

Interplay of Investors' Financial Knowledge and Risk Taking

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There are many possible explanations for the financial behavior of investors. One of the explanations is financial knowledge. Using a survey data, this study demonstrates that, at least for investors, their objective knowledge, subjective knowledge, and risk taking are highly correlated. More importantly, gender emerges as an important factor that differentiates investors' levels of objective knowledge, subjective knowledge, and risk taking, whereas investors' subjective knowledge mediates investors' objective knowledge on risk taking.

Keywords: Financial knowledge, Risk taking in investment, Gender difference

INTRODUCTION

Investors often take risks in their financial decisions. Investors may gain by taking risks in their investments. Investors also can make poor decisions in taking risks because they do not know how to make good ones. The financial literacy literature suggests two central themes that may explain the relationship between financial knowledge and risk taking in investment. The first theme is that good financial behaviors are positively associated with higher levels of financial knowledge (Edmiston and Gillett-Fisher [2006]). The second theme is that financial education and experience positively influence financial knowledge and behavior (Lyons, Palmer, Jayaratne, and Scherpf [2006]). However, limited research has directly investigated the link between risk taking in investment and financial knowledge (Lyons et al. [2006]). In particular, limited empirical evidence is available to demonstrate gender difference regarding financial knowledge and risk taking in investment. These limitations motivate this study's investigations.

Financial knowledge is information that is learned, organized, represented, and stored in memory (Alba and Hutchinson [1987]). Investors can retrieve, use, and update their financial knowledge to create inherent and useful property of the knowledge itself and make reasoning and elaboration regarding their financial decisions (Alba and Hutchinson [2000]). Research has suggested that there are two different

aspects of financial knowledge, objective knowledge and subjective knowledge. Objective knowledge facilitates financial information acquisition through effective deliberation using newly acquired knowledge, whereas subjective knowledge may increase the reliance on what investors believe they know (Alba and Hutchinson [2000]). While subjective knowledge does not represent the true validity of objective knowledge that an investor exhibits, it suggests how confident an investor is in making his or her financial decisions (Alba and Hutchinson [2000]).

First, this study wants to examine gender difference in investors' objective knowledge, subjective knowledge, and risk taking in investment. Then this study examines the interplay among objective knowledge, subjective knowledge, and risk taking in investment. Since research suggests that knowledge has its specific domain (Alba and Hutchinson [2000]), this study focuses its investigations on investing in mutual funds as the tested knowledge domain. Consequently, risk taking in investment refers to investors' risk taking in investing in mutual funds. In the following sections, this study reviews relevant literature and the role of objective knowledge and subjective knowledge. This study then explains the survey study and data collection. Finally, this study presents results and concludes with some next steps.

LITERATURE REVIEW

Financial Knowledge

Financial knowledge has two important components: objective knowledge and subjective knowledge (Friestad and

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Wright [1995]). Consumer psychology research has a long tradition of distinguishing between objective knowledge and subjective knowledge (Friestad and Wright [1994]). Research has regarded objective knowledge as accurate stored information and subjective knowledge as a belief about that state of knowledge (Bettman and Park [1980], Park and Lessig [1981], Sujan [1985]). "Subjective knowledge can be thought of as including an individual's degree of confidence in his/her knowledge, whereas objective knowledge refers only to what an individual actually knows" (Brucks [1985], p. 2).

Past research has demonstrated that objective knowledge and subjective knowledge are distinct constructs with unique measures (Moreau, Lehmann, and Markman [2001], Park, Mothersbaugh, and Feick [1994]) and influence information search and behavior differently (Campbell and Kirmani [2000], Radecki and Jaccard [1995], Raju, Lonial, and Mangold [1995]). Accuracy depends on objective knowledge, whereas confidence may be influenced more by investors' self-assessed subjective knowledge, leaving objective knowledge unchanged (Alba and Hutchinson [2000]). Investors who have higher level of objective knowledge usually are able to employ category-based processing since knowledgeable investors are likely to develop a set of expectations about financial products over time (Wang [2006]). Those categories are represented by typical exemplars or prototypes that can embody several features and attributes most commonly associated with the members of the category (Alba and Hutchinson [1987]).

Knowledgeable investors can process financial information regarding a mutual fund effortlessly since an initial categorization is accessible to process the information. Due to their capability of using category-based processing, they could process the information at category level rather than based on individual attributes (Chang [2004], Cohen [1982], Fiske [1982]). Consequently, higher level of objective knowledge facilitates elaboration of the information since real knowledge helps investors digest the information regarding the mutual fund (Chang [2004], Hallahan [2000a]). By matching newly acquired information to what they already know, investors can use objective knowledge to elaborate on information (Wang [2006]).

