The Effect of Financial Literacy and Financial Education on Downstream Financial Behaviors

Daniel Fernandes*

John G. Lynch, Jr.*

Richard G. Netemeyer*

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Daniel Fernandes (affiliation: Rotterdam School of Management, Erasmus University, The Netherlands. Email: dfernandes@rsm.nl).

John G. Lynch, Jr. (affiliation: Leeds School of Business, University of Colorado-Boulder, Boulder, CO. Email: john.g.lynch@colorado.edu).

Richard G. Netemeyer (affiliation: McIntire School of Commerce, University of Virginia, Charlottesville, VA. Email: rgn3p@comm.virginia.edu).

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Abstract

Policymakers have embraced financial education as a necessary antidote to the increasing complexity of consumers' financial decisions over the last generation. We conduct a meta-analysis of the effects of financial literacy and of financial education on financial behavior in 155 papers covering 188 prior studies. We find that interventions to improve financial literacy explain only 0.1% of the variance in financial behavior. Correlational studies that measure financial literacy find larger effects on financial behaviors. We conduct three empirical studies and we find that these effects of financial literacy diminish dramatically when one controls for psychological traits that have been omitted in prior research or when one uses instrumental variables analysis. Our findings suggest the need for re-examination of public policy around how financial education is used to improve financial decision-making.

1. Introduction

The financial environment that consumers face today has become dramatically more perilous just in one generation (Boshara et al. 2010). Baby boomers witnessed during their working careers the advent of exotic mortgage forms (Lacko and Pappalardo 2007, cf. Woodward and Hall 2012), much-expanded credit availability and new borrowing options such as payday loans, debt consolidation loans. They experienced five-fold increases in bankruptcies in the US in the last 30 years (White 2009). In the arena of retirement savings, defined benefit pensions of boomers' parents were replaced by defined contribution retirement systems, simplifying the balance sheets of employers but requiring employees to figure out how much to save, where to invest, and how to make lump sum payouts last throughout retirement (McKenzie and Liersch 2011).

Many experts observed the phenomena above and prescribed the same remedy: increased financial literacy and financial education (Hilgert et al. 2003, Greenspan 2005, Morton 2005, Lusardi and Mitchell 2007, Mishkin 2008, Dodd-Frank 2010). It is a solution that appeals to all political persuasions and to all geographies. For example, the Second Annual Child and Youth Finance Summit in Istanbul in May of 2013 brought together experts describing initiatives by the US, UK, Turkey, Chile, the Philippines, Chile, Nigeria, Egypt, Ghana, Nepal, Macedonia, Spain, the United Nations to provide financial education to millions.[1] Worldwide, employers, non-profits, and governments are creating educational interventions that have real costs and create much larger opportunity costs by supplanting some other activities, such as required high school courses that replace other electives. We estimate these real and opportunity costs to be in the billions.

[1] See http://www.childfinanceinternational.org/program-2013/summit-program-overview-2013

Creating financial literacy interventions is an obvious and common sense response to the increased complexity of the financial world. There are many domains of social policy where it is obvious what should work to redress a social problem. But as Watts (2011) has admonished, "everything is obvious (once you know the answer)." For example, it is obvious that incentives should matter, e.g., to improve educational performance. But sometimes effects are surprisingly weak (Gneezy et al. 2011), and rigorous scientific approaches can shed light on which "obvious" conclusions are true and which are not.

Academic work has concluded that financial literacy is an antecedent to various healthy financial behaviors. But several excellent recent literature reviews have drawn sharply different conclusions about the effects of financial literacy and financial education (Thaler and Sunstein 2008; Willis 2009, 2011; Collins and O'Rourke 2010; Hira 2010; Adams and Rau 2011). Adams and Rau (2011, p. 6) conclude: *"*Perhaps one of the most robust findings across the literature is that financial literacy (a cognitive factor…) plays a key role in financial preparation for retirement. Both experimental and nonexperimental studies demonstrate that understanding the basic principles of saving, such as compound interest, has a direct effect on financial preparation. This effect holds after controlling for demographic characteristics." Willis (2009, p. 456) disagrees: "What degree of effectiveness should appropriately be claimed for the current model of financial literacy education? As yet, none, and the barriers to research that would soundly demonstrate effectiveness may be insurmountable."

We attribute disagreements about this literature to two factors. First, prior analysts like those just cited have conflated two kinds of studies. One type includes experimental and quasi-experimental studies of the effects of financial education *interventions.* A second type includes correlational and econometric studies that *measured* financial literacy by percent of correct

answers on tests of financial knowledge and predicted downstream financial behaviors. We refer to these two types of studies as "manipulated financial literacy" and "measured financial literacy" below. Second, prior reviews relied on qualitative summaries rather than statistical summaries via transparent meta-analysis. Meta-analysis can test the magnitude of the average effect of an independent variable, whether there is systematic variation in effect-sizes across studies and, if so, what differences among the studies could explain this variation (Lipsey and Wilson 2001).

We report the first systematic meta-analysis of this literature. Our working hypothesis was that we would find weak effects of financial literacy in studies of financial education *interventions* intended to improve downstream financial behaviors. In contrast, we expected to find stronger effects in econometric studies that predicted downstream financial behavior based on measured financial literacy, controlling for various demographics. We find strong support for our hypothesis, and we propose and test three explanations for the gap between the moderate effect-size of measured financial literacy and the miniscule effect of interventions that were intended to improve financial literacy. We then follow up this meta-analysis with empirical studies suggesting that the larger effect-sizes for measured literacy studies may be due in part to the correlation of measured financial literacy with other traits that are omitted from prior research. These omitted variables might plausibly produce overestimates of the effect of financial literacy on the financial behaviors studied.

2. Meta-Analysis

2.1. Meta-Analysis Overview

In a traditional qualitative literature review, the authors may rely on a convenience sample of studies, and the rules for inclusion and treatment are often unstated. There is often room for interpretation, and flaws in studies are taken in a one-off fashion. In contrast, meta-analysis makes explicit the rules for inclusion and exclusion of studies, as well as the coding procedures to characterize similarities and differences among studies. Further, meta-analysis examines roughly the same independent variable to dependent variable relationships. The key statistic used to summarize the findings is an effect-size that varies continuously.

In a typical meta-analysis, there are four basic questions that the researcher asks:

1. Pooling across all studies, is there a statistically significant effect?

2. If there was a significant effect, what is the magnitude of the effect? Because different papers use different operational definitions and units of variables, it is typical to use some standardized measure of the relationship between independent and dependent variables.

3. Was there systematic variation in effect-sizes across studies beyond what would be expected by chance?

4. If variation across studies is significant, are there systematic features of studies that explain why effect-sizes are larger for studies with those features?

We examined all studies that *manipulated* financial literacy with some education intervention or that *measured* financial literacy with well-known psychometric scales. We quantified effect-sizes by the (partial) *r* of manipulated or measured financial literacy on measures of financial behaviors: saving; planning for retirement; absence of debt, stock

ownership and investment decisions, cash flow management, activity in retirement plans, and financial inertia such as choice of default options and payment of unnecessary fees.

Via a computerized bibliographic search, we identified 155 papers covering 188 non-redundant studies and included them in a meta-analysis. Appendix 1 presents the authors of each paper, their respective effect-sizes, and relations investigated. Studies in Appendix 1 are sorted by whether the independent variables were manipulated or measured financial literacy and within each group and by the type of design and analysis employed. We also coded all identified studies in terms of the financial behavior dependent variable examined and sample characteristics. Appendix 2 provides the reference list of the papers included in the meta-analysis. Most studies reported multiple effect-sizes across dependent variables. We averaged the effect-sizes for each study that manipulated financial literacy and for each study that measured financial literacy. Using this approach, 188 effect-sizes were available: 87 effects of interventions (manipulated financial literacy) and 101 effects of measured financial literacy.

Among the studies that manipulated financial literacy, we coded for what type of educational intervention was conducted (high school financial education, counseling, seminar or workshop, multiple sources of education, and exposure to information such as a newsletter or a fair). We also coded for their method. The majority of studies (76 in total) were quasi-experiments. Only 11 studies had better designs with randomized control trials. In addition, when reported, we coded for the hours of instruction in the interventions and for the delay in months between the intervention and measurement of behavior.

Among the studies that measured financial literacy, we coded for what type of analysis was performed. The majority of studies (78 in total) performed only Ordinary Least Squares (OLS) regressions to estimate the effect of financial literacy on downstream financial behavior.

Only 23 studies used econometric analyses with instrumental variables to control for endogeneity on the effect of measured financial literacy on financial behaviors.

We followed common guidelines for meta-analysis to compute and integrate the effect-sizes (Rosenthal 1984, Hedges and Ingram 1985, Lipsey and Wilson 2001). We selected the (partial) correlation coefficient, *r*, as the effect-size metric because it is an easy-to-interpret, scale-free measure imputable from a variety of statistics. Calculation of effect-sizes was made using the statistical information in the papers. Direct calculation of effect-size from group mean contrasts or frequency distributions was difficult in cases in which means and standard deviations were not reported. Under those circumstances, we calculated effects sizes through a range of statistical information (e.g., Student's *t, F* ratios, χ^2) via the formulae given by Lipsey and Wilson (2001). When necessary, we solicited additional information from authors.

Because the true relationship between variables is influenced by sample size, we first weighted effects by the inverse variance. Empirically in our sample, smaller studies reported larger effect-sizes. Given that it requires a larger effect-size to reach statistical significance with a smaller N, this might imply a publication bias favoring significant results. We examined significance for the mean effect-size by calculating the confidence intervals of the effect-sizes to determine whether the confidence interval includes 0.

2.2. Meta-Analysis Results

2.2.1. Measured Financial Literacy versus Financial Education Interventions

Our most striking finding was that financial education interventions have statistically significant but miniscule effects, explaining about 0.1% of the variance in downstream financial behaviors studied (87 effect-sizes, $r^2 = .0011$, $r = .033$, $CI_{95} = .030$ to $.036$). High school courses

with many contact hours produce the largest effects, but even here, exposure to a course explained only 0.18% of the variation in downstream behaviors studied. By social science and education conventions, $r \leq .10$ is a small effect-size; $.10 < r < .40$ is medium; and $r \geq .40$ is large.

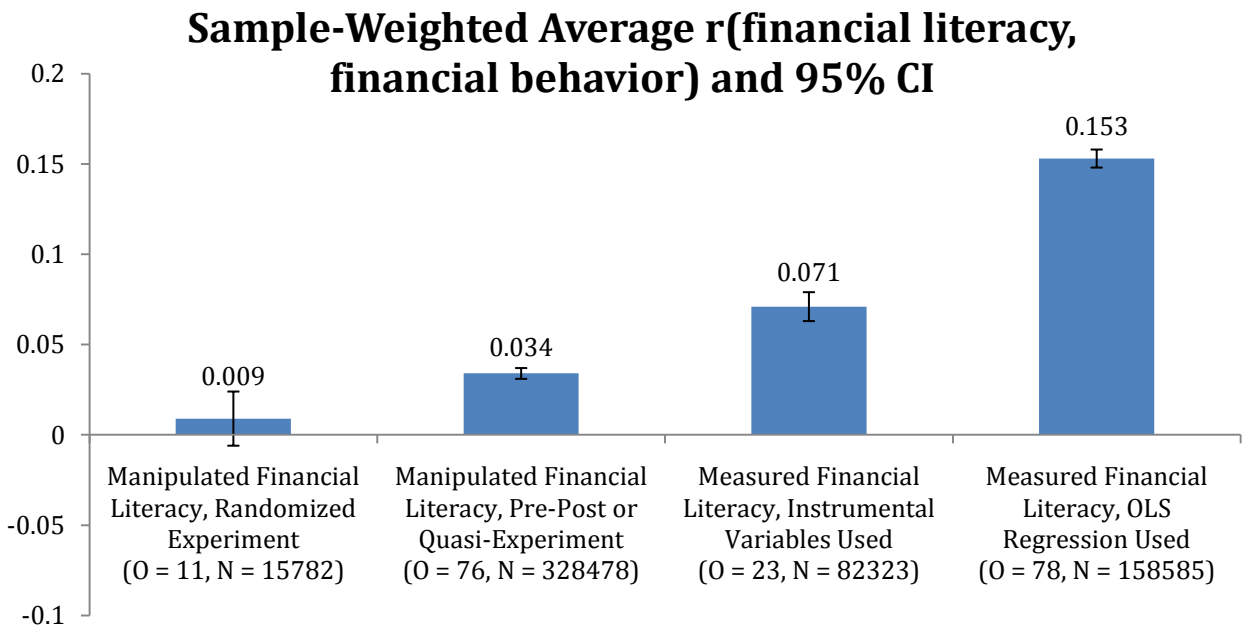
As hypothesized, we found a larger effect-size for measured financial literacy (101 effect-sizes, $r^2 = .0179$, $r = .134$, $CI_{95} = .13$ to 138) than for manipulated financial literacy. Figure 1 presents a summary of the results from the meta-analysis. Within these groups of studies, there was strong variation in effect-size not due to outlier effect-sizes (see funnel plots in Figures 1a and 1b in Appendix 3). A trimming procedure to control for possible outliers yielded very similar results. Intervention studies with randomized control group designs found significantly smaller effects (11 studies: sample-weighted $r = .009$, CI_{95} is from -.006 to .024) than studies with weaker pre-post designs (76 studies: sample weighted $r = .034$, CI_{95} is from .031 to .037).

Among studies of measured literacy, one might distinguish studies using simple OLS regression from econometric studies using instrumental variables and two-stage least squares (2SLS). Arguably, properly chosen instruments can control for reverse causation and are similar to quasi-experiments when the instrument for financial literacy is not plausibly caused by the dependent variable (Angrist and Krueger 2001). A proper instrument should predict financial literacy but have no partial relationship with the financial behavior in question except through financial literacy. It is difficult to prove the validity of an instrument, and consequently many authors will use instrumental variables analyses only for robustness analysis (e.g., Morse 2011) or take the view that estimates using instrumental may be, in some cases, more rather than less biased compared to OLS estimates (Bound et al. 1995, Larcker and Rusticus 2010).

We found smaller effects for studies using instrumental variables than for studies lacking those controls. For papers that used instrumental variables, the sample-weighted effect-size of

measured financial literacy on behavior is significantly lower (23 studies: r = .071, CI_{95} is from .064 to .078) than for papers that did not use instrumental variables (78 studies: r = .153, CI_{95} is from .148 to .158). Moreover, the 23 studies that used instrumental variables found weaker effect-sizes using instrumental variables analysis than using OLS regressions (r = .095, CI_{95} is from .088 to .102).[2] These results indicate that studies with better designs and analyses find weaker effects of manipulated and of measured financial literacy.

Figure 1: Study Method Affects Average Partial Effect-Size in Meta-Analysis of the Relationship between Manipulated or Measured Financial Literacy on Financial Behavior



[2] Lusardi and Mitchell (2013) claim that studies using instrumental variables find larger effect-size estimates than would be found by OLS. They point to two specific studies. But our meta-analysis of the entire set of papers using instrumental variables clearly shows the opposite to be true, on average. Moreover, 8 of the 23 studies in our meta-analysis using instrumental variables either report failing tests for weak instruments in the first stage regression or do not report such tests; 15 report passing tests for weak instruments (cf. Angrist and Pischke 2009). In the 8 papers in the first group, we find no difference between average effect-size with OLS (average effect-size = .106) and instrumental variables (average effect-size = .109). In the 15 studies with good instruments, authors report stronger effects with OLS (average effect-size = .092) than with instrumental variables (average effect-size = .060). See Appendix 4, Tables 1 and 2. In some studies, unstandardized coefficients are dramatically larger with instrumental variables compared to OLS (Meier 2011), but standardized coefficients clearly show smaller average effects with instruments.

Details of the papers that used instrumental variables are presented in Appendix 4. Appendix 4 also reports subsidiary analyses of how effect-size depends on the nature of the financial behavior studied and type of intervention. For every behavior, effect-size of manipulated financial literacy is much less than of measured financial literacy.

Our meta-analysis so far makes three main points. First econometric and correlational studies of measured financial literacy show significantly larger effect-sizes than studies of the effects of manipulated financial education interventions. Interventions on average explain only 0.1% of the variance in the behaviors they attempt to influence.

Second, within each subset (manipulated and measured), more careful methodology leads to smaller effect-sizes. True randomized experiments lead to smaller effect-size than less rigorous experimental designs, consistent with Collins and O'Rourke (2010). Among studies of measured literacy, studies using instrumental variables find smaller effects than studies using simple cross sectional designs and OLS. Moreover, studies that use instrumental variables find smaller effects using that estimation strategy than when they use OLS on the same data sets.

