Myopic Loss Aversion, Personality and Gender

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ABSTRACT

Investors' propensity to exhibit myopic loss aversion (MLA) varies. Our analysis, which follows and extends the experimental design of Gneezy and Potters (1997) and Haigh and List (2005), finds that *Neuroticism* and *Extraversion*, two of Norman's "Big 5" personality traits (Norman, 1963) are associated with variation in subjects' MLA. *Extraversion*, a trait positively associated with risk, reduces MLA. *Neuroticism*, which has a negative association with risk behaviors, increases MLA. Gender does not appear to have robust association with MLA. Our findings suggest that it may be advantageous to use readily measurable psychological constructs rather than gender *per se* in both experimental and field research.

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1. Introduction

Investors' asymmetric responses to gains and losses (Kahneman and Tversky, 1979) are well known both through archival and experimental analyses. Experiments have demonstrated that subjects exhibit myopic loss aversion (Gneezy and Potters, 1997 (GP); Haigh and List, 2005 (HL)). Experiments have demonstrated that subjects exhibit myopic loss aversion (Gneezy and Potters, 1997 (GP); Haigh and List, 2005 (HL). Subjects' displaying MLA present asymmetric responses to expected outcomes; these responses become more pronounced as the period over which investments are evaluated shorten. Given investments, or bets, differing *only* in the regularity over which they are evaluated, investors (subjects) become more sensitive to losses the more often they assess outcomes. HL examine MLA using students and CBOT traders and find that MLA is more pronounced for traders. Behavioral biases such as myopic loss aversion should become less pronounced with expertise (Feng & Seasholes, 2005; List, 2003). Researchers also found that experts, when working in familiar, job-related tasks, demonstrated such behavioral and judgmental biases, such as base rate neglect and anchoring biases, to a lesser extent when compared to student subjects (For a review, see Smith & Kida, 1991). Exaggerated myopic loss aversion amongst professionals is unexpected and, to date, unexplained.

The literature is silent on why investors' propensity to exhibit MLA varies.[1] Gender has also been extensively used to model risk behavior in general

[1] Bellemare, Krause, Kröger and Zhang (2005) demonstrate the role of feedback in MLA. They argue that the difference in evaluation periods (the treatments we denote as *Frequent* and *Infrequent*) is a function of information feedback. Langer and Martin

and in financial decision marking (e.g. Levin, Snyder, & Chapman, 1988; Johnson & Powell, 1994; Byrnes, Miller and Schafer, 1999; Barber & Odean, 2001; Charness and Gneezy, 2012; Eckel and Füllbrunn, 2015). Males produce more testosterone, a hormone associated with financial risk taking (Coates and Herbert, 2008; Coates, Gurnell and Rustichini, 2009) and other risk behaviors (Roberti, 2004; Dreber and Hoffman, 2007; Mazur and Booth, 2009). Therefore consideration of the role of gender and MLA is a natural place to start to address subjects' MLA heterogeneity. We find *prima facie* evidence that gender might explain MLA. That *prima facie* evidence is, however, not robust.

We find that a subject's propensity to exhibit MLA is a function of his, or her, personality. When subjects' personality traits are considered, gender does not have a robust association with MLA. In addition to helping us understand MLA, we believe that the findings presented in this paper should lead to the reconsideration of the role of gender *per se* in financial decisions. Our methodology is well known in Psychology and readily applicable to research in Behavioral and Experimental Finance.

In particular, *extraversion*, one of Norman's "Big 5" personality traits (Norman, 1963), plays a particularly important role in subjects' propensities to exhibit MLA. We also find evidence that *neuroticism* may also play an important role in MLA. The "Big 5" traits – *Neuroticism*, *Extraversion*, *Openness to*

(2008) find that commitment and feedback affect MLA. They find that subjects' commitment to decisions reduces their MLA. Neither study considers subjects' heterogeneity, the focus of this paper.

Experience, *Agreeableness* and *Conscientiousness* – are higher-order traits summarizing peoples' personalities.[2,3] Personality helps not only to describe and differentiate people, but it also helps us to understand what motivates their actions and choices. The *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*-5) (American Psychiatric Association, 2013) exhibits the increasing use of these factors in the description of personality disorders. The five-factors have been used to model a wide range of behaviors[4,5] and have been used in studies examining a range of financial decisions and outcomes (Durand, Newby and Sanghani, 2008; Durand, Newby, Peggs and Siekierka, 2013; Durand, Newby, Tant and Treepongkaruna, 2013; Fung and Durand, 2014).

The structure of this paper is as follows. We discuss the experimental design in the following section. Analyses are presented in Section 3. We discuss

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2 The five factors may be decomposed into lower-order facet sub-traits. We consider sub-traits in Section 3 but our results are inconclusive.

3 Paraphrasing Fung and Durand's discussion of the traits (2014, p. 101)" *"Extraversion* refers to the degree of activity level, preferred interaction, need for stimulation, and capacity for joy of the person. *Agreeableness* refers to the extent to which an individual demonstrate characteristics considered as trusting, altruistic, good-natured, empathic, and helpful. *Conscientiousness* refers to the degree of organization, control, persistence, and motivation to goal-directed behavior. *Neuroticism* refers to a person's level of emotional stability. *Openness to Experience* refers to the active seeking and appreciation of experiences for their own sake."

4 For example, the Big 5 personality model is used to investigate individual differences in risk-taking propensity. Nicholson, Soane, Fenton-O'Creevy, and Willman (2005) find that participants with higher levels of Extraversion and Openness to Experience demonstrate higher level of risk-taking in the domains of recreational, health finance, safety, social, and career decision making, whereas Neuroticism, Agreeableness, and Conscientiousness are found to be negatively associated with risk-taking behaviour. Furthermore, in their study on overconfidence and the Big 5 personality model, Schaefer et al. (2004) report that extraverts are significantly more overconfident in their performance on a test; on the other hand, the elevated confidence of individuals with higher Openness to Experience is indeed substantiated by their actual performance, indicating that unlike the extraverts, individuals with high Openness have accurate confidence calibration.

5 It is of interest to note that Hirsh and Peterson (2009) find an association of *Extraversion* and *Neurotism* to the behaviour of subjects in the prisoner's dilemma. The behavior documented in that paper is consistent with the behavior we report.

our results in Section 4. Section 5 concludes the paper. We discuss the experimental design and procedures in the following section.