Alternatively, piecemeal processing could explain how investors with lower level of objective knowledge process financial information. When employing piecemeal processing, investors with lower level of objective knowledge perceive financial information as made up of discrete pieces of attributes. They use an attribute-by-attribute processing approach to add or average the overall evaluation (Fiske [1982]). Because of insufficient objective knowledge, their category knowledge usually is not well developed. In this case, investors with lower levels of objective knowledge need to process attributes one by one to reach their decisions (Sujan [1985]).

Compared to knowledgeable investors, less knowledgeable investors may not be able to process financial information regarding mutual funds effortlessly because an initial categorization of financial information regarding mutual funds is not available. Due to their incapability of using category-based processing, less knowledgeable investors need to process the information based on individual attributes regarding mutual funds (Chang [2004], Cohen [1982], Fiske [1982]). Consequently, a lower level of objective knowledge does not facilitate elaboration of the information since a lower level of objective knowledge may not be able to help investors digest the information (Chang [2004], Hallahan [2000a]).

Research has examined the effects of subjective knowledge on information search and decision making (Raju et al. [1995]). Since subjective knowledge is not actual knowledge and cannot provide a real infrastructure for investors to make inference or elaboration, subjective knowledge does not affect how many elaborative thoughts investors can generate (Sujan [1985], Wang [2006]). Research also has documented that subjective knowledge reflects self-confidence in information processing and decision making (Campbell and Kirmani [2000], Friestad and Wright [1994]). Gardner [1983] and Brucks [1985] have suggested that subjective knowledge is not likely to facilitate efficiency in distinguishing variability of attribute search and influence the ability to formulate the benefit/cost ratio of acquiring financial information. Brucks [1985] has found self-accessed knowledge may be more likely to be efficient in relying on one's own processing skills and, as a result, may affect the acceptance of financial information.

These studies suggest that investors who consider themselves unfamiliar with investing in mutual funds may find it more difficult to process financial information regarding mutual funds. In contrast, investors with higher level of subjective knowledge may find it easier to process financial information regarding mutual funds. They may not be accurate in interpreting financial information because they may not have the true objective knowledge to process the information. However, they are more likely to process the information and make use of them to make a decision based on confidence level of their self-assessed knowledge.

Research has suggested possible interplay between subjective knowledge and objective knowledge (Alba and Hutchinson [1987, 2000]). Investors with higher levels of objective knowledge can maximize their skills or proficiencies in comprehending, interpreting, and connecting financial information. They can process financial information more schematically than novices. As a result, objective knowledge may enhance subjective knowledge, as a positive relationship exists between objective knowledge and self-accessed knowledge (Alba and Hutchinson [1987, 2000]). However, objective knowledge and subjective knowledge may influence behavior differently. Objective knowledge is more likely to help process financial information analytically by applying decision criteria readily available from memory (Bettman

and Sujar [1987]) and is less likely to rely on heuristic cues when investors make product inferences (Biswas and Sherrell [1993]).

Objective knowledge is data-driven, integrating newly acquired information with existing knowledge. Subjective knowledge is confidence-driven, evaluating newly acquired information with the confidence of knowing. Therefore, disconfirmation may emerge more easily when knowledgeable investors' evaluations indicate discrepancies due to their counter-arguments (Alba and Hutchinson [2000], Chang [2004]). In reasoning out the discrepancies, knowledgeable investors will generate more external-based elaborative thoughts in relation to internal-based elaborative thoughts. On the other hand, disconfirmation also may emerge when confident consumers evaluate discrepancies due to their subjective preferences (Alba and Hutchinson [2000]). In reasoning out the discrepancies, confident investors will generate more internal-based elaborative thoughts in relation to external-based elaborative thoughts (Chang [2004]).

FINANCIAL EDUCATION, KNOWLEDGE, AND BEHAVIOR

Studies examining the behavioral effects of financial education generally support the notion that financial education improves financial behavior (Bernheim, Garrett, and Maki [2001]). Participation in a financial education course has been shown to increase contributions to savings plans (Bayer, Bernheim, and Scholz [1996], Bernheim, Skinner, and Weinberg [2001]) and improve household knowledge of relative asset returns and pension plans (Maki [2001]). Research also has found a positive relationship between financial education and retirement planning behaviors. Bernheim and Garrett [2003] found that the availability of financial education in the workplace stimulates retirement savings among individuals in the lowest half of the savings distribution. Female participants, enrolled in a financial education seminar that focused on retirement planning and used a workbook-based curriculum, increased their ability to set up a retirement plan. Joo and Grable [2005] found that respondents who had participated in a financial education program were more likely to have a retirement savings program in place.