Third, one can see from Figure 1 that effect-size estimates using instrumental variables are far higher than from experiments. Econometric studies using instrumental variables for financial literacy are sometimes held up as equivalent to quasi-experiments in power to support causal claims, notwithstanding that these studies do not show a way to translate to effective educational interventions. But there is no overlap between the 95% confidence intervals for effects of financial literacy in these studies using instrumental variables and either the group of quasi-experiments, or the true randomized control experiments that remain the gold standard for causal inference. Something is causing these studies using instrumental variables to produce larger effect-sizes, even though instrumental variables seem to be partially effective in

controlling for alternative explanations present in correlational studies that do not use instrumental variables. We will return to this issue in Conclusion of our paper.

2.2.2. Why Does Manipulated Literacy Have Weaker Effects than Measured Literacy?

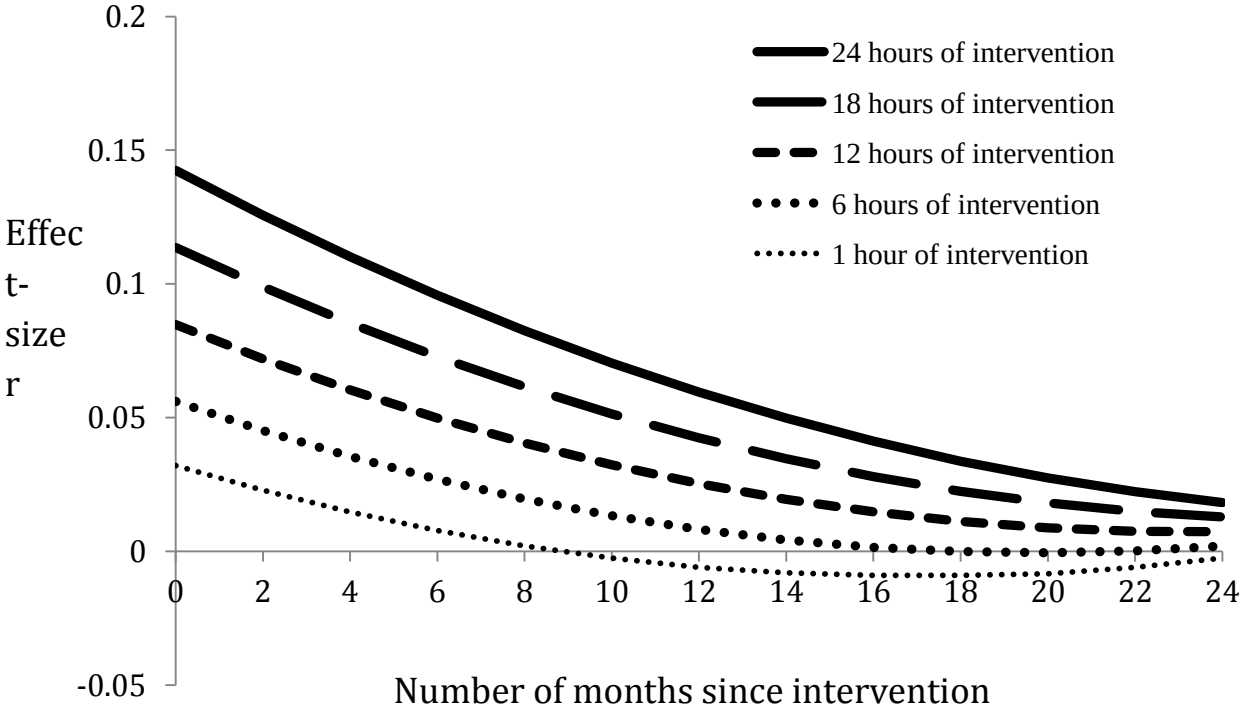
Why are effects of financial education interventions so weak, and why are effects stronger when financial literacy is measured rather than manipulated? We offer two answers to these questions pertaining to intervention studies and a third pertaining to measured literacy studies.

Explanation 1. Intervention effects decay over time: the case for "just in time" financial education. Effect-sizes for interventions may be small because effects of interventions decay. We examine the effects of the intensity of the intervention and of the delay between intervention and measurement of financial behavior using meta-regression analysis. Most studies omit key information about intervention details, but 33 papers reported a mean of 9.7 hours of instruction (SD = 11.9), and 29 papers reported a mean delay of 11 months between intervention and measurement of behavior (SD = 12.4). Our model regressed effect-size (*r* or partial *r*) on linear and quadratic effects of mean-centered number of hours of instructions, number of months between intervention and measurement of behavior, and the interaction of their linear effects. Figure 2 shows the estimated response surface from this meta-regression model.

The meta-regression analysis revealed a positive linear simple effect of the number of hours of instructions on the effect-sizes (B = .005, SE = .001, t = 4.78, p = .0001). More hours of instruction produce larger effects on downstream behaviors at an average delay. This effect was qualified by a marginally significant negative effect of the quadratic term (B = -.0001, SE = .00007, t = -1.77, p = .09), suggesting that the effect of an additional hour of instruction on the

effect-size reduces with increasing hours of instruction. In addition, there was a negative effect of delay of instructions in number of months between intervention and measurement of behavior on the effect-sizes (B = -.003, SE = .0009, t = -3.21, p = .004) at average number of hours of instruction. The longer the delays between intervention and measurement of behavior, the smaller effects on downstream behaviors. This effect was also qualified by a positive quadratic term (B = .00014, SE = .00004, t = 3.41, p = .003), suggesting that the effect of an additional month of delay on the effect-size reduces with increasing delay after the instruction. Finally, those two factors (number of hours of instruction and delay after instructions) interact (B = -.0001, SE = .00003, t = -3.46, p = .002).

Figure 2: Partial Correlation of Financial Education Interventions on Financial Behavior by Number of Hours of Intervention and Number of Months since Intervention



In Figure 2above, decay over time is stronger for larger interventions. Importantly, at delays of 20 months or greater, there is no significant effect of even 24 hours of instruction nor are there significant differences as a function of amount of instruction. But brief interventions at short delays have effects equal to more intensive interventions at long delays. We observe equal effects for 6 hours of intervention at no delay and 18 hours of intervention at 10 months of delay, and equal effects of one hour of instruction at no delay and 12 hours at 10 months delay. We argue below that these findings militate toward "just in time" financial education rather than lengthy education years before the behaviors it is intended to change.

Explanation 2. Financial education produces weak effects on financial knowledge that is presumed to cause financial behavior. Another explanation for why the effects of interventions are much weaker than the effect of measured financial literacy is that financial education yields surprisingly weak changes in financial knowledge presumed to cause financial behavior. In 12 papers reporting effects of interventions on both measured literacy (knowledge) and some downstream financial behavior, the interventions explained only 0.44% of the variance in financial knowledge. By comparison, meta-analyses in other domains of education show interventions explain 5 to 13 times as much variance in acquired knowledge from science and math instruction (2.25%), organizational and work setting interventions (5.76%), and special topic interventions from creative thinking to career counseling (5.29%) (Lipsey and Wilson 1993). Something is amiss in how financial education is now being delivered.

Explanation 3. Is there omitted variables bias in studies of effects of measured financial literacy? Perhaps measured financial literacy has larger effects than manipulated financial literacy because effect-size estimates for measured financial literacy in econometric studies may

be inflated. Scores on financial literacy tests may predict behavior because of their correlation with other unmeasured variables. Our meta-analysis indicates that the prior research that controls for omitted variable bias with instrumental variables on average finds weaker effects than studies that use OLS regression.

In our empirical studies, we replicate results found in the 78 studies in our meta-analysis that used OLS to examine links between measured financial literacy and financial behavior; we show how results change with addition of certain traits that are arguably correlated with both financial literacy and with the financial behaviors predicted by financial literacy. In addition, we attempt to control for omitted variable bias by using instrumental variables, similar to the 23 studies in our meta-analysis that examined links between measured financial literacy and financial behavior using instrumental variables. Our designs are simple cross-sectional designs typical of the 78 OLS studies, and thus so not permit strong claims about causality. Our results do however serve as a concrete evidence of the possibility of omitted variable bias in a large body of measured literacy studies just analyzed.

3. Empirical Studies

To test whether apparent effects of measured financial literacy on financial behaviors might be due to confounding of literacy with other omitted psychological traits in the 75 OLS regression studies included in our meta-analysis, we conducted three primary research surveys of U.S. English-speaking adults. Studies 1 (N=103) and 2 (N=543) used samples provided by the online panel company QUALTRICS, and Study 3 used a true probability sample of U.S. adults aged 21-65, provided by Knowledge Networks (N=506). Each survey contained several items measuring financial literacy, financial behaviors, psychological traits, and demographic

characteristics. Appendix 5 shows these measures across studies; Appendix 6 elaborates on the procedures and results of all studies; and Appendix 6 Tables 1, 2, and 3 shows summary statistics and correlations for all variables of Studies 1, 2, and 3.

Prior work had not followed rigorous psychometric procedures to validate measures of financial literacy. Thus, in Studies 1 and 2, we follow well-known scientific recommendations to derive a 13-item uni-dimensional financial literacy scale with excellent psychometric properties (e.g., Nunnally and Bernstein 1994, Haynes et al. 1995, Netemeyer et al. 2003, Linacre 2009, DeVellis 2012). See Appendix 6 sub-section "Deriving the Financial Literacy Scale" for details. In Studies 2 and 3, we used scores on the resultant 13-item measure of financial literacy to predict five behaviors shown in our meta-analysis to be predicted by financial literacy. We hoped to replicate prior findings that financial literacy predicted these financial behaviors, controlling for demographics. We expected the effects of financial literacy to diminish when we added measures of four psychological traits that might be correlated with both financial literacy and with the financial behaviors studied.

We predicted each behavior with demographics, financial literacy, and four trait constructs that were potentially correlated with both financial literacy and the financial behaviors: a 5-item scale of confidence in financial information search (Bearden et al. 2001); a 6-item measure of propensity to plan for money-long term (Lynch et al. 2010); a 1-item (Study 2) or 5-item (Study 3) measure of willingness to take financial risks (Weber et al. 2002); and an 11-item (Lipkus et al. 2001; Study 2) or 8-item (Soll et al. 2013; Study 3) numeracy scale. We compared three hierarchical regression models: 1) Model 1 - demographics alone; 2) Model 2 - demographics + financial literacy; and 3) Model 3 - demographics + financial literacy + four correlated traits. The results of all of these analyses are summarized below, and Appendix 6

(Empirical Studies: Regression Results) contains a more detailed description of the rationale, procedures, and results of these analyses.

In Studies 2 and 3, for four of five financial behaviors, we replicated prior findings showing that financial literacy significantly predicted the financial behaviors after controlling for demographics (Model 2). (The effect of financial literacy was only marginal at $p < .07$ for the fifth behavior of incurring avoidable credit and checking fees.) But in both studies, for all five behaviors R^2 values changed dramatically from model 2 to Model 3 that added the covariates of confidence in financial information search, propensity to plan, willingness to take financial risks, and numeracy. R^2 values increased by an average of 39% in Study 2 and 38% in Study 3 (mainly due to propensity to plan, confidence, and willingness to take investment risks). Tables 4 and 5 of Appendix 6 show Model 3 results for Studies 2 and 3, respectively.

More critically, adding those variables caused effects of financial literacy to become non-significant for four of five financial behaviors in Study 2 and three of five in Study 3. In both studies, financial literacy remained a small but significant predictor for the four-item measure of positive savings and investment behaviors, and in Study 3, it remained significant for figuring out needed savings for retirement in Study 3.

Robustness analyses of Studies 2 and 3 used two-stage least squares; we used a scale of need for cognition (Epstein et al. 1996) as an instrument for financial literacy not plausibly caused by financial behaviors. As is the norm in 2SLS, the residual term of predicting NFC with the four traits (i.e., numeracy, confidence in financial information search, planning for money long-term, and willingness to take investment risk) becomes the instrument for financial literacy (Angrist and Pischke 2009). The residual term was uncorrelated with all financial behavior dependent variables, and the residual term could also not operate as a predictor of the behaviors

through the four traits that it was predicted by (Bound et al. 1995, Larcker and Rusticus 2010). See Appendix 6 sub-section "Empirical Studies: 2SLS Results" for details. We included confidence in financial information search, propensity to plan, willingness to take financial risks, numeracy and demographic covariates predicting behaviors.

Tables 6 and 7 of Appendix 6 show the results. In both studies, for all 5 behaviors, financial literacy was not significant in these models with instrumental variables. Other robustness analyses of Study 3 demonstrated that effects of confidence in financial information search were not plausibly caused by its correlation with general self-efficacy (Chen et al. 2001), and effects of propensity to plan were not plausibly caused by its correlation with a delay of gratification (Hoerger and Quirk 2011) and self-control (Maloney et al. 2012).

Because all constructs were measured in the same survey, it is not possible to make claims that our covariates of confidence in information search, propensity to plan, willingness to take financial risks, and numeracy are causes of the financial behaviors studied. The data are equally consistent with four interpretations: 1) those covariates cause financial behaviors, with financial literacy spuriously related to financial behaviors; 2) financial literacy causes those covariates which then in turn cause the financial behaviors; 3) financial literacy causes the financial behaviors, which in turn cause the covariates; 4) the financial behaviors cause both financial literacy and the covariates. Other papers report similar cross-sectional data to our studies and assert a causal link from financial literacy to planning and from planning to financial behavior (e.g., Lusardi and Mitchell 2007). Although we are not entirely persuaded by the evidence offered in these prior studies, our data similarly cannot sort this out. When two or more interpretations are consistent with an observed data pattern, all theories consistent with the data

should logically have increased posterior probability in a Bayesian updating process (Brinberg et al. 1992).

4. Conclusion

The widely shared intuition that financial education should improve consumer decisions has led governments, businesses, and NGOs worldwide to create interventions to improve financial literacy. These interventions cost billions of dollars in real spending and larger opportunity costs when these interventions supplant other valuable activities. Our meta-analysis revealed that financial education interventions studied explained only about 0.1% of the variance in the financial behaviors studied. Education effects on knowledge of material taught were also small compared to effects of education in other seemingly comparable domains.

4.1. Study Methodology Affects Apparent Size of Financial Literacy Effects

Our meta-analysis found much larger effects on financial behavior when financial literacy was measured rather than manipulated. Our Studies 2 and 3 suggested larger effects may be due to omitted variable bias from failure to control for alternative traits correlated with financial literacy. Our cross-sectional research designs do not permit positive claims that these other traits cause the financial behaviors. We instead make a negative point: past work considered to support a causal role for financial literacy might need revisiting – particularly the 78 studies in our meta-analysis that used OLS and produced far larger effects of financial literacy on financial behavior than studies using other methods. We found that effects of financial literacy diminished when other traits ignored by prior researchers were included in the model

(Model 3 versus Model 2) and if we used instrumental variables to control for reverse causation from behavior to financial literacy in Model 3 for each behavior.

In our meta-analysis, we likewise found much weaker effects of measured financial literacy in studies that made some attempt to control for endogeneity and omitted variable bias via instrumental variables analysis. Studies with instrumental variables produced a small but significant estimate of the positive effect of financial literacy on financial behaviors, explaining on average about 0.5% of the variance in the financial behaviors studied. That estimate is significantly higher than the 0.1% effect-size across all experiments or the 0.01% effect-size estimate coming from experimental studies that used true randomized control group designs.

This discrepancy requires some explanation. One interpretation is that intervention studies show much smaller effects than econometric studies with instrumental variables because the instruments used for financial literacy were not entirely successful – i.e., they may not have in controlled for other stable omitted traits that might precede the dependent variables in time but be correlated with both financial literacy scores and with the behaviors financial literacy has been held to cause. If so, this would imply upward bias in even the small effect-sizes uncovered using instruments. For example, with an instrument such as exposure to high school-level economics, one might argue that the instrument might influence financial behavior via its correlation with general intelligence of some other stable trait such as our covariates (Meier 2011). It is sometimes difficult to tell from published reports why a particular instrument was chosen or what other instruments might have been tried. This mirrors ambiguities in reporting of experiments with covariates (cf. Simmons et al. 2011). Arguably, if the instruments were successful in producing a design comparable to a quasi-experiment, effect-sizes should match what one finds in intervention studies that manipulate financial education.

