowledge assessment may lead to a misunderstanding of the risks associated with unenforceable financial contracts, leading to suboptimal outcomes. Additionally, risk preferences are also related to investment behaviors whereby those with higher risk tolerances give more trusting investments. Risk-taking individuals who are also

overconfident make even larger trusting investments, demonstrating an escalating effect. Thus, financial overconfidence, interacted with risk preferences, explains much of the investment behavior.

While the role of risk and overconfidence has been established, the disentangling of financial literacy and social preferences is incomplete. To fully separate the two drivers of behaviors, one would use a tool such as a social preference survey, analogous to the financial literacy quiz. The contribution here is to illustrate that social preferences are not the only explanation for investments in this setting. Furthermore, future research could investigate further whether risk and financial overconfidence have causal impacts on decisionmaking or whether other environmental factors are important. These investigations are left for future study.

Acknowledgments

We thank Kim McCannon for assistance conducting the experiments. The financial support provided by the Koch Foundation is greatly appreciated.

References

- Andreoni, J. (1995) Warm-Glow Versus Cold-Prickle: The effects of positive and negative framing on cooperation in experiments, *Quarterly Journal of Economics*, **110**, 1-21.
- Baker III, R. J., Laury, S. K., and Williams, A. W. (2008) Comparing small group and individual behavior in lottery-choice experiments, *Southern Economic Journal*, **75**, 367-382.
- Barber, B. M. and Odean, T. (2000) Trading is hazardous to your wealth: The common stock investment performance of individual investors, *Journal of Finance*, **55**, 773-806.
- Barr, A. and Serra, D. (2009) The effects of externalities and framing on bribery in a petty corruption experiment, *Experimental Economics*, **12**, 488-503.

Barsky, R. B., F. Juster, T., Kimball, M. S., and Shapiro, M. D. (1997) Preference parameters and behavioral heterogeneity: An experimental approach in the health and retirement study, *Quarterly Journal of Economics*, **112**, 537-579.

Becchetti, L., S. Caiazza, and D. Coviello (2013) Financial education and investment attitude in high school: Evidence from a randomized experiment, *Applied Financial Economics*, **23**, 817-834.

Behrman, J., Mitchell, O. S., Soo, C., and Bravo, D. (2012) Financial literacy, schooling, and wealth accumulation, *American Economic Review*, **102**, 300-304.

Berg, J., Dickhaut, J., and McCabe, K. (1995) Trust, reciprocity, and social history, *Games and Economic Behavior*, **10**, 122-142.

Bhandari, G. and Deaves, R. (2006) The demographics of overconfidence, *Journal of Behavioral Finance*, **7**, 5-11.

Biais, B., Hilton, D., Mazurier, K., and Pouget, S. (2005) Judgmental overconfidence, self-monitoring, and trading performance in an experimental financial market, *Review of Economic Studies*, **72**, 287-312.

Camerer, C. and Lovallo, D. (1999) Overconfidence and excess entry: An experimental approach, *American Economic Review*, **89**, 306-318.

Charness, G. and Gneezy, U. (2008) What's in a name? Anonymity and social distance in Dictator and Ultimatum Games, *Journal of Economic Behavior & Organization*, **68**, 29-35.

Chiang, Y.-M., Hirshleifer, D., Qian, Y., and Sherman, A. E. (2011) Do investors learn from experience? Evidence from frequent IPO investors, *Review of Financial Studies*, **24**, 1560-1589.

Cordell, D. M., Smith, R., and Terry, A. (2011) Overconfidence in financial planners, *Financial Services Review*, **20**, 253-263.

Daniel, K., Hirshleifer, D., and Subrahmanyam, A. (1998) Investor psychology and security market under- and overreactions, *Journal of Finance*, **53**, 1839-1885.

de Bassa Scheresberg, C. (2013) Financial literacy and financial behavior among young adults: Evidence and implications, *Numeracy: Advancing Education in Quantitative Literacy*, **6**, Article 5.

Deaves, R., Lüders, E., and Luo, G. Y. (2009) An experimental test of the impact of overconfidence and gender on trading activity, *Review of Finance*, **13**, 555-575.

Deck, C., Lee, J., Reyes, J., and Rosen, C. (2012) Risk-taking behavior: An experimental analysis of individuals and dyads, *Southern Economic Journal*, **79**, 277-299.

Fehr, E. and Fischbacher, U. (2002) Why social preferences matter – The impact of non-selfish motives on competition, cooperation and incentives, *Economic Journal*, **112**, C1-C33.

Fehr, E. and Leibbrandt, A. (2011) A field study on cooperativeness and impatience in the Tragedy of the Commons, *Journal of Public Economics*, **95**, 1144-1155.

Fong, C. M. and Luttmer, E. F. P. (2011) Do fairness and race matter in generosity? Evidence from a nationally representative charity experiment, *Journal of Public Economics*, **95**, 372-394.