Other studies examining the effects of specific types of financial education have found that individuals who participated in credit counseling practiced responsible financial behaviors following the experience (Elliehausen, Lundquist, and Staten [2007]). Loibl and Hira [2005] found financial management behaviors to be related to self-directed financial learning. In addition, they found good financial management practices to be positively inter-correlated with greater financial and career satisfaction. For example, participants in retirement planning seminars are more likely to increase their retirement goals, start new tax deferred savings accounts, increase contributions to current retirement

plans, and reallocate their investments (Clark, d'Ambrosio, McDermid, and Sawant [2003]).

Hilgert, Hogarth, and Beverly [2003] have explored the importance of the link between financial knowledge and behavior and focused on four broad categories of financial practices: cash-flow management, credit management, saving, and investments. They have found that financial knowledge in a specific area is positively correlated with financial practices in that area. They have also found that learning about financial matters from family, friends, and personal experiences is also highly correlated with positive improvements in financial behaviors. Finally, they have found that those who scored highest on questions relating to credit management, saving, and investing are most likely to exhibit good credit management, saving, and investing habits, respectively. Perry and Morris [2005] have tested the relationship between financial knowledge and responsible financial behavior and concluded that financial knowledge has the greatest effect on eliciting responsible financial behavior.

Chen and Volpe [1998] have reported that people with higher levels of financial knowledge tend to have right opinions and make correct decisions related to savings, borrowing, and investing. Edmiston and Gillett-Fisher [2006] have found that the advanced level of financial knowledge category contains a greater proportion of individuals with a sufficient emergency fund (31.7%) than both the intermediate financial knowledge (12.2%) and low financial knowledge (3.9%) categories. Only 9.8% of individuals in the advanced financial knowledge group lacked an emergency fund altogether, compared to 22.5% of those with intermediate financial knowledge and 49% of those with low financial knowledge. They concluded that individuals with a higher level of financial knowledge made decisions that more closely mirrored experts' recommendations than did those with a lower level of financial knowledge.

Risk-Taking Behavior

The financial literature indicates an important role for behavioral aspects of investment decision-making as demographics and personality type may influence financial risk behavior (Siegal and Hoban [1982]). Empirical evidence has indicated that factors such as age, education, income, and wealth play an important role in distinguishing risk tolerance among individuals (Riley and Chow [1992], Schooley and Worden [1999]). Riley and Chow [1992] have found a positive relationship between risk tolerance and investors' ages. In particular, they have found that risk aversion decreases with age until the period five years prior to retirement, where risk aversion reverses direction and increases with age.

Schooley and Worden [1999] have found that investors with higher levels of education hold higher percentages of equity securities in their portfolios. Other studies have examined personal characteristics that may lend some insight into the level of risk that an individual can tolerate. Barnewall

[1987] has concluded that investors are either passive or active. Passive investors have become wealthy by inheritance or by risking the capital of others rather than their own. These individuals have a greater need for security and a lower risk tolerance. On the other hand, active investors, those who have risked their own capital and earned their own wealth, have a much higher risk tolerance than passive investors. Barnewall [1987] has also found that certain occupational groups such as corporate executives and lawyers are more risk averse.

Filbeck, Hatfield, and Horvath [2005] have explored the relationship between investors' personality and their risk tolerance. Using the Myers-Briggs Type Indicator (MBTI), they have hypothesized that higher levels of risk tolerance are related to the Myers-Briggs preferences for extraversion, intuition, thinking, and perceiving. They have found that investors with a stronger preference toward feeling have a lower tolerance for risk behavior, whereas investors with a stronger preference for thinking have a higher tolerance for risk behaviors. In other words, as the thinking score declines, tolerance for risk behavior diminishes. Investors with the strongest preference for judging exhibit an exponentially increasing tolerance for risk behavior. Investors with the highest preference for perceiving have no tolerance for risk behavior. Investors with a preference for judging tend to be able to tolerate much more risk than those with a preference for perceiving. Likewise, investors with a preference for sensing are willing to tolerate more upside or downside potential than those with a preference for intuition.