There is an alternative interpretation for the greater magnitude of effects of measured literacy in the 23 studies with instrumental variables compared to the 87 studies of manipulated financial literacy. Perhaps measured literacy reflects the cumulative effects of all information over an individual's lifetime that affects financial knowledge. In contrast, the manipulated financial literacy studies test the effect of a small subset of that information contained in the educational "dose." This is analogous to the finding in marketing that a given advertisement may have a very small effect on behavior, but the long-term effects of cumulative advertising can be strong (Mela et al. 1997). This interpretation is possible, but it begs the question of how much education would be required for a specific initiative to have a measurable effect, and at what cost. Our view is that the larger effect-sizes in 23 instrumental variables studies of measured literacy should not be used as a justification for further expenditures on financial education of the same sort tried so far until researchers are able to show larger effects of financial education interventions or, to test the "cumulative" effect interpretation, use appropriate designs to estimate long-term cumulative effects, as in these marketing studies.

4.2. Implications for Policy to Help Consumer Decisions

It is clear from our findings that different approaches to financial education are required if one expects to produce effects on behavior. What is unclear is why educational interventions investigated thus far have been unsuccessful. Our findings provide hints for future directions. Perhaps future education should teach soft skills like propensity to plan, confidence to be proactive, and willingness to take investment risks more than content knowledge about compound interest, bonds, etc. (Hader et al. 2013).

Moreover, given our findings in Figure 2 showing decay of effects of financial education

interventions, content knowledge may be better conveyed via "just-in-time" financial education tied to a particular decision, enhancing perceived relevance and avoiding forgetting. It may be difficult to retrieve and apply knowledge from education to later personal decisions with similar relevant principles but different surface details (Thompson et al. 2000), particularly decisions coming years after the education. Our findings suggest re-examining efforts at child and youth financial education, particularly if intended to affect behaviors a significant delay.

Thus far we have not considered alternatives to financial education. An open question is the role that financial education should play in the policy mix. Others have advocated defaults, "nudges", and "choice architecture" such as opt-out retirement savings plans as less costly and more effective alternatives to financial education (Choi et al. 2003, Thaler and Sunstein 2008, Boshara et al. 2010). But defaults work best when almost all consumers have similar needs. When consumers' needs are heterogeneous, one needs to know something to decide for oneself.

Here, "just-in-time" financial education may have promise, alone and embedded in decision support systems that help select tailored options. Just-in-time financial education might be embedded in recommender systems close to the time of financial decisions or in the form of coaching, which has the advantage of high relevance, low propensity for forgetting between information receipt and behavior, and opportunities to learn from feedback. Such tools are encouraged by "Smart Disclosures" that require sellers of financial products to disclose their features in a machine-readable form that can then be packaged by trustworthy "infomediaries" to develop recommender systems (Lynch and Woodward 2009, Thaler 2012, White House Executive Office of the President National Science and Technology Council 2013). Future research should focus on these kinds of tools and on the problem of how to reach consumers at a point in time close to their decision when they are impatient for closure.

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Appendix 1: Studies Included in the Meta-Analysis, Sorted by Method (Tables 1 – 4)

Table 1: Studies of Manipulated Financial Literacy with Randomized Experiments

	Study	Effect-size r(financial literacy, behavior)	Dependent Variable						
			Save	Plan	Debt	Cash flow	Invest	Plan active	Inertia
1	Carpena, Cole, Shapiro, and Zia (2013)	0.02				X			
2	Clark, Maki and Morril (2012)	0.02					X		
3	Cole et al. (2012)	-0.03	X						
4	Cole, Sampson, and Zia (2011) sample 1	-0.03				X			
5	Cole, Sampson, and Zia (2011) sample 2	-0.07				X			
6	Drexler, Fischer, and Schoar (2011) sample 1	0.02	X			X	X		
7	Drexler, Fischer, and Schoar (2011) sample 2	0.06	X			X	X		
8	Duflo and Saez (2003)	-0.01						X	
9	Gaurav, Cole, and Tobacman (2011)	0.08		X					
10	Giné, Karlan and Ngatia (2013)	0.04		X					
11	Seshan and Yang (2012)	-0.04	X						
Total	*Sample Weighted Average Effect-size*	*0.009*	4	2	0	5	3	1	0

Table 2: Studies of Manipulated Financial Literacy with Pre-Post or Quasi-Experiments

	Study	Effect-size r(financial literacy, behavior)	Dependent Variable						
			Save	Plan	Debt	Cash flow	Invest	Plan active	Inertia
12	Agarwal et al. (2010) sample 1	0.03				X			
13	Agarwal et al. (2010) sample 2	0.03				X			
14	Bauer et al (2011)	0.12	X		X				
15	Bayer, Bernheim, and Scholz (2009)	0.07						X	
16	Bell, Gorin and Hogarth (2009)	0.02	X	X		X		X	
17	Bernheim and Garrett (2003)	0.07						X	
18	Bernheim, Garrett and Maki (2001)	0.01	X				X		
19	Choi, Laibson and Madrian (2005)	0.01					X		
20	Choi, Laibson and Madrian (2007)	0.03						X	
21	Choi, Laibson and Madrian (2008)	0.02					X		X
22	Clancy, Ginstein-Weiss and Schreiner (2001)	0.06	X						
23	Clark and Schieber (1996)	0.04						X	
24	Clark, Ambrosio, McDermed, and Sawant (2006)	0.01		X			X		
25	Clark, Morrill and Allen (2010)	0.01							X
26	Cole and Shastry (2010)	-0.004					X		

	Study	Effect-size r(financial literacy, behavior)	Dependent Variable						
			Save	Plan	Debt	Cash flow	Invest	Plan active	Inertia
27	Collins (2011)	0.02	X		X		X		
28	Courchane and Zorn (2005)	0.01	X		X				
29	Danes (2004)	0.14			X	X			X
30	Danes, Huddleston-Casas and Boyce (1999)	0.13	X	X	X		X		
31	Ding, Quercia, and Ratcliffe (2008)	0.04			X				
32	Elliehausen, Lindquist, and Staten (2007)	0.04			X				
33	Garman et al. (1999)	0.12	X	X	X	X	X		
34	Goda, Manchester, and Sojourner (2012)	0.01						X	
35	Grinstein-Weiss et al. (2011)	0.02	X	X	X		X		
36	Guo, Sherraden and Johnson (2009)	0.04						X	
37	Han, Grinstein-Weiss and Schreiner (2007) study 1	0.06	X						
38	Han, Grinstein-Weiss and Schreiner (2007) study 2	0.06	X						
39	Hartarska and Gonzalez-Vega (2005)	0.04							X
40	Hartarska and Gonzalez-Vega (2006)	0.06							X
41	Hartarska, Gonzalez-Vega and Dobos (2002) sample 1	0.10							X
42	Hartarska, Gonzalez-Vega and Dobos (2002) sample 2	0.03							X
43	Haynes-Bordas, Kiss and Yilmazer (2012)	0.04	X				X		
44	Hershey et al. (1998)	0.14		X					
45	Hershey, Mowen and Jacobs-Lawson (2003)	0.12	X	X					
46	Hira and Loibl (2005a)	0.01			X				
47	Hira and Loibl (2005b)	0.11						X	
48	Hirad and Zorn (2001)	0.05			X				
49	Kim, Garman, and Sorhaindo (2003)	0.09							X
50	Kim, Kratzer, and Leech (2001)	0.08							X
51	Kim, Sorhaindo, and Garman (2003)	0.21							X
52	Kimball and Shumway (2007)	0.06					X		
53	Loibl and Hira (1999)	0.21							X
54	Loibl, Hira and Rupured (2006) study 1	-0.03			X				
55	Loibl, Hira and Rupured (2006) study 2	-0.01			X				
56	Lusardi (2002)	0.03	X						
57	Lusardi (2005)	0.03	X						
58	Lyons, Chang and Scherpf (2006)	0.06			X	X			
59	Lyons, White and Howard (2008) study 1	-0.001							X
60	Lyons, White and Howard (2008) study 2	0.002							X
61	Maki (2004)	0.08					X		
62	Mandell (2005)	0.02	X		X				

	Study	Effect-size r(financial literacy, behavior)	Dependent Variable						
			Save	Plan	Debt	Cash flow	Invest	Plan active	Inertia
63	Mandell (2006a)	0.02							X
64	Mandell (2006b)	0.02							X
65	Mandell (2009a)	0.05	X						
66	Mandell (2009b)	0.04	X		X				
67	Mandell and Klein (2009)	0.03	X		X				
68	Mastrobuoni (2007) study 1 sample 1	0.01						X	
69	Mastrobuoni (2007) study 1 sample 1	0.01						X	
70	Mastrobuoni (2007) study 2 sample 2	0.01						X	
71	Mastrobuoni (2007) study 2 sample 2	-0.03						X	
72	Mills, Patterson, Orr and DeMarco (2004) sample 1	-0.02	X	X			X		
73	Mills, Patterson, Orr and DeMarco (2004) sample 2	0.03	X	X			X		
74	Muller (2003a)	0.01					X		
75	Muller (2003b)	-0.03		X					
76	Peng, Bartholomae, Fox and Cravener (2007)	0.03	X						
77	Schreiner and Sherraden (2007)	0.05	X						
78	Schreiner et al. (2001)	0.08	X						
79	Shim, Xiao, Barber, and Lyons (2009)	0.02	X		X				
80	Spader and Quercia (2008) sample 1	0.001		X					X
81	Spader and Quercia (2008) sample 2	0.02		X					X
82	Tennyson and Nguyen (2001)	0.05	X		X		X		
83	Varcoe, Martin, Devitto and Go (2005)	0.12				X			X
84	Way and Holden (2009) sample 1	0.03	X	X		X	X		
85	Way and Holden (2009) sample 2	0.03	X	X		X	X		
86	Wiener, Baron-Donovan, Gross and Block-Lieb (2005)	0.20	X						
87	Xiao, Serido and Shim (2010)	0.01			X		X		
Total	*Sample Weighted Average Effect-size*	*0.034*	29	14	20	9	16	9	18

Table 3: Studies of Measured Financial Literacy with Instrumental Variables (effect-sizes from OLS regressions are inside parentheses)

	Study	Effect-size r(financial literacy, behavior)		Dependent Variable					
			Save	Plan	Debt	Cash flow	Invest	Plan active	Inertia
88	Alessie, van Rooij and Lusardi (2011)	0.12 (0.17)		X					
89	Behrman, Mitchell, Soo and Bravo (2010)	0.09 (0.12)					X		
90	Bucher-Koenen and Lusardi (2011)	0.08 (0.08)		X					

	Study	Effect-size r(financial literacy, behavior)	Dependent Variable						
			Save	Plan	Debt	Cash flow	Invest	Plan active	Inertia
91	Calcagno and Monticone (2011)	0.06 (0.11)					X		
92	Disney and Gathergood (2011)	0.08 (0.05)				X	X		
93	Duca and Kumar (2012)	0.01 (0.05)		X					
94	Fornero and Monticone (2011) sample 1	0.05 (0.06)						X	
95	Fornero and Monticone (2011) sample 2	0.08 (0.05)						X	
96	Giofré (2012)	0.11 (0.06)					X		
97	Jappelli and Padula (2011) sample 1	0.04 (0.06)					X		
98	Jappelli and Padula (2011) sample 2	0.06 (0.08)					X		
99	Kimball and Shumway (2007)	0.11 (0.31)					X		
100	Klapper, Lusardi, and Panos (2011)	0.07 (0.17)				X			X
101	Kotlikoff and Bernheim (2001)	0.08 (0.09)	X						
102	Lusardi and Mitchell (2007a)	0.09 (0.12)		X					
103	Lusardi and Mitchell (2009)	0.05 (0.08)	X						
104	Lusardi and Mitchel (2011)	0.06 (0.07)		X					
105	Monticone (2010a)	0.04 (0.08)							X
106	Mullock and Turcotte (2012)	0.15 (0.15)	X	X					
107	Sekita (2011)	0.04 (0.07)		X					
108	van Rooij, Lusardi and Alessie (2008)	0.06 (0.12)		X					
109	van Rooij, Lusardi and Alessie (2011)	0.06 (0.18)					X		
110	Yoong (2010)	0.08 (0.19)					X		
Total	*Sample Weighted Average Effect-size*	*0.071 (0.060)*	3	8	0	2	9	2	2

Table 4: Studies of Measured Financial Literacy with OLS Regression

	Study	Effect-size r(financial literacy, behavior)	Dependent Variable						
			Save	Plan	Debt	Cash flow	Invest	Plan active	Inertia
111	Abreu and Mendes (2010)	0.11					X		
112	Agnew and Szykman (2005) study 1	0.26							X
113	Agnew and Szykman (2005) study 2	0.32							X
114	Agnew, Bateman, and Thorp (2012)	0.11		X					
115	Agnew, Szykman, Utkus, and Young (2007) sample 1	0.33						X	
116	Agnew, Szykman, Utkus, and Young (2007) sample 2	0.19						X	
117	Alexander, Jones, and Nigro (1997)	0.15					X		
118	Almenberg and Säve-Söderberg (2011)	0.11		X					
119	ANZ (2008)	0.30	X						

	Study	Effect-size r(financial literacy, behavior)		Dependent Variable					
			Save	Plan	Debt	Cash flow	Invest	Plan active	Inertia
120	Bateman et al. (2011)	0.09					X		
121	Burke and Mihaly (2012)	0.08							X
122	Cao and Hill (2005)	0.08					X		
123	Caratelli and Ricci (2011)	0.16					X		
124	Ceccarelli and Rinaldi (2011)	0.04						X	
125	Chan and Stevens (2008)	0.04	X						
126	Chang, Tang and Zhang (2010)	0.20			X		X		
127	Chen and Volpe (1998)	0.26				X	X		
128	Clark, Morrill and Allen (2011)	0.13		X					
129	Cole, Sampson, and Zia (2011) sample 3	0.11	X						
130	Cole et al. (2012)	0.03	X						
131	Courchane and Zorn (2005)	0.24	X		X				
132	Crossan, Feslier, and Hurnard (2011)	0.13		X			X		
133	Croy, Gerrans and Speelman (2010)	0.33					X		
134	Danes and Hira (1987)	0.32				X			
135	Delafrooz and Paim (2011)	0.25	X						
136	Dimmock, Kouwenberg, and Wakker (2010)	0.19					X		
137	Dwyer, Gilkeson and List (2002)	0.18					X		
138	Eisenstein and Hoch (2012) study 1	0.36					X		
139	Eisenstein and Hoch (2012) study 2	0.30					X		
140	Forbes and Kara (2010)	0.29					X		
141	Fornero, Monticoney and Trucchiz (2011)	0.17					X		
142	Gerardi, Goette, and Meier (2010)	0.15			X				
143	Glaser and Klos (2012)	0.16					X		
144	Guiso and Jappelli (2009) sample 1	0.07					X		
145	Guiso and Jappelli (2009) sample 2	0.10					X		
146	Guiso, Sapienza and Zingales (2011)	0.11			X				
147	Gustman, Steinmeier, and Tabatabai (2012)	0.06	X						
148	Hansen (2012)	0.29				X			
149	Hastings and Mitchell (2012)	0.06		X			X		
150	Hastings and Tejeda-Ashton (2008) sample 1	0.11				X			
151	Hershey et al. (1998)	0.37		X					
152	Hilgert, Hogarth and Beverly (2003)	0.51	X			X	X		
153	Hira and Loibl (2005b)	0.20						X	
154	Hogarth, Hilgert, and Schuchardt (2002)	0.17	X		X	X	X		
155	Honekamp (2012)	0.16	X						
156	Hung, Meijer, Mihaly and Yoong (2009)	0.14	X	X					
157	Jacobs-Lawson and Hershey (2005)	0.52	X						

	Study	Effect-size r(financial literacy, behavior)		Dependent Variable					
			Save	Plan	Debt	Cash flow	Invest	Plan active	Inertia
158	James, Boyle, Bennett, and Bennett (2012)	0.49				X			
159	Kharchenko (2011)	0.10	X						
160	Loibl, Hira and Rupured (2006) study 1	0.06			X				
161	Loibl, Hira and Rupured (2006) study 2	0.17			X				
162	Lusardi (1999)	0.19		X					
163	Lusardi (2010)	0.08	X	X	X				
164	Lusardi and Mitchell (2006)	0.21		X			X		
165	Lusardi and Mitchell (2007b)	0.10		X					
166	Lusardi and Tufano (2009)	0.14	X						
167	Lyons and Scherpf (2003)	0.26	X						
168	Lyons and Scherpf (2004)	0.49							X
169	Lyons, Rachlis and Scherpf (2007)	0.40				X			
170	Mandell (2009a)	0.06	X						
171	Mandell (2009b)	0.54	X		X				
172	Mayer, Zick and Marsden (2011) sample 1	0.24		X					
173	Mayer, Zick and Marsden (2011) sample 2	0.22		X					
174	Mckay (2011)	0.39		X		X	X		
175	Meijer and Smeets (2011)	0.26					X		
176	Monticone (2010b)	0.36					X		
177	Moore (2003)	0.10			X				
178	Müller and Weber (2010)	0.23					X		
179	Navarro-Martinez et al. (2011)	0.19				X			
180	Okura and Kasuga (2007)	0.21					X		
181	Pahnke and Honekamp (2010)	0.06	X	X					
182	Peng, Bartholomae, Fox and Cravener (2007)	0.09	X						
183	Perry and Morris (2005)	0.15	X						
184	Robb and Sharpe (2009)	0.11			X	X			
185	Shim, Xiao, Barber, and Lyons (2009)	0.19	X		X				
186	von Gaudecker (2011)	0.05					X		
187	Xiao, Serido and Shim (2010)	0.13			X		X		
188	Yoong, See, and Baronovich (2012)	0.15				X			
Total	*Sample Weighted Average Effect-size*	*0.152*	22	15	13	12	28	4	4

The dependent variables noted in the above tables are: 1) “Save” indicating the amount saved for retirement, 2) “Plan” reflecting the level of planning for retirement, 3) “Debt” about the level of debt for each respondent, 4) “Investment” reflecting ownership of stocks or return on investment, 5) “Cash Flow” management” about the ability to perform healthy financial behaviors in a day-to-day basis, 6) “Plan Activity” indicating the participation and contribution to retirement plans and 7) “Inertia” about the likelihood to choose default options rather than choosing actively.