2. Experimental Design and Procedures

We follow the experimental protocol of GP and HL utilizing a 2 x 2 experimental design with Treatment (*Frequent* versus *Infrequent*) and Gender (*Male* versus *Female*) as independent variables. We examine 128 subjects (64 female and 64 male) and, for 32 subjects from each gender, apply either one of two treatments. Comparing cohorts of female and male subjects allows us to consider whether whether gender affects myopic loss aversion. Again following GP and HL, we have two alternative treatments. The *Frequent* treatment allowed subjects to make bets in nine rounds. The *Infrequent* treatment was identical save that subjects placed bets for three rounds at a time (in rounds 1, 4 and 7). Subjects received payment based on the outcome of their betting. If subjects exhibit MLA, we should find that *Frequent* subjects place lower bets; this was found to be the case in both in GP and HL.

We address the question of the role of personality traits through measuring subjects' Big 5 personality traits before they undertook the experiment. Subjects completed the 240-item Revised NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992).

Although shorter inventories designed to measure the Big-Five Traits are also available, such as Costa and McCrae's (1992) 60-item NEO Five Factor

Inventory, Donnellan, Oswald, Baird and Lucas' (2006) 20-item mini-IPIP measure, and various 10-item (e.g. the Ten Item personality Inventory; Gosling et al., 2003) and 5-item (e.g. Aronson, Reilly, & Lynn, 2006; Bernard, Walsh, & Mills, 2005; Woods & Hampson, 2005) inventories, we have chosen the more comprehensive 240-item NEO-PI-R (Costa & McCrae, 1992) for a number of reasons. Short inventories of personality may have lower validity compared to well-constructed longer measures. First, responses to individual items are likely to suffer from random measurement errors (Credé, Harms, Niehorster, & Gaye-Valentine, 2012), this problem is particularly pronounced in very short personality inventories with single-item or two-item measures for each Big-5 factors. Second, short personality inventories are also likely to suffer from content deficiency (Credé, Harms, Niehorster, & Gaye-Valentine, 2012). As each of the Big-5 factors are considered to be made up of several sub-facets (Costa & McCrae, 1992), small sets of items may not be sufficient to capture all facets of each Big-5 factors. In contrast, well-constructed longer inventories such as the NEO-PI-R accesses 6 different facets of each of the five broad personality domains. The facet scales include: Anxiety, Angry Hostility, Depression, Self-Consciousness, Impulsiveness, and Vulnerability for Neuroticism; Warmth, Gregariousness, Assertiveness, Activity, Excitement Seeking, and Positive Emotions for Extraversion; Fantasy, Aesthetics, Feelings, Actions, Ideas, and Values for Openness to Experience; Trust, Straightforwardness, Altruism, Compliance, Modesty, and Tender-Mindedness for Agreeableness; Competence, Order, Dutifulness, Achievement Striving, Self-Discipline, and Deliberation for

Conscientiousness. This results in 5 domain scores and a total of 30 personality facet scores for the scale.

However, participants may be prone to boredom, fatigue, and carelessness in responses when completing longer inventories of personality, we attempted to curtail the impact by asking the respondents to complete the 240-item NEO-PI-R online at their own time prior to participating the experiment in person. The participants received an hyperlink to the NEO-PI-R and were given one week to complete the questionnaire once they have started. The amount of time spent on completing the questionnaire was tracked to ensure that the participants have spent a reasonable amount of time to respond to the items carefully.

Our subjects were recruited from printed and online advertisements circulated at Hong Kong Baptist University. Table 1 reports summary statistics for subjects' personality traits. There appears to be no substantive differences in personality traits between female and male subjects.

[TABLE 1 ABOUT HERE]

The subjects performed the nine-round betting game in person after the completion of the 240-item NEO-PR-I online (Costa & McCrae, 1992), and they were randomly assigned to either the *Frequent* or the *Infrequent* treatment.

The subjects performed the lottery game on the computer. At the start of the game, the subjects were assigned a personal "winning color" (i.e. either red, blue, or green). They were given an endowment of 100 units to bet for each of the 9 rounds. At the start of each round, subjects placed bets of any amount of their endowment from 0 to 100 by entering their chosen amount to the computer. Any uncommitted amount of the endowment (that is, 100 – X) where X is the amount bet, was added to the subject's cumulative earnings. The experimenter then randomly drew a "round color" from a box containing three colors (red, blue, and green). Subjects won that round if the "round color" that was drawn was the same as their personal "winning color". The subjects were therefore fully informed of having 1/3 (33%) chance of winning and 2/3 (67%) chance of losing in the lottery game.

Subjects' earnings in each round were determined as follows. If a subject decided to place X units out of 100 in that round, her final earnings for that round would be – X. (she would lose if the round color drawn was different from the subject's personal "winning color"). If the subject won (she would wine if the round color drawn matches the winning color), her earnings for that round would be equal to + 2.5X.

After completing a sequence of 9 rounds, the earnings of all individual rounds will be summated by the computer to the total earnings for the lottery game at the end of the experiment. The subjects were paid at a rate of 1 unit = 0.075 Hong Kong Dollars (HKDs). The participants took approximately 15-20

minutes to complete the experiment. On average, the participants earned a total of 1024.48 units in the lottery game, which amounts to 76.84 HKD of payment.

The difference between the *Frequent* treatment condition and the *infrequent* treatment condition is that, under the *Frequent* treatment condition, the subjects played the 9 rounds of the lottery game one by one. At the start of round 1 they had to decide how much of the 100 units they choose to bet for that round. After the "round color" was drawn their earnings for this round were shown on the computer automatically. After the completion of round 1, they could then decide how much of their new endowment of 100 units to be bet for round 2, and so on until the completion of all 9 rounds.