The role of gender also has been examined in forming judgments about risk tolerance (Grable and Lytton [1998]). Although research shows that men are actually more risk tolerant in a variety of contexts (Byrnes, Miller, and Schafer [1999]), research has suggested that gender stereotypes are evident. Several studies have been conducted about how investors perceive risk tolerance among men and women. Martin (1987) studied the accuracy of gender stereotypes for a variety of attributes, including willingness to take risks. She asked 150 visitors (94 women, 56 men) at a university open house to provide self-ratings and found males were viewed as more risk tolerant than they really were, and females were viewed as more risk averse than they really were. Siegrist, Cvetkovich, and Gutscher [2002] asked 91 undergraduates (61 females and 30 males) to choose seven loss and seven gain scenarios, which differed in degree of risk, and then to indicate which option they thought most other female students and most other male students would have chosen. They concluded that both males and females overestimated male risk taking, but the women's overestimates were greater than the men's. Both genders were accurate in their predictions of women's lower risk preferences.

Eckel and Grossman [2003] asked 256 college students (136 males and 120 females) to wager money on one of five gambles. The gambles, which differed in degree of risk, reflected the linear increase in the risk of the gambles. Each participant had to predict which gamble every other person

taking part in the study would choose. They concluded that there was a significant gender difference in actual risk tolerance favoring males as both genders correctly predicted that males would be more risk-taking than females. Roszkowski and Grable [2005] used a sample of 183 financial advisors and 290 advisory clients to determine the degree of correspondence between advisors' subjective judgments about their clients' financial risk tolerance and the clients' actual financial risk tolerance. They concluded that advisors overestimated the risk tolerance of men and underestimated the risk tolerance of women. The results suggest that commonly used judgments of risk tolerance based on advisor experience and intuition tend to be inadequate both in terms of precision and because of the likelihood of bias.

Determinants of Financial Knowledge and Risk Taking

The level of financial knowledge an individual possesses is likely to be a function of a number of different determinants beyond exposure to financial education. Age, gender, and amount of experience are all factors in determining the level of financial knowledge (Chen and Volpe [1998]). In a more general context, individuals with less education and low incomes have generally been found to have lower financially literacy scores (Kotlikoff and Bernheim [2001]). Hilgert, Hogarth, and Beverly [2003] found financial knowledge to be greatly influenced by an individual's experience with personal financial matters. Hogarth, Beverly, and Hilgert [2003] expanded upon previous findings, adding that those with the greatest level of financial knowledge were more likely than those with lesser knowledge to give credit to their employers for financial learning. They also pointed out that the relatively high incomes of the top knowledge group might have been offered greater access to financial education than those in lower income positions.

While studies regarding financial education, knowledge, and behavior are available, research still does not have a clear understanding of gender difference in financial knowledge and risk-taking behavior. Edmiston and Gillett-Fisher [2006] suggest that even though research has shed light on a number of influential factors, it is important to continue to examine individuals' financial knowledge levels and risk taking as means of better understanding financial literacy and behavior among men and women. This study addresses these critical gaps in the literature and provides a starting place for future discussions. Specifically, this study asks the following research questions.

1. Do male and female investors have different levels of subjective knowledge, objective knowledge, and risk taking in investing in mutual funds?
2. What are the relations among subjective knowledge, objective knowledge, and risk taking in investing in mutual funds?

3. Do investors' personal involvement, age, income, education, and experience influence their subjective knowledge, objective knowledge, and risk taking in investing in mutual funds?

METHODOLOGY

Survey Process and Data

To assess the study's research questions, an online survey was conducted at the regional level. The online survey was open between February 5, 2007, and April 24, 2007. Recruiting advertisements were posted on several tri-state listserves, finance-related blogs, and websites that targeted financial professionals and investors. Financial professionals and investors interested in participating in the study were instructed to click on a survey link. The link directed participants to the survey, which was divided into sections including measurement of subjective knowledge, measurement of objective knowledge, investment experiences, investment behaviors, and general demographics.

The online survey was self-administered with participants recording an identifier code in place of their names to ensure confidentiality and promote confidence in providing sensitive information accurately. No personnel information was sufficient to identify participants. A total of 2,751 people responded to the recruiting advertisements and visited the online survey site. However, 524 participants eventually completed the online survey, whereas 272 participants answered the survey partially and did not complete it. No observations from 524 participants had to be dropped because of missing information. It is important to acknowledge that the survey sample was not randomly selected. However, the advertisements used to recruit the sample covered a wide range of groups whose members specialized in financial and investing.

Variables and Measures

This study measured three dependent variables. Past research has demonstrated that objective knowledge and subjective knowledge are distinct constructs with unique measures (Moreau et al. [2001], Park et al. [1994]). Objective knowledge reflects what investors know, whereas subjective knowledge reflects what investors think they know. Three bipolar, 7-point semantic differential, scales ranging from 1 to 7 were used to measure participants' subjective knowledge regarding investing in mutual funds. The three questions asked participants to rate their knowledge of investing in mutual funds, familiarity with investing in mutual funds, and understanding about which financial characteristics are important when investing in mutual funds (Moreau et al. [2001]). The mean of these three items determined participants' subjective knowledge score. The mean of participants' subjective knowledge was 4.13 ($SD = 1.71$), whereas Cron-

TABLE 1
Objective Knowledge Score.