Appendix 2: Reference List of the Papers Included in the Meta-Analysis

Abreu, Margarida, and Victor Mendes (2010), "Financial Literacy and Portfolio Diversification," *Quantitative Finance*, 10 (5), 515-528.

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Appendix 3: Effect-Size (Partial r) Funnel Plots

Figure 1a: Funnel Plot for the Effect-Sizes of Measured Financial Literacy

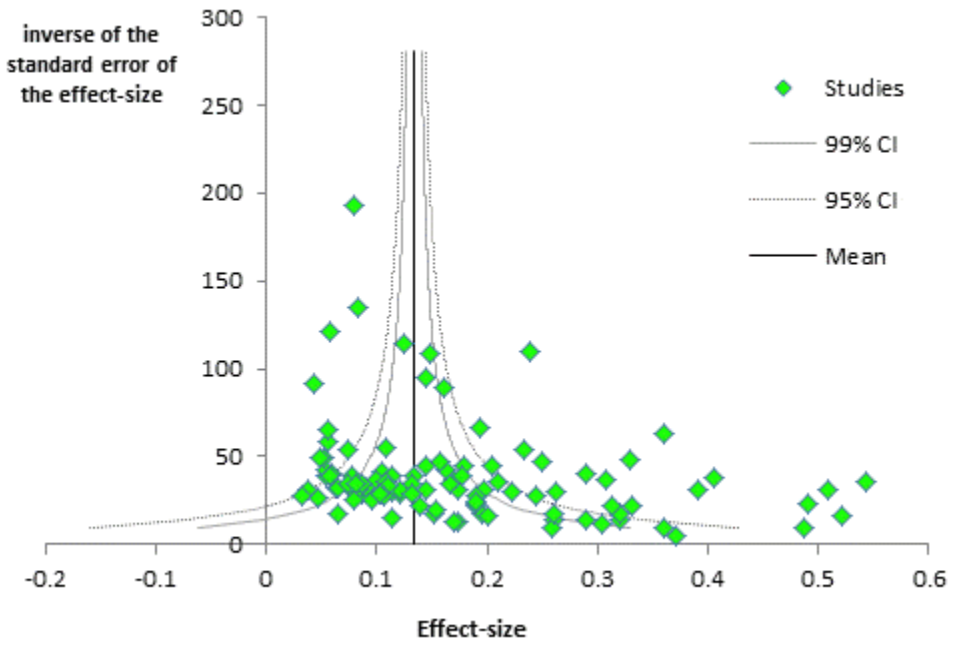
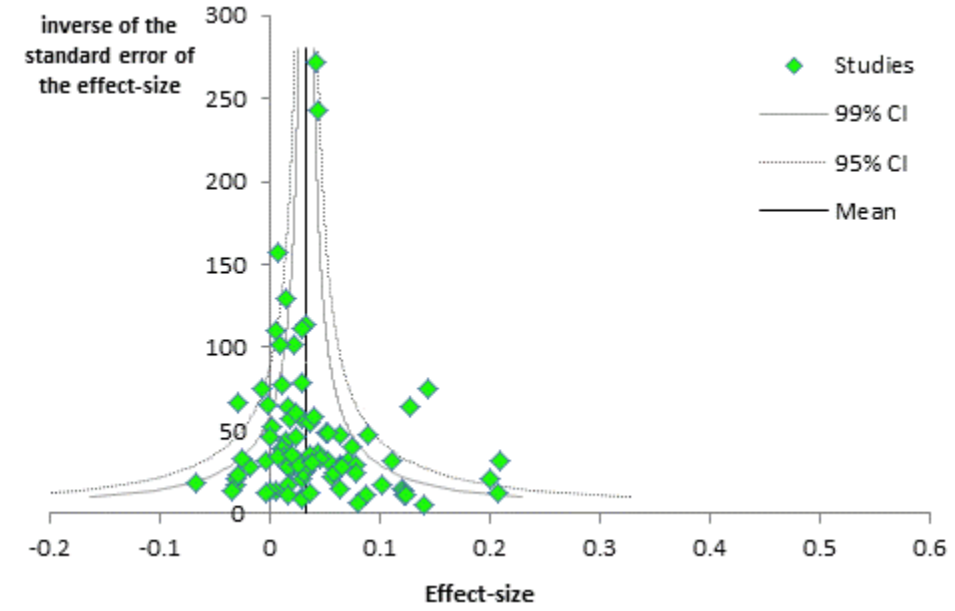


Figure 1b: Funnel Plot for the Effect-Sizes of Manipulated Financial Literacy



Each funnel plot relates effect-size (r) to the inverse standard error. Under the null hypothesis that all effect-sizes in a plot are random draws from a common distribution, the symbols for each study should all fall within the single-peaked distribution shown. Effect-sizes here clearly violate that assumption, showing statistically significant heterogeneity as confirmed by Q statistics. For measured financial literacy, $Q=1628$, $p<.01$. For Manipulated Financial Literacy, $Q=304$, $p<.01$.

Appendix 4: Further Effect-Size Grouping

Appendix 4 Tables 1 and 2 below report details of the papers that used instrumental variables including the effect-sizes using OLS regression and instrumental variables, the instrument used and whether they pass tests for non-weak instruments and exogeneity. Instruments that explain little of the variation in the endogenous explanatory variables can lead to large inconsistencies in the IV estimates (Bound, Jaeger, and Baker 1995). Table 1 describes papers that pass tests for non-weak instruments and exogeneity. Table 2 describes papers that fail the tests or that don't report them. We find in Table 1 that the (partial r) effect-sizes using instrumental variables are generally lower than using OLS regression. In Table 2, we find no difference on the sample-weighted effect-size using instrumental variables and OLS regression.

Table 3 shows subsidiary analyses of how effect-size depends on the nature of the financial behavior studied. For all seven financial behaviors, effects of measured financial literacy were greater than effects of manipulated literacy. For manipulated financial literacy, sample-weighted effect-sizes ranged from 0.018 (plan activity) to 0.063 (planning for retirement). For measured financial literacy, sample-weighted effect-sizes ranged from 0.092 (plan activity) to 0.234 (cash-flow management).

Table 4 shows the effects of different types of financial education interventions. Unsurprisingly, more intensive interventions produce slightly larger effect-sizes. High school courses produce the largest effects, but even here, the average effect-size was miniscule (r = .043 = 0.18% of the variation in downstream behaviors explained). Being exposed to information about some financial education program via a fair or a newsletter produced the smallest effects (r = .025 = 0.06% of the variation in downstream behaviors explained).

Table 1: Effect-Sizes of Studies with Non-weak and Exogenous Instruments

Study	OLS Regression Effect-size	Instrumental variables Effect-size	Instrument Used	Weak Instrument Test Used	Passed Test?	Exogenous Instrument Test Used	Passed Test?
Alessie, van Rooij and Lusardi (2011)	0.17	0.12	financial experiences of siblings and parents	First-stage F-value	Yes	Hansen J	Yes
Behrman, Mitchell, Soo and Bravo (2010)	0.12	0.09	macroeconomic conditions and family background	First-stage F-value	Yes	Hansen J	Yes
Calcagno and Monticone (2011)	0.11	0.06	average financial literacy at regional level	First-stage F-value	Yes	Hansen J	Yes
Duca and Kumar (2012)	0.05	0.01	whether respondent worked in a managerial or professional occupation	First-stage F-value	Yes	Hansen J	Yes
Fornero and Monticone (2011) sample 1	0.06	0.05	cost of learning financial knowledge	First-stage F-value	Yes	Hansen J	Yes
Fornero and Monticone (2011) sample 2	0.05	0.08	cost of learning financial knowledge	First-stage F-value	Yes	Hansen J	Yes
Jappelli and Padula (2011) sample 1	0.06	0.04	math performance in school	First-stage F-value	Yes	Sargan test	Yes
Jappelli and Padula (2011) sample 2	0.08	0.06	math performance in school	First-stage F-value	Yes	Sargan test	Yes
Kimball and Shumway (2007)	0.31	0.11	financial education and demographics	First-stage F-value	Yes	Correlation with residuals	Yes
Klapper, Lusardi, and Panos (2011)	0.17	0.07	number of newspapers in circulation and of universities per region	Kleibergen -Paap	Yes	Hansen J	Yes
Lusardi and Mitchell (2007a)	0.12	0.09	background training in economics	First-stage F-value	Yes	Hansen J	Yes
Sekita (2011)	0.07	0.04	individual and average regional Japanese skills	First-stage F-value	Yes	Hansen J	Yes
van Rooij, Lusardi and Alessie (2008)	0.12	0.06	economic education, financial condition of siblings and knowledge of parents	First-stage F-value	Yes	Hansen J	Yes
van Rooij, Lusardi and Alessie (2011)	0.18	0.06	background training in economics	First-stage F-value	Yes	Hansen J	Yes
Yoong (2010)	0.19	0.08	bond pricing knowledge	First-stage F-value	Yes	Hansen J	Yes
Sample Weighted Average Effect-size	*0.092*	*0.060*					

Table 2: Effect-Sizes of Studies with Weak, Endogenous, or Untested Instruments

Study	OLS Regression Effect-size	Instrumental variables Effect-size	Instrument Used	Weak Instrument Test Used	Passed Test?	Exogenous Instrument Test Used	Passed Test?
Bucher-Koenen and Lusardi (2011)	0.08	0.08	voting share for the libertarian party	First-stage F-value	No	Hansen J	Yes
Disney and Gathergood (2011)	0.05	0.08	self-reported mathematical ability in school	None	-	None	-
Giofré (2012)	0.06	0.11	lagged values of financial literacy	None	-	None	-
Kotlikoff and Bernheim (2001)	0.09	0.08	macroeconomic knowledge	None	-	None	-
Lusardi and Mitchell (2009)	0.08	0.05	lived in a state with mandated financial education at age 17	First-stage F-value	No	Hansen J	No
Lusardi and Mitchel (2011)	0.07	0.06	exposure to mandate and length of time to mandate	None	-	None	-
Monticone (2010a)	0.08	0.04	trust in advisors and trust in banks	First-stage F-value	No	Hansen J	Yes
Mullock and Turcotte (2012)	0.15	0.15	whether first language is English or French and is the one in charge of financial management at home	None	-	None	-
Sample Weighted Average Effect-size	*0.106*	*0.109*					

Table 3: Effect of Financial Literacy per Downstream Behavior

Relationships	Number of Raw Effects	Total N	Sample Weighted Average r	95% CI		% Variance Explained
				Lower Bound	Upper Bound	
Manipulated Financial Literacy → Save	33	56634	0.034	0.004	0.026	0.12
Manipulated Financial Literacy → Plan	16	11378	0.063	0.045	0.082	0.41
Manipulated Financial Literacy → Debt	20	115015	0.043	0.037	0.049	0.19
Manipulated Financial Literacy → Cash Flow	14	36891	0.046	0.036	0.056	0.21
Manipulated Financial Literacy → Invest	19	23500	0.042	0.029	0.055	0.17
Manipulated Financial Literacy → Plan Active	13	135044	0.018	0.012	0.023	0.03
Manipulated Financial Literacy → Inertia	18	31596	0.046	0.035	0.057	0.22
Measured Financial Literacy → Save	25	65397	0.161	0.153	0.169	2.60
Measured Financial Literacy → Plan	23	40475	0.129	0.119	0.139	1.66
Measured Financial Literacy → Debt	13	20975	0.218	0.205	0.232	4.77
Measured Financial Literacy → Cash Flow	14	14928	0.234	0.218	0.25	5.47
Measured Financial Literacy → Invest	36	131913	0.116	0.111	0.122	1.35
Measured Financial Literacy → Plan Active	6	7967	0.092	0.070	0.114	0.85
Measured Financial Literacy → Inertia	6	6988	0.115	0.091	0.138	1.31

For every behavior studied, effect-sizes are smaller for effects of manipulated financial literacy compared to studies of measured financial literacy.

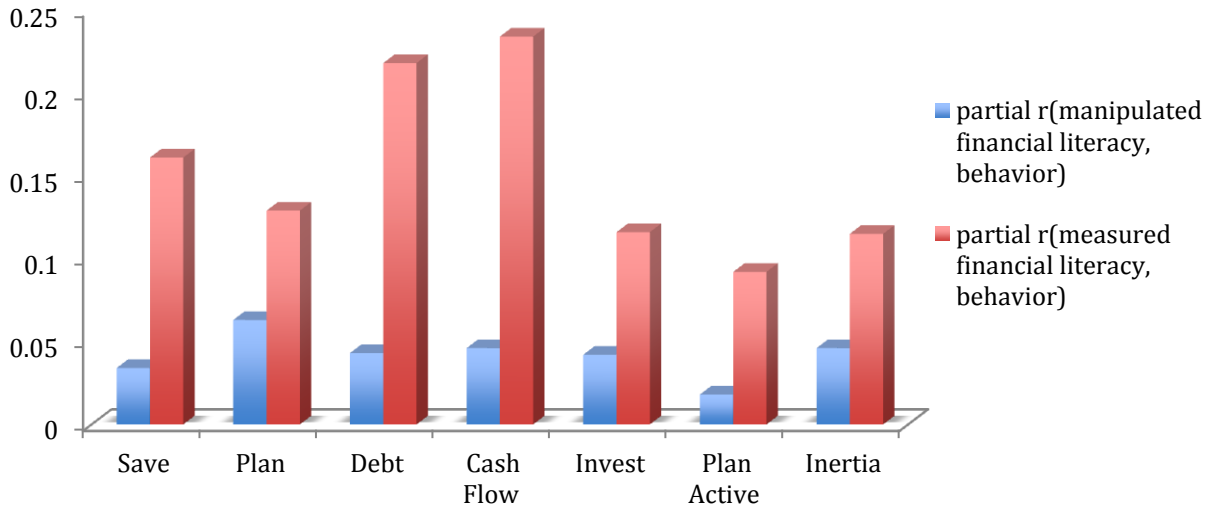

0.25
0.2
0.15
0.1
0.05
0
Save
Plan
Debt
Cash Flow
Invest
Plan Active
Inertia
partial r(manipulated financial literacy, behavior)
partial r(measured financial literacy, behavior)

Table 4: Effect of Manipulated Financial Literacy per Type of Intervention

Type of Intervention	Number of Raw Effects	Total N	Sample Weighted Average r	95% CI		% Variance Explained
				Lower Bound	Upper Bound	
Counseling	14	111324	0.038	0.032	0.044	0.14%
Exposure to information about financial education (e.g., newsletter, participation in a fair)	16	141629	0.025	0.020	0.030	0.06%
Financial education in high school	15	47192	0.043	0.034	0.052	0.18%
Multiple sources of financial education	6	3606	0.035	0.022	0.068	0.12%
Participation in seminars/workshops	15	16482	0.042	0.027	0.057	0.18%
Participation in a program of financial education	21	24027	0.033	0.021	0.046	0.11%

Appendix 5: Measures for Studies 1, 2 and 3

13-Item Financial Literacy Measure (correct response in italics):

1) Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy:

- ❍ more than today with the money in this account
- ❍ exactly the same as today with the money in this account
- ❍ *less than today with the money in this account*
- ❍ Don't know
- ❍ Refuse to answer

2) Do you think that the following statement is true or false? "Bonds are normally riskier than stocks."