On the other hand, subjects under the *Infrequent* treatment condition played the 9 rounds of lottery game in blocks of 3. At the start of round 1, they had to decide how much of their endowment of 100 units they would bet for rounds 1, 2, and 3 simultaneously. Furthermore, they were restricted to place the same amount of bet for all three rounds. For example, if the subject was to bet 50 units in round 1, they also had to bet 50 units for rounds 2 and 3. After they decided their amount of bet for all three rounds, the "round colors" were drawn randomly one by one for all three rounds. It was only after all three "round colors" were drawn, then the combined earnings for rounds 1, 2, and 3 were shown on the computer, so only the aggregated result for the whole block of 3 rounds were given to them. After the completion of the first block of three

rounds, the subject began the second block that consisted of rounds 4, 5, and 6, followed by the third block of rounds 7, 8, and 9.

Hence, by manipulating the length of evaluation period, subjects under the *Frequent* condition made 9 different betting decisions while those under the *Infrequent* condition made only 3 betting decisions. Subjects under the *Frequent* condition also had more freedom to change their amount of bet for every round and those under the Infrequent condition were only allowed to change their amount of bet every other 3 rounds. Finally, subjects under the *Frequent* condition received more information about their earnings after the completion of each round, but those under the Infrequent condition only received aggregate information about their realized earnings every three rounds.

3. Analysis

Our subjects exhibit MLA (Table 2). *Frequent* subjects (that is, those in the *Frequent* treatment) bet less, on average, than *Infrequent* subjects when we consider *all* subjects, *females* and *males*. Our results confirm GP and HL. We follow HL[6] and depict our results, theirs and GP's in Figure 1; in all cases, we see the pattern of *lower* bets being placed by subjects in the *Frequent* treatment.[7] We also find, however, that the difference between males and females (depicted in Figure 2) is found only in the *Frequent treatment.* The Mann-Whitney test (Siegel

[6] In particular, we follow HP's Figure 1 on page 528.

[7] In this analysis, and all other analyses save the robustness tests reported in Table 5, both *frequent* and *infrequent* subjects are analyzed as if they are making nine decisions.

and Castellan, 1988, pp. 128-197)[8] of the null hypothesis that the female and male bets have been drawn from the same population is insignificantly different from zero (the *z*-score is -0.795).

[TABLE 2 ABOUT HERE]

[FIGURE 1 ABOUT HERE]

[FIGURE 2 ABOUT HERE]

The Mann-Whitney tests reported in Table 2 compare two samples only. HS extend GS by recognizing the data are a panel and we follow HS' lead by turning to Tobit analyses to consider treatments, gender and also personality traits. The dependent variable, the bets subjects make, has a lower bound of zero and an upper bound of 100 units. The data is a panel: we have nine observations (one for each round) for each of the 128 subjects. We utilize random effects estimation following Greene (2004). He finds that the bias of standard errors associated with coefficients estimated with fixed effects Tobit falls with T (the number of rounds) but, as T becomes large, these errors are biased towards zero. Additionally, where T=3 there may be some affect through the incidental parameters problem; we will estimate a panel where T=3 for robustness in Table 5**.** Given such issues with fixed effects, we utilize random effects estimation.

We report models of the amount bet estimated using random effects Tobit in Table 3 and we begin by focussing on model 5, where the treatment (*Frequent*

[8] GP and HL also use the Mann-Whitney test.

or *Infrequent*), gender (*Male* or *Female*) and two of Norman's Big 5 personality traits – *Neuroticism* and *Extraversion* – are included as dependent variables. This model has the lowest AIC of those equations reported in Table 3 and is therefore the preferred model using this criterion. *Treatment* is a dummy variable taking a value of 1 if the *Frequent* subjects (that is, subjects being tested under the *Frequent* condition). It is significant at the 1% level and the coefficient is of an order of magnitude consistent with the difference for *all subjects* observed in Table 1. We find similar estimates significant at the 1% level in all of the models we report in Table 3. Gender, a dummy variable taking the value of 1 if the subject is male, is positive and significant at the 10% level.

[TABLE 3 ABOUT HERE]

Traits are themselves composed of sub-traits. The Five Factor Model of Personality identifies different levels of specificity in personality assessments. For example, with the use of factor analysis, the combination of groups of covarying traits will form broader domains of personality traits. The NEO-PI-R (Costa & McCrae, 1992) Big 5 personality measure we used defines the Big Five measures as broad "domains" of personality. They are considered as "multifaceted collections of specific cognitive, affective, and behavioural tendencies that might be grouped in many different ways" (Costa & McCrae, 1995: pp. 23), and the lower level, more specific traits that corresponds to these grouping were called the "facets". For example, as anxiety, angry hostility, and depression are all concerned with aspects of one's vulnerability to negative

emotion, they are therefore belong in the domain of Neuroticism. We consider if replacing *Extraversion* and *Neuroticism* with their sub-traits might help us understand why these traits work as they do. Therefore, we re-estimate model 5 in Table 4 using the sub-traits of *Neuroticism* - *anxiety*, *angry hostility*, *depression*, *self-consciousness*, *impulsiveness* and *vulnerability* – and *extraversion* – *warmth*, *gregariousness*, *assertiveness*, *activity*, *excitement seeking* and *positive emotions* – and report the results in Table 4. None of the sub-traits of *extraversion* are found to be significant. *Anxiety* is negative and significant at the 10% level and *angry hostility* is significant and positive at the 10% level. Despite the fact that these different facets of *Neuroticism* should covary, they are distinguishable types of negative affectivity and may relate to a person's propensity to demonstrate MLA in different manners. A person high in *Anxiety* is nervous and anxious, and is more prone to worry. *Angry Hostility* refers to the tendency to experience anger and irritability. Furthermore, *Angry Hostility* implies problems with disinhibition of emotional impulses, resulting in the externalized expression of negative affect and volatility; whereas *Anxiety* is associated with withdrawal behaviour and the internalized negative affectivity (DeYoung & Quilty, 2007).

[TABLE 4 ABOUT HERE]

Subjects with the *Infrequent* treatment only bet in rounds 1, 4 and 7. The analyses presented in Table 3 compare subjects in all nine rounds. Comparing *Frequent* subjects with *Infrequent* subjects in rounds when the *Infrequent*

subjects cannot act may be misleading. Therefore, we re-estimate the models using panel random effects Tobit. We consider two specifications, the first, Model 1 in Table 5**,** has the treatment (*Frequent* or *Infrequent*), gender (*male* or *female*) and *all* of Norman's Big 5 or just *Neuroticism* and *Extraversion*. Model 2 uses only *Neuroticism* and *Extraversion* and is the preferred model (on which we focus). *Extraversion* is positive and significant at the 1% level. *Extraversion's* significance, and also the magnitude of its coefficient, are consistent with our observations in Table 3. *Neuroticism* and gender are statistically insignificant.