Objective Knowledge	Frequency	Percentage (%)
11	3	.6
12	3	.6
13	1	.2
14	2	.4
15	5	1.0
16	14	2.7
17	12	2.3
18	12	2.3
19	24	4.6
20	29	5.5
21	36	6.9
22	50	9.5
23	44	8.4
24	49	9.4
25	59	11.3
26	46	8.8
27	41	7.8
28	36	6.9
29	32	6.1
30	11	2.1
31	8	1.5
32	1	.2
33	4	.8
34	2	.4
Total	524	100

bach's α value for subjective knowledge was .96, indicating that three measures of subjective knowledge were reliable.

Thirty-seven questions were used to measure participants' objective knowledge regarding investing in mutual funds. Ten multiple-choice questions were used to reflect participants' objective knowledge regarding investing in mutual funds (Celsi and Olson [1988]), whereas 27 true-false questions were used to measure participants' objective knowledge about investing in mutual funds (Moreau et al. [2001]). Each correct answer was worthy of one point, and the mean of objective knowledge was 23.73 ($SD = 4.04$). Table 1 summarizes the results of participants' objective knowledge scores. The highest objective knowledge score was 34 and the lowest was 11. The results revealed that a range of participants' objective knowledge scores was captured even though participants' objective knowledge was at the high end of the range. This was evident as the mode of objective knowledge score was 25 and the median of objective knowledge score was 24.

A 7-point scale ranging from 1 (not at all) to 7 (extremely) was used to ask participants how often they would take risks in investing in mutual funds. The mean of participants' risk taking was 3.3 ($SD = 1.61$). Gender was asked and coded as the independent variable. There were 317 male participants and 207 female participants. Edmiston and Gillett-Fisher [2006] suggest future study should control the relevant factors to isolate the effects of any one variable of interest. Moreover, investors' demographics and amount of

experience are all factors in determining the level of financial knowledge (Chen and Volpe [1998]). Thus, this study measured several covariates. Participants' personal involvement was measured during the study by asking the participants to complete the sentence, processing information about mutual funds is . . . , using a 10-item scale composed of unimportant/important, boring/interesting, irrelevant/relevant, unexciting/exciting, means nothing/means a lot to me, unappealing/appealing, mundane/fascinating, worthless/valuable, uninvolved/involved, and not needed/needed (Zaichkowsky, 1994). The Cronbach's α value for personal involvement ($M = 4.69$, $SD = 1.42$) was .96. Age, education, and income were also asked. Finally, participants were asked how often they search information regarding investment ($M = 4.19$, $SD = 2.02$) and how often they purchase mutual funds ($M = 3.18$, $SD = 1.96$). These two covariates represented participants' experiences.

RESULTS

Statistical Analysis

Bivariate correlations tests were conducted to test the relations among the three dependent variables (Table 2). The results revealed all dependent variables were correlated with each other. Thus, this study used *MANCOVA* as the statistical procedure for data analysis. An advantage of the *MANCOVA* procedure is that the set of dependent variables are considered simultaneously. That is, the test considers the correlations among the set of dependent variables. If there is main effect for the independent variable, condition differences with respect to the dependent variables are established. Consequently, this study can determine on which dependent variables the conditions differ. This approach also supports Edmiston's and Gillett-Fisher's (2006) proposition that a multivariate analysis should be used to allow study to control the relevant factors to isolate the effect of any one variable of interest.

MANCOVA

A *MANCOVA* was run on objective knowledge, subjective knowledge, and risk taking as the dependent variables (Table 3), whereas gender was used as the fixed factor. Personal involvement (Wilks' $\lambda = .92$, $p < .000$), age (Wilks' $\lambda = .99$, $p < .058$), education (Wilks' $\lambda = .96$, $p < .000$),

TABLE 3
Multivariate Tests.