- ❍ True
- ❍ *False*
- ❍ Don't know
- ❍ Refuse to answer

3) Considering a long time period (for example 10 or 20 years), which asset described below normally gives the highest return?

- ❍ savings accounts
- ❍ *stocks*
- ❍ bonds
- ❍ Don't know
- ❍ Refuse to answer

4) Normally, which asset described below displays the highest fluctuations over time?

- ❍ savings accounts
- ❍ *stocks*
- ❍ bonds
- ❍ Don't know
- ❍ Refuse to answer

5) When an investor spreads his money among different assets, does the risk of losing a lot of money:

- ❍ increase
- ❍ *decrease*
- ❍ stay the same

- ❍ Don't know
- ❍ Refuse to answer

6) Do you think that the following statement is true or false? “If you were to invest $1000 in a stock mutual fund, it would be possible to have less than $1000 when you withdraw your money.”

- ❍ *True*
- ❍ False
- ❍ Don't know
- ❍ Refuse to answer

7) Do you think that the following statement is true or false? “A stock mutual fund combines the money of many investors to buy a variety of stocks.”

- ❍ *True*
- ❍ False
- ❍ Don't know
- ❍ Refuse to answer

8) Do you think that the following statement is true or false? “After age 70 1/2, you have to withdraw at least some money from your 401(k) plan or IRA.”

- ❍ *True*
- ❍ False
- ❍ It depends on the type of IRA and/or 401(k) plan
- ❍ Don't know
- ❍ Refuse to answer

9) Do you think that the following statement is 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.”

- ❍ *True*
- ❍ False
- ❍ Don't know
- ❍ Refuse to answer

10) Suppose you had $100 in a savings account and the interest rate is 20% per year and you never withdraw money or interest payments. After 5 years, how much would you have on this account in total?

- ❍ *More than $200*
- ❍ Exactly $200
- ❍ Less than $200

- ❍ Don't know
- ❍ Refuse to answer

11) Which of the following statements is correct?

- ❍ Once one invests in a mutual fund, one cannot withdraw the money in the first year
- ❍ *Mutual funds can invest in several assets, for example invest in both stocks and bonds*
- ❍ Mutual funds pay a guaranteed rate of return which depends on their past performance
- ❍ None of the above
- ❍ Don't know
- ❍ Refuse to answer

12) Which of the following statements is correct? If somebody buys a bond of firm B:

- ❍ He owns a part of firm B
- ❍ *He has lent money to firm B*
- ❍ He is liable for firm B's debts
- ❍ None of the above
- ❍ Don't know
- ❍ Refuse to answer

13) Suppose you owe $3,000 on your credit card. You pay a minimum payment of $30 each month. At an Annual Percentage Rate of 12% (or 1% per month), how many years would it take to eliminate your credit card debt if you made no additional new charges?

- ❍ less than 5 years
- ❍ between 5 and 10 years
- ❍ between 10 and 15 years
- ❍ n*ever*
- ❍ Don't know
- ❍ Refuse to answer

NOTE*:* Items 1 and 2: Lusardi and Mitchell (2006); Items 3, 4, 5, 10, 11, 12: van Rooij, Lusardi and Alessie (2011); Item 6: Agnew and Utkus (2005); Items 7 and 8: Hung, Meijer, Mihaly, Yoong (2009); Item 9: Lusardi (2010); Item 13: Lusardi and Tufano (2009). See the references in appendix 2.

Related Traits of Studies 1 and 2:

Preference for Numerical Information (coefficient alpha = .90 in Study 1). Each item scored 1 = strongly disagree, 6 = strongly agree.

1) I enjoy work that requires the use of numbers.
2) I find it satisfying to solve day-to-day problems involving numbers.
3) Numerical information is very useful in everyday life.

4) I prefer not to pay attention to information involving numbers (reverse coded).
5) I don't like to think about issues involving numbers (reverse coded).
6) I like to make calculations using numerical information.
7) I don't find numerical information to be relevant for most situations (reverse coded).
8) I think it is important to learn and use numerical information to make well informed decisions.

Attitude toward Money (coefficient alpha = .89 in Study 1). Each item scored 1 = strongly disagree, 6 = strongly agree.

1) I do financial planning for the future.
2) I put money aside on a regular basis for the future.
3) I save now to prepare for my old age.
4) I keep track of my money.
5) I follow a careful financial budget.
6) I am very prudent with money.

Tightwad-Spendthrift Scale **(coefficient alpha = .67 in Study 1)**

1) Which of the following description fits you better?

Tightwad (difficulty spending money)				About the same or neither				Spendthrift (difficulty controlling spending)		
1	2	3	4	5	6	7	8	9	10	11

2) Some people have trouble limiting their spending: they often spend money – for example on clothes, meals, vacations, phone calls – when they would do better not to. Other people have trouble spending money. Perhaps because spending money makes them anxious, they often don't spend money on things they should spend it on

a) How well does the first description fit you? That is, do you have trouble limiting your spending? Never (1); Rarely (2); Sometimes (3); Often (4); Always (5)

b) How well does the second description fit you? That is, do you have trouble spending money? Never (1); Rarely (2); Sometimes (3); Often (4); Always (5)

3) Following is a scenario describing the behavior of two shoppers. After reading about each shopper, please answer the question that follows. Mr. A is accompanying a good friend who is on a shopping spree at a local mall. When they enter a large department store, Mr. A sees that the store has a "one-day-only-sale" where everything is priced 10-60% off. He realizes he doesn't need anything and ends up spending almost $100.00 on stuff. Mr. B is accompanying a good friend who is on a shopping spree at a local mall. When they enter a large department store, Mr. B sees that the store has a "one-day-only-sale" where everything is priced 10-60% off. He figures he can get great deals on many items that he needs, yet the thought of spending the money keeps him from buying the stuff. In terms of your own behavior, who are you more similar to, Mr. A or Mr. B?

Mr. A		about the same or neither		Mr. B
1	2	3	4	5

Need for Cognition (coefficient alpha = .76 in Study 1; .73 in Study 2; .77 in Study 3). Each item scored 1 = strongly disagree, 6 = strongly agree.

1) I don't like to have to do a lot of thinking (reverse coded).
2) I try to avoid situations that require thinking in depth about something (reverse coded).
3) I prefer to do something that challenges my thinking rather than something that requires little thought.
4) I prefer complex to simple problems.
5) Thinking hard and for a long time about something gives me little satisfaction (reverse coded).

Numeracy (coefficient alpha = .79 in Study 1; .79 in Study 2)

1) Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up even (2, 4, or 6)?
2) In the BIG BUCKS LOTTERY, the chances of winning a $10.00 prize are 1%. What is your best guess about how many people would win a $10.00 prize if 1,000 people each buy a single ticket from BIG BUCKS?
3) In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets of ACME PUBLISHING SWEEPSTAKES win a car? (Enter a number below without a % sign.)
4) Which of the following numbers represents the biggest risk of getting a disease?
a) 1 in 100; b) 1 in 1000; c) 1 in 10
5) Which of the following represents the biggest risk of getting a disease?
a) 1%; b) 10%; c) 5%
6) If Person A's risk of getting a disease is 1% in ten years, and Person B's risk is double that of A's, what is B's risk? (Enter a number below without a % sign.)
7) If Person A's chance of getting a disease is 1 in 100 in ten years, and Person B's risk is double that of A, what is B's risk (out of 100)?
8) If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 100?
9) If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 1000?
10) If the chance of getting a disease is 20 out of 100, this would be the same as having a ____% chance of getting the disease. (Enter a number below without a % sign.)
11) The chance of getting a viral infection is .0005. Out of 10,000 people, about how many of them are expected to get infected?

Numeracy (coefficient alpha = .75 in Study 3)

1) Imagine that we roll a fair, six-sided die 1,000 times. Out of 1,000 rolls, how many times do you think the die would come up as an even number? Of the values below, which is the most likely outcome?

- ❍ 157
- ❍ 298
- ❍ 512
- ❍ 754

- ❍ 919
- ❍ The above answers are all equally likely.
- ❍ I do not know.

2) In the BIG BUCKS LOTTERY, the chances of winning a $10.00 prize are 1%. What is your best guess about how many people would win a $10.00 prize if 1,000 people each buy a single ticket from BIG BUCKS?

- ❍ 1
- ❍ 2
- ❍ 10
- ❍ 100
- ❍ 110
- ❍ The answers above are equally likely.
- ❍ I do not know.

3) If the chance of getting a disease is 20 out of 100, this would be the same as having a _____% chance of getting the disease.

- ❍ 0.02
- ❍ 0.2
- ❍ 2
- ❍ 2.0
- ❍ 20
- ❍ 25
- ❍ 200
- ❍ I do not know.

4) In the ACME PUBLISHING SWEEPSTAKES, the chance of winning a car is 1 in 1,000. What percent of tickets of ACME PUBLISHING SWEEPSTAKES win a car?

- ❍ 0.001%
- ❍ 0.01%
- ❍ 0.1%
- ❍ 1.0%
- ❍ 1.1%
- ❍ None of the above
- ❍ I do not know.

5) If the chance of getting a disease is 10%, how many people would be expected to get the disease out of 1,000?

- ❍ 1
- ❍ 10
- ❍ 11
- ❍ 50
- ❍ 100
- ❍ 110

- ❍ 1,000
- ❍ I do not know.

6) If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

- ❍ 1 minute
- ❍ 5 minutes
- ❍ 10 minutes
- ❍ 100 minutes
- ❍ 1,000 minutes
- ❍ 1 day
- ❍ None of the above
- ❍ I do not know.

7) A bat and ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?

- ❍ 1 cent
- ❍ 5 cents
- ❍ 10 cents
- ❍ 11 cents
- ❍ 20 cents
- ❍ 100 cents
- ❍ 1 dollar
- ❍ I do not know.

8) In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

- ❍ 16 days
- ❍ 24 days
- ❍ 25 days
- ❍ 32 days
- ❍ 26 days
- ❍ 22 days
- ❍ 47 days
- ❍ I do not know.

Consumer Confidence in Financial Information Search (coefficient alpha = .94 in Study 1; .93 in Study 2; .92 in Study 3). Each item scored 1 = strongly disagree, 6 = strongly agree.

1) I am confident in my ability to recognize a good financial investment.
2) I know what investments to look for to get the most return on my money.
3) I know the right questions to ask when making financial investment decisions.
4) I have the skills required to make sound financial investments.
5) I know the right sources to consult to make wise financial decisions.

Planning for Money–Long Run (coefficient alpha = .95 in Study 1; .93 in Study 2; .95 in Study 3). Each item scored 1=strongly disagree, 6 = strongly agree.

1) I set financial goals for the next 1-2 years for what I want to achieve with my money.
2) I decide beforehand how my money will be used in the next 1-2 years.
3) I actively consider the steps I need to take to stick to my budget in the next 1-2 years.
4) I consult my budget to see how much money I have left for the next 1-2 years.
5) I like to look to my budget for the next 1-2 years in order to get a better view of my spending in the future.
6) It makes me feel better to have my finances planned out in the next 1-2 years.

NOTE: The items above reflect long-run planning; the phrase "1-2 years" was replaced by "1-2 months" for short-run planning used in Study 1.

Willingness to Take Investment Risk (coefficient alpha = .81 in Study 3). Items 1-4 scored 1=very unlikely, 5 = very likely. Item 5 scored 1=not at all willing, 5 = very willing.

1) Investing 10% of your annual income in a moderate growth mutual fund.
2) Investing 5% of your annual income in a very speculative stock.
3) Investing 5% of your annual income in a conservative stock.
4) Investing 10% of your annual income in government bonds (treasury bills).
5) When thinking of your financial investments, how willing are you to take risks?

Generalized Self-efficacy (coefficient alpha = .93 in Study 3). Each item scored 1=strongly disagree, 6 = strongly agree.

1) I will be able to achieve most of the goals that I have set for myself.
2) When facing difficult tasks, I am certain that I will accomplish them.
3) In general, I think that I can obtain outcomes that are important to me.
4) I believe I can succeed at most any endeavor to which I set my mind.
5) I will be able to successfully overcome many challenges.

Delayed Gratification Inventory (coefficient alpha = .74 in Study 3). Each item scored 1=strongly disagree, 6 = strongly agree.

1) I would have a hard time sticking with a special, healthy diet.
2) I have always tried to eat healthy because it pays off in the long run.
3) I have given up physical pleasure or comfort to reach my goals.
4) When faced with a physically demanding chore, I always tried to put off doing it.
5) I try to consider how my actions will affect other people in the long-term.
6) I do not consider how my behavior affects other people.
7) I try to spend my money wisely.
8) I cannot be trusted with money.
9) I cannot motivate myself to accomplish long-term goals.
10) I have always felt like my hard work would pay off in the end.

Restraint (coefficient alpha = .89 in Study 3). Each item scored 1=strongly disagree, 6 = strongly agree.

1) I am good at resisting temptation.
2) I have a hard time breaking bad habits.
3) I wish I had more self-discipline.
4) People would say that I have iron self- discipline.

Impulsivity (coefficient alpha = .89 in Study 3). Each item scored 1=strongly disagree, 6 = strongly agree.

1) I do certain things that are bad for me, if they are fun.
2) Pleasure and fun sometimes keep me from getting work done.
3) Sometimes I can't stop myself from doing something, even if I know it is wrong.
4) I often act without thinking through all the alternatives.

Financial Behavior Dependent Variables of Study 2 and of Study 3

1) ***Savings for an emergency fund*** (yes – no).

Have you set aside emergency or rainy day funds that would cover your expenses for 3 months, in case of sickness, job loss, economic downturn, or other emergencies?

- ❍ Yes
- ❍ No

2) ***Figuring out how much savings is needed for retirement*** (yes – no).

Have you ever tried to figure out how much you need to save for retirement?

- ❍ Yes
- ❍ No

3) ***Positive savings / investment behaviors*** **(coefficient alpha = .68 in Study 2; .68 in Study 3)**.

Have you ever opened a savings account or bought a CD.

- ❍ Yes
- ❍ No

Have you ever bought a savings bond or other bonds.

- ❍ Yes
- ❍ No

Have you ever invested in mutual funds.

- ❍ Yes
- ❍ No

Have you ever invested in individual stocks.

- ❍ Yes
- ❍ No

4) The respondent's perception of ***how banks or credit card companies would rate the respondent's credit score***.

How do you think banks or credit card companies would rate your credit?

Very Poor 1 2 3 4 5 6 7 8 9 10 Excellent

5) ***Credit and checking fees*** relating to check bouncing and late credit card payments **(in coefficient alpha = .65 in Study 2; .66 in Study 3)**.

Over the past two years, how frequently have you been late paying credit card bills?

- ❍ Never
- ❍ Once or twice since had credit cards
- ❍ Once or twice per year
- ❍ More than twice per year

How often have you bounced a check?

- ❍ Never
- ❍ Once or twice in lifetime
- ❍ Once or twice per year
- ❍ More than twice per year

Please indicate below the option that best describes your payments on credit cards.

- ❍ Always pays off monthly
- ❍ Generally pays off monthly
- ❍ Occasionally pays off monthly
- ❍ Seldom pays off, but tries to pay down
- ❍ Generally pays minimum each month

Appendix 6: Empirical Studies 1, 2, and 3

Overview

In our meta-analysis, we found much larger effect-sizes in the 78 studies that tested effects measured financial literacy on behaviors using OLS regression than in research using "better" designs. We conjectured that this reflected omitted variables bias in the estimates coming from the OLS designs. To test this conjecture, we conducted three primary research surveys of U.S. English-speaking adults. With these studies, we sought to distill a large pool of items used to measure financial literacy into to a shorter, reliable, and valid scale, and to replicate prior findings that financial literacy predicted financial behaviors, controlling for demographics. We also sought to test whether the effects of financial literacy diminished when we added measures of four psychological traits that might be correlated with both financial literacy and with the financial behaviors studied.