[TABLE 5 ABOUT HERE]

We continue the robustness tests in Table 5 by estimating rounds 1, 4 and 7 separately using Tobit analyses. In all rounds, the AIC indicates the model where only *Extraversion* and *Neuroticism* is included is preferred and we focus on this specification. *Extraversion* is positive and significant in rounds 1, 4 and 7 (models 4, 6 and 8) as it was when we estimated it in model 2. We find that *Neuroticism* is negative and statistically significant only in round 4. In no instance in Table 5 do we find *gender* to be statistically significant.

4. Discussion.

As subjects' *Extraversion* increases, their propensity to exhibit MLA falls. We estimate positive coefficients for *Extraversion* in our main analysis (Table 3, Model 5) and all subsequent robustness tests (Table 5) indicating that the difference in bets in *Frequent* and *Infrequent* subjects falls as subjects'

Extraversion increases, *ceteris paribus*. *Extraversion* is associated with a need for stimulation and also optimism[9] and it has been found to be associated with decisions which may be seen to expose investors to greater risk (Durand, Newby, Tant and Treepongkaruna, 2013, p.123). *Extraversion* is also associated with dopamine, a neurotransmitter associated with reward-driven "approach" behaviour (Fung and Durand, 2014, p. 102, provide a summary and a discussion of the relevant literature).

Neuroticism is associated with risk aversion. We also find this association in our main analysis (Table 3, Model 5) but only in one instance in the robustness tests presented in Table 5. Therefore, as subjects' *Nueroticism* increases, their propensity to exhibit MLA also increases: the difference between the bets in the *Frequent* and *Infrequent* treatments becomes greater. We discuss this in more depth shortly.

In studies of investment behaviour, *Neuroticism* is related to the disposition effect which also reflects investors' asymmetric responses to expected gains and losses (Durand, Newby, Peggs and Siekierka, 2012). *Neuroticism* has a complex relationship to risk. It is almost as if investors with high *Neuroticism* are drawn to portfolios which intensify the negative emotions linked to this trait; the actions they seemingly take to relieve these disturbing stimuli are ultimately ineffective and self-defeating (Durand *et al.*, 2013).

[9] See footnote 3.

Our finding that *Extraversion* and *Nueroticism* are related to MLA highlights the link between our study and the growing body of work studying genetics, neurobiology and Finance. As we have noted above, Fung and Durand (2014, pp. 101 to 103) highlight the biological basis for the Five-Factor model, noting the roles of dopamine, serotonin, norepinephrine and cortisol.[10] For instance, *Extraversion* is identified to be related to the activity of dopamine, which plays a role in "approach" behavior towards rewards and positive incentives (Depue & Collins, 1999). On the other hand, Neuroticism was found to be linked with brain activities associated with withdrawal and avoidance behavior. For example, it is associated with higher level of activities in the right frontal lobe, which is the brain area related to emotions associated with withdrawal behavior (Davidson, 2002); and the brain's anterior insula, which is related to aversive affect and risk-averse decision making (e.g. Simmons, Matthews, Stein, and Paulas, 2004). *Neuroticism* is also related to lower functioning of the neurotransmitter serotonin, which is associated with negative emotion (Arnold, Zai, & Richter, 2004) and higher level of stress hormones such as nonrepinephrine (adrenaline) (Henning, 2004; Zuckerman, 2005) and cortisol (Netter, 2004). Cesarini, Johannesson, Lichtenstein, Sandewall and Wallace (2010) find an association between portfolio risk and genes. Cronqvist and Siegel (2014) also find that many investment biases have a strong association with investors' genes. Sapra, Beavin and Zak (2014) find that there is a relationship between genes and success on Wall Street and, in particular, the sub-group that the genes associated

[10] Coates and Herbert (2008) discussed mentioned in the introduction to this paper, analyze cortisol levels in traders and find a positive correlation of cortisol to expected risk.

with success are associated with personality traits.[11] The analysis of personality traits, however, deals with phenotypes, not genotypes.

Gender has a *prima facie* correlation with MLA but we do not find that it is robust. Our initial analyse (Table 2 and Figures 1 and 2) suggest that males exhibit less MLA than females. This is in keeping with our expectations that gender is associated with risk behavior (see Section 1 above). As we also noted in Section 1, gender is significant only at the 10% level in the analyses reported in Table 3. Additionally, we do not find significant coefficients for gender in the robustness tests reported in Table 5. Therefore, these results lead us to conclude that the role of gender is, at best, marginal.

What role does the inclusion of gender have in our analyses? When we are able to measure the psychological constructs which gender is thought to proxy for, there is little or no effect of gender *per se*. As we have highlighted, research has establish that both *Extraversion* and *Neuroticism* have associations with risk decisions. The effects are different and we obtain a nuanced picture when we include them in our analyses. When we do not include these constructs, we find a role for gender that is in keeping with received views that males are more risk-loving than females. In this broad sense, gender appears to be a noisy proxy for the personality traits. Gender is often the only proxy for attitudes to

11 Sapra, Beavin and Zak (2014) use the Myers-Brigg traits on a subset of the traders from whom they take genetic samples. These traits relate to those used in this study (McCrae and Costa 1989). The "Big 5" are taken from the predominate model in the field. Moreover, the traits are measured as covariates rather than dichotomous or multichotomous, variables. Measuring traits as covariates makes them particularly useful for the analyses reported in this paper.

risk available to researchers, especially researchers using archival rather than experimental data. Undoubtedly it is relatively easy to observe and it is routinely recorded in databases. The unthinking use of gender, however, obscures fundamental differences in what motivates people's decision.[12]

5. Conclusion.

Investors' propensity to succumb to myopic loss aversion (MLA) varies. The literature has little to say about why this might be so. We address this gap and consider if personality traits and, or, gender explains this variation. We measure personality traits using Norman's "Big 5" (Norman, 1963) traits: *Neuroticism*, *Extraversion*, *Openness to Experience*, *Agreeableness* and *Conscientiousness*.