Effect	Wilks' λ	F	df	p	η^2
Intercept	.567	130.87	3, 514	.000	.433
Personal involvement	.917	15.48	3, 514	.000	.083
Age	.986	2.51	3, 514	.058	.014
Education	.964	6.47	3, 514	.000	.036
Income	.957	7.64	3, 514	.000	.043
Investment information search	.784	47.26	3, 514	.000	.216
Purchasing mutual funds	.941	10.78	3, 514	.000	.059
Gender	.918	15.21	3, 514	.000	.082

income (Wilks' $\lambda = .96$, $p < .000$), investment information search (Wilks' $\lambda = .78$, $p < .000$), and purchasing mutual funds (Wilks' $\lambda = .94$, $p < .000$) were used as covariates. Personal involvement, education, income, investment information search, and purchasing mutual funds were found to contribute to the model significantly. Gender (Wilks' $\lambda = .92$, $p < .000$) had a significant main effect on the dependent variables. In other words, the mean vectors were not equal and the set of means between male and female participants was different.

The tests of between-participants effects based on the individual univariate tests were reported in Table 4. Male participants ($M = 24.34$, $SD = 3.95$) scored higher objective knowledge than female participants ($M = 22.79$, $SD = 4$), $F(1, 516) = 4.75$, $p < .03$, $\eta^2 = .01$. Male participants ($M = 4.61$, $SD = 1.55$) had higher subjective knowledge than female participants ($M = 3.4$, $SD = 1.68$), $F(1, 516) = 30.14$, $p < .000$, $\eta^2 = .06$. Male participants ($M = 3.69$, $SD = 1.64$) were more likely to take risks in investing in mutual funds than female participants ($M = 2.7$, $SD = 1.35$), $F(1, 516) = 22.31$, $p < .000$, $\eta^2 = .04$.

Participants who had higher personal investment in processing information about mutual funds were more likely to have higher subjective knowledge, $F(1, 516) = 41.63$, $p < .000$, $\eta^2 = .08$, and objective knowledge, $F(1, 516) = 8.64$, $p < .003$, $\eta^2 = .02$. Participants with higher education were also more likely to have higher subjective knowledge, $F(1, 516) = 5.71$, $p < .017$, $\eta^2 = .01$, and objective knowledge, $F(1, 516) = 14.36$, $p < .000$, $\eta^2 = .03$. Participants with higher income were more likely to have higher subjective knowledge, $F(1, 516) = 22.33$, $p < .000$, $\eta^2 = .04$. Participants who often searched information about mutual funds were more likely to have higher subjective knowledge, $F(1, 516) = 114.09$, $p < .000$, $\eta^2 = .18$, score higher objective knowledge, $F(1, 516) = 26.61$, $p < .000$, $\eta^2 = .05$, and take risks in investing in mutual funds, $F(1, 516) = 38.84$, $p < .000$, $\eta^2 = .07$. Finally, participants who often purchased mutual funds were more likely to have higher subjective knowledge, $F(1, 516) = 29.71$, $p < .000$, $\eta^2 = .05$.

TABLE 2
Correlations.

Pearson correlation (p)	Risk taking	Objective knowledge
Risk taking		
Objective knowledge	.114 (.009)	
Subjective knowledge	.343 (.000)	.472 (.000)

TABLE 4
Tests of Between-Participants Effects.

Source	Dependent Variable	df	F	P	η^2
Corrected Model	Subjective knowledge	7	99.26	.000	.574
	Knowledge score	7	19.51	.000	.209
	Risk taking	7	15.5	.000	.174
Intercept	Subjective knowledge	1	1.04	.307	.002
	Knowledge score	1	280.58	.000	.352
	Risk taking	1	61.04	.000	.106
Personal involvement	Subjective knowledge	1	41.63	.000	.075
	Knowledge score	1	8.64	.003	.016
	Risk taking	1	.48	.489	.001
Age	Subjective knowledge	1	3.04	.082	.006
	Knowledge score	1	4.68	.031	.009
	Risk taking	1	.89	.346	.002
Education	Subjective knowledge	1	5.71	.017	.011
	Knowledge score	1	14.36	.000	.027
	Risk taking	1	2.12	.146	.004
Income	Subjective knowledge	1	22.33	.000	.041
	Knowledge score	1	3.54	.060	.007
	Risk taking	1	.14	.713	.000
Investment information search	Subjective knowledge	1	114.98	.000	.182
	Knowledge score	1	26.61	.000	.049
	Risk taking	1	38.84	.000	.070
Mutual funds purchase	Subjective knowledge	1	29.71	.000	.054
	Knowledge score	1	.04	.850	.000
	Risk taking	1	.48	.489	.001
Gender	Subjective knowledge	1	30.14	.000	.055
	Knowledge score	1	4.75	.030	.009
	Risk taking	1	22.31	.000	.041
Error	Subjective knowledge	516			
	Knowledge score	516			
	Risk taking	516			
Total	Subjective knowledge	524			
	Knowledge score	524			
	Risk taking	524			
Corrected Total	Subjective knowledge	523			
	Knowledge score	523			
	Risk taking	523			