Gamble, K. J., Boyle, P. A., Yu, L., and Bennett, D. A. (2013) Aging, financial literacy, and fraud, Netspar Discussion Paper.

Gerardi, K., Goette, L., and Meier, S. (2010) Financial literacy and subprime mortgage delinquency: Evidence from a survey matched to administrative data, Federal Reserve Bank of Atlanta Working Paper 2010-10.

Hilgert, M., Hogarth, J., and Beverly, S. (2003) Household financial management: The connection between knowledge and Behavior. *Federal Reserve Bulletin*, **89**, 309-322.

Holt C. A. and Laury, S. K. (2002) Risk Aversion and incentive effects, *American Economic Review*, **92**, 1644-1655.

Hong, H., Kubik, J. D., and Stein, J. C. (2004) Social interaction and stock market participation, *Journal of Finance*, **59**, 137-163.

Huston, S. J. (2010) Measuring financial literacy, *Journal of Consumer Affairs*, **44**, 296-316.

Kluger, B. D. and Wyatt, S. B. (2004) Are judgment errors reflected in market prices and allocations? Experimental evidence based on the Monty Hall problem, *Journal of Finance*, **59**, 969-997.

Landry, C. E., Lange, A., List, J. A., Price, M. K., and Rupp, N. G. (2006) Toward an understanding of the economics of charity: Evidence from a field experiment, *Quarterly Journal of Economics*, **121**, 747-782.

Lichtenstein, S., Fischhoff, B., and Phillips, L. D. (1982) Calibration of probabilities: The state of the art to 1980, (eds) D. Kahneman, P. Slovic, and A. Tversky (eds.), *Judgment Under Uncertainty: Heuristics and Biases*, 306-334.

Lusardi, A., Mitchell, O. S., and Curto, V. (2010) Financial literacy among the young, *Journal of Consumer Affairs*, **44**, 358-380.

Lusardi, A. and Mitchell, O. S. (2007) Baby boomers' retirement security: The role of planning, financial literacy and housing wealth, *Journal of Monetary Economics*, **54**, 205-224.

Lusardi, A. and Mitchell, O. S. (2014) The economic importance of financial literacy: Theory and evidence, *Journal of Economic Literature*, **52**, 5-44.

Malmendier, U. and Tate, G. (2008) Who makes acquisitions? CEO overconfidence and the market's reaction, *Journal of Financial Economics*, **89**, 20-43.

Marwell, G. and Ames, R. E. (1981) Economists free ride, does anybody else?, *Journal of Public Economics*, **15**, 295-310.

McCannon, B. C. and Peterson, J. (2014) Born for finance? Experimental evidence of the impact of finance education, *Journal of Behavioral Finance* (forthcoming).

Moore, D. (2003) Survey of financial literacy in Washington state: Knowledge, behavior, attitudes and experiences, Washington State University Social and Economic Sciences Research Center Technical Report 03-39.

Odean, T. (1998) Volume, volatility, price, and profit when all traders are above average, *Journal of Finance*, **53**, 1887-1934.

Polinsky, A. M. and Shavell, S. (2000) The fairness of sanctions: Some implications for optimal enforcement policy, *American Law and Economics Review*, **2**, 223-237.

Puri, M. and Robinson, D. T. (2007) Optimism and economic choice, *Journal of Financial Economics*, **86**, 71-99.

Robb, C. A. and Woodyard, A. S. (2011) Financial knowledge and best practice behavior, *Journal of Financial Counseling & Planning*, **22**, 60-70.

Stango, V. and Zinman, J. (2009) Exponential growth bias and household finance, *Journal of Finance*, **64**, 2807-2849.

Sunden, A. E. and Surette, B. J. (1998) Gender differences in the allocation of assets in retirement savings plans, *American Economic Review*, **88**, 207-211.

Tyran, J.-R. and Sausgruber, R. (2006) A little fairness may induce a lot of redistribution in democracy, *European Economic Review*, **50**, 469-485.

van Rooij, M., Lusardi, A., and Alessie, R. (2011) Financial literacy and stock market participation, *Journal of Financial Economics*, **101**, 449-472.