Our analysis follows and extends the experimental design of Gneezy and Potters (1997) (GP) and Haigh and List, (2005). We examine 128 subjects (64 female and 64 male) and, for 32 subjects from each gender, applying either one of two treatments: *Frequent* and *Infrequent*. The *Frequent* treatment allowed subjects to make bets in nine rounds. The *Infrequent* treatment allowed subjects to bet only in rounds 1, 4 and 7.

[12] In Finance research, when the Big-5 are used in analyses along with psychological, rather than biological gender using Bem's sex-role inventory (Bem, 1977), the findings are often the *opposite* of what standard biologically based gender analyses would lead us to expect (Durand, Newby and Sanghani, 2008; Durand, Newby, Peggs and Siekierka, 2013; Durand, Newby, Tant and Treepongkaruna, 2013).

Extraversion, a trait positively associated with risk, reduces MLA. The is also evidence that *Neuroticism*, a trait that is generally believed to have a negative association with risk behaviors, increases MLA. We do not believe that gender has a robust association with MLA. In reaching this conclusion, we introduce a *caveat* to inferences made on the basis of gender in research in Behavioral Finance.

Our results highlight, and perhaps reiterate, the potential importance of including personality traits in behavioral finance research. Our inclusion of readily measurable personality traits may also suggest a tractable way of examining subjects' heterogeneity in experiment work. Measuring personality traits using the Big-5 is tractable and robust (McRae, 1999).

References

Arnold, P.D., Zai, G., Richter, M.A., 2004. Genetics and Anxiety Disorders, *Current Psychiatry Reports, 6,* 243-254.

Aronson, Z.H., Reilly, R.R., Lynn, G.S., 2006. The Impact of Leader Personality on New Product Development Teamwork and Performance: The Moderating Role of Uncertainty, *Journal of Engineering and Technology Management, 23,* 221-247.

Barber, B.M., Odean, T., 2001. Boys Will Be Boys: Gender, Overconfidence, and Common Stock Investment, *Quarterly Journal of Economics, 116,* 261-292.

Bellamare, C., Krause, M., Kröger, S., Zhang, C., 2005. Myopic Loss Aversio: Information Feedback vs. Investment Flexibility*, Economics Letters 87*, 319-324.

Bem, S.L., 1997. Bem Sex-Role Inventory (BRSI). In John E. Jones and J. William Pfeiffer, eds., *The 1997 Annual Handbook for Group Facilitators,* 83-97. Sand Diego, CA: University Associates.

Bernard, L.C., Walsh, R.P., Mills, M., 2005. Ask Once, May Tell: Comparative Validity of Single and multiple Item Measurement of the Big-Five Personality Factors, *Counseling and Clinical Psychology Journal, 2,* 20-57.

Byrnes, J.P., Miller, D.C., Schafer, W.D., 1999. Gender Differences in Risk Taking: A Meta-Analysis, *Psychological Bulletin 125*, 367-383.

Cesarini, D., Johannesson, M., Lichtenstein, P., Sandewall, Ö, Wallace, B., 2010. Genetic Variation in Financial Decision Making, *Journal of Finance 65*, 1725-1754.

Charness, G., Gneezy, U., 2012. Strong Evidence for Gender Differences in Risk Taking, *Journal of Economic Behavior and Organization 83*, 50-58.

Costa, P.T., Jr., McCrae, R.R. Revised NEO Personality Inventory (NEO-PI-R) and NEO Five-Factor Inventory (NEO-FFI) Professional Manual. Psychological Assessment Resources; Odessa, FL: 1992.

Costa P.T., Jr., McCrae, R.R., 1995. Domains and Facets: Hierarchical Personality Assessment Using the Revised NEO Personality Inventory, *Journal of Personality Assessment 1995,* 21-50.

Credé, M., Harms, P.D., Niehorster, S., Gaye-Valentine, A., 2012. An Evaluation of the Consequences of Using Short Measures of the Big Five Personality Traits, *Journal of Personality and Social Psychology, 102,* 874-888.

Cronqvist, H., Siegel, S., 2014. The Genetics of Investment Biases, *Journal of Financial Economics 113*, 215-234.

Davidson, R.J., 2002. Anxiety and Affective Style: Role of Prefrontal Cortex and Amygdala, *Biological Psychiatry, 51*, 68-80.

Depue, R.A., Collins, P.F. 1999. Neurobiological of the Structure of Personality: Dopamine, Facilitation of Incentive Motivation, and Extraversion, *Behavioral and Brain Sciences, 22,* 491-517.

DeYoung, C.G., Quilty, L.C. 2007. Between Facets and Domains: 10 Aspects of the Big Five, *Journal of Personality and Social Psychology, 93,* 580-896.

Donnellan, M.B., Oswald, F.L., Baird, B.M., Lucas, R.E., 2006. The Mini-IPIP Scales: Tiny-Yet-Effective Measures of the Big Five Factors of Personality, *Psychological Assessment, 18,* 192-203.

Durand, R.B., Newby, R., Sanghani, J., 2008. An Intimate Portrait of the Individual Investor, *Journal of Behavioral Finance 9*, 193-208.

Durand, R.B., Newby, R., Tant, K., Treepongkaruna, S., 2013. Overconfidence, Overreaction and Personality, Review *of Behavioral Finance 5*, 104-133.

Durand, R,B., Newby, R., Peggs, L., Siekierka, M., 2013. Personality, *Journal of Behavioral Finance 14*, 116-133.

Eckel, C.C., Füllbrunn, S.C., 2015. Thar SHE Blows? Gender, Competition, and Bubbles in Experimental Asset Markets, *American Economic Review 105*, 906-920.

Feng, L., Seasholes, M.S., 2005, Do Investor Sophistication and Trading Experience Eliminate Behavioral Biases in Financial Markets? *Review of Finance 9,* 305-351.

Fung, L, Durand, R.B., 2014, "Personality" in Investor Behavior. The Psychology of Financial Planning and Investing, H. Kent Baker and Victor Ricciardi (eds.), Wiley, New Jersey, 99-115.

Gneezy, U., Potters, J., 1997. An Experiment on Risk Taking and Evaluation Periods, *Quarterly Journal of Economics 102*, 631-645.