We first sought to create a reliable and valid measure of financial literacy. In Study 1, 103 U.S. adults from the on-line panel company QUALTRICS responded to several demographic questions, 26 financial literacy items, and measures of other psychological traits theoretically related to financial literacy. The 26 financial literacy items had been previously used to assess financial literacy in several studies, including many of those included in our meta-analyses (e.g., Agnew and Szykman 2005; Hung et al. 2009; Mandell and Klein 2009; van Rooij et al. 2011). We included the following theoretically-related psychological traits with financial literacy: an 8-item measure of preference for numerical information (PNI) (Viswanathan 1993); a 5-item attitude toward/concern for money scale (Yamaichi and Templer 1982); the spendthrift-tightwad scale (Rick, Cryder, and Loewenstein 2008); a 5-item need for cognition (NFC) scale (Epstein et al. 1996); an 11-item numeracy scale (Lipkus, Samsa, and Rimer 2001); a 5-item confidence in

financial information search scale (Bearden, Hardesty, and Rose 2001); and a 6-item measure of planning for money in the short-run (Lynch et al. 2010). We predicted that a valid measure of financial literacy would be positively correlated with PNI, attitude toward/concern for money, NFC, numeracy, confidence in financial information search, and planning for money in the short-run; and negatively correlated with being a spendthrift.

In Study 2, we surveyed 543 U.S. adults from a QUALTRICS panel. We again included numerous demographic questions, the 26 financial literacy items, the numeracy and the confidence in financial information search scales of Study 1, as well as a 6-item measure of planning for money-long-term (Lynch et al. 2010), and a single-item measure of willingness to take investment risk. We also gathered responses on financial behaviors. The financial behavior measures were taken from research reviewed in our meta-analysis: 1) a yes or no measure of "saving for an emergency fund"; b*);* 2) a yes or no measure of "figuring out how much savings is needed for retirement"; 3) four yes or no questions about performing "positive savings / investment behaviors" summed to form an overall score ranging from 0 to 4; 4) a rating of "How do you think banks or credit card companies would rate your credit?" 1 =Very Poor, 10 = Excellent" found to correlate r = .85 with FICO credit scores (Lynch et al. 2010); and 5) three multiple choice items assessing bouncing of checks and late or incomplete credit card payments ("Credit and Checking Fees"*).* We summed these three items to form an overall score that could range from 3 to 14.

In Study 3 we collected responses from a nationally representative sample of 506 adults aged 21-65 provided by GfK Knowledge Networks. Study 3 collected the same measures as Study 2 with the addition of four more traits: generalized self-efficacy (Chen, Gully, and Eden 2001); delayed gratification (Hoerger and Quirk 2011); restraint; and impulsivity (Maloney, Grawitch, and Barber 2012). Further, Study 3 collected a 5-item measure of willingness to take

investment risk (Weber, Blais, and Betz 2002) rather than a single-item measure, and an 8-item (rather than an 11-item) numeracy measure (Soll, Keeney, and Larrick 2012). The financial behavior dependent variables of Study 3 were the same as those assessed in Study 2. Appendix 4 shows all items of the measures included in all studies.

Deriving the Financial Literacy Scale

A primary criticism of financial literacy research is that it has been conducted with widely varying conceptualizations, dimensions, and measures of the concept (e.g., Huston, 2010; Knoll and Houts, 2012). Thus, one goal of Studies 1 and 2 was to derive a uni-dimensional, reliable, and valid measure of financial literacy. We aimed for a measure that: 1) reflects widely adopted definitions of the concept; 2) taps its key agreed-upon content domain areas; and 3) is brief enough to encourage study participation in survey or experimental research. Consistent with prevailing views, we define financial literacy as "… *the knowledge of basic concepts of personal finance with respect to borrowing / debt, and saving/investments that leads to better lifetime financial decision-making."* This definition construes financial literacy as a single dimension reflecting objective knowledge with the content domains of personal finance knowledge spanning borrowing/debt and savings/investments.

Prior research in financial literacy had not used standard methods for deriving reliable, valid, and uni-dimensional measures (but see Knoll & Houts 2012). Using recommended scaling procedures, we developed and refined a financial literacy measure (DeVellis 2012; Linacre 2009; Netemeyer, Bearden, and Sharma 2003; Nunnally and Bernstein 1994). We originally chose the 26 financial literacy items based on our judgment of their content/face validity given the definition adopted (Haynes, Richard, and Kubany 1995). We then assessed the simple structure of these items via a series of iterative exploratory factor analyses (principal components) with

both Study 1 and Study 2 data. We trimmed the pool to 13 items that best reflected the content domain of financial literacy while having significant factor loadings of .30 and above on a general factor (Netemeyer et al. 2003; Nunnally and Bernstein 1994). General factor loadings for these 13 items ranged from .45 to .78 in Study 1 (mean loading = .57), and .33 to 64 is Study 2 (mean loading = .55). We then further assessed the psychometric properties of these 13 items via dimensionality analysis, Item Response Theory (IRT) Rasch modeling, and reliability and construct validity testing.

Using our Study 2 data, we assessed the dimensionality of our 13 items by estimating a one-factor confirmatory model. Given that the items were coded dichotomously (1= correct answer; 0 = wrong answers), we used a polychoric correlation matrix with diagonally weighted least squares in model estimation (Jöreskog and Sörbom 2006). This model fit the data well, χ^2 = 612.33, df = 65, CFI = 97, NNFI = .97; all factor loadings were significant ($p < .01$); and standardized loadings ranged from .45 to .74 with an average of .64. These results suggest that one dimension underlies the 13 items.

Via Study 2 data, we also assessed discriminant validity by estimating a two-factor model of the financial literacy and numeracy items. (We again used a polychoric correlation matrix and diagonally-weighted least squares.) This model fit well (χ^2 = 2,938.08, df = 251, CFI = 96, NNFI = .96) and a 95% confidence interval around the correlation between financial literacy and numeracy did not contain a value of "1," supporting discriminant validity (DeVellis 2012; Netemeyer et al. 2003*).* When all 11 numeracy and all 13 financial literacy items were constrained to a single factor (χ^2 = 4,809.84, df = 252), the two-factor model fit better than this one-factor model (χ^2_{diff} = 1,871.76, df_{diff} = 1, $p < .01$), also supporting discriminant validity.

We next used a one-parameter logistic Rasch Item Response Theory (IRT) model via the WINSTEPS package for Study 2 data to further asses item fit and overall scale goodness. We

looked at three measures of fit (Linacre 2009; Cole et al. 2004*)*: 1) infit and outfit mean-square statistics; 2) point-measure correlations; and 3) separation values. Across our 13 items infit mean-square levels ranged from .89 to 1.25 (mean = 1.01); and outfit mean-square values ranged from .70 to 1.32 (mean = .93). These values indicate good-fitting items (Cole et al., 2004*).* Point-measure correlation values of .50 and above have been advocated as good fitting items and our items showed point-measure correlations ranging from .47 to .62. Separation reflects the ratio of the overall scale standard deviation corrected for estimation error, with high values being desirable relative to the number of items in a measure. For our 13 items, separation was 10.34; thus, 10 statistically different levels of financial literacy can be distinguished in a normal distribution with the same corrected test standard deviation as the current sample.

The results from Studies 1 and 2 suggest that our 13 items form a uni-dimensional measure of financial literacy. Given these results we assessed internal consistency via KR-20 coefficient alpha. This value was .84 and .82 for Studies 1 and 2, respectively, suggesting adequate consistency reliability (Nunnally and Bernstein 1994).

As further evidence of scale structure, we again examined the 13-item scale using Study 3 data. A one-factor financial literacy model fit the data well, χ^2 = 564.373, df = 65, CFI = 99, NNFI = .98; all factor loadings were significant ($p < .01$); and standardized loadings ranged from .51 to .82 with an average of .71. We assessed discriminant validity by estimating a two-factor model of the financial literacy and numeracy items. Due to a problematic numeracy item that resulted in a Heywood case (Bollen 1989), we could not obtain a fitting function for when all eight numeracy items were used. We thus dropped the problematic item and estimated the two-factor model with 7 numeracy items. This model fit well (χ^2 = 1,616.71, df = 169, CFI = 99, NNFI = .98) and a 95% confidence interval around the correlation between financial literacy and numeracy did not contain a value of "1," supporting discriminant validity. When all 7 numeracy

and all 13 financial literacy items were constrained to a single factor (χ^2 = 2,036.06, df = 170), the two-factor model fit better than this one-factor model (χ^2_{diff} = 419.35, df_{diff} = 1, $p < .01$), also supporting discriminant validity. KR-20 alpha for the financial literacy scale was .85.

Finally, as evidence of construct validity, Table 1 in Appendix 6 shows that in Study 1 financial literacy was positively correlated with numeracy (r = .59), confidence in financial information search (r = .31), planning for money-short term (r = .11), preference for numerical information (r = .39), attitude/concern for money (r = .27), and NFC - need for cognition (r =.29). Financial literacy was negatively correlated with being a spendthrift (r = -.17). Table 2 in Appendix 6 shows that in Study 2 financial literacy was positively correlated with numeracy (r = .50), confidence in financial information search (r = .23), planning for money-long term (r = .10), willingness to take investment risk (r = .19), and NFC (r = .35). Finally, Table 3 in Appendix 6 shows that in Study 3 financial literacy was positively correlated with numeracy (r = .63), confidence in financial information search (r = .27), planning for money-long term (r = .21), willingness to take investment risk (r = .34), self-efficacy (r = .21), delayed gratification (r = .24) and NFC (r = .31). In totality across Studies 1, 2, and 3, these correlations are all significant and in the directions expected/predicted, lending confidence to the construct validity of the financial literacy measure.

Empirical Studies: Regression Results Predicting Financial Behaviors

Study 2 - Hierarchical Regression Results. We used scores on the 13-item financial literacy scale to predict financial behaviors shown in our meta-analysis to be predicted by financial literacy. We predicted each financial behavior by demographics, financial literacy, and four traits that were potentially correlated with both financial literacy and the financial behaviors: confidence in financial information search; planning for money-long term;

willingness to take investment risk, and numeracy. We compared three hierarchical regression models: Model 1) demographics alone; Model 2) demographics + financial literacy; and Model 3) demographics + financial literacy + four correlated traits.

We used OLS regression for the scaled financial behaviors, but used logistic regression for the dichotomously-measured financial behaviors. Rather than reporting unstandardized coefficients, β, we follow convention in reporting Exp(β) for logistic regression. Exp(β) reflects how raising the predictor variable's score by one unit influences the odds of being placed in the group coded 1 (e.g., have an emergency savings fund) rather than the group coded 0 (do not have an emergency savings fund). Significant Exp(β) values > 1 indicate that the odds of an outcome (being placed in the group coded as 1) increase with a unit change in the independent variable; significant Exp(β) values < 1 indicate that a unit increase in the predictor leads to a decrease in the odds of an outcome occurring. As such, significant Exp(β) coefficients have 95% confidence intervals that exclude values of one. For example, in Table 4 of Appendix 6, for predicting "Saving for an Emergency Fund," for the predictor of "Planning for Money-Long Term", Exp(β) = 1.620. A consumer's propensity to plan for money-long term scale ranged from a low score of 1 to a high score of 6. Thus, for each 1-point increase on this scale, the odds (P(Yes)/P(No)) of having an emergency savings fund increased by a multiple of 1.620.

In our logistic regressions, the first model used demographics alone to predict the "yes" or "no" outcome measure of "saving for an emergency fund." This model (Model 1) explained 13.6% of the variance (R^2), primarily due to the positive effects of income. Model 2 hierarchically added the financial literacy scale to the demographic predictors. The effect of financial literacy was significant (Exp(β) = 1.073, $p < .05$), but only increased R^2 to 14.3%. Model 3 added the four traits of confidence in financial information search, planning for money-long term, willingness to take investment risk, and numeracy. Table 4 in Appendix 6 shows that

the effect of financial literacy became non-significant in Model 3 (Exp(β) = 1.062, $p > .05$), but the effects of confidence in financial information search (Exp(β) = 1.776, $p < .01$) and planning for money-long term (Exp(β) = 1.620, $p < .01$) were significant, with R^2 increased to 24.8%.

We used a similar set of models to predict the "yes or no" measure of "figuring out how much savings is needed for retirement." Model 1 (demographics alone) explained 15.7% of the variance, primarily due to the positive effects of income. The effect of financial literacy was significant in Model 2 (Exp(β) = 1.126, $p < .01$), and increased R^2 to 17.5%. With the addition of the four traits in Model 3 (Table 4 in Appendix 6), the effect of financial literacy became non-significant (Exp(β) = 1.092, $p > .05$), and three of the four traits were significant predictors: confidence in financial information search (Exp(β) = 1.839, $p < .01$); planning for money-long term (Exp(β) = 1.277, $p < .05$); and willingness to take investment risk (Exp(β) = 1.248, $p < .05$). These three traits increased R^2 to 26.7%.

For the scaled measure of "How do you think banks or credit card companies would rate your credit?" (1 =Very Poor, 10 = Excellent), we used OLS regression. Model 1 (demographic alone) showed an R^2 of 25.5%, primarily due to the positive effects of income. In Model 2, financial literacy was significant (β = .125, $p < .01$) and increased R^2 to 26.9%. When the four traits were added creating Model 3, the effect of financial literacy became non-significant (β = .061, $p > .05$). The effects of confidence in financial information search (β = .609, $p < .01$) and planning for money-long term (β = .317, $p < .01$) were significant; R^2 increased to 33.0%.

For "Credit and Checking Fees" (range 3 to 14), Model 1 showed an R^2 of 16.3%, with incurring higher fees associated with lower education and lower income. Financial literacy was marginally significant (β = -.076, $p = .07$) in Model 2; lower financial literacy predicted higher fees. When the four traits were added creating Model 3, financial literacy became non-significant

(β = -.053, $p > .10$), and only the effect of confidence in financial information search was significant (β = -.505, $p < .01$), increasing R^2 to 22.7%.

For the summed index of performing "positive savings / investment behaviors" (ranging from 0 to 4), Model 1 showed an R^2 to 34.0%, with higher levels of age and income the primary predictors. The effect of financial literacy in Model 2 was significant (β = .116, $p < .01$), increasing R^2 to 40.0%. In Model 3, financial literacy remained significant (β = .128, $p < .01$), along with willingness to take investment risk (β = .112, $p < .01$) and numeracy (β = -.068, $p < .01$). The R^2 of Model 3 was 44.3%.

In summary, for Study 2, four of the five financial behaviors examined, the effect of financial literacy became non-significant when the traits of confidence in financial information search, planning for money-long term, willingness to take investment risk, and numeracy were added as predictors and R^2 increased on average by a factor of 1.39.

Study 3 - Hierarchical Regression Results. In Study 3, we again predicted each financial behavior by demographics (Model 1), demographics + financial literacy (Model 2), and demographics + financial literacy + four correlated traits (Model 3). Table 5 in Appendix 6 shows parameter estimates for Model 3. For "saving for an emergency fund," Model 1 explained 19.2% of the variance (R^2), primarily due to positive effects of income. Model 2 hierarchically added the financial literacy scale. Its effect was significant Exp(β) = 1.116 ($p < .01$) and increased R^2 to 20.6%. The effect of financial literacy became non-significant in Model 3 (Exp(β) = 1.012, $p > .05$), but the effects of propensity to plan for money-long term (Exp(β) = 2.235, $p < .01$) and willingness to take investment risk (Exp(β) = 1.956, $p < .01$) were significant, and increased R^2 to 34.6%.

Model 1 explained 23.2% of the variance in "figuring out how much savings is needed for retirement" primarily due to the positive effects of income. The effect of financial literacy

was significant in Model 2 (Exp(β) = 1.269, $p < .01$) and increased R^2 to 28.6%. With the addition of the four traits in Model 3, the effect of financial literacy remained significant (Exp(β) = 1.180, $p < .01$). Propensity to plan for money-long term (Exp(β) = 1.915, $p < .01$), willingness to take investment risks (Exp(β) = 1.851, $p < .01$), and numeracy (Exp(β) = 1.174, $p < .05$) were also significant in Model 3 (R^2 = 35.0%).

For "How do you think banks or credit card companies would rate your credit?" Model 1 showed an R^2 of 24.0%, primarily due to the positive effects of income. In Model 2, financial literacy was significant (β = .192, $p < .01$) and increased R^2 to 27.2%. When the four traits were added creating Model 3, the effect of financial literacy became non-significant (β = .089, $p > .05$), but the effects of numeracy (β = .134, $p < .05$), planning for money-long term (β = .419, $p < .01$), and willing to take investment risk (β = .450, $p < .01$) were significant, increasing R^2 to 34.4 % (See Table 5 in Appendix 6).