To examine the relations among subjective knowledge, objective knowledge, and risk taking, a series of linear regression models were used to test for a mediation effect (Judd and Kenny, 1981). Subjective knowledge was regressed on objective knowledge ($\beta = .47$, $p < .000$), $F(1, 522) = 149.24$, $p < .000$, $R^2 = .22$. The results revealed that higher objective knowledge enhanced subjective knowledge. Risk taking was regressed on objective knowledge ($\beta = .11$, $p < .000$), $F(1, 522) = 6.83$, $p < .009$, $R^2 = .01$. The results revealed that higher objective knowledge elicited risk taking. Risk taking was regressed on objective knowledge ($\beta = -.06$, $p = .187$) and subjective knowledge ($\beta = .37$, $p < .000$), $F(2, 251) = 35.61$, $p < .000$, $R^2 = .12$. The results revealed that the effect of objective knowledge was no longer evident, and higher subjective knowledge elicited risk taking. The results revealed a mediation (Baron and Kenny [1986]) as subjective knowledge mediated objective knowledge on risk taking.

DISCUSSION

Alternatively, this study examined the link between financial knowledge and behavior from an investor-centered perspective that focused on how different were investors' subjective knowledge, objective knowledge, and risk taking based on gender. The findings highlighted the relationship between investors' subjective knowledge and objective knowledge on risk taking. Male investors tended to have higher subjective knowledge as well as objective knowledge than female investors. These results were consistent as objective knowledge enhanced subjective knowledge. Male investors also exhibited stronger risk-taking behavior than female investors. This result was also consistent with the mediation effect as investors' subjective knowledge mediated their objective knowledge on their risk taking. The results suggested that investors' confidence level initiated investors to take more risks, and investors' confidence levels were supported by their objective knowledge.

To integrate the findings, the results revealed that subjective knowledge might be the key to investors' risk taking. Research has documented that subjective knowledge reflects self-confidence in information processing and decision making (Campbell and Kirmani [2000]). While accuracy of investment information processing is dependent on objective knowledge (Alba and Hutchinson [2000]), self-accessed knowledge may be more likely to be efficient in relying on one's own processing skills and, as a result, may affect the acceptance of financial decisions. Even though investors may rely on their objective knowledge to make decisions, confidence mediates the accuracy of taking risks. This explanation is reasonable since it is hard to have absolute accuracy when taking risks. In other words, risk taking is encouraged when investors are confident in making their investments.

These arguments suggest that investors who consider themselves unfamiliar with investing in mutual funds may find taking risks undesirable. They may not be confident in their knowledge to take risks. In contrast, investors with higher level of subjective knowledge may find it easier to accept risk taking because of higher confidence level. They could make bad decisions because they might not use the true objective knowledge to make decisions. However, they are more likely to make a decision based on confidence level of their self-assessed knowledge.

Consistent with previous research, the results revealed that investors' personal involvement, income, education, and experiences enhanced their financial knowledge. However, the results revealed that subjective knowledge was enhanced by higher personal involvement, education, income, investment information search, and mutual funds purchase; objective knowledge was enhanced by higher personal involvement, education, and investment information search. The results suggested that income might not be a good predictor of investors' objective knowledge. The results indicated that education, experience, and involvement rather than income

reflected investors' objective knowledge, whereas investors with higher income might have higher confidence in investing. Finally, age was not an indicator for financial knowledge and risk taking, enhanced by more investment information search.

Even though the results supported most of previous studies regarding the effects of demographics on financial knowledge, gender was the only indicator of risk taking. In particular, the study results did not indicate that factors such as age, education, and income played an important role in distinguishing risk taking among investors. In fact, most of important factors related to risk taking in past studies were personal characteristics rather than demographics (Barnewall [1987], Filbeck et al. [2005], Schooley and Worden [1999]).

This study tried to explicate gender difference and the effects of subjective and objective knowledge on risk taking. The findings presented here are noteworthy in light of understanding gender difference in financial risk-taking behavior. Since most of past studies have examined perception or attitude rather than direct experience of gender difference in financial behavior, this study argues that direct experience rather than perception or attitude regarding gender difference in risk taking needs to be examined. Roszkowski and Grable [2005] initiated this argument when they suggested that factors such as financial knowledge and risk-taking behavior be properly assessed and documented. This study asked participants to assess their subjective knowledge and measured participants' objective knowledge and risk-taking behavior. Direct experience rather than perception was measured. Even though gender stereotypes might be evident in past studies (e.g., Martin [1987], Roszkowski and Grable [2005], Siegrist et al. [2002]), this study revealed gender difference in financial knowledge and risk taking was true rather than just a stereotype. The results revealed that there was a significant gender difference in actual risk-taking behavior favoring males.