Gosling, S.D., Rentfrow, P.J., Swann, W.B., 2003. A Very Brief Measure of the Big Five Personality Domains, *Journal of Research in Personality, 37,* 504-528.

Greene, W., 2004. The Behaviour of the Maximum Likelihood Estimator of Limited Dependent Variable Models in the Presence of Fixed Effects, *Econometrics Journal 7*, 98-119.

Haigh, M.S., List, J.A., 2005. Do Professional Traders Exhibit Myopic Loss Aversion? An Experimental Analysis, *Journal of Finance 60*, 523-534.

Henning, J., 2004. Personality, Serotonin, and Noradrenaline. In Robert M. Stelmack, ed., *On the Psychobiology of Personality: Essays in Honor of Marvin Zuckerman,* 379-395. New York: Elsevier.

Hirsh, J.B., Peterson, J.B., 2009. Extraversion, neuroticism, and the prisoner's dilemma, *Personality and Individual Differences 46*, 254-256.

Johnson, J.E.V., Powell, P.L., 1994. Decision Making, Risk and Gender: Are Managers Different? *British Journal of Management, 5,* 123-138.

Levin, I.P., Snyder, M.A., Chapman, D.P., 1988. The Interaction of Experimental and Situational Factors and gender in a Simulated Risky Decision-Making Task, *Journal of Psychology, 122,* 215-226.

Langer ,T., Weber, M., 2008. Does Commitment or Feedback Influence Myopic Loss Aversion? An Experimental Analysis, *Journal of Economic Behavior and Organization 67*, 810-819.

List, J.A., 2003. Does Market Experience Eliminate Market Anomalies? *Quarterly Journal of Economics 118,* 41-71.

Netter, P., 2004. Personality and Hormones. In Robert M. Stelmack, ed., *On the Psychobiology of Personality,* 357-377. New York: Elsevier.

Nicholson, N., Soane, E, Fenton-O'Creevy, M., Willman, P., 2005. Personality and Domain-Specific Risk Taking, *Journal of Risk Research, 8,* 157-176.

Norman, W.T., 1963. Toward an adequate taxonomy of personality affect, *Journal of Abnormal and Social Psychology 66*, 574-583.

Sapra, S., Beavin, L.E., Zak, P.J., 2014, "A Combination of Dopamine Genes Predicts Success by Professional Wall Street Traders", *PLoS One* 7(1): e30844.

Schaefer, P.S., Williams, C.C., Goodie, A.S., Campbell, W.K., 2004. Overconfidence and the Big Five, *Journal of Research in Personality, 38,* 473-480.

Siegel, S., Castellan Jr., N.J., 1988. Nonparametric Statistics for the Behavioral Sciences, Mc-Graw-Hill, New York.

Simmons, A., Matthews, S.C., Stein, M., Paulus, M., 2004. Anticipation of Emotionally Aversive Visual Stimuli Activates Right Insula, *NeurReport, 15,* 2261-2265.

Smith, J. F., Kida, T., 1991. Heuristics and Biases: Expertise and Task Realism in Auditing, *Psychological Bulletin, 109,* 472-489.

Woods, S.A., Hampson, S.E., 2005. Measuring the Big Five with Single Items Using Bipolar Response Scale, *European Journal of Personality, 19,* 373-390.

Zuckerman, M., 2005. *Psychobiology of Personality*, 2nd ed. New York: Cambridge University Press.

Table 1: Summary Statistics – Personality Traits

This table presents summary statistics for Norman's "Big 5" personality traits (Norman, 1963) – *Neuroticism*, *Extraversion*, *Openness to Experience*, *Agreeableness* and *Conscientiousness* – for the 128 subjects (64 female and 64 male) examined in the experiment presented in this paper.

Trait: all subjects (n=128)	Mean	Median	Minimum	Maximum
Neuroticism:	138	138	25	187
Extraversion:	154	156	30	192
Openness to experience	157	155	22	201
Agreeableness:	159	161	27	194
Conscientiousness:	155	156	32	200
Trait: females (n=64)				
Neuroticism:	138	137	25	187
Extraversion:	154	156	30	188
Openness to experience	157	159	22	201
Agreeableness:	161	162	27	194
Conscientiousness:	153	154	32	186
Traits: males (n=64)				
Neuroticism:	138	138	78	174
Extraversion:	154	156	108	192
Openness to experience	157	153	133	199
Agreeableness:	158	158	125	194
Conscientiousness:	158	158	110	200

Table 2: Betting Outcomes

This table presents the bets of 128 subjects (64 female and 64 male). The *Frequent* treatment allowed subjects to make bets in nine rounds. The *Infrequent* treatment was identical save that subjects placed bets for three rounds at a time (in rounds 1, 4 and 7). The Mann-Whitney (Siegel and Castellan, 1988, pp. 128-197) tests the null-hypothesis that two independent groups have been drawn from the same population.
***, **, * indicate statistical significance at the 1%, 5% and 10% levels respectively.

Bets	Mean	Median	Minimum	Maximum	
All subjects (*n*=1,152)	57	30	0	100	
Females (*n*=576)	55	29	0	100	
Males (*n*=576)	61	31	0	100	
Bets and treatments					Mann-Whitney *z-score*
a. All subjects					
*Frequent (*n=*576)*	51	30	0	100	7.124***
*Infrequent (*n=*576)*	64	29	0	100	
b. Females					
*Frequent (*n=*288)*	46	28	0	100	7.214***
*Infrequent (*n=*288)*	63	27	5	100	
c. Males					
*Frequent (*n=*288)*	56	31	0	100	3.051***
*Infrequent (*n=*288)*	65	31	0	100	
d. Frequent					
*Females (*n=*288)*	46	28	0	100	-3.818***
*Males (*n=*288)*	56	31	0	100	
d. Infrequent					
*Females (*n=*288)*	63	27	5	100	-0.795
*Males (*n=*288)*	65	31	0	100	