For "Credit and Checking Fees," Model 1 showed an R^2 of 16.1%, with higher levels of age predicting higher fees. Financial literacy was significant (β = -.135, $p < .01$) in Model 2, increasing R^2 to 18.6%. When the four traits were added creating Model 3, the effect of financial literacy became non-significant (β = -.070, $p > .05$). R^2 for Model 3 increased to 29.5% based on the significant effects of confidence in financial information search (β = -.341, $p < .01$) and planning for money-long term (β = -.472, $p < .01$). For "positive savings / investment behaviors," Model 1 showed an R^2 of 39.6%, with higher levels of age, education, and income the primary predictors. The effect of financial literacy in Model 2 was significant (β = .134, $p < .01$), increasing R^2 to 46.5%. In Model 3, financial literacy remained significant (β = .098, $p < .01$), along with planning for money-long term (β = .124, $p < .05$) and willingness to take investment risk (β = .283, $p < .01$). The total R^2 of Model 3 was 50.7%.

In summary, for Study 3, three of the five financial behaviors examined, the effect of financial literacy became non-significant when the traits of confidence in financial information search, planning for money-long term, willingness to take investment risks, and numeracy were added, and R^2 increased on average by a factor of 1.38.

Summary of Hierarchical Regression Results from Studies 1 and 2. Overall, in 7 of 10 regression models of Studies 1 and 2, the effect of financial literacy on financial behaviors became non-significant when the traits of confidence in financial information search, planning for money-long term, willingness to take investment risks, and numeracy were added as predictors. With these cross-sectional OLS and logistic regression analyses then, a potential interpretation is that the significant effects of financial literacy in Model 2 were due to omitted variables bias. Another interpretation, though, is that the dependent variables caused the independent variables rather than the reverse. If the financial behaviors studied caused our "omitted variables" of numeracy, confidence, propensity to plan, and willingness to take financial risks, this would produce results exactly of the sort we found, with higher R^2 values in our Model 3 including those variables as predictors than in our Model 3 without those predictors. We find this critique to be only mildly compelling. To explain a near-doubling of R^2 values from Model 3 compared to Model 2 by reverse causation of behaviors on those traits requires one to assume that single behaviors of the sorts we study to have extremely large effects on stable traits.

Our aim is not to make a positive claim that those variables in particular are causes of the financial behaviors we studied but to make the negative point that prior investigations that failed to control for those omitted traits. Thus, we are much more interested in the coefficient on financial literacy than on the coefficients on those other traits. We argue that these results are relevant to interpreting the findings from the 78 OLS studies reported in our meta-analysis that claimed to show strong positive effects of measured financial literacy on financial behaviors.

Still, given a potential concern for endogeneity, or reverse causality among financial literacy and financial outcomes in our primary research findings and the 78 OLS studies, we now present the results of robustness analyses based on two stage least squares (2SLS) with an instrumental variable for financial literacy (Angrist and Krueger 2001; Foster 1997; Stock, Wright, and Yogo 2002).

Empirical Studies: 2SLS Results. Though it has been consistently noted that selecting an appropriate instrument is a daunting task in 2SLS analyses (Angrist and Krueger 2001; Bound, Jaeger, and Baker 1995; Larcker and Rusticus 2010; Stock et al. 2002), some criteria have been advocated.

First, suitable instrumental variables should be correlated with the independent variable of interest (financial literacy), but have zero or very low correlation with the dependent variables (Angrist and Krueger 2001; Larcker and Rusticus 2010; Stock et al. 2002). Need for cognition (NFC), a stable personality trait assessed in Studies 2 and 3, meets this criterion. NFC is correlated with financial literacy ($r = .35$ in Study 2 and $r = .31$ in Study 3), but it has zero or very low correlations with our dependent variables (see Tables 2 and 3 of Appendix 6). Second, when both NFC and financial literacy are included as predictors, NFC is not correlated with the error terms in prediction of any financial behavior dependent variable, suggesting that it is a suitable instrument (Sargan, 1958). Third, for a variable to be a "non-weak" instrument, the *F*-statistic from the first stage model of 2SLS should be greater than 10 for second stage estimates to be reliable (Stock et al., 2002). NFC exceeded this criterion when it was used in the first stage alone ($F = 48.30$, $p < .001$ for Study 2; $F = 80.55$, $p < .001$ for Study 3), and when it was used with all other independent variables (covariates) in the model ($F = 15.69$, $p < .001$ for Study 2; $F = 27.88$, $p < .001$ for Study 3).

Fourth, we use as the instrument the residual term from predicting NFC with the four correlated traits of numeracy, confidence in financial information search, planning for money long-term, and willingness to take investment risk that is used as the instrument (Angrist and Pischke 2009). This residual term was also uncorrelated with all financial behavior dependent variables (range of -.06 to .08, $p > .05$ for all across both Studies 2 and 3), making (residual) NFC a suitable instrument. The residual is a function of the four correlated traits, and thus cannot operate as a predictor of the financial behaviors through the four traits that it was predicted by (Bound et al. 1995; Larcker and Rusticus 2010). Finally, NFC "makes sense." It is a stable personality trait different from financial literacy (Angrist and Krueger 2001; Stock et al. 2002), not plausibly caused by the financial behaviors, and in effect "outside of the system" for predicting the behaviors (Larcker and Rusticus 2010).[3]

Study 2 - 2SLS Results. Table 6 of Appendix 6 shows the results of the 2SLS analyses for Study 2. When numeracy, confidence in financial information search, planning for money-long term, and willingness to take investment risk are included as predictors, the effect of financial literacy is non-significant for all five behaviors, whereas the effects of confidence in financial information search and planning for money-long term are mostly significant.

Specifically, for "saving for an emergency fund," the effect of financial literacy was not significant ($Exp(\beta) = .835$, $p > .05$), but the effects of confidence in financial information search ($Exp(\beta) = 2.048$, $p < .01$) and planning for money-long term ($Exp(\beta) = 1.624$, $p < .01$) were significant. For "figuring how much is needed for retirement," the effect of financial literacy was not significant ($Exp(\beta) = 1.089$ $p > .05$), but the effects of confidence in financial information search ($Exp(\beta) = 1.810$, $p < .01$), planning for money-long term ($Exp(\beta) = 1.286$, p

[3] In our 2SLS analyses for both Studies 1 and 2, we ran separate models with just NFC as the instrument for financial literacy and models with the just residual term from predicting NFC with the correlated traits of numeracy, confidence in financial information search, planning for money long-term, and willingness to take investment risk as the instrument. As expected, virtually identical results were found.

< .05), and willingness to take investment risk (Exp(β) = 1.244, $p < .05$) were significant. For the "How do you think banks or credit card companies would rate your credit?" the effect of financial literacy was not significant (β = -.752, $p > .05$), but the effects of numeracy (β = .545, $p < .05$), confidence in financial information search (β = .854, $p < .01$), and planning for money-long term (β = .405, $p < .01$) were significant. For "Credit Card and Checking Fees," the effect of financial literacy was not significant (β = .704, $p > .05$), but the effects of numeracy (β = -.420, $p < .05$) and confidence in financial information search (β = -.851, $p < .01$) were significant. For the "positive savings / investment behaviors," the effect of financial literacy was not significant (β = -.281, $p > .05$), but effects of confidence in financial information search (β = .238, $p < .05$) and willingness to take investment risk (β = .180, $p < .01$) were significant.

In sum, the 2SLS analyses are consistent with what was found for Model 3 in the preceding analyses of Study 2. This lends validity to the result that the effect of financial literacy is attenuated in the presence of other predictors while controlling for potential endogeneity.

Study 3 - 2SLS Results. Table 7 of Appendix 6 shows 2SLS results for Study 3 with NFC as the instrument for financial literacy. When numeracy, confidence in financial information search, planning for money-long term, and willingness to take investment risk are included as predictors, the effect of financial literacy is non-significant for all five behaviors.

Specifically, for "saving for an emergency fund," the effect of financial literacy was not significant (Exp(β) = .835, $p > .05$), but the effects of planning for money-long term (Exp(β) = 2.371, $p < .01$) and willingness to take investment risk (Exp(β) = 2.280, $p < .05$) were significant. For "figuring how much is needed for retirement," the effect of financial literacy was not significant (Exp(β) = 2.003, $p > .05$), but the effect of planning for money-long term (Exp(β) = 1.700, $p < .01$) was significant. For "How do you think banks or credit card

companies would rate your credit?," the effect of financial literacy was not significant (β = -.999, $p > .05$), but planning for money-long term (β = .525, $p < .05$) was significant. For "Credit Card and Checking Fees," the effect of financial literacy was not significant (β = .546, $p > .05$), but planning for money-long term (β = -.575, $p < .01$) was significant. And, for "positive savings / investment behaviors," the effect of financial literacy was not significant (β = .329, $p > .05$), but the effect of planning for money long term (β = .116, $p < .05$) was significant.[4]

Overall then, the robustness check of 2SLS with NFC as an instrument for financial literacy shows that the effect of financial literacy was not significant in the presence of other traits, which is largely consistent with the finding from the OLS and logistic regression results. These results raise the possibility that instrumental variables studies that find small effects of financial literacy on financial behavior in our meta-analysis may not have controlled completely for problems of endogeneity and omitted variables bias that might contribute to the dramatically higher effect-sizes in OLS studies. We noted earlier that instrumental variables studies find much larger effects of financial literacy on financial behavior than studies that manipulate financial literacy. Quasi-experimental and pre-experimental studies show significant but trivially small effects, and randomized control group studies that show effects that, in aggregate, do not differ from zero.

[4] Finally, other robustness analyses of Study 3 demonstrated that effects of confidence in financial information search were not plausibly caused by its correlation with general self-efficacy, and effects of propensity to plan were not plausibly caused by its correlation with a delay of gratification and self-control.

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Appendix 6, Table 1: Study 1 Summary Statistics, Cronbach Alpha Reliabilities, and Correlations

	Mean	SD	Cronbach Alpha	1	2	3	4	5	6	7	8	9	10	11	12
1. Financial Literacy	7.27	3.51	.84	1											
2. Numeracy	7.43	2.57	.79	**.59**	1										
3. Consumer Confidence	3.61	1.15	.94	**.31**	.10	1									
4. Plan For Money – Short Term	4.16	1.01	.95	.11	.04	.36	1								
5. Pref. for Numerical Info.	4.07	.93	.90	**.39**	**.39**	**.43**	**.31**	1							
6. Attitude/Concern for Money	4.21	.99	.89	**.27**	.05	**.64**	**.70**	**.44**	1						
7. NFC	3.82	.87	.76	**.29**	**.40**	**.24**	.11	**.51**	**.22**	1.00					
8. Spendthrift/Tightwad	13.97	3.77	.67	-.17	-.08	-.12	**-.20**	-.04	**-.35**	.01	1				
9. Gender	.26	.44	-	**.23**	**.19**	**.25**	-.01	**.20**	.08	.16	-.15	1			
10. Age	46.30	12.95	-	**.28**	.15	-.14	.02	.01	-.01	-.07	.02	-.11	1		
11. Number of Children	2.57	1.45	-	-.15	-.19	-.01	.03	-.01	.06	.00	-.05	-.05	.16	1	
12. Years to Retire	3.49	1.95	-	**-.23**	-.19	-.05	-.06	-.01	-.10	.07	.06	.15	**-.79**	-.14	1

Note: Significant correlations ($p < .05$) are in **bold**. Coding is as follows: Gender: 1 = Male, 0 = Female; Years to retire: 1 = 5 or less, 2 = 6-10, 3 = 11-15, 4 = 16-20, 5 = 20-30, 6 = 31 or more.

Appendix 6, Table 2: Study 2 Summary Statistics, KR-20 or Cronbach Alpha Reliabilities, and Correlations

	Mean	SD	Alpha	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1. Financial literacy	7.43	3.18	.82	1																		
2. Numeracy	7.81	2.53	.79	**.50**	1																	
3. Confidence	3.63	1.02	.93	**.23**	.01	1																
4. Plan For Money – LT	3.64	1.09	.93	**.10**	.04	**.43**	1															
5. Willing to Take Risks	3.43	1.52	-	**.19**	**.39**	**.46**	**.23**	1														
6. Savings for Emergency Fund	0.45	0.50	-	**.21**	.05	**.39**	**.32**	**.22**	1													
7. Figure Needed for Retire	0.42	0.49	-	**.26**	**.40**	**.38**	**.25**	**.28**	**.43**	1												
8. Positive Savings / Investment Behaviors	2.06	1.33	.68	**.47**	.05	**.33**	**.16**	**.32**	**.35**	**.36**	1											
9. Banks / CC Credit Score	6.48	2.96	-	**.29**	**.19**	**.37**	**.27**	**.19**	**.49**	**.30**	**.28**	1										
10. Credit and Checking Fees	5.58	2.34	.65	**-.18**	**.15**	**-.30**	**-.20**	**-.15**	**-.41**	**-.13**	**-.14**	**-.59**	1									
11. Gender	.39	.49	-	.16	**.14**	**.16**	-.03	**.27**	.06	.06	**.35**	**.13**	-.02	1								

Appendix 6, Table 2 (cont.): Study 2 Summary Statistics, KR-20 or Cronbach Alpha Reliabilities, and Correlations

	Mean	SD	Alpha	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
12. Age	46.55	14.72	-	**.35**	.05	-.01	-.06	**-.10**	**.09**	**.14**	.05	.02	.01	.01	1							
13. Race / Ethnicity	0.81	0.39	-	**.20**	**.18**	-.07	-.07	**-.13**	-.03	.00	**.37**	**.36**	-.02	.01	**.20**	1						
14. Income	4.00	1.95	-	**.26**	**.12**	**.28**	**.14**	**.28**	**.30**	**.29**	**.37**	**.29**	-.17	.05	.06	-.02	1					
15. Education	3.34	1.04	-	**.29**	**.23**	**.28**	**.19**	**.26**	**.24**	**.18**	.03	-.05	-.18	.06	-.03	-.08	**.34**	1				
16. Number of Children	2.49	1.45	-	-.01	-.06	-.04	-.01	-.05	-.05	.10	.13	**.23**	**.18**	-.03	**.35**	-.01	.06	**-.12**	1			
16. Marital Status	0.55	0.50	-	**.13**	.04	**.13**	.05	.08	.15	.23	.13	**.23**	-.08	-.01	**.14**	-.02	**.42**	**.11**	**.32**	1		
17. Years to Retire	3.65	1.99	-	**-.30**	-.01	-.03	.04	.04	-.07	-.16	-.33	**-.12**	.04	.02	**-.81**	-.13	**-.09**	.01	**-.27**	**-.13**	1	
19. Need for Cognition	3.99	0.82	.73	**.35**	**.31**	**.25**	.14	.18	.04	**.12**	.07	.03	.03	.11	**.**04	.13	**.**08	.20	-.03	.05	.03	1

Note: Significant correlations ($p < .05$) are in **bold**; Race/Ethnicity: 1 = Caucasian, 0 = Other; Income: 1 = less than $15K, 2 = $15K to < $25K, 3 = $25K to <$35K, 4 = $35K to < $50K, 5 = $50K to < 75K, 6 = $75K to < $100K, 7 = $100 K to < $150K, 8 = more than $150K; Education: 1 = Some High School, 2 = High School Graduate, 3 = Some College, 4 = College Degree, 5 = Masters, 6 = Doctor, Ph.D., or Law degree; Marital status: 1 = Married, 0 = Other.