TABLE 1: Decision Problem

	Option (a)		Option (b)	
Choice 1	\$10	if X	\$19.25	if X
	\$8	if 1, 2, 3, 4, 5, 6, 7, 8, 9, 10	\$0.50	if 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Choice 2	\$10	if 1	\$19.25	if 1
	\$8	if 2, 3, 4, 5, 6, 7, 8, 9, 10	\$0.50	if 2, 3, 4, 5, 6, 7, 8, 9, 10
Choice 3	\$10	if 1, 2	\$19.25	if 1, 2
	\$8	if 3, 4, 5, 6, 7, 8, 9, 10	\$0.50	if 3, 4, 5, 6, 7, 8, 9, 10
Choice 4	\$10	if 1, 2, 3	\$19.25	if 1, 2, 3
	\$8	if 4, 5, 6, 7, 8, 9, 10	\$0.50	if 4, 5, 6, 7, 8, 9, 10
Choice 5	\$10	if 1, 2, 3, 4	\$19.25	if 1, 2, 3, 4
	\$8	if 5, 6, 7, 8, 9, 10	\$0.50	if 5, 6, 7, 8, 9, 10
Choice 6	\$10	if 1, 2, 3, 4, 5	\$19.25	if 1, 2, 3, 4, 5
	\$8	if 6, 7, 8, 9, 10	\$0.50	if 5, 6, 7, 8, 9, 10
Choice 7	\$10	if 1, 2, 3, 4, 5, 6	\$19.25	if 1, 2, 3, 4, 5, 6
	\$8	if 7, 8, 9, 10	\$0.50	if 7, 8, 9, 10
Choice 8	\$10	if 1, 2, 3, 4, 5, 6, 7	\$19.25	if 1, 2, 3, 4, 5, 6, 7
	\$8	if 8, 9, 10	\$0.50	if 8, 9, 10
Choice 9	\$10	if 1, 2, 3, 4, 5, 6, 7, 8	\$19.25	if 1, 2, 3, 4, 5, 6, 7, 8
	\$8	if 9, 10	\$0.50	if 9, 10
Choice 10	\$10	if 1, 2, 3, 4, 5, 6, 7, 8, 9	\$19.25	if 1, 2, 3, 4, 5, 6, 7, 8, 9
	\$8	if 10	\$0.50	if 10

TABLE 2: Background Characteristics of the Subjects

Variable	Description	Mean
<i>Male</i>	= 1 if subject is a male	0.726
<i>Year</i>	year in school (1 = 1 st year, 2 = 2 nd , etc.)	2.221
<i>USA</i>	= 1 US citizen	0.926
<i>NY</i>	= 1 New York state resident	0.737
<i>Vote</i>	= 1 if voted in November 2012 election	0.274

TABLE 3: Background Characteristics of the Subjects

Variable	Mean	St. Dev.	Median
<i>Competence</i>	10.96	2.66	11
<i>General Competence</i>	4.43	1.84	4
<i>Numeracy Competence</i>	6.54	1.37	7
<i>Overconfidence</i>	9.05	6.10	8
<i>General Overconfidence</i>	5.91	4.22	6
<i>Numeracy Overconfidence</i>	3.14	3.19	3
<i>Safe</i>	5.49	2.16	5

TABLE 4: Outcomes – Descriptive Statistics

	Mean	St. Dev.	Frequencies	
<i>Trust</i>	2.930	1.75	= 5	28.3%
			= 0	16.2%
<i>Reciprocity</i>	4.513	3.71	≥ 5	53.4%
<i>Reciprocity-4</i>	3.463	2.88	≥ 4	49.5%
<i>Reciprocity-3</i>	2.476	2.16	≥ 3	49.5%
<i>Reciprocity-2</i>	1.463	1.42	≥ 2	43.9%
<i>Reciprocity-1</i>	0.658	1.10	≥ 1	42.1%

TABLE 5: Trust
(dependent variable = *Trust*; $N = 371$)

	I	II	III
<i>Overconfidence</i>	0.028 ** (0.011)	0.049 *** (0.007)	0.154 *** (0.028)
<i>Literacy</i>	0.054 (0.043)	0.057 (0.044)	0.057 (0.044)
<i>Overconfidence</i> <i>x Safe</i>			-0.020 *** (0.005)
<i>Safe</i>	-0.164 *** (0.037)	-0.186 *** (0.026)	0.066 (0.065)
<i>Reciprocity</i>		0.151 *** (0.014)	0.159 *** (0.013)
Controls:			
background?	YES	YES	YES
round?	NO	YES	YES
session?	NO	YES	YES
adj R ²	0.110	0.237	0.258
AIC	1364.2	1317.4	1308.6

Notes: Standard errors presented in parentheses are clustered by round of play.
Background controls include *Male*, *Year*, *USA*, *NY*, *Vote*, and a set of dummies for major (*Finance*, *Journalism*, *Science*, *Social Science/Humanities*, *Education*) with other business majors as the omitted variable.
*** 1%; ** 5%; * 10%

TABLE 6: Literacy Dimensions
(dependent variable = *Trust*; $N = 371$)

	coefficient	SE
<i>General Overconfidence</i>	0.035 **	(0.014)
<i>General Competence</i>	0.003	(0.021)
<i>Numeracy Overconfidence</i>	0.117 ***	(0.013)
<i>Numeracy Competence</i>	0.224 ***	(0.109)
Controls:		
background?	YES	
round?	YES	
session?	YES	
adj R ²	0.236	
AIC	1319.7	

Notes: Standard errors presented in parentheses are clustered by round of play.
Controls are all those presented in Table 5, including *Safe* and *Reciprocity*.
*** 1%; ** 5%; * 10%