Table 3: Analyses – Bets, Treatment, Gender and Personality Traits

This table presents analyses of the determinants of the amount bet by 128 subjects in each of the nine rounds of the experiment. Models are estimated using panel random effects Tobit. Treatment takes a value of 1 if it is *Frequent* and zero otherwise (that is, when the treatment is *infrequent*). Gender is a dummy variable taking a value of 1 if the subject is *Male* (and zero if the subject is *Female*). *Neuroticism*, *extraversion*, *openness to experience*, *conscientiousness* and *agreeableness* are Norman's (1963) "Big Five" personality constructs. σ_u is the between-entity error, σ_e is the within-entity error, ρ is the intraclass correlation and σ_ρ is the error associated with the estimate of ρ. The χ^2 statistic tests the null hypothesis that the estimated coefficients are jointly equal to zero. The lowest AIC is in bold.
***, **, * indicate statistical significance at the 1%, 5% and 10% levels respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept	71.079***	66.128***	68.396***	75.382***	54.212**	79.467**	59.000**	26.176	94.647***
z-statistic	17.15	13.25	11.90	2.23	1.99	2.33	2.16	1.16	5.10
p-value	0.000	0.000	0.000	0.025	0.046	0.020	0.031	0.247	0.000
Treatment	-17.395***	-17.378***	-21.885***	-14.766***	-15.591***	-14.651**	-15.589***	-15.62***	-17.504***
z-statistic	-2.99	-3.02	-2.70	-2.61	-2.74	-2.56	-2.71	-2.71	-3.07
p-value	0.003	0.003	0.007	0.009	0.006	0.010	0.01	0.007	0.002
Gender		9.901*	5.305	10.118*	9.538*			9.744*	9.729*
z-statistic		1.72	0.65	1.80	1.70			1.71	1.70
p-value		0.086	0.515	0.072	0.090			0.086	0.088
Interaction of condition and gender			9.094						
z-statistic			0.79						
p-value			0.428						
Neuroticism				-0.272***	-0.23*	-0.269**	-0.234*		-0.206*
z-statistic				-2.08	-1.81	-2.03	-1.82		-1.60
p-value				0.038	0.071	1.690	0.07		0.110
Extraversion				0.301*	0.279**	.298*	0.283**	0.254*	
z-statistic				1.72	2.00	1.69	2.16	1.81	
p-value				0.085	0.046	0.920	0.031	0.071	
Openness				0.257		0.26			
z-statistic				1.41		1.41			
p-value				0.158		0.159			

Agreeableness				-0.172		-0.208			
z-statistic				-0.09		-1.09			
p-value				0.366		0.276			
Conscientiousness				-0.210		-0.168			
z-statistic				-1.32		-1.06			
p-value				0.186		0.289			
σ_u	31.87***	31.51***	31.409***	30.205***	30.685***	30.579***	31.035***	31.072***	31.203***
σ_e	21.08***	21.088***	21.088***	21.093***	21.09***	21.085***	21.084***	21.09***	21.09***
ρ	0.696	0.691	0.689	0.672	0.679	0.678	0.684	0.685	0.686
σ_ρ	0.032	0.032	0.0322	0.033	0.033	0.033	0.033	0.032	0.032
$\chi 2$	8.93***	12.04***	12.73***	23.41***	19.11***	19.82***	15.96***	15.56***	19.11***
AIC	8619.75	8618.82	8620.19	8618.53	**8616.35**	8619.74	8617.21	8617.59	8618.28

Table 4: Analysis of bets, treatment, gender and the sub-traits of *Neuroticism* and *Extraversion*

Model 5 in Table 3 presents the lowest AIC value and is therefore considered the preferred model. In this table, we re-estimate model 5 replacing *neuroticism* and *extraversion* with their sub-traits. The sub-traits of *neuroticism are: anxiety, angry hostility, depression, self-consciousness, impulsiveness and vulnerability*. The sub-traits of *extraversion* are: *warmth*, *gregariousness*, *assertiveness*, *activity*, *excitement seeking* and *positive emotions*. Treatment takes a value of 1 if it is *Frequent* and zero otherwise (that is, when the treatment is *Infrequent*). Gender is a dummy variable taking a value of 1 if the subject is *Male* (and zero if the subject is *Female*). *Neuroticism*, *extraversion*, *openness to experience*, *conscientiousness* and *agreeableness* are Norman's (1963) "Big Five" personality constructs. σ_u is the between-entity error, σ_e is the within-entity error, ρ is the intraclass correlation and σ_ρ is the error associated with the estimate of ρ. The χ^2 statistic tests the null hypothesis that the estimated coefficients are jointly equal to zero. The lowest AIC is in bold.
***, **, * indicate statistical significance at the 1%, 5% and 10% levels respectively.

		Neuroticism		Extraversion	
Intercept	71.106	N1. Anxiety	-1.326*	E1. Warmth	0.449
z-statistic	1.78	z-statistic	-1.87	z-statistic	0.56
p-value	0.074	p-value	0.061	p-value	0.578
Treatment	-19.321***	N2. Angry hostility	1.398*	E2. Gregariousness	-1.073
z-statistic	-3.34	z-statistic	1.71	z-statistic	-1.54
p-value	0.001	p-value	0.087	p-value	0.122
Gender	14.798**	N3. Depression	-1.001	E3. Assertiveness	-0.450
z-statistic	2.59	z-statistic	-1.50	z-statistic	-0.56
p-value	0.010	p-value	0.134	p-value	0.575
		N4. Self-Consciousness	-1.524	E4. Acivity	0.773
		z-statistic	-1.45	z-statistic	1.03
		p-value	0.147	p-value	0.303
		N5. Impulsiveness	-0.590	E5. Excitement seeking	0.625
		z-statistic	-1.12	z-statistic	1.04
		p-value	0.262	p-value	0.299
		N6. Vulnerability	1.603*	E5. Positive Emotions	0.754
		z-statistic	1.88	z-statistic	0.87
		p-value	0.060	p-value	0.382
σ_u	28.97***				
σ_e	21.1***				
ρ	0.653				
σ_ρ	0.034				
χ^2	35.86***				

Table 5: Analyses – Rounds 1, 4 and 7

This table presents analyses of the determinants of the amount bet by 128 subjects in rounds 1, 4 and 7 of the experiment. Models 1 and 2 are estimated using panel random effects Tobit. Models 3 to 8 are estimated using Tobit. The lowest AIC is in bold for each pair of comparable models. Treatment takes a value of 1 if it is *Frequent* and zero otherwise (that is, when the treatment is *infrequent*). Gender is a dummy variable taking a value of 1 if the subject is male (and zero otherwise). *Neuroticism*, *extraversion*, *openness to experience*, *conscientiousness* and *agreeableness* are Norman's (1963) "Big Five" personality constructs. σ_u is the between-entity error, σ_e is the within-entity error, ρ is the intraclass correlation and σ_ρ is the error associated with the estimate of ρ. The χ^2 statistic tests the null hypothesis that the estimated coefficients are jointly equal to zero.
***, **, * indicate statistical significance at the 1%, 5% and 10% levels respectively.