The results have significant implications for investors and financial educators. Assuming it is true that risk and return are positively related in the aggregate, investors who take less risk are likely to accumulate fewer assets (Eckel and Grossman [2002]). In view of lower risk-taking behavior for female investors, they are facing the danger of making investments that will result in low rates of return. In addition, assuming it is true that financial knowledge and behavior are positively related, female investors are also facing the danger of poor financial behavior due to lower knowledge and confidence in investing. The findings reported here may help explain why women accumulate less wealth than men over time (Eckel and Grossman [2002]). It may be primarily due to women's lower risk-taking behavior and financial knowledge. Thus, more financial programs should be promoted to female investors to help them enhance their financial knowledge and opportunities to make better financial decisions.

LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

The findings regarding the mediating effect of subjective knowledge on risk taking make the gap between financial knowledge and behavior even more important to understand since the nature of investment information stored in memory may underrepresent or misrepresent true knowledge about the domain. The variation in the correspondence between subjective knowledge and objective knowledge raises an important future research issue concerning knowledge calibration. Thus, the first limitation of this study is that the effects of knowledge calibration on risk taking need to be examined and addressed more in the future.

Two kinds of poor knowledge calibration are possible when investors have low confidence in assessing their knowledge but turn out to have high objective knowledge or otherwise. For example, some investors like to search information about mutual funds for fun. They constantly read reviews regarding mutual funds but purchase few mutual funds. They seem to have high objective knowledge about choosing a mutual fund, but they are unable to accumulate their direct experiences of purchasing mutual funds to build up their confidence. In other words, direct results of investing in mutual funds are not available to match up with their experiences of information search. In this case, investors may be less confident but have actual knowledge in choosing a mutual fund.

Investors can also be overconfident in believing what they think they know compared to what they actually know. They can invest in mutual funds but never know how to choose a mutual fund. They purchase mutual funds through their financial brokers but do not understand the impact of different attributes of mutual funds. In either case of knowledge calibration, is subjective knowledge or objective knowledge the determinant of risk taking? If investors are overconfident while there is not enough capacity of true knowledge, will they make more bad decisions? If investors are actually knowledgeable but less confident, will subjective knowledge still mediate objective knowledge and, as a result, strengthen risk-taking behavior? The whole point of understanding interplay of financial knowledge and behavior in financial literature is so important that future research regarding the knowledge calibration is definitely worthy of being investigated.

Another limitation of this study involves the type of financial products used in this study. Attitudes toward different financial products may moderate investors' attitudes and behaviors regarding their investments (Hallahan [2000a]). Thus, future study should use different financial products to examine financial knowledge and behavior. In this case, future studies can generalize the study's results. In the same line of reasoning, another area of future study lies in investors' relevant product-related experiences. Relevant product-related experiences may affect investors' knowledge calibration.

This study did not examine the breadth of investment experience in different product classes (e.g., using only mutual fund versus using many different types of investment options such as real estate and stock). Relevant product-related experiences may affect investors' subjective knowledge, objective knowledge, and risk taking.

The evaluative nature or valence of the experience (e.g., whether it was a positive or negative experience) may affect investors' subjective knowledge and objective knowledge (Campbell and Kirmani [2000]). Since product-related experiences may offer unambiguous information about the product, knowledge assessments based on past product-related experiences may lead to knowledge assessments that may or may not coincide with the level of subjective and objective knowledge. Thus, the nature of relevant product-related experiences may determine the extent of the difference between subjective knowledge and objective knowledge (Chang [2004], Friestad and Wright [1995]).

CONCLUSION

With increasingly complex financial products in the marketplace, investors' financial literacy has become ever more important. The goal of this study is to extend theoretical and practical knowledge of how different male and female investors' financial knowledge and risk-taking behavior are. Using survey data focusing on investing in mutual funds as tested knowledge domain and measured behavior, this study demonstrates that, at least for investors, their objective knowledge, subjective knowledge, and risk taking are highly correlated. Gender emerges as an important factor that differentiates investors' levels of objective knowledge, subjective knowledge, and risk taking. Moreover, it is investors' subjective knowledge that mediates their objective knowledge on risk-taking behavior. Since male investors have higher subjective knowledge and objective knowledge than female investors, they often take more risks because of the mediation effect of subjective knowledge.

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