Appendix 6, Table 3: Study 3 Summary Statistics, KR-20 or Cronbach's Alpha Reliabilities, and Correlations

	Mean	SD	Alpha	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. Financial literacy	7.81	3.52	.85	1																					
2. Numeracy	3.35	2.14	.75	**.63**	1																				
3. Confidence	4.05	0.97	.92	**.27**	**.16**	1																			
4. Plan For Money – LT	3.64	1.12	.95	**.21**	.06	**.53**	1																		
5. Willing to Take Risks	2.78	0.85	.81	**.34**	**.15**	**.30**	**.30**	1																	
6. Savings for Emergency Fund	0.53	0.50	-	**.33**	**.21**	**.32**	**.40**	**.36**	1																
7. Figure Needed for Retire	0.47	0.50	-	**.44**	**.30**	**.21**	**.31**	**.35**	**.44**	1															
8. Positive Savings / Investment Behaviors	2.20	1.32	.68	**.59**	**.38**	**.25**	**.27**	**.40**	**.40**	**.49**	1														
9. Banks / CC Credit Score	7.44	2.80	-	**.40**	**.26**	**.30**	**.32**	**.34**	**.49**	**.36**	**.39**	1													
10. Credit and Checking Fees	5.30	2.25	.66	**-.24**	**-.16**	**-.35**	**-.36**	**-.24**	**-.44**	**-.24**	**-.13**	**-.66**	1												
11. Gender	.50	.50	-	**.21**	**.19**	.08	.04	**.13**	**.11**	**.09**	**.12**	.02	**-.18**	1											

Appendix 6, Table 3 (cont.): Study 3 Summary Statistics KR-20 or Cronbach's Alpha Reliabilities, and Correlations

	Mean	SD	Alpha	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
12. Age	2.58	0.93	-	**.20**	.02	.01	.02	-.03	**.18**	**.18**	**.31**	**.15**	.01	.03	1										
13. Race / Ethnicity	0.77	0.42	-	**.24**	**.23**	.05	-.04	.04	.06	**.10**	**.20**	**.13**	-.05	-.02	.08	1									
14. Income	5.11	2.00	-	**.44**	**.27**	**.16**	**.15**	**.33**	**.30**	**.36**	**.44**	**.39**	**-.14**	**.08**	.08	**.16**	1								
15. Education	2.97	0.94	-	**.51**	**.41**	**.22**	**.19**	**.31**	**.21**	**.28**	**.40**	**.29**	**-.16**	.02	**-.11**	**.12**	**.47**	1							
16. Marital Status	0.60	0.49	-	**.20**	**.15**	.07	.05	**.10**	**.17**	**.18**	**.25**	**.23**	-.01	.02	**.16**	**.22**	**.38**	**.14**	1						
17. Years to Retire	3.75	1.88	-	**-.23**	-.02	-.05	-.05	-.01	**-.20**	**-.18**	**-.33**	**-.19**	.07	-.03	**-.79**	-.07	-.07	**.10**	**-.13**	1					
18. Restraint	3.54	0.89	.76	.04	-.06	**.35**	**.35**	**.11**	**.21**	**.12**	.02	**.23**	**-.31**	.04	.03	-.08	.06	.07	.04	-.04	1				
19. Need for Cognition	4.16	0.84	.77	**.31**	**.26**	**.25**	**.25**	**.16**	**.15**	**.23**	**.24**	**.13**	**-.11**	**.09**	.06	**.11**	.06	**.28**	.07	-.01	**.20**	1			
20. Self-efficacy	4.66	0.79	.93	**.21**	**.16**	**.41**	**.31**	**.13**	**.14**	.07	**.14**	**.16**	-.06	-.05	-.03	**.12**	**.22**	**.20**	**.12**	.01	**.26**	**.38**	1		
21. Delayed Gratification	4.41	0.59	.74	**.24**	**.14**	**.43**	**.41**	**.17**	**.28**	**.22**	**.19**	**.30**	**-.29**	-.07	**.12**	.05	**.18**	**.18**	**.13**	**-.10**	**.47**	**.43**	**.55**	1	
22. Impulsivity	2.93	0.92	.78	-.06	.07	**-.21**	**-.20**	-.05	**-.13**	**-.12**	-.06	**-.18**	**.18**	**.14**	**-.14**	.06	-.02	.02	-.04	**.12**	**-.55**	**-.22**	**-.19**	**-.44**	1

Note: Significant correlations ($p < .05$) are in **bold**; Age: 1 = 18-29, 2 = 30-44, 3 = 45-59, 4 = 60+. ; Race/Ethnicity: 1 = Caucasian, 0 = Other; Income: 1 = less than $15K, 2 = $15K to < $25K, 3 = $25K to <$35K, 4 = $35K to < $50K, 5 = $50K to < 75K, 6 = $75K to < $100K, 7 = $100 K to < $150K, 8 = more than $150K; Education: 1 = Some High School, 2 = High School Graduate, 3 = Some College, 4 = College Degree; Marital status: 1 = Married, 0 = Other.

Appendix 6, Table 4: Study 2 Logistic Regression / OLS Results for Model 3

	Saving for Emergency Fund	How Much is Needed for Retirement	Banks and Credit Card Firms Rate Credit Score	Credit and Checking Fees	Positive Savings / Investment Behaviors
	N = 475	N = 477	N = 483	N = 373	N = 483
Intercept	.006	.004	2.173*	7.281**	.831*
Gender (1 = M, 0 = F)	1.057	.874	-.243	.293	.263*
Age (30 – 44 years)	1.697	.850	-1.48*	.524	.195
Age (45- 59 years)	2.006	1.172	-.255	.801	.687*
Age (60 and older)	3.181*	1.335	1.544	-.278	1.446**
Race/Ethnicity (1 = Caucasian, 0 = Not)	.884	.979	-.091	-.184	-.043
Income ($15K, but < $25K)	.883	2.610*	-.789	2.044**	.378
Income ($25K, but < $35K)	.975	1.010	-.928	1.722**	.132
Income ($35K, but < $50K)	.954	1.206	.078	1.425*	.651**
Income ($50K, but < $75k)	1.489	1.774	.116	1.452	.491*
Income ($75K, but < $100K)	2.390*	2.467	1.544*	-.068	.612*
Income ($100K, but < $150K)	2.516	1.761	1.54*	.602	1.247**
Income ($150K, or more)	3.635	2.599	2.630*	-.369	.478
High School Graduate	1.152	.647	-.771	-1.398	-1.506**
Some College	1.460	1.040	-.415	-1.177	-1.332**
College Graduate	1.695	.895	.460	-1.220	-.545
Master's Degree	1.690	1.188	.415	-1.877*	-.394
Dr., Ph.D., Law Degree	1.603	1.189	.521	-1.268	-.705
Number of Children	.830*	1.114	-.251**	.344**	-.048
Marital Status (1 = Married, 0 = Not)	1.301	2.007**	.985**	-.368	-.055
Years to Retire	1.039	.937	.080	.056	-.015
Financial Literacy	**1.062**	**1.092**	**.061**	**-.053**	**.128****
Numeracy	.952	.980	.080	.019	-.068**
Consumer Confidence-Investing	1.776**	1.839**	.609**	-.505**	.092
Planning for Money–Long Term	1.620**	1.277*	.317**	-.138	.045
Willing to Take Investment Risks	1.006	1.248*	-.068	.002	.112**

R^2 Model 1 (only demographics)	.136	.157	.255	.163	.340
R^2 Model 2 (model 1 + fin. literacy)	.143	.175	.269	.166	.400
R^2 Model 3 (model 2 + psychol. traits)	.248	.267	.330	.227	.443

Notes: * $p < .05$; ** $p < .01$. For "Saving for an Emergency Fund" and planning "How Much is Needed for Retirement," logistic regression is used and $\mathbf{R^2}$ is Cox and Snell $\mathbf{R^2}$. Further, the coefficients for these two dependent variables are the odds ratio coefficients of logistic regression (Exp(β)). OLS regression is used for "Banks and Credit Card Firms Rate Credit Score," "Credit and Checking Fees," and "Positive Savings / Investment Behaviors." Model 1 used just the demographic variables as predictors; Model 2 used the demographic variables and financial literacy as predictors; and Model 3 used the demographic variables, financial literacy, numeracy, consumer confidence-investing, planning for money-long term, and willing to take investment risks as predictors. All coefficients above reflect Model 3 estimates. The reference category for the age based dummy variable is "18 – 29 years"; the reference category for the income-based dummy variable is "< $15,000"; and the reference category for the education-based variable is "some high school."

Appendix 6, Table 5: Study 3 Logistic Regression / OLS Results for Model 3

	Saving for Emergency Fund	How Much is Needed for Retirement	Banks and Credit Card Firms Rate Credit Score	Credit and Checking Fees	Positive Savings / Investment Behaviors
	N = 440	N = 440	N = 455	N = 370	N = 455
Intercept	.001	.004	2.387*	7.085**	-.382
Gender (1 = M, 0 = F)	1.067	.884	-.350	-.692**	-.033
Age (30 – 44 years)	.751	1.844	-.750*	1.461**	.343*
Age (45- 59 years)	1.413	2.580	-.540	1.416**	.457*
Age (60 and older)	2.290	2.589	.274	1.078	.464
Race/Ethnicity (1 = Caucasian, 0 = Not)	.697	.782	.030	-.148	.145
Income ($15K, but < $25K)	2.403	.586	-.289	.238	-.117
Income ($25K, but < $35K)	7.660**	2.060	.458	-.155	-.012
Income ($35K, but < $50K)	2.297	1.345	.666	.111	-.059
Income ($50K, but < $75k)	3.364	1.596	1.241*	.683	.298
Income ($75K, but < $100K)	4.848*	3.229	1.738**	.488	.381
Income ($100K, but < $150K)	4.292*	1.963	1.760**	-.075	.396
Income ($150K, or more)	8.523**	4.124*	1.191	.259	.548*
High School Graduate	3.214	3.149	-.211	1.082*	.076
Some College	2.329	3.115	-.086	.838	.255
Bachelor's Degree or Higher	2.901	2.790	-.088	.898	.376
HH Size: (Number of Children)	.862	.944	-.146	.129	.128
Marital Status (1 = Married, 0 = Not)	1.598	1.414	.647*	-.118	.149
Years to Retire	.889	.948	-.065	.076	-.108*
Financial Literacy	**1.012**	**1.180****	**.089**	**-.070**	**.098****
Numeracy	1.117	1.174*	.134*	-.045	.047
Consumer Confidence-Investing	1.214	.783	.237	-.341**	-.011
Planning for Money–Long Term	2.235**	1.915**	.419**	-.472**	.124*
Willing to Take Investment Risks	1.956**	1.851**	.450**	-.139	.283**

R^2 Model 1 (only demographics)	.192	.232	.240	.161	.396
R^2 Model 2 (model 1 + fin. literacy)	.206	.272	.272	.186	.465
R^2 Model 3 (model 2 + psychol. traits)	.346	.349	.344	.295	.507

Notes: * $p < .05$; ** $p < .01$. For "Saving for an Emergency Fund" and planning "How Much is Needed for Retirement," logistic regression is used and $\mathbf{R^2}$ is Cox and Snell $\mathbf{R^2}$. Further, the coefficients for these two dependent variables are the odds ratio coefficients of logistic regression (Exp(β)). OLS regression is used for "Banks and Credit Card Firms Rate Credit Score," "Credit and Checking Fees," and "Positive Savings / Investment Behaviors." Model 1 used just the demographic variables as predictors; Model 2 used the demographic variables and financial literacy as predictors; and Model 3 used the demographic variables, financial literacy, numeracy, consumer confidence-investing, planning for money-long term, and willing to take investment risks as predictors. All coefficients above reflect Model 3 estimates. The reference category for the age based dummy variable is "18 – 29 years"; the reference category for the income-based dummy variable is "< $15,000"; and the reference category for the education-based variable is "some high school."

Appendix 6, Table 6: Study 2 2SLS Results - NFC as an Instrumental Variable

	Saving for Emergency Fund	How Much is Needed for Retirement	Banks and Credit Card Firms Rate Credit Score	Credit and Checking Fees	Positive Savings / Investment Behaviors
	N = 475	N = 477	N = 475	N = 360	N = 467
Intercept	.004	.003	.104	7.136**	-1.538
Gender (1 = M, 0 = F)	1.079	.962	.075	-.046	.449*
Age (30 – 44 years)	1.785	.916	-.314	.099	.570*
Age (45- 59 years)	2.281*	1.372	1.109	-.631	1.179*
Age (60 and older)	3.716*	1.626	2.040	-1.251	1.764**
Race/Ethnicity (1 = Caucasian, 0 = Not)	.951	1.070	.552	-1.059	.328
Income ($15K, but < $25K)	.860	2.610	-.480	2.211**	.455
Income ($25K, but < $35K)	.997	1.100	-.280	1.479*	.529
Income ($35K, but < $50K)	.980	1.292	.559	1.281*	.991*
Income ($50K, but < $75k)	1.559	1.980	1.499*	.811	.934**
Income ($75K, but < $100K)	2.425*	2.717*	1.757*	.059	1.019**
Income ($100K, but < $150K)	2.519	1.970	1.804*	.347	1.373**
Income ($150K, or more)	3.582	2.693	2.179*	.579	.783
High School Graduate	1.309	.752	1.658	-1.166	.945
Some College	1.720	1.228	2.355*	-.961	1.246*
College Graduate	2.028	1.072	3.114*	-1.206	1.828**
Master's Degree	2.085	1.435	3.190*	-1.908	1.943**
Dr., Ph.D., Law Degree	1.769	1.215	1.581	-.002	1.583*
Number of Children	.817*	1.092	-.404**	.550	-.098
Marital Status (1 = Married, 0 = Not)	1.310	1.988*	.933*	-.612	-.122
Years to Retire	1.029	.918	-.231	.276	-.126
Financial Literacy	**.835**	**1.089**	**-.752**	**.704**	**-.281**
Numeracy	1.107	.976	.545*	-.420*	.152
Consumer Confidence-Investing	2.048**	1.810**	.854**	-.851**	.238*
Planning for Money–Long Term	1.624**	1.286*	.405**	-.180	.090
Willing to Take Investment Risks	1.051	1.244*	.070	-.129	.180**

R^2 Model	.25	.26	.23	.15	.27

Notes: * $p < .05$; ** $p < .01$. For "Saving for an Emergency Fund" and planning "How Much is Needed for Retirement," logistic regression is used and $\mathbf{R^2}$ is Cox and Snell $\mathbf{R^2}$. Further, the coefficients for these two dependent variables are the odds ratio coefficients of logistic regression (Exp(β)). All coefficients above reflect Model 3 estimates consistent with OLS results in Appendix 6, Table 4. The reference category for the age based dummy variable is "18 – 29 years"; the reference category for the income-based dummy variable is "< $15,000"; and the reference category for the education-based variable is "some high school."

Appendix 6, Table 7: Study 3 2SLS Results - NFC as an Instrumental Variable

	Saving for Emergency Fund	How Much is Needed for Retirement	Banks and Credit Card Firms Rate Credit Score	Credit and Checking Fees	Positive Savings / Investment Behaviors
	N = 429	N = 428	N = 399	N = 342	N = 425
Intercept	.001	.001	1.846	9.151**	-.514
Gender (1 = M, 0 = F)	1.011	1.064	.497	-.983*	-.159
Age (30 – 44 years)	.736	2.007	-.529	1.494**	.345
Age (45- 59 years)	1.585	2.670*	.549	.839	.250
Age (60 and older)	2.718	2.826	1.279	.212	.256
Race/Ethnicity (1 = Caucasian, 0 = Not)	1.625	.811	.591	-.392	-.091
Income ($15K, but < $25K)	.2.665	.429	-1.227	-.134	.135
Income ($25K, but < $35K)	1.923*	1.720	.721	-1.527	.091
Income ($35K, but < $50K)	2.442	1.384	1.641	-1.431	-.046
Income ($50K, but < $75k)	3.966*	1.454	2.171	-1.285	.195
Income ($75K, but < $100K)	5.460*	3.004	2.731*	-1.508	.152
Income ($100K, but < $150K)	4.744*	1.964	2.839*	-2.038	.213
Income ($150K, or more)	10.360**	5.231*	2.391	-1.741	.372
High School Graduate	3.316	5.082*	1.943	-.134	-.198
Some College	2.449	5.601*	2.879	-1.041	-.143
Bachelor's Degree or Higher	2.172	5.214*	3.889	-1.442	-.270
HH Size: (Number of Children)	.857	.943	-.170	.164	-.015
Marital Status (1 = Married, 0 = Not)	1.499	1.368	.303	-.064	.185
Years to Retire	.9350	.890	-.373	.183	-.052
Financial Literacy	**.835**	**2.003**	**-.999**	**.546**	**.329**
Numeracy	1.335	.687	.899	-.496	-.125
Consumer Confidence-Investing	1.278	.657	.401	-.402	-.043
Planning for Money–Long Term	2.371**	1.700**	.525*	-.575**	.116*
Willing to Take Investment Risks	2.280*	1.114	1.057	-.498	.153
R^2 Model	.35	.34	.21	.24	.42

Notes: * $p < .05$; ** $p < .01$. For "Saving for an Emergency Fund" and planning "How Much is Needed for Retirement," logistic regression is used and $\mathbf{R^2}$ is Cox and Snell $\mathbf{R^2}$. Further, the coefficients for these two dependent variables are the odds ratio coefficients of logistic regression (Exp(β)). OLS regression is used for "Banks and Credit Card Firms Rate Credit Score," "Credit and Checking Fees," and "Positive Savings / Investment Behaviors." All coefficients above reflect Model 3 estimates consistent with OLS estimates in Appendix 6, Table 5. The reference category for the age based dummy variable is "18 – 29 years"; the reference category for the income-based dummy variable is "< $15,000"; and the reference category for the education-based variable is "some high school."