	Rounds 1, 4 and 7		First round		Round 4		Round 7	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	77.249**	53.104**	49.651***	43.923**	88.5***	61.734***	85.856***	46.326
z/t-statistic	2.43	2.06	2.71	2.31	5.15	2.81	3.32	1.17
p-value	0.015	0.040	0.008	0.022	0.000	0.006	0.001	0.242
Treatment	-16.76***	-17.827***	-12.991**	-13.254**	-17.807***	-19.137***	-19.902***	-21.685***
z/t-statistic	-3.13	-3.29	-2.17	-2.26	-3.09	-3.30	-2.72	-2.93
p-value	0.002	0.001	0.032	0.026	0.003	0.001	0.007	0.004
Gender	6.689	6.588	5.71	4.925	6.277	6.44	7.907	8.314
z/t-statistic	1.29	1.23	1.00	0.86	1.13	1.15	1.09	1.13
p-value	0.197	0.218	0.318	0.394	0.261	0.253	0.280	0.262
Neuroticism	-0.231*	-0.196	-0.187	-0.138	-0.274**	-0.247**	-0.168	-0.157
z/t-statistic	-1.86	1.62	-1.51	-1.25	2.10	-1.95	-1.00	-0.88
p-value	0.063	0.106	0.133	0.213	0.037	0.053	0.317	0.383
Extraversion	0.282	0.255*	0.209	0.235**	0.245	0.219*	0.400*	0.319*
z/t-statistic	1.70	1.92	1.27	2.09	1.61	1.78	1.84	1.71
p-value	0.088	0.055	0.205	0.038	0.109	0.078	0.068	0.090
Openness	0.278		0.208		0.315*		0.357	
z/t-statistic	1.61		1.03		1.73		1.43	
p-value	0.108		0.306		0.087		0.156	

Agreeableness	-0.244		-0.006		-0.33**		-0.504**	
z/t-statistic	-1.35		-0.03		-2.12		-2.16	
p-value	0.176		0.978		0.036		0.033	
Conscientiousness	-0.187		-0.175		-0.157		-0.173	
z/t-statistic	-1.24		-1.10		-1.04		-0.96	
p-value	0.214		0.272		0.301		0.341	
Left censored observations	7	7	0	0	4	4	3	3
Right censored observations	74	74	21	21	19	19	34	34
σ_u	26.67***	27.3***						
σ_e	20.94***	20.93***						
ρ	26.665	0.630						
σ_ρ	1.060	0.046						
χ^2	26.03***	20.49***						
F-statistic			2.38**	3.43**	4.17***	5.29***	3.05***	3.47**
Pseudo R^2			0.01	0.01	0.02	0.18	0.02	0.01
σ_ρ			31.44	31.62	30.03	30.73	38.93	39.86
ε_σ			2.20	2.27	2.28	2.41	3.10	3.10
AIC	3058.39	**3057.27**	1107.46	**1103.65**	1082.53	**1082.36**	1012.24	**1012.08**

Figure 1. Betting Patterns.

This figure depicts the bets of 128 subjects (64 female and 64 male) that were summarized in Table 2. The *Frequent* treatment allowed subjects to make bets in nine rounds. In the *infrequent* treatment subjects placed bets for three rounds at a time (in rounds 1, 4 and 7). In addition to the 128 subjects (denoted All) and the male and female sub-groups (Males and Females), we include the results presented in
Gneezy and Potters (1997) (GP) and Haigh and List (2005) (HL).

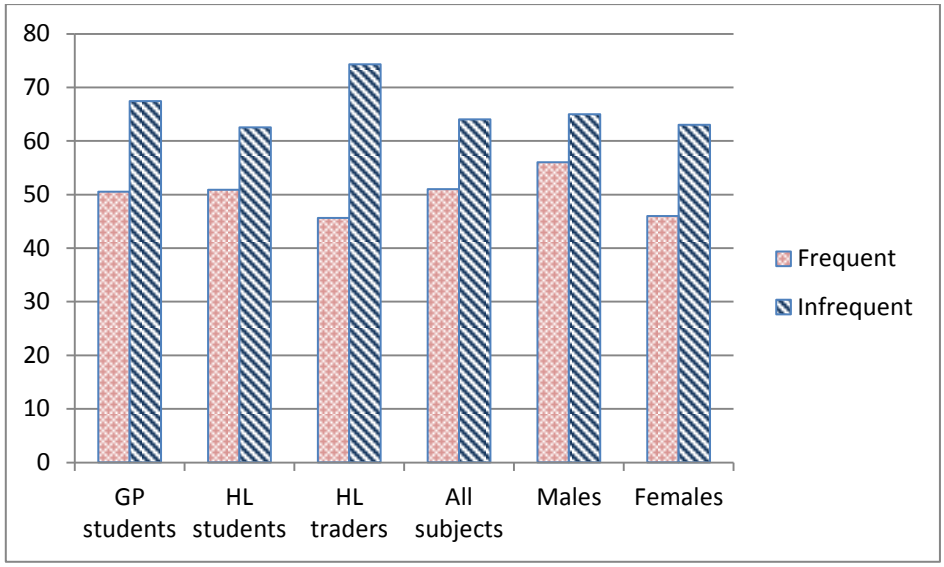

Figure 2. Betting Patterns by Gender
This figure depicts the bets (reported in Table 2) of 64 *Female* and 64 Male subjects. The *Frequent* treatment allowed subjects to make bets in each of nine rounds. In the *infrequent* treatment subjects placed bets for three rounds at a time (in rounds 1, 4 and